NON-DETRIMENT FINDINGS (NDF) FOR WEDGEFISHES (FAMILY RHINIDAE) FROM INDONESIAN WATERS

INDONESIAN INSTITUTE OF SCIENCES (LIPI)

LIPI

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Selvia Oktaviyani (Indonesian Institute of Sciences)
Wanwan Kurniawan (Indonesian Institute of Sciences)
Ayuningtyas Indrawati (Indonesian Institute of Sciences)
Ana Faricha (Indonesian Institute of Sciences)
Benaya M. Simeon (Wildlife Conservation Society Indonesia Program)
Effin Mutaqin (Wildlife Conservation Society Indonesia Program)
Ita Sualia (Wildlife Conservation Society Indonesia Program)
Umi Chodrijah (Ministry of Marine Affairs and Fisheries)
Dharmadi (Ministry of Marine Affairs and Fisheries)
Fahmi (Indonesian Institute of Sciences)

RESEARCH CENTER FOR OCEANOGRAPHY (RCO)
INDONESIAN INSTITUTE OF SCIENCES (LIPI)

FOREWORD

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is the international agreement between governments of the member countries to ensure that international trade in wild flora and fauna specimens does not threaten their sustainability in the wild. Indonesia ratified CITES in 1978 and became the 42nd member country of CITES and now CITES has 183 parties. Each party must implement the convention decisions and provisions on protection and management relating to international trade in species listed in the CITES Appendices.

One of the 18th Conference of the Parties (CoP) results added ten species of wedgefishes to CITES Appendix II. From those species, only four species were found in Indonesian waters, i.e., *Rhynchobatus australiae, R. laevis, R. springeri,* and *Rhina ancylostoma*. As the world's largest catcher and active exporter of elasmobranchs and CITES members as well, Indonesia should provide the Non-Detriment Findings (NDF) document, a scientific-based analysis to assess the extent to which the survival of the species would be affected by the trade. Scientific Authority made this document and in Indonesia, the mandate was given to the Indonesian Institute of Sciences (LIPI).

LIPI, through Research Center for Oceanography, prepared the NDF document for wedgefishes in Indonesian waters as a follow up of the 18th COP CITES' decision. The recommendations of the study are intended as a reference or guidance for the Management Authority to establish a sustainable management strategy for wedgefishes in Indonesia. This valuable document was successfully completed due to good collaboration and coordination with all stakeholders are involved, such as the Ministry of Marine Affairs and Fisheries (MMAF), Non-Government Organizations, Association and others. Hopefully, the collaboration will continue for the subsequent studies of other CITES Appendix II species.

Jakarta, September 2020

Dr. Augy Syahailatua, M.Sc

Director of Research Center for Oceanography

Indonesian Institute of Sciences (LIPI)

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1. INTRODUCTION

1.1. Background

Indonesia has participated in international agreements on natural resource conservation since the 1970s, one of which is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), also known as the Washington Convention. Indonesia ratified CITES in 1978 through Presidential Decree Number 43 of 1978 and became the 42nd member country of CITES. This convention is an international agreement amongst governments of the member countries to ensure that international trade in wild flora and fauna specimens does not threaten their sustainability in the wild (CITES, 2020a). As a CITES member country, Indonesia must comply with the decisions and implement the convention provisions on protection and management relating to international trade in species listed in the three Appendices.

To date, around 37,000 species of wild flora and fauna are listed in the CITES Appendices, including sharks and rays (*Elasmobranchii*). This group has been listed since the 2000s, most of them are listed in CITES Appendix II, and the number increases over time. Appendix II lists species that are not necessarily threatened to extinction, but their trade must be controlled to avoid utilization incompatible with their survival (CITES, 2020b). The proposal to include sharks and rays in the CITES Appendices was driven by species extinction due to high fishing activities, as both a target and by-catch. On the other hand, sharks and rays are naturally vulnerable to extinction due to their biological characteristics, i.e., long-lived, slow growth rate, late maturity, and low fecundity (Coleman, 1996; Camhi et al., 1998; Bonfil, 2002; Cavanagh et al., 2003).

The 18th Conference of the Parties (CoP) in August 2019 decided to add ten species of wedgefishes consisting of three genera, namely *Rhynchobatus, Rhynchorhina,* and *Rhina,* to CITES Appendix II. In total, there are 17 species of rays listed in CITES found in Indonesian waters, i.e. four species of sawfishes (*Anoxypristis cuspidata, Pristis pristis, P. zijsron,* and *P. clavata*), two species of manta rays (*Mobula alfredi* and *M. birostris*), four species of mobula rays (*M. kuhlii, M. mobular, M. thurstoni,* and *M. tarapacana*), four species of wedgefishes (*Rhynchobatus australiae, R. laevis, R. springeri,* and *Rhina ancylostoma*), and two species of giant guitarfishes (*Glaucostegus thouin,* and *G. typus*). Of these, only four sawfishes are listed in CITES Appendix I, and the rest are in Appendix II. Appendix I includes species threatened with extinction which is prohibited from being traded, except in exceptional circumstances (CITES, 2020b).

In Indonesia, manta rays and sawfishes are fully protected based on the Decree of the Minister of Marine Affairs and Fisheries (*Kepmen KP*) Number 4 of 2014 and Government Regulation of the Republic of Indonesia (PP) Number 7 of 1999, of which the attachments were renewed through the Minister of Environment and Forestry Regulation (*Permen LHK*) Number 106 of 2018. While other species of rays that are listed in CITES, have not been regulated yet.

As the world's largest catcher and active exporter of elasmobranchs (FAO, 2019), including the species listed CITES Appendix II, Indonesia should assess the utilization of those CITES-listed species for its sustainability. The analysis for sustainable utilization of the CITES-listed species is documented, known as Non-Detriment Findings (NDF). CITES requires member countries to provide the NDF document before exporting species listed in Appendix II. The document is usually prepared by a Scientific Authority of the exporting country. In Indonesia, the mandate was given to the Indonesian Institute of Sciences (LIPI) according to Presidential Decree Number 103 of 2001.

Wedgefish (Family Rhinidae) is one of the batoid or ray group mostly caught in Indonesian waters. Of the ten wedgefish species listed in CITES Appendix II, only four species found in Indonesian waters, i.e., *Rhynchobatus australiae, R. laevis, R. springeri,* and *Rhina ancylostoma*. In this country, almost all parts of wedgefish body are used and traded both domestically and internationally, such as fins, meat, cartilages, snouts, and skins. With the inclusion of those species in Appendix II of CITES, the trade-in wedgefish products must be regulated under a management mechanism referring to CITES provisions. The assessment is based on main four aspects: biology (life history, reproduction, population, distribution, and habitat), fishery (fishing operations, production, area and fishing season), utilization (economic value, domestic trade, and exports) and management (available management tools). Based on the assessment, a Scientific Authority advising whether such export will or will not be detrimental to the survival of that species, as well as monitor both the export permits and the actual exports of such specimens.

1.2. Objective

The NDF document of wedgefishes (Family Rhinidae) is an assessment or analysis conducted by the Indonesian Institute of Sciences (LIPI) as a Scientific Authority of Indonesia and to assess the effect of proposed trade on the survival of the species. Recommendations in the NDF document can be used as a reference or guidance for the Management Authority to establish a sustainable management strategy for wedgefishes in Indonesia.

1.3. Scope

The NDF document of wedgefishes (Family Rhinidae) includes the latest information on biological, fishery, trading, and management aspects of wedgefishes in Indonesia. The information is based on the data from various literature, such as biological, volume production, and trade data recording, as well as research results conducted both in Indonesia and in other countries.

2. BIOLOGICAL ASPECT

The biological aspect is important to be evaluated in the NDF decision-making process. Based on the biological characteristics, it can be seen the level of the intrinsic vulnerability of the species to overexploitation pressure. Certain biological characteristics contribute to the risk that harvest will be detrimental to their survival (Mundy-Taylor et al., 2014). Therefore, on giving advice or recommendations, the Scientific Authority must consider the intrinsic biological characteristics of the species. Information regarding the biological aspects of four wedgefish species is presented below.

2.1. *Rhynchobatus australiae*

a. Biological Information

Taxonomy

Class	Chondrichthyes	
Order	Rhinopristiformes	
Family	Rhinidae	
Genus	*Rhynchobatus*	
Species	*R. australiae* Whitley, 1939	
Names:	Common	Bottlenose wedgefish
	Indonesian	*Pari kekeh*
	Local	*Pari kemejan, pari liong bun, pari pandrung, pari mremang,yee baji, kio-kio*

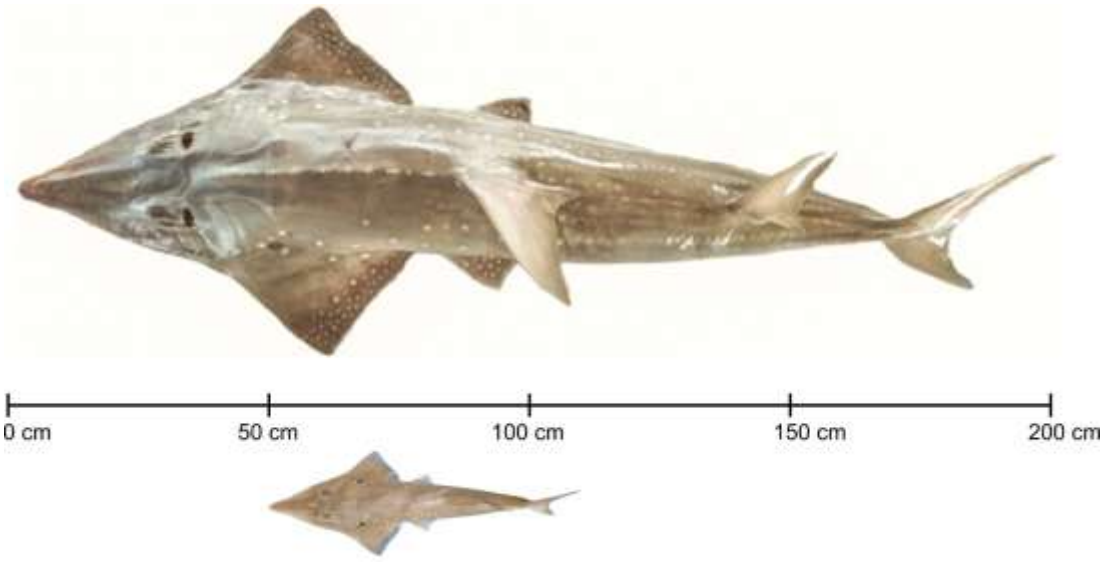


Figure 1. *Rhynchobatus australiae* at the mature and juvenile stages

Photo: B. M. Simeon, 2019; Fahmi, 2018

Morphology

Rhynchobatus australiae possesses some general characteristics as follows: bottle-shaped snout slightly constricted near the tip, black pectoral marking surrounded by five white spots (diagonal row of 3 usually above and two white spots below), the dorsal surface is almost blackish with no markings in some adults, origin of first dorsal fins slightly in front of pelvic fin origin, spiracles with two membranes or skin bumps on the rear side, and caudal fin with very distinct lower lobe (White et al., 2006; Jabado, 2019).

Life history

Age at maturity	female 3-6 years (D'Alberto et al., 2019) 5-6 years (Kurniawan et al., 2020, unpublished)
Size at maturity	female ~155 cm, male 110-130 cm (White & Dharmadi, 2007; Weigmann, 2011) female 219 cm and male 212 cm TL in the Java Sea (Yuwandana et al., 2019) female 326 cm and male 213 cm TL on the continental shelf bordering the Indian Ocean (Simeon et al., 2020)
Size at birth	46-50 cm TL (White & Dharmadi, 2007; Last & Stevens, 2009; Weigmann, 2011) 32-35 cm TL (LIPI, 2019, unpublished) 41-47 cm TL (LIPI, 2018, unpublished)
Maximum age	11-22 years (D'Alberto et al., 2019)
Maximum size	female 300 cm TL (White & Dharmadi, 2007; Last et al., 2016) combination 306 cm TL, female 305 cm TL and male 296 cm TL di in the Jave Sea (Yuwandana et al., 2019; LIPI, 2020, unpublished) female 323 cm and male 301 cm on the continental shelf bordering the Indian Ocean (Simeon et al., 2020)

Reproduction

Fecundity	7-19 (White & Dharmadi, 2007) 8 (LIPI, 2005, unpublished)
Intrinsic population growth (r)	0.095 (White et al., 2014) 0,22-0.50 (D'Alberto et al., 2019) 0.21-0.26 (Kurniawan et al., 2020, unpublished)
Growth coefficient (k)	0.40 (White et al., 2014) 0.083 (D'Alberto et al., 2019) 0.095 (Kurniawan et al., 2020, unpublished) female 0.25, male 0.21 (Simeon et al., 2020)
Natural mortality (M)	0.22 - 0.36 (White 2014, Simeon et al., 2020)

b. Distribution

Rhynchobatus australiae is widespread in the Indo-West Pacific from Mozambique to the Western Indian Ocean, Arabian Sea, Southeast Asia, and extending north to Taiwan, south to Australia and east the Solomon Islands (Last et al., 2016; Hylton et al., 2017).

c. Habitat

Rhynchobatus australiae has an extensive habitat from coastal waters to continental shelf waters, from near shore to 60 m depth (Compagno & Last, 1999; Last et al., 2016). This species is found in almost all Indonesian waters with mud substrate to coral reefs. *R. australiae* juveniles are often caught in shallow waters near the coast.

d. Conservation status

Rhynchobatus australiae is listed as Critically Endangered (CR) in the International Union for Conservation of Nature and Natural Resources (IUCN) red list and CITES Appendix II. However, there has been no national regulation for this species.

2.2. *Rhynchobatus laevis*

a. Biological Information

Taxonomy

Class	Chondrichthyes	
Order	Rhinopristiformes	
Family	Rhinidae	
Genus	*Rhynchobatus*	
Species	*R. laevis* Bloch & Schneider, 1801	
Names	Common	Smoothnose wedgefish
	Indonesian	*Pari kekeh*
	Local	*Pari kemejan, pari liongbun, pari pandrung, yee baji, kio-kio, pari mremang*

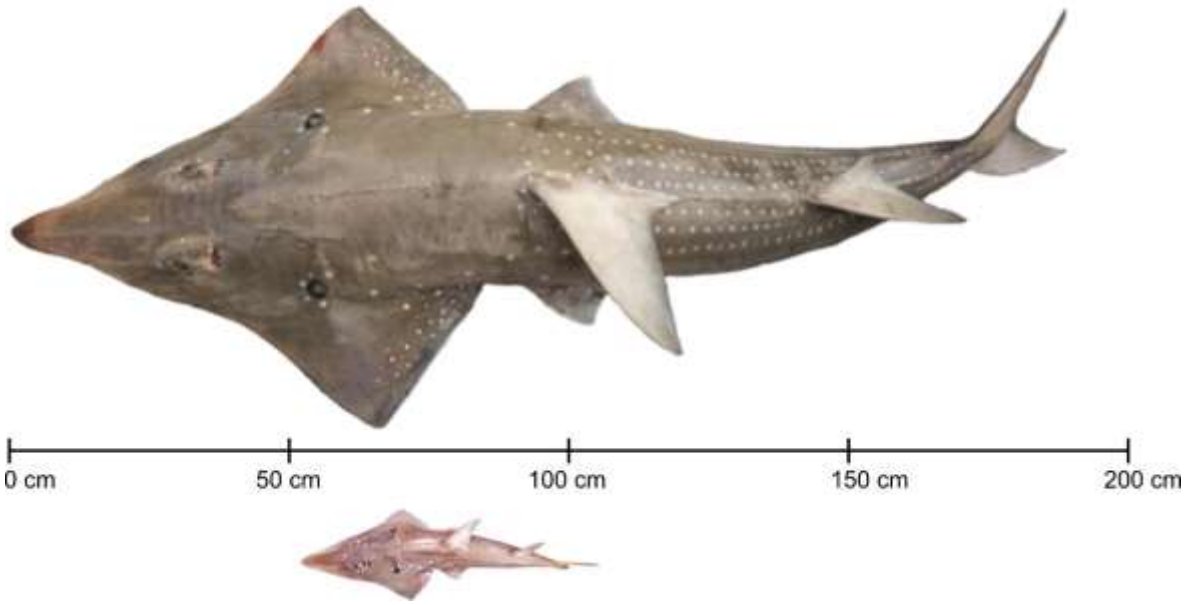


Figure 2. *Rhynchobatus laevis* at the mature and juvenile stage

Photo: B. M. Simeon, 2020

Morphology

Rhynchobatus laevis has two black pectoral spots often ocellated, surrounded by 4-7 white spots; 4-5 rows of white spots along each side beneath the first dorsal fin; and snout underside usually with dark blotch (Jabado, 2019).

Life history

Age at maturity	unknown
Size at maturity	male 130 cm TL (Last et al., 2016) female 183 cm TL and male 132 cm TL in the Java Sea (Yuwandana et al., 2019)
Size at birth	unknown
Maximum age	unknown
Maximum size	200 cm TL (Last et al., 2016) female 255 cm TL, male 184 cm TL (Yuwandana et al., 2019) 248 cm TL (Sadri & Yuneni, 2019) 270 cm TL (Whitley, 1939)

Reproduction

Fecundity	unknown
Intrinsic population growth (r)	unknown
Growth coefficient (k)	unknown
Natural mortality (M)	unknown

b. Distribution

Rhynchobatus laevis was initially estimated to exist only in eastern waters of Africa, but this species was also reportedly found in nearly all Southeast Asia and Northern Australia (Last & Stevens, 2009). Allegedly, this species currently spreads from the waters of Oman to Japan (Last et al., 2016). So far, this species has only been recorded to be captured in Western Indonesian waters (Simeon et al., 2019; Sadri & Yuneni, 2019).

c. Habitat

Rhynchobatus laevis has an extensive habitat from coastal waters to continental shelf waters, from near the coast to a depth of 60 m (Compagno & Last, 1999; Last et al., 2016).

d. Conservation Status

Rhynchobatus laevis is listed as Critically Endangered (CR) in the IUCN red list and CITES Appendix II. However, there has been no national regulation for this species.

2.3. *Rhynchobatus springeri*

a. Biological Information

Taxonomy

Class	Chondrichthyes	
Order	Rhinopristiformes	
Family	Rhinidae	
Genus	*Rhynchobatus*	
Species	*R. springeri* Compagno & Last, 2010	
Names	Common	Broadnose wedgefish
	Indonesian	*Pari kekeh*
	Local	*Pari kemejan, pari liong bun, pari pandrung, yee baji, kio-kio, pari mremang*

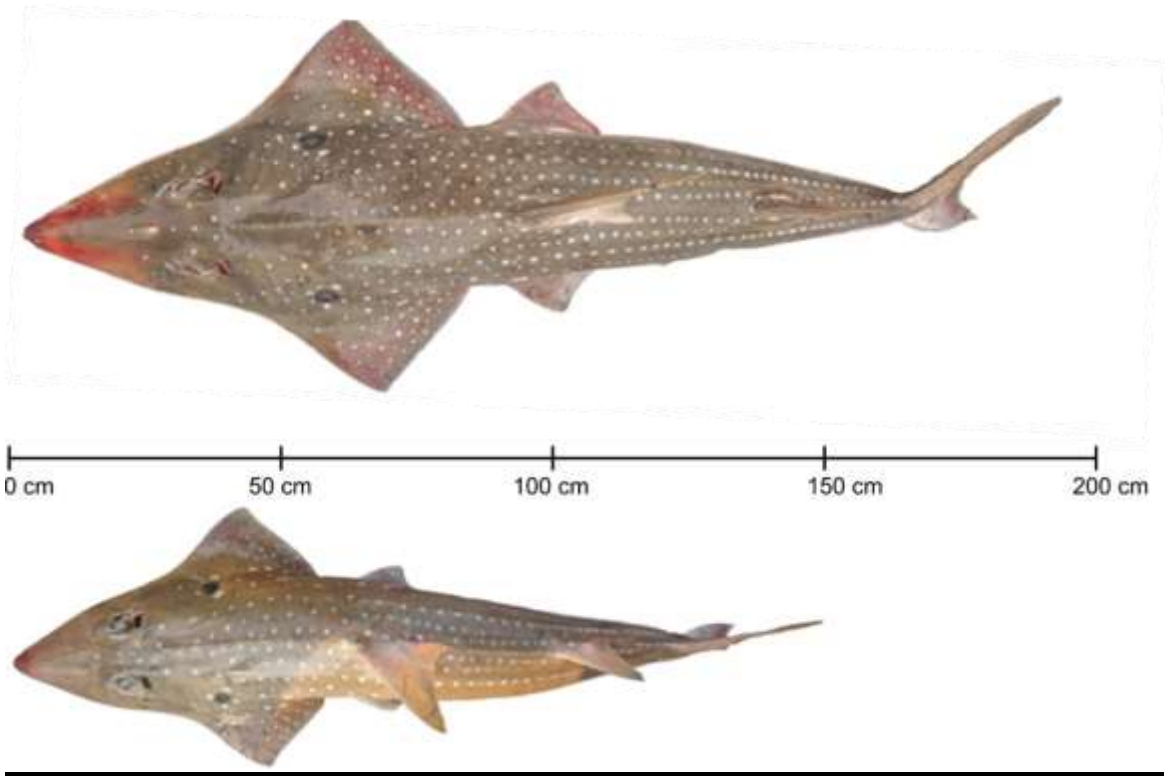


Figure 3. *Rhynchobatus springeri* at the mature stage

Photo: B. M. Simeon, 2020

Morphology

Rhynchobatus springeri has dark markings on and/or behind eyes, 3-4 rows of white spots each side extending along the tail, sometimes forming pale lines, black pectoral marking usually surrounded by 3-4 white spots with the outermost pair closer together than the inner pair (Jabado, 2019).

Life history

Age at maturity	unknown
Size at maturity	male 115 cm TL (Last et al., 2016) female 204 cm TL; male 116 cm TL in the Java Sea (Yuwandana et al., 2019)
Size at birth	unknown
Maximum age	unknown
Maximum size	213 cm TL (Last et al., 2016) female 304 cm TL, male 170 cm TL (LIPI, 2019, unpublished)

Reproduction

Fecundity	unknown
Intrinsic population growth (r)	unknown
Growth coefficient (k)	unknown
Natural mortality (M)	unknown

b. Distribution

Rhynchobatus springeri is commonly found in the Northern Indian Ocean and West Pacific Ocean, including the Indonesia (Java, Sumatera, Borneo), Singapore, Malaysia, Thailand, and the Philippines (Compagno & Last, 2010; Last et al., 2016).

c. Habitat

Rhynchobatus springeri lives in coastal waters and continental shelf waters at a depth of 16-37 meters. This species can also live in estuaries or brackish waters (Compagno & Last, 2010).

d. Conservation Status

Rhynchobatus springeri is listed as Critically Endangered (CR) in the IUCN red list and CITES Appendix II. However, there has been no national regulation for this species.

2.4. *Rhina ancylostoma*

a. Biological Information

Taxonomy

Class	Chondrichthyes	
Order	Rhinopristiformes	
Family	Rhinidae	
Genus	*Rhina*	
Species	*R. ancylostoma* Bloch & Schneider, 1801	
Names	Common	Bowmouth Guitarfish
	Indonesian	*Pari kekeh*
	Local	*Pari barong, pari kupu-kupu, batok pawon*

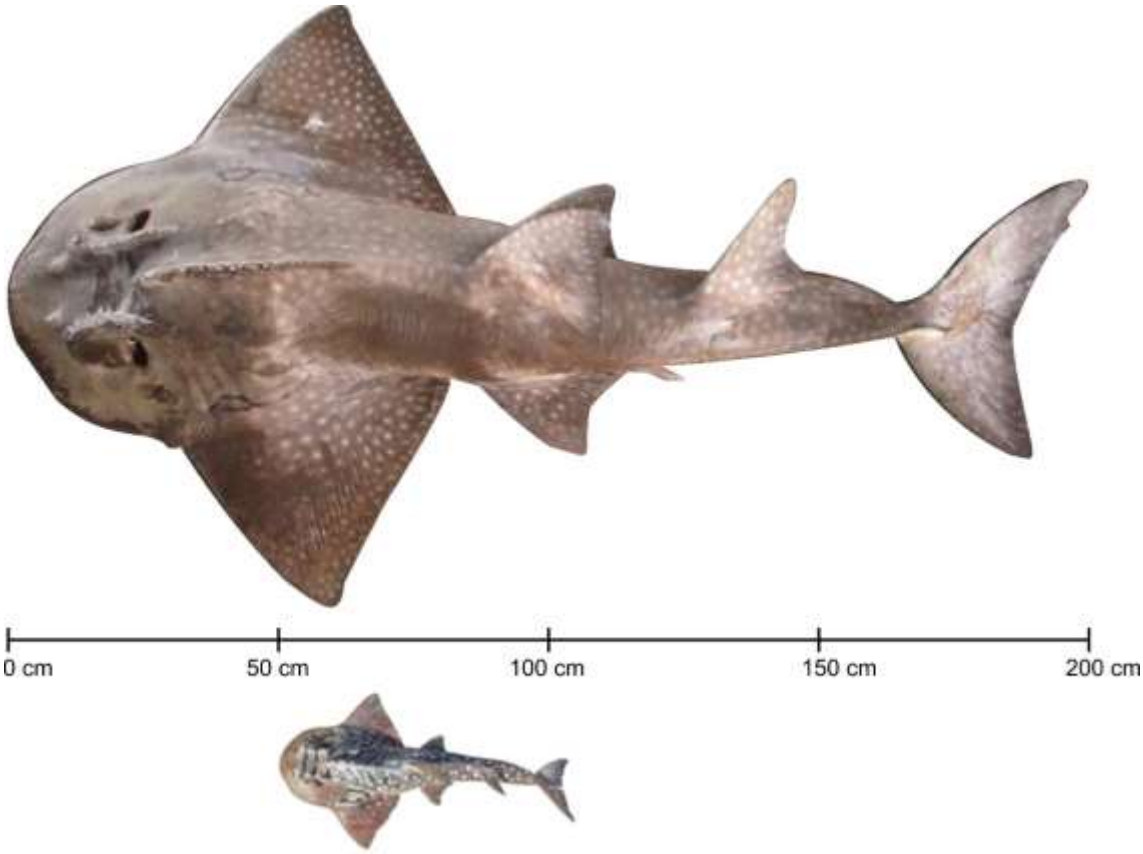


Figure 4. *Rhina ancylostoma* at the mature and juvenile stages

Photo: LIPI, 2018; B. M. Simeon, 2020

Morphology

This species has morphological characters such as its first dorsal fin origin located at the front of the pelvic origin, caudal fin lunate and almost symmetrical, thick and rounded snout, no membranes or skin bumps on the rear spiracles and eye circle, and has prominent ridges with large thorns on its back (White et al., 2006; Jabado, 2019).

Life history

Age at maturity	unknown
Size at maturity	female ~180 cm TL, male 150-175 cm TL (Last & Stevens, 2009; Last et al., 2016) female 213 cm TL, male 206 cm TL (Yuwandana et al., 2019)
Size at birth	46-48 cm TL (Last et al., 2016)
Maximum age	unknown
Maximum size	female 297 cm TL, male 287 cm TL (Yuwandana et al., 2019)

Reproduction

Fecundity	2-11 pups (Raje, 2006; Last et al., 2016) 4 pups (Masuda et al., 1975) 7-9 pups (Devadoss & Batcha, 1995; Last & Stevens, 2009)
Intrinsic population growth (r)	0.04-0.14 (Kurniawan et al, 2020, unpublished)
Growth coefficient (k)	unknown
Natural mortality (M)	unknown

b. Distribution

Rhina ancylostoma occurs in the Western Indo-Pacific region from the Persian Gulf, the Red Sea, East Africa, to Papua New Guinea and extends from Japan to southern Australia (Last & Stevens, 2009; Last et al., 2016). This species can be found in almost all Indonesian waters.

c. Habitat

Rhina ancylostoma generally lives near the coast to a depth of at least 70 m on the continental shelf (Last et al., 2016). This species is demersal fish that lives on sandy or muddy substrate and also around coral reefs.

d. Conservation Status

Rhina ancylostoma is listed as Critically Endangered (CR) in the IUCN red list and CITES Appendix II. However, there is no national regulation for this species.

Wedgefishes are not easy to identify, especially for the three species of the genera *Rhynchobatus*, i.e., *R. australiae, R. laevis* and *R. springeri*. The taxonomic difficulty is due to their morphology are relatively similar and high variations on the body pattern of each species. The identification keys for those species are located on the number and position of white spots on the black pectoral marking, presence of dark markings on and/or behind eyes, and the number of white spot rows on each side. This issue causes the field staff is difficult to record wedgefishes up to the level of species, misidentification and then influenced the quality of data recording.

3. FISHERIES ASPECT

3.1. Production

Information on capture fisheries production is regularly published by the Ministry of Marine Affairs and Fisheries (MMAF) in the "Indonesian Capture Fisheries Statistics Book." This book is the only source of data officially released by the government and is frequently used as a basis to develop fisheries management in Indonesia. Based on statistical data, the annual ray fisheries production in Indonesia from 2005 to 2015 ranged from 50,000 to 70,000 tons (MMAF, 2016). The recording of ray production data in Indonesia is divided into six groups based on local names, namely leopard rays (Family Dasytidae), devil/bat rays (Family Mobulidae), eagle rays (Family Aethiddae and Rhinopteridae), shovelnose rays (Family Glaucostegidae), wedgefishes (Family Rhinidae), and other rays. The wedgefishes contributed around 16% to Indonesia's total ray productions. In general, the production of rays in Indonesia increased in the last ten years, but wedgefishes production decreased by up to 80% (Figure 5).

The decline was estimated due to a significant decrease in the number of vessels targeting wedgefishes in several locations in Indonesia (Simeon et al., 2019). In Cirebon, for example, around 74 ships targeted the species in the 2000s, but the number decreased to 13 vessels in 2017. The interviews with fishers indicated that the declining number of vessels was due to the fishers' perception that other fisheries were more profitable and because of the difficulty of getting catches. However, both of these reasons need to be verified by further study (Simeon et al., 2019). So far, there are several locations with the vessels targeting wedgefishes, such as West Kalimantan, Bangka Belitung, and West Papua (PESIHIPINDO, pers. comm., 2020).

There are four species of wedgefishes commonly found in Indonesian waters, i.e., *Rhynchobatus australiae, R. springeri, R. laevis*, and *Rhina ancylostoma*. The currently recorded data is still aggregated data of those species. This condition is due to the difficulty of identification by field staff up to the species level, so that information on fishing trends for each species could not be obtained. The main factors behind the difficulty in species identification are the taxonomic issue and overlapping habitats, especially for the three species of the genera *Rhynchobatus*. Therefore, all species of *Rhynchobatus* are frequently identified as *R. australiae.*

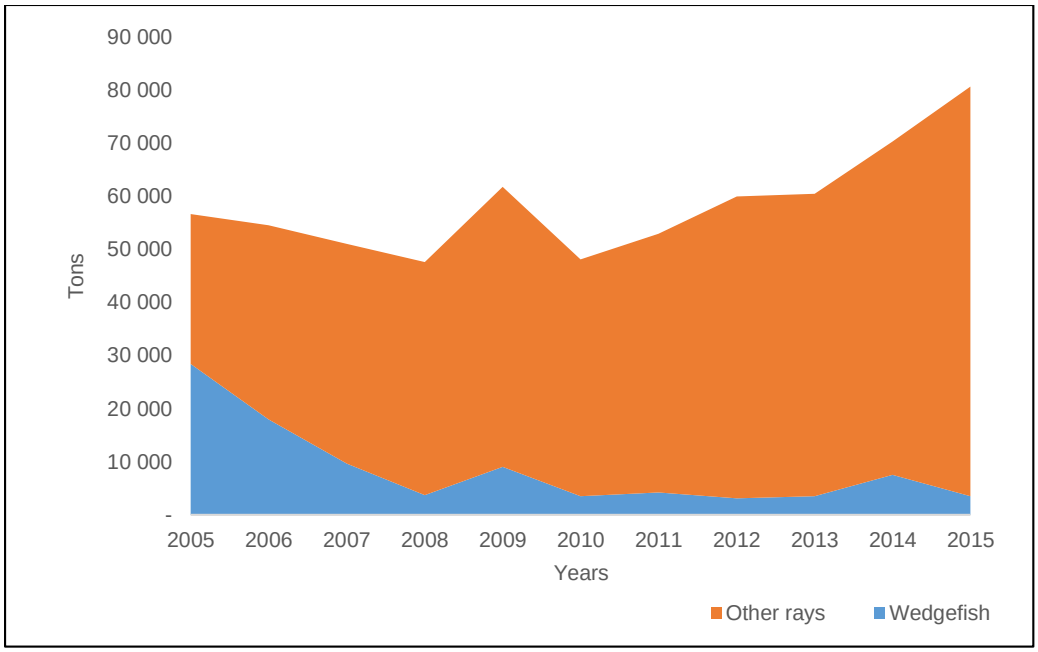


Figure 5. The total catch of wedgefishes in Indonesia from 2005 to 2015 (MMAF, 2016)

Despite the only official data released by the government, the Indonesian capture fisheries statistics are often considered not reflecting the actual catch due to some issues, such as double counting between the subnational and national levels, misidentification, and human error in data input. Therefore, additional information is required to understand the real condition of capture fisheries. Data on the catch per unit effort (CPUE) from several landing sites in Indonesia, i.e., Tanjung Luar and the Natuna Sea as well as Karimata Strait, were calculated to give a better overview of the condition of the catch (Figure 6 and Figure 7).

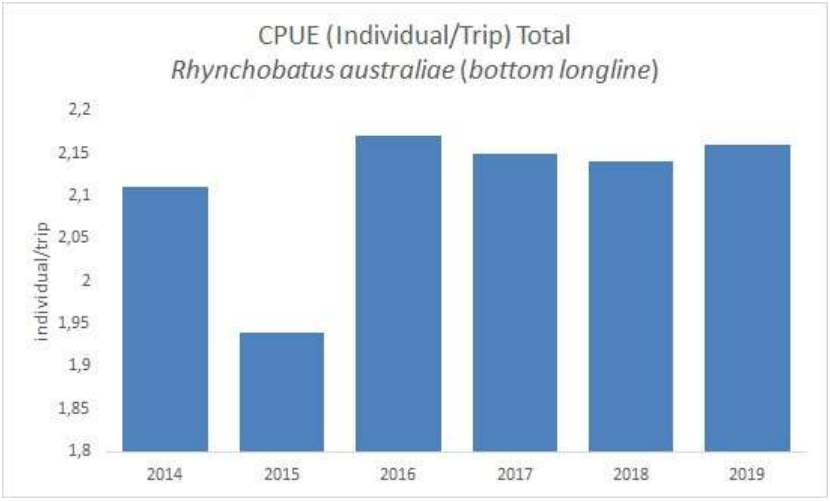


Figure 6. CPUE of *R. australiae* in the Indian Ocean region

Tanjung Luar, West usa Tenggara was considered to represent the wedgefishes caught in the shallow waters of the eastern Indian Ocean. The CPUE in this area was estimated 2-3 individuals per trip and without significant changes over the past five years. However, the lowest catch was recorded in 2015, with only 1-2 individuals per trip (WCS, 2020, unpublished). There is no indication of a decline in fishing efforts in this area (Figure 6).

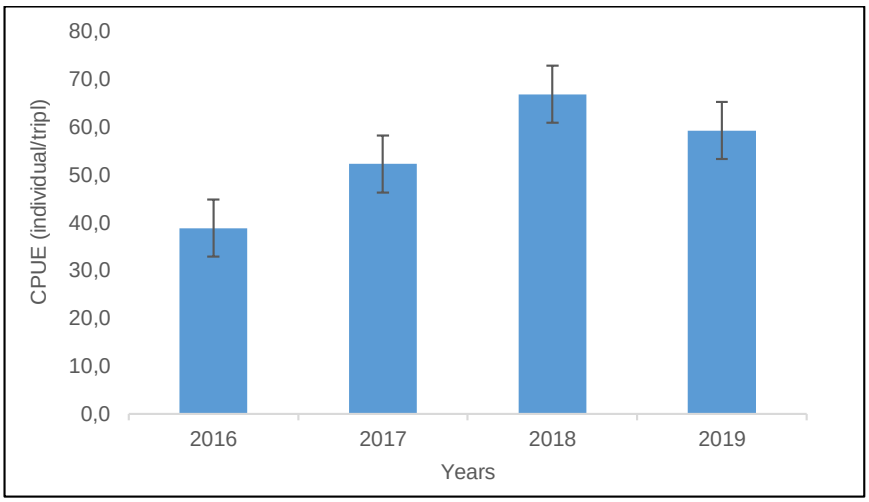


Figure 7. CPUE of *Rhynchobatus* spp. in the Fisheries Management Area (FMA) 711

Fisheries Management Area (FMA) 711, including the Natuna Sea and Karimata Strait, is one of the fishing grounds for wedgefishes in Indonesian waters. The area is relatively shallow with a muddy substrate and is a suitable habitat for wedgefishes. The CPUE values of this area were estimated at 38-67 individuals per trip based on landing data from Sungai Kakap, West Kalimantan, between 2016 and 2019 (Sadri et al., 2020, unpublished; Figure 7). The highest CPUE was recorded in 2018, with approximately 67 individuals per trip. One trip lasted for 31 days on average.

3.2. Fishing Gear

Fishers catch wedgefishes using various fishing gear types both as target and as by-catch. The types of fishing gear are described as follows:

a. Wedgefishes as a target

1. Tangle net

Tangle net is similar to a gill net, but it works by trapping or twisting the wedgefishes. It is generally made from monofilament and polyethylene (PE), with mesh size up to 60 cm. Several locations using a tangle net include West Kalimantan, Bangka Belitung, and West

Papua. Local communities know this gear type as *jaring liongbun* or *jaring kemejan* (Oktaviyani, 2018; Suharsono, pers. comm., 2019; Sadri & Yuneni, 2019).

b. Wedgefishes as a by-catch

1. Bottom longline

   The bottom longline generally targets demersal fishes, such as snapper, grouper, and threadfin bream. It usually has a hundred hooks with medium-size (No. 6-7). Commonly, juveniles or small wedgefishes are caught by the bottom longline as a by-catch due to its habitat intersecting with other demersal fishes. This gear type is used in almost all regions of Indonesia.

2. Shark bottom longline

   Despite targeting demersal sharks, shark bottom longline catches a large number of by-catches, including wedgefishes. The bottom longline has the largest fishing hook size of 0-1, depending on the hook brand, with the number of hooks varying from 50 to 100. The fishing gear is set on the bottom slope of the continental shelf. This fishing gear is commonly used on the east side of the Java Sea, the Bali Strait, the southern of Lombok Island, the Savu Sea, the Timor Sea, the Bali Strait and surrounding areas (Simeon et al., 2019; Rekam, 2020, unpublished; Oktaviyani, 2019; Oktaviyani et al., 2020).

3. Bottom gillnet

   The bottom gillnet catches juveniles of wedgefishes as by-catch and generally targets shrimps and demersal fishes starting from the river estuary to the coastal waters. It is commonly found in almost all regions of Indonesia and was once found to be operating in two nursery wedgefish habitats, i.e., Aceh and West Nusa Tenggara (Simeon et al., 2019).

4. Seine net

   Seine net is known as *cantrang* or *payang* by local people. It is still widely used around the Java Sea. Both are kinds of trawl, mostly used by fishers from the North Coast of Java with fishing fleets of 20 to 150 GT and various net lengths, between 19-40 m (Rekam, 2020, unpublished). The primary targets are demersal fishes, but in practice, many other species are caught, including wedgefishes.

5. Trammel net

   Trammel net consists of three layers that settle at the bottom or are washed away by current / vessel / pulled to one side. It primarily targets shrimps but catches quite a lot of juveniles of wedgefishes as by-catch. One of the locations known of trammel net operations is around Bintuni Bay, Papua (WWF, 2020, unpublished).

3.3. Fishing Grounds

Wedgefishes are caught in almost all Indonesian waters, from coastal waters to shallow seas of Sunda and Sahul shelves. However, the total catch varies among areas. Based on the statistics data of capture fisheries, the highest total catch of wedgefishes is the Java Sea (FMA 712), followed by the Natuna Sea and Karimata Strait waters (FMA 711), and the Flores Sea (FMA 713). The wedgefishes are also found in the west coast of Sumatra (FMA 572) and the southern Indonesian waters (FMA 573; Figure 8; MMAF, 2016).

The diversity of wedgefishes vary among fishing grounds. *Rhynchobatus australiae* and *Rhina ancylostoma* are the two common species found in all Indonesian waters. Meanwhile, *R. laevis* is estimated to inhabit the east coast of Sumatra, the Malacca Strait, the Karimata Strait, the Natuna Sea, the Arafura Sea and the Java Sea. *Rhynchobatus springeri* is widely distributed in the Karimata Strait, the Java Sea, south of Lombok Island, the Savu Sea, around Sumba Island and the Arafura Sea (Yuwandana, 2020, unpublished; LIPI, 2018, unpublished; Sadri & Yuneni, 2019; BPSPL Denpasar, 2019, unpublished; LPSPL Sorong, 2019, unpublished; BPSPL Pontianak, 2019).

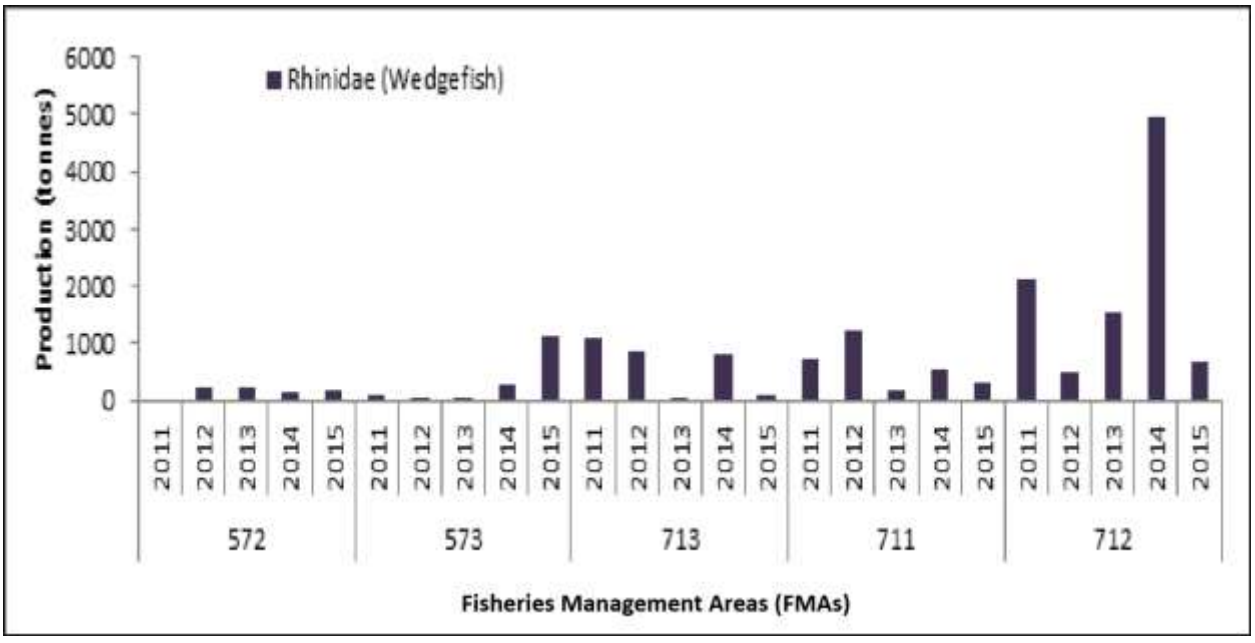


Figure 8. Wedgefish productions by FMA in 2011-2015 (MMAF, 2016)

Of all fishing areas in FMA 711 and 712, including the Java Sea, the Karimata Strait, and the Natuna Sea, have the highest abundance and the richest of species composition. Those

waters are particularly suitable as the wedgefish habitat because those are shallow waters with muddy substrates. The species caught in the Java Sea are mainly *R. australiae*, followed by *R. laevis*, and *R. springeri* (Figure 9; Yuwandana et al., 2019). The catch from the Java Sea is usually landed at the ports in northern Java, such as Lamongan, Rembang, Batang, Pati, and Indramayu.

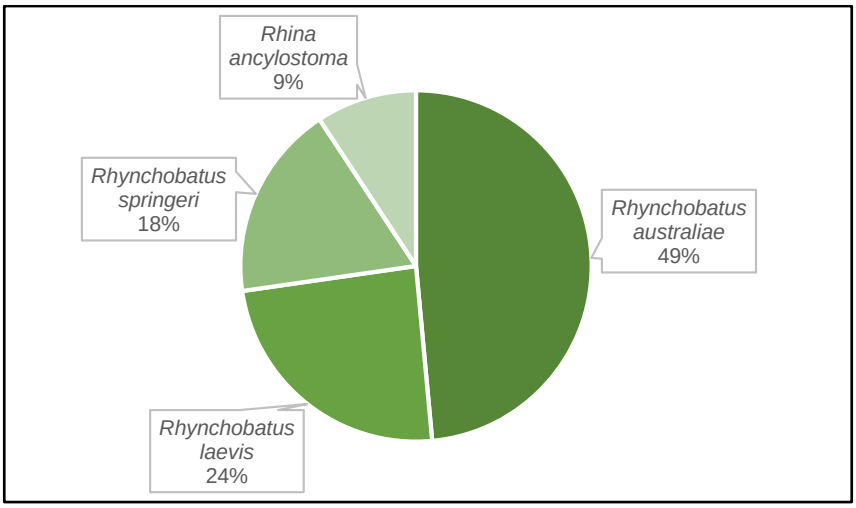


Figure 9. Composition of the catch abundance of wedgefishes in the Java Sea during data collection in April - September 2019

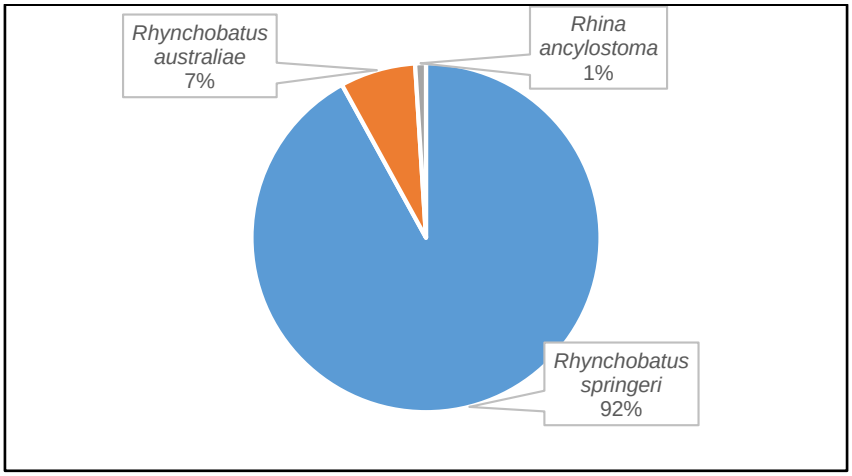


Figure 10. Wedgefishes composition in the catch recorded from May 2018-April 2019 from Karimata Strait

Fishers who catch wedgefishes in the Karimata Strait and the Natuna Sea generally land their catches at the Port of Muara Angke-Jakarta, Bangka Belitung Province, and sites around West Kalimantan. In contrast to the Java Sea, the catch from the Natuna Sea and Karimata Strait

are dominated by *R. springeri*. The data collected in the Sungai Kakap-West Kalimantan from May 2018 to April 2019 noted that this species contributed almost 92% to the total catches (LIPI, 2019, unpublished; Figure 10). Apart from the three species, *R. laevis* was also caught by fishers in the Natuna Sea and Karimata Strait (Sadri & Yuneni, 2019). Observers recorded 94 individuals in three fishing trips during the period of August-October 2019. Thus, in total, there are four species of wedgefishes found in the Natuna Sea and Karimata Strait.

3.4. The Mean Capture Size

Wedgefishes are caught at various sizes, from juveniles to mature individuals. Different fishing gear and catch characteristics (targeted or by-catch) affect individual size. The capture size at various locations shows differences in average length, as presented in the table below.

Table 1. The mean length of captured wedgefishes in Indonesian waters

Species	Average of Total Length	Fishing Gear	FMA	Source
R. australiae	105 cm (n = 2.640)	Tangle net and Seine net	711, 712, 713	Kurniawan et al., 2020, unpublished
	Female 224 cm (n=693) Male 183 cm (n = 113)	Shark bottom longline	573	Simeon et al., 2020
	Female 135 cm (n=95) Male 225 cm (n=39)	Bottom longline, gillnet	572	Simeon et al., 2020
R. springeri	128-145 cm (n = 448)	Tangle net	711	Sadri & Yuneni, 2019;
	170-199 (n=998)	Tangle net	711	LIPI, 2019, unpublished
	Female 129 cm (n = 849) Male 106 cm (n = 395)	Seine net	711, 712, 713	Rekam, 2020, unpublished
R. laevis	Female 113 cm (n=1069) Jantan103 cm (n = 487)	Seine net	712	Rekam, 2019, unpublished
	Female 151 cm (n=27) Male 225 cm (n=113)	bottom gillnet, bottom longline	572	Simeon et al., 2020
Rhina ancylostoma	145 cm (n = 334)	Tangle net and seine net	711, 712, 713	Kurniawan et al., 2020, unpublished
	Female 185 cm (n = 28) Male 192 cm (n = 18)	Shark bottom longline	573, 713	Simeon et al., 2020

The data above shows that the wedgefishes caught in the continental shelf waters bordering the Indian Ocean has a larger size than the ones from the Java Sea and the surroundings (FMA 712). It is probably due to the selectivity of fishing gear. The tangle net and bottom shark longlines have higher selectivities compared to the seine net (*cantrang*).

3.5. Critical Habitat

Critical habitat has an essential part in the life cycle of biota, such as areas for mating, giving birth, and as a nursery ground. A location called a critical habitat if a species found in a large number at a specific time return to the waters in a particular season, or the discovery of a large number of juveniles (Heupel et al., 2007). So far, two locations have been suspected as the nursery areas of wedgefishes, such as Aceh Jaya of Nanggroe Aceh Darussalam Province and Lunyuk of West Nusa Tenggara Province, indicated by many juveniles caught in those areas. The wedgefish growing areas also overlap with other juvenile sharks in the two locations. The capture size range of *R. australiae* in Lunyuk was 50-140 cm of total length (TL), with an average size of 79.8 cm (Simeon et al., 2018). It shows that the species is caught from the size at birth to juvenile (sexually immature). The juveniles of *R. australiae* are usually caught with juveniles of *Sphyrna lewini* and *Carcharhinus brevipinna* and other small-size shark species, such as *C. tjutjot, C. sorrah* and *Rhizoprionodon oligolinx.*

In contrast to Lunyuk, two juveniles of wedgefish species were recorded from the waters of Aceh Jaya, i.e., *R. australiae* and *R. laevis* (Simeon et al., 2020). The juveniles of wedgefishes are usually caught with juveniles of scalloped hammerhead shark (*Sphyrna lewini*) and other small-size shark species, such as *Loxodon macrorhinus, Rhizoprionodon oligolinx,* and *Rhizoprionodon acutus.*

The third location is Binuangeun-Banten, where sharks and rays are landed from the gill net fishery as by-catch. At this location, *R. australiae* is mostly landed from the birth size to immatures with the size ranges between 50 and 120 cm TL (Oktaviyani, 2019). The fishers of Binuangeun-Banten catch not only *R. australiae* but also the juveniles of *Sphyrna lewini, Carcharhinus falciformis, C. brevipinna* and *C. longimanus*. The fishing area is generally in shallow waters or near small islands around the Binuangeun waters, Banten. This area is suggested to be a nursery ground for shark and ray species.

3.6. Fishing Season

A fishing season indicates the high abundance of fishes available at a certain period and/or specific locations. The fishing season is used to determine the population abundance through fisheries approaches. In general, fishing seasons are marked based on the tropical seasons that occur in Indonesia, i.e., west monsoon season, a transitional season I, east monsoon season, and transitional season II. Every location has a different fishing season, depending on the geography, abundance, and fish distribution.

Fishing season of the wedgefishes in the eastern Indian Ocean generally occurs in the transitional season from the west to the east season, from February to April. However, the number of catches and captured size per month is not significantly different throughout the year. It may be because they use the bottom shark longline as fishing gear that tends to be selective at a specific size (Simeon et al., 2019).

Unlike the bottom shark longline fishers, the seine net fishers from the North Coast of Java have a fishing pattern based on fishing season and fishing ground. From May to October is considered the peak fishing season with the fishing ground located in the eastern Java Sea. While the lowest season occurs from November to February, and the fishing ground moves to the western Java Sea adjacent to the Karimun Jawa islands (Yuwandana et al., 2019). Each species has a different abundance per month, which *R.australiae* is mostly landed in large number between April and May, in January for *R. springeri*, while *R. laevis* is more abundant in April, May, August, and November, and from April to June for *Rhina ancylostoma* (Rekam, 2020, unpublished).

4. UTILIZATION ASPECT

4.1. Socio-economy

Elasmobranch fishing in Indonesia has been identified since the 1970s. At that time, sharks and rays were mostly caught as by-catch from tuna fisheries. The fishery became more popular since the increasing price of shark fins in the international market in 1988, thus encouraging fishers, particularly in artisanal fisheries, to target sharks and rays (Anung & Widodo, 2002; Fahmi & Dharmadi, 2013). A similar situation applied to the wedgefish group. Fishers in some areas, such as Bangka Island, West Kalimantan, and West Papua, have targeted this group since a long time ago. In the North Coast of Java, wedgefishes are caught mostly as by-catch in seine net fishery. Many people make a living from elasmobranch catches (including wedgefishes), such as fishers, fish collectors, traders, and fish product processors involved in the trade chain. Meanwhile, the general public consumes wedgefishes as food and a source of protein.

4.2. Post-Harvest Processing

Field observations showed that some fishers did not care much about the quality of their elasmobranch catch, including wedgefishes, indicated by the poor post-harvest handling. Nevertheless, the economic value of this group is still high due to the fin price, despite the falling price of the meat product. The handling process of wedgefishes can vary between regions, depending on the character of fisheries at each location. Most fishers catching wedgefishes are more interested in the fins that have high economic value. Wedgefish fins are one of the commodities that have the best quality and highest price in the fin trade (Kyne et al., 2020). Therefore, wedgefish fins become one of the leading export commodities in Indonesian fishery products.

In the Sungai Kakap of West Kalimantan, the wedgefishes are generally landed in whole-body or finless. The vessel owners have a warehouse to process their catches independently. Usually, the fins will be cut and dried on board during the fishing trip. In a warehouse or landing site, the fish will be processed with skin, meat, fins, snouts, cartilage, and liver separated. At the same time, the guts are collected for animal feed or discarded. The skins, cartilages and fins are dried under the sun, while the meat is salted (if the quality is unacceptable) or sold wet (if still in good condition and fresh; Figure 11). Generally, local communities process meat into smoked, grilled, dried or salted meat and processed to be meatballs, crackers or other products. Crackers are usually labelled as being made from other fish species (such as mackerel) to increase the

selling price. Large-size skins are also sold in dried condition for fashion materials to exporters or taken over by domestic craftsmen (Figure 12). Another derivative product of wedgefishes is cartilages from the vertebrae and head bone (Figure 13).

Figure 11. Handling process of wedgefish products in Sungai Kakap, West Kalimantan
Photo: S. Oktaviyani, 2018; M. Sabri, 2019

Figure 12. *Rhina ancylostoma* skin as one of the export commodities
Photo: WCS-IP, 2019

Figure 13. Dried wedgefish cartilages for trade
Photo: WCS-IP, 2019

In contrast to the Sungai Kakap, other locations such as Tanjung Luar-West Nusa Tenggara, Muncar-East Java and other regions, have different processing patterns. In general, wedgefishes are sold to buyers either in whole or per body part, for example, meat is sold to processors while fins are sold to fin collectors or collected by the owners.

The drying process of fins still relies on the traditional method using the sunlight. The fins are dried under the sun until they are completely dry, usually for four to seven days, depending on the weather condition. Furthermore, the collectors process the fins into fibers by cleaning them from other elements and particles, such as sand, dust or other impurities, and soaking them in water for four to five days until they are soft. The fins are then boiled for half an hour until the skin layer can be separated from the meat fibers. The processed fins become the raw material for making shark soup, usually served as a traditional Chinese dish.

4.3. Trade Chain

The trade chain of shark and ray products in Indonesia is long and complicated, starting from fishers, collectors, processors, to exporters (Fahmi & Dharmadi, 2013). Collectors are very complex business actors because they exist in large cities up to small towns or outer islands. Therefore, the traceability of shark and ray products poses a very big challenge to the government, thus requiring good strategy (Fahmi & Dharmadi, 2013). A general description of the trade chain of shark and ray products in Indonesia is presented as follows (Dharmadi & Presetyo, 2019):

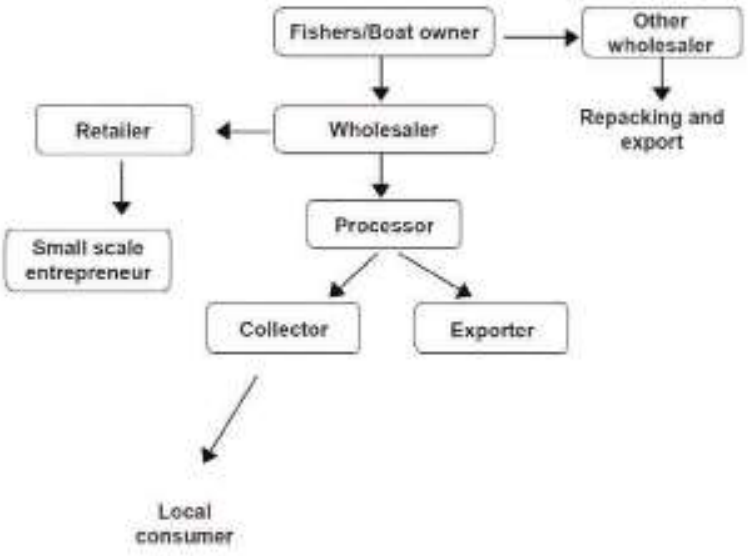


Figure 14. Diagrammatic representation of the trade chain of shark and ray products in Indonesia

Local utilization of elasmobranch (including wedgefishes) focuses on meat. Shark and ray meat is used locally or sold domestically through regions in Indonesia, especially to remote areas because of affordable price and durability (Dharmadi & Presetyo, 2019). Meanwhile, fins, skin, bones, and snouts are mostly exported to East and Southeast Asian countries.

4.4. Domestic Trade

Kalimantan is one of the Indonesian regions where wedgefish products distributed initially. From 2017 to 2019, the MMAF's Coastal and Marine Resource Management Agency (BPSPL) of Pontianak recorded nine wedgefish products from Kalimantan sent to other regions in the form of dried meat, moist meat, dry fins, wet fins, dried skin, living fishes, cartilages, snouts and small fins (Table 2).

In general, the products from the Kalimantan region are sent to several major cities in Indonesia, such as Jakarta and Surabaya, as the export exits or locations of exporters. It was rare that wedgefish products from Kalimantan were sent overseas directly, except for the snout product. Of nine products traded, dried fin product is the primary commodity from wedgefish fishery and has the highest economic value as well (Table 3).

Table 2. Weights of wedgefish products shipped from the Kalimantan region in 2017-2019

Type of Products	Species	Weight (kg)		
		2017	2018	2019
Dried meat	*R. australiae*	150.00	-	-
Wet meat	*Rhina ancylostoma*	739.56	495.81	412.87
	R. australiae	2,533.47	8,364.99	9,661.76
	R. springeri	-	2,488.20	-
Dried fin	*Rhina ancylostoma*	363.22	382.38	317.65
	R.australiae	10,601.40	6,228.63	43,893.80
	R. springeri	1,018.01	5,242.53	9,074.61
Wet fin	*Rhina ancylostoma*	3.88	15.40	7.33
	R. australiae	148.91	29.44	119.98
	R. springeri	106.55	127.31	322.87
Dried skin	*Rhina ancylostoma*	31.00	22.70	80.00
	R. australiae	474.26	1,055.02	0.32
	R. springeri	-	4,060.22	11,326.79
Live	*Rhina ancylostoma*	9.20	-	3.00
	R. australiae	-	9.28	-
	R. springeri	-	36.00	-
Cartilage	*R. australiae*	1,710.00	5,378.05	0.11
	R. springeri	-	1,773.40	3,330.80
Snouth	*R. australiae*	31.50	-	-
	R. springeri	89.39	-	-
Small fin	*R. australiae*	15.00	-	-

Table 3. The economic value of wedgefish products shipped from the Kalimantan region in 2017-2019

Type of Products	Species	Economic values (million IDR)		
		2017	2018	2019
Dried meat	*R. australiae*	12.00	-	-
Wet meat	*Rhina ancylostoma*	9.61	6.45	5.37
	R. australiae	32.94	108.74	125.60
	R. springeri	-	32.35	-
Dried fin	*Rhina ancylostoma*	254.25	267.67	222.36
	R.australiae	23,323.08	13,702.99	96,566.36
	R. springeri	2,239.62	11,533.57	19,964.14
Wet fin	*Rhina ancylostoma*	2.72	10.78	5.13
	R. australiae	327.60	64.77	263.96
	R. springeri	234.41	280.08	710.31
Dried skin	*Rhina ancylostoma*	1.86	1.36	4.80
	R. australiae	28.46	63.30	0.02
	R. springeri	-	243.61	679.61
Live	*Rhina ancylostoma*	2.15	-	0.70
	R. australiae	-	2.17	-
	R. springeri	-	8.40	-
Cartilage	*R. australiae*	51.30	161.34	0.01
	R. springeri	-	53.20	99.92
Snouth	*R. australiae*	0.95	-	-
	R. springeri	2.68	-	-
Small fin	*R. australiae*	10.50	-	-

The economic values presented in Table 3 were estimated from the average product selling prices in 2019, with the scenario that there has not been an extreme price change in the last three years. In the Kalimantan region, the price of fresh meat of wedgefishes is IDR 7,000-15,000/kg, depending on the level of freshness, while the price of dried salted meat is in the range of IDR 20,000-27,000/kg. The price of wet skin is around IDR 80,000/kg, while dried skin is IDR 20,000-40,000/kg in pieces and IDR 60,000-70,000/kg in the whole-body form. Other products, i.e., cartilage and snouts, are between IDR 25,000-35,000/kg.

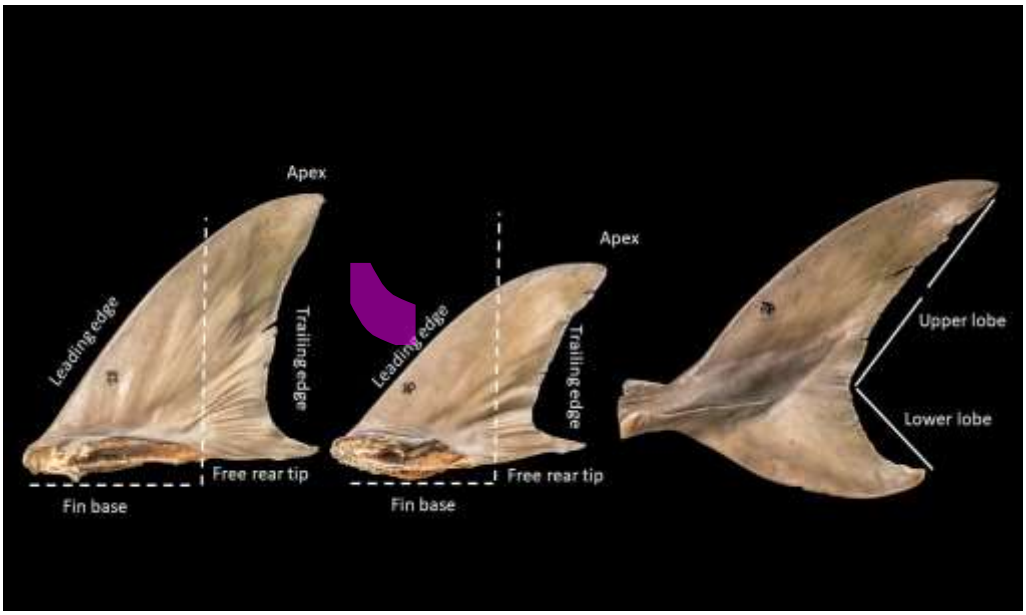


Figure 15. A set of *Rhynchobatus* spp. fins
Photo: WCS-IP, 2020

Fins of *Rhynchobatus spp.* have the highest value among shark and ray species, i.e. in the range of IDR 1,700,000-2,700,000/kg in the international market. A 20 cm-long fin is valued around IDR 700,000/kg, the 40 cm is around IDR 2,200,000/kg, and the 50 cm is IDR 2,700,000/kg. Meanwhile, the price of *Rhina ancylostoma* dried fins ranges IDR 500,000-900,000/kg (BPSPL Pontianak, 2020, unpublished; LIPI, 2020, unpublished). Wedgefish dried fins are usually sold in sets, in that one set consists of two dorsal fins and two caudal fins (Figures 15 and 16). The price list was obtained from the interview in 2018-2020. The selling price of wedgefish products varies in each region, usually depending on the type, quality and size.

Figure 16. A set of *Rhina ancylostoma* dried fin products

Photo: S. Oktaviyani, 2020

The Sorong Coastal and Marine Resource Management Unit (LPSPL Sorong), which has a working area covering Maluku and Papua, recorded that wedgefish products were actively shipped from eight locations within Maluku and Papua. The two locations with the most significant number of wedgefish products are Sorong and Merauke, with the dominant species being *R. australiae*. The total wedgefish products distributed from the Maluku and Papua regions in 2018 and 2019 are shown in Figure 17 (LPSPL Sorong, 2019, unpublished).

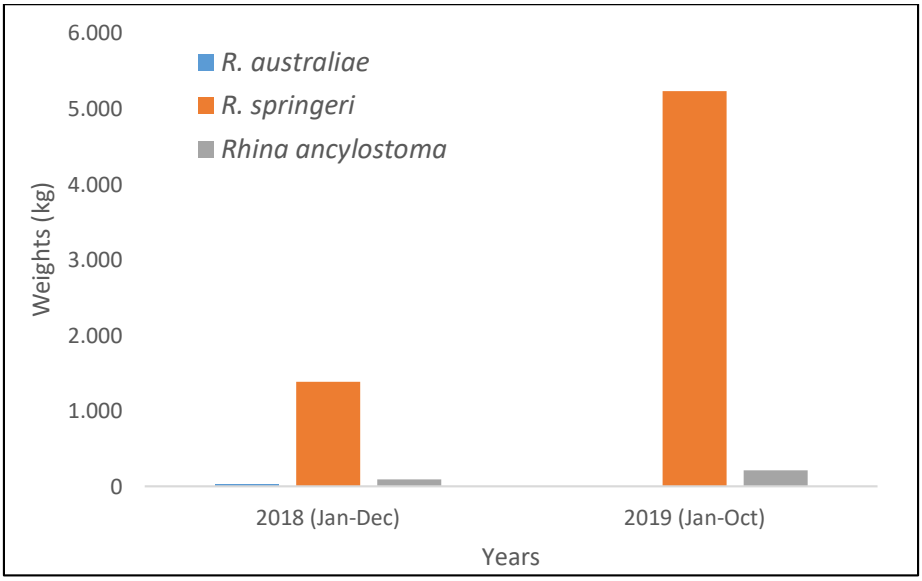


Figure 17. Total wedgefish products from Maluku and Papua in 2018-2019

The data collected by the MMAF's Marine and Coastal Resource Management Agency (BPSPL) also indicated some other areas where wedgefish products originated, such as Aceh, Batam, Bintan, Lingga, Sibolga, Nias, Bangka-Belitung, Ambon, Ternate, Dobo, Pulau Bacan,

other cities in the northern Java, Merauke, Sorong, Kupang and Mataram. Most of the wedgefish products from those locations are sold to prominent collectors or exporters in big cities, such as Surabaya, Manado, Jakarta, Medan, Semarang, Tanjung Pinang, Makassar and Bali (Primary data of MMAF, 2020).

Some areas in the north coast of Java where wedgefish products originated is spreading from West to East Java. There are some fishing ports where wedgefishes are usually being landed along the north coast of Java, such as Karangsong-Indramayu Fishing Port, Tegalsari-Tegal Coastal Fishing Port, Juwana-Pati Beach Fishing Port, Tasik Agung-Rembang Fish Landing Site, Tawang-Kendal Fishing Port, Palang-Tuban Fishing Port, and Brondong-Lamongan Archipelagic Fishing Port. The meat and cartilages are used as material for smoked fish that is consumed by people within Central and East Java, such as Semarang, Mojokerto, Pati, Rembang, Tegal and Lamongan.

4.5. International Trade (Export)

There are more than 250 companies engaged in the trade of shark and ray products in Indonesia, both domestically and abroad. Around 150 of them are exporters (Primary data of MMAF, 2020). From 2016 to 2019, the wedgefish products (*Rhynchobatus* spp. and *Rhina ancylostoma*) exported abroad consisted of dried fins, dried skin, cartilages, snouts, living fishes and meat products (fillets, finless, headless, whole body and headless-finless). The total exports for all *Rhynchobatus* spp. products (excluding living fish) in 2016-2019, are shown in Figure 18.

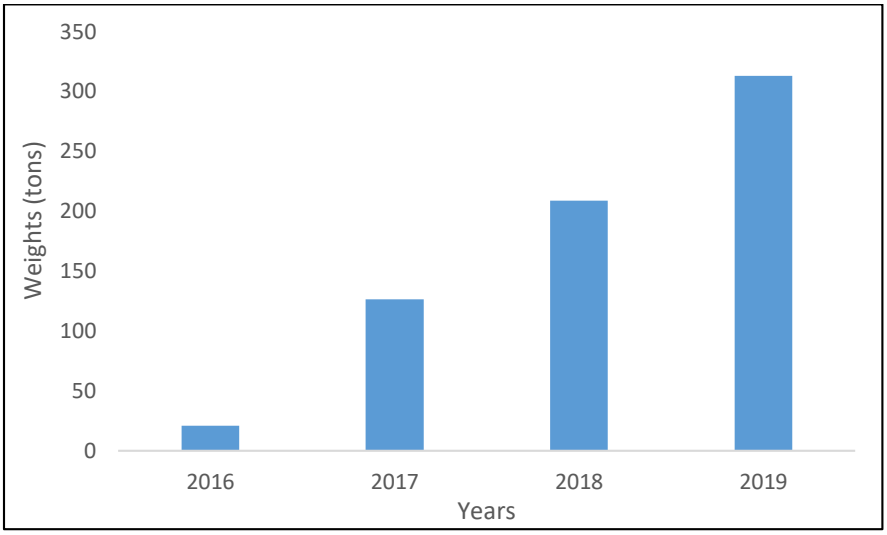


Figure 18. Total exports of *Rhynchobatus* spp. products in 2016-2019

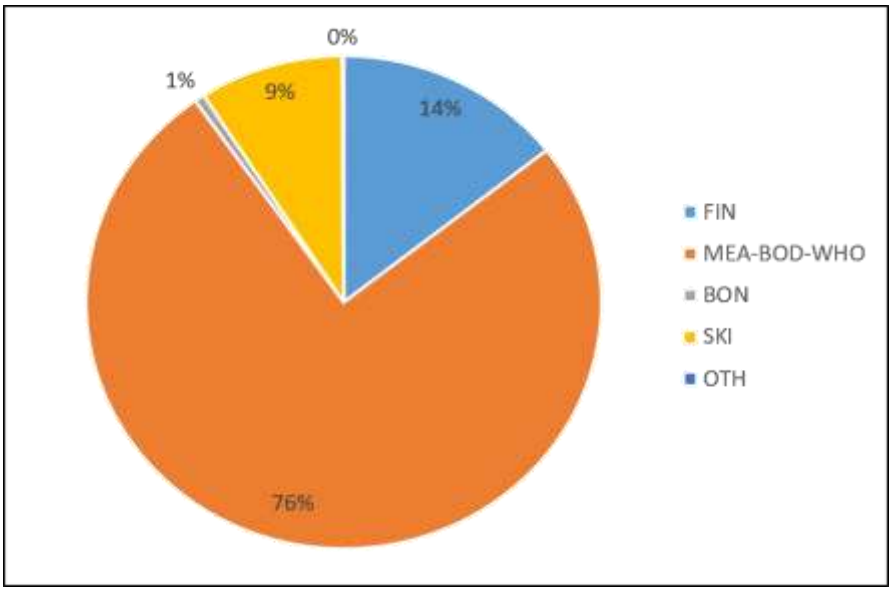


Figure 19. The average percentage of each *Rhynchobatus* spp. product from 2016-2019

The total exports of *Rhynchobatus* spp. (excluding live wedgefishes) show an increasing trend every year. In 2019, the number of exports reached 312.7 tons, an increase of 1.5 times from the previous year of only 208.7 tons. Meat products (fillets, finless, headless, whole body and headless-finless) dominated the export with an average percentage of 75.8%. The average percentage for other products included dried fins was 14.4%; dried skin, 9.1%; cartilages, 0.6%; and snouts, 0.1% (Figure 19; Processed primary data of MMAF, 2020).

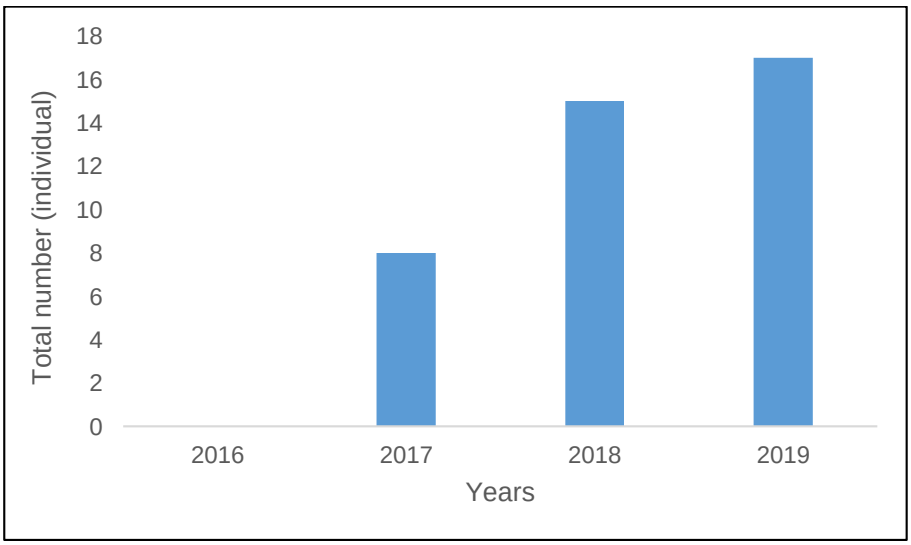


Figure 20. Total exports of living *Rhynchobatus spp*. in 2016-2019

Apart from those products, *Rhynchobatus* spp. are also sold as living fish. The export of living *Rhynchobatus* spp. increases every year (Figure 20), with the most significant number of exports in 2019 amounting to 17 individuals. Three importing countries of living *Rhynchobatus* spp. are Singapore, the United States and the United Arab Emirates, with shipments of around 80%, 13.3% and 6.7%, respectively.

Each wedgefish product has different destination countries. Products of *Rhynchobatus* spp. are mainly sent to Hong Kong and China. The percentage of total exports to each importing country for each product is shown in Table 4 (Processed primary data of MMAF, 2020).

Table 4. Percentage of total exports by destination country in 2016-2019

No	Negara	Total exports based on CITES trade code (%)							
		FIN	MEA	BON	SKI	OTH	LIV	BOD	WHO
1	The United States						5.0		
2	Australia			11.9					
3	China	0.9	50.1	46.4	3.0	4.8		13.5	
4	Hongkong	81.4	1.7		52.8	79.4			
5	Japan	0.2		41.7					
6	South Korea	0.2							
7	Malaysia	0.4			1.6	15.9		2.3	7.4
8	Singapura	15.7	0.1		0.2		92.5	3.8	92.6
9	Sri Lanka		23.2					80.3	
10	Taiwan		24.9		35.7				
11	Thailand	0.1			0.6				
12	Vietnam	1.1			5.9				
13	United Arab Emirates						2.5		

*FIN: fins; MEA: meat (fillet); BON: cartilage; SKI: skin; OTH: snouts; BOD: *finless, headless, headless-finless*; WHO: fresh whole-body

Table 4 shows that there are eight products of *Rhynchobatus* spp. based on the CITES trade codes. Meat products, especially finless, headless and headless-finless, are mostly shipped to Sri Lanka as an importing country (BOD code), except for fresh whole-body (WHO) to Singapore and full meat (fillets) to China. *Rhynchobatus* spp. in a whole-body form is sent to

Singapore and Malaysia from Tanjung Pinang, with the area of origin from the Bintan and Riau Islands (Primary data from MMAF, 2020).

Apart from *Rhynchobatus* spp., another wedgefish species traded internationally is *Rhina ancylostoma*. The export products of this species consist of dried fin, skin and live fish. The number of exports and the percentage of dried fin and skin products from *Rhina ancylostoma* in 2016-2019 is shown in Figure 21.

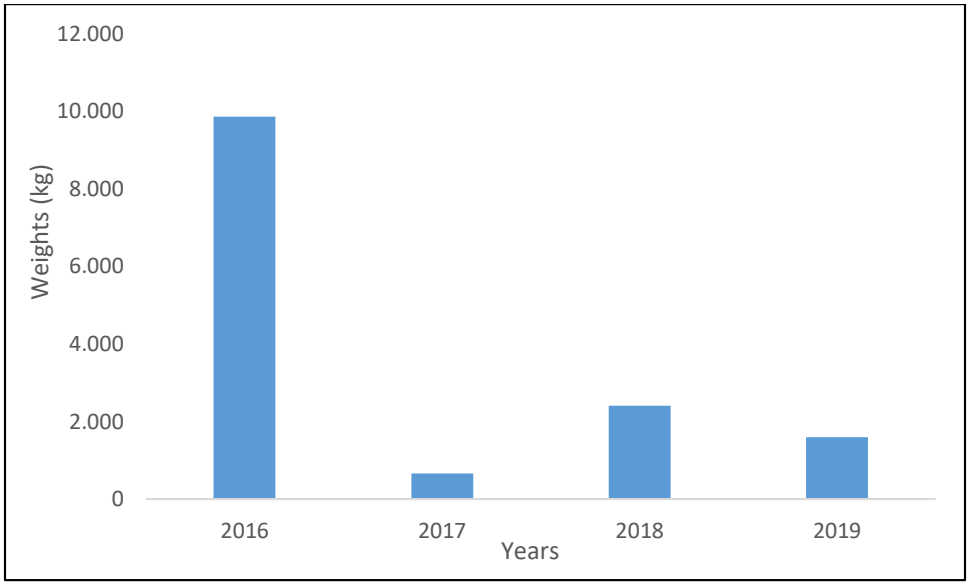


Figure 21. Total exports of *Rhina ancylostoma* products in 2016-2019

Of the total exports of *Rhina ancylostoma*, dried skin was only recorded to be exported in 2016 and 2018 with much less shipping intensity compared to dried fins. However, the weight of dried skin sent was more than that of dried fins, which amounted to 98% and 42% of total exports in 2016 and 2018, respectively. *Rhina ancylostoma* dried fins were sent to Hong Kong and Russia. For dried fin exports, Hong Kong dominated the destination countries by 85.8%, followed by Singapore (13.1%), China (0.8%) and Thailand (0.3%). This percentage was obtained from all exports of dried fins from 2016 to 2019 (Primary data from MMAF, 2020). In addition to dried skin and dried fins, *Rhina ancylostoma* was also sold live to several countries, such as Singapore, the Netherlands, Malaysia, Hong Kong, Sri Lanka, Russia and China. The number of living fish exports for *Rhina ancylostoma* species in 2016-2019 is shown in Figure 22.

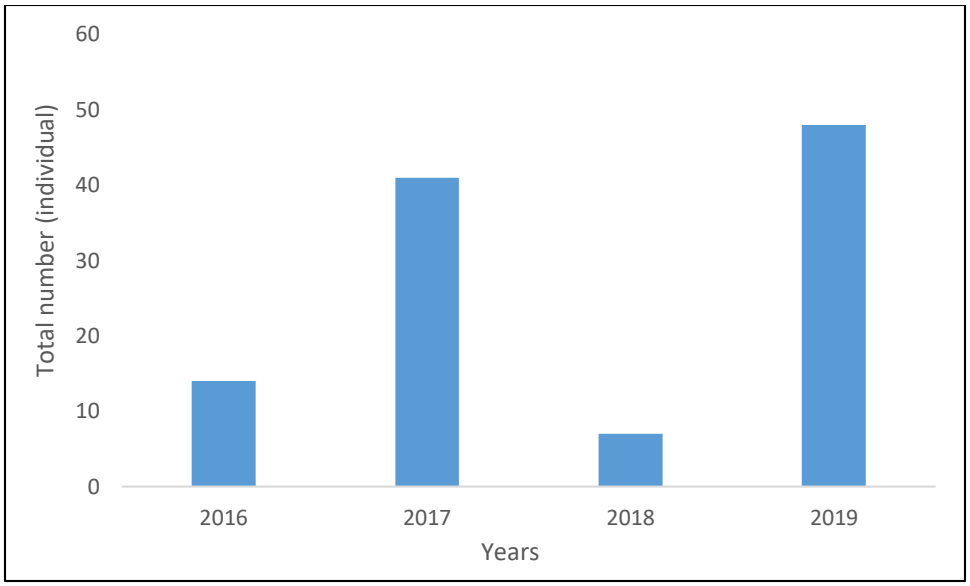


Figure 22. Total exports of living *Rhina ancylostoma* in 2016-2019

The highest export of living *Rhina ancylostoma* occurred in 2019, with 48 individuals (one individual is estimated to weigh 2-3 kg). The fish were recorded to be sent by air through the exits of Tanjungpinang, Tarakan and Jakarta. The highest demand for living *Rhina ancylostoma* was from Singapore, around 48.2% of total exports. The demands also came from other countries, such as the Netherlands (5.5%), China (0.9%), Hongkong (35.5%), Malaysia (3.6%), Rusia (2.7%) and Sri Lanka (3.6%). The number of exports of *Rhynchobatus* spp. and *Rhina ancylostoma* presented in this document does not represent the actual export situation since it was mixed with other wedgefish species along with other sharks and rays. It means that the records have not been separated by species or genus and sometimes mixed with other families.

Other than these documents, export volume for elasmobranch products can be obtained from quarantine data as well. Unfortunately, it is recorded for general or all species, not divided into genus or species groups. Annual export volumes are recorded at between 2,000-4,000 tonnes per year or only 1.7-3.3% from the total landing of sharks and rays in Indonesia, which is approximately 120,000 tonnes (Muttaqin et al., 2018). Muttaqin et al. (2018) estimated that Indonesia exports a total of 1,800-3,600 tonnes of non-fin commodities per year or 90% of total export, while the remainder is fin commodities. In the current export data recording system, elasmobranch commodities (fin and non-fin commodities) are not specified at the product and species level. Muttaqin et al. (2018) stated that according to ComTrade data, non-fin commodities consisted of sharks frozen, sharks chilled, rays frozen and rays chilled, as based on international Harmonized System (HS) classifications, with the largest product category by volume is sharks

frozen (Figure 23). The other products may be recorded under general fish records or different codes, such as liver oil, gill plates and teeth. It is difficult to obtain accurate data on export volumes of specific products, both fin and non-fin commodities. Also, some categories of products are unclear to classified and mixed up with other species or products (Muttaqin et al., 2018). Therefore, it should be quite challenging to summarise and trace until the species level.

Figure 23. The trend of export for fin and non-fin commodities from 2014-2016
Source: Muttaqin et al., 2018

Lack of knowledge and understanding is one of the problems underlying the poor classification of wedgefish products in the export commodities. Identifying shark and ray products is very difficult if they are no longer attached to their bodies. Therefore, the separation of products up to the species level and product origin information is the biggest challenge in the elasmobranch product traceability in Indonesia. Exporting data recording systems must be developed as well to

reduce misrecorded data. The traceability will enable the recording of domestic and export trade data to be more specific (up to the species level), detailed and accurate.

Elasmobranch products are sent to importing countries by sea and air. Some of the ports known as the exits for wedgefish product exports from Indonesia are Tanjung Perak Port, Batu Ampar Port, Kijang Port, Belawan Port and Senayang Port. Meanwhile, the airports known as export exits include Juanda Airport-Surabaya, Soekarno Hatta Airport-Tangerang, Kualanamu Airport-Deli Serdang, Hasanuddin Airport–Makassar and Sam Ratulangi Airport–Manado. Therefore, control and supervision systems are needed at these points to support the management of sharks and rays in Indonesia. A control system is intended to prevent loopholes for illegal trade, especially for endangered and protected species nationally and internationally.

5. MANAGEMENT ASPECT

5.1. National Plan of Action

To adopt and implement the International Plan of Action (IPOA) of sharks 1999, the Government of Indonesia has prepared the National Plan of Action (NPOA) for the conservation and management of sharks and rays in Indonesia for the periods of 2010-2014 and 2016-2020. The NPOA for sharks and rays 2016-2020 includes nine primary strategies, i.e.: (1) Development and implementation of national regulations to support sustainable shark and ray management; (2) Review of shark and ray fisheries status at national, regional and international levels; (3) Strengthening of shark and ray fisheries data and information; (4) Development of shark and ray research; (5) Strengthening of conservation efforts for endangered sharks and rays; (6) Strengthening of management steps; (7) Awareness-raising on sharks and rays; (8) Institutional empowerment; and (9) Human resource capacity building.

Some priority programs in the NPOA for Sharks and Rays 2016-2020 include the improvement of shark and ray data collection by placing enumerators on primary landing sites and observers on tuna fishing vessels. The data improvement aims to strengthen research on the biological and fisheries aspects. Other priority programs are strengthening the protection of endangered sharks and rays as well as encouraging campaign and awareness programs for all stakeholders. Some expected outputs of the NPOA implementation are policies on the protection of several types of sharks and rays, monitoring of sharks and rays, and writing a book on shark and ray fisheries status in Indonesia.

5.2. Fishing Regulations

Several regulations regarding sharks and rays fishing in Indonesian waters have been issued and implemented. Some regulations are relatively general to all fisheries-related but can be implemented to shark and ray fisheries in particular, i.e.:

1. **Minister of Marine Affairs and Fisheries Regulation No. 14 of 2011 on Capture Fisheries Business**

   This regulation stipulates that every fishing vessel operating both in the Indonesian FMA and in the high seas must have a permit.

2. **Minister of Marine Affairs and Fisheries Regulation No. 48 of 2014 on Fishing Log Books**

This regulation amended the previous Minister of Marine Affairs and Fisheries Regulation No. PER.18 / MEN / 2010 on fishing logbooks, which was considered to be less effective in the implementation. This regulation requires every fishing vessel over 5 GT, which is licensed, Indonesian-flagged and operating in Indonesian territorial waters to have a logbook, fill it out, and hand it over to the harbormaster of the fishing port. For the vessels catching the wedgefishes, this regulation is quite relevant since the wedgefish fishing grounds are in Indonesian waters.

Various breakthroughs have been made to improve the compliance of fishing vessels in filling in and reporting the fishing logbooks, one of which is the use of e-logbook. This technology enables vessel captains to fill in the logbooks using an application. The impact of applying this technology is quite positive. This can be seen from the increased compliance with logbook filling and reporting, although still low.

3. **Minister of Marine Affairs and Fisheries Regulation No. 71 of 2016 on the Fishing Routes and Placement of Fishing Gears in Fisheries Management Areas**

Based on the ministerial regulation, a net that catches explicitly wedgefishes is called as *jaring liongbun* or tangle/gillnet. It has a fishing route of at least 12 nautical miles. The permit to use this net is only given to fleets with a size of more than 30 GT. The allowable mesh size is 8 inches with a maximum rope length of 2,500 m. However, to increase the selectivity, *liongbun* nets are currently included in the revised study. This aims to manage the caught wedgefishes of having reached a size at sexual maturity. Although there are regulations for fishing gear that specifically target wedgefishes, these species are also caught as by-catch by other fishing gears.

4. **Minister of Marine Affairs and Fisheries Regulation No. 1 of 2013 on the Monitoring of Fishing Vessels and Fish Transporting Vessels**

Based on the ministerial regulation, every vessel with a size above 30 GT must place a fishing monitor to monitor, measure, record and report fishing activities. This monitoring aims to obtain objective and accurate data on fishing and fish transfer activities directly on fishing vessels and fish transporting vessels. The role of the monitor is required, particularly in preventing Illegal, Unreported and Unregulated (IUU) Fishing.

The fishing and fish transporting monitor works on a fishing vessel that uses purse seine and longline fishing gear operating on the high seas. The monitor also works on a vessel that uses fishing rods, ring nets, lift nets, gillnets, seine nets and trawls operating in Indonesian waters, and fish transporting vessels operating both in Indonesian waters and in the high seas. Based on the evaluation results of the monitoring implementation, the compliance of fishing vessels to place monitoring officers on the vessels is still deficient.

5. Minister of Marine Affairs and Fisheries Regulation No. 2 of 2015 on the Prohibition of Trawls and Seine Nets in the Indonesian Fisheries Management Areas

Trawl, which include *cantrang,* is the fishing gear used to catch demersal fish. Wedgefishes landed on the North Coast of Java are mostly by-catch from *cantrang*. Despite by-catch, the catch of this group by *cantrang* is quite high. This closely relates to the number of vessels using the fishing gear. The regulation/prohibition of *cantrang* operation provides a real opportunity for the restoration of demersal fish, including wedgefishes.

Based on the Minister of Marine Affairs and Fisheries Regulation No. 71 of 2016 on the Routes of Fishing in the Indonesian Fisheries Management Areas (FMAs), trawl, including *cantrang*, is the type of fishing gear that damages the sustainability of marine resources. Therefore, this gear type is prohibited from operating on all fishing routes throughout the Indonesian FMAs. Due to the refusal from the fishers on the North Coast of Java, the regulation has not yet been fully implemented.

5.3. Trade Regulations

1. **Minister of Marine Affairs and Fisheries Regulation No. 61 of 2018 on the Utilization of Protected Fish Species and/or Fish Species Listed in the CITES Appendix**

The ministerial regulation was revised through the Minister of Marine Affairs and Fisheries Regulation No. 44/ PERMEN-KP/2019 of 2019 concerning the Amendment to the Minister of Marine Affairs and Fisheries Regulation No. 61 of 2018. The regulation stipulates the procedures for the use of protected fish species and the species listed in the CITES Appendix, which include wedgefishes. The utilization under this regulation includes six components: research and development, breeding, trade, aquaria, exchange and maintenance for pleasure. The ministerial regulation stipulates the utilization by adopting CITES principles, i.e., legality, sustainability and traceability. Based on the regulation, every person or legal entity is required to have a permit to utilize protected species and/or species listed in CITES Appendix, including wedgefishes. The permit

granted is then regulated for use by a quota mechanism to ensure the utilization does not detriment the population with a catch quota and export quota.

2. Regulation of the Director-General of Marine Space Management Number 13 of 2018 concerning Procedures for the Issuance of Shark and Ray Trading Recommendations

The monitoring mechanism for shark and ray product trading refers to this regulation to ensure the traceability of the products traded domestically and internationally. Authorized officers will check the information on every shark and ray product to be traded between provinces, which includes the name of shark and ray species, product name, product volume, product origin (landing and city), and destination. In practice, this regulation has been implemented since 2015 and shows increasing compliance. Most sharks and rays traders have their products registered and checked before being traded.

5.4. Conservation Efforts – Conservation of Important Habitat

Wedgefishes live in coastal areas up to the continental shelf at a depth of at least 60 meters with a muddy substrate. Coastal areas are rich of marine biological resources and provide places for nurturing, spawning and foraging because coastal areas have three connective ecosystems: mangroves, seagrass beds and coral reefs. In addition to the wealth of marine biological resources, coastal ecosystems also undergo enormous fisheries pressure and habitat destruction due to destructive fishing practices and other activities in coastal areas. To reduce the level of habitat destruction and fisheries pressure in coastal areas, the Government of Indonesia, through the MMAF, designated Marine Protected Areas (MPA) in 2019 to reach 23.14 million hectares, most of which are in coastal areas.

Apart from the MPA designated by the central government, there are several marine areas managed by local governments that establish shark and ray conservation areas. In all these areas, the fishing of sharks and rays is not permitted, such as in Raja Ampat-West Papua and West Manggarai-East Nusa Tenggara. In other areas, there are two MPAs specifically designated for shark protection, including wedgefishes as their conservation targets. The areas are Aceh Jaya Coastal Park and Tatar Sepang Sumbawa Coastal Park. The two protected areas have been designated because it was a habitat of juvenile wedgefishes, especially *R. australiae*.

5.5. Information Dissemination and Awareness-Program

In September 2019, the MMAF as the management authority for Class of Pisces held a meeting with relevant stakeholders to disseminate the results of the 18th CoP CITES that had taken place in Geneva, Switzerland on August 17-28, 2019, and to formulate a follow-up plan for the conference decisions and results. The planned follow-up to the proposed listing includes three aspects, namely:

a. Protection aspect: comprising the protection of habitat, juveniles and broodstocks, preparation of MMAF Decree for full/limited protection and preparation of MMAF Decree for the export ban.
b. Conservation aspect: consisting of restocking of populations to the natural habitat, habitat rehabilitation, technical assistance/training in data collection and species recognition, awareness-raising or information dissemination of legislation to the public, preparation of Non-Detriment Findings (NDF) document, recording of traceability, improvement of shark and ray logbook and landing recording.
c. Utilization aspect: covering the preparation of catch and export quotas, data collection of business actors, data collection of shark and ray warehouse business actors, guidance for business actors, licensing facilitation for business actors, preparation of recommendations for zero quotas of export by LIPI, and collection of information on sea cucumber products traded.

6. SUSTAINABILITY ASSESSMENT

Based on the data and information presented in the previous section, we assess to know whether such export will or will not be detrimental to the survival of those four wedgefish species. The assessment followed a guideline by Mundy-Taylor et al. (2014), detailed description and worksheets can be seen in the Annexes.

Table 5. Sustainability assessment for wedgefishes from Indonesian waters

Step 2: Intrinsic biological vulnerability and conservation concern						
Intrinsic biological vulnerability (Question 2.1)			High	**Medium**	Low	Unknown
Conservation concern (Question 2.2)			**High**	Medium	Low	Unknown
Step 3: Pressures on species			**Step 4: Existing management measures**			
Pressure	**Level of severity (Questions 3.1 and 3.2)**	**Level of confidence (Questions 3.1 and 3.2)**	**Are the management measures effective* at addressing the concerns/pressures/impacts identified? (Question 4.1b)** **Taking into account the evaluation of management appropriateness and implementation under Question 4.1a*			
Trade pressures						
a) Magnitude of legal trade	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable			
a) Magnitude of illegal trade	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable			

Fishing pressures			
a) Fishing mortality (retained catch)	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
b) Discard mortality	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
c) Size/age/sex selectivity of fishing	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
d) Magnitude of IUU fishing	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
A) Can a positive NDF be made?	**YES** – *go to B*		**NO** – *go to **Step 6** and list recommendations for measures to improve monitoring/management under Reasoning/comments below*
B) Are there any mandatory conditions to the positive NDF?	**YES -** *list under Reasoning/comments below and go to C*		**NO** – *go to C*

C) Are there any other further recommendations? *(e.g. for improvements to monitoring/management)*	**YES** - *go to **Step 6** and list recommendations for measures to improve monitoring/management under Reasoning/comments below*	**NO**

According to Table 5, existing management measures have not covered all the critical points yet to ensure the sustainability of wedgefish fisheries from Indonesian waters. Several issues were identified and then needed to get attention and followed up by the management authority, such as:

1. Data recording not specific to the species level.
2. Strengthening elasmobranch research, including wedgefishes, especially in identifying the critical habitat.
3. No management measures in place to manage fishing of juvenile wedgefishes. Several sites still catch juvenile or small wedgefishes as a by-catch.
4. A lack of implementation of fishing management regulations, such as the seine net still allowed to operate on the North Coast of Java.
5. No management measures in place to reduce discard mortality
6. No official data for domestic trade, this is important to know how much percentage of national utilization or consumption of wedgefish products.
7. Export data still on aggregated data, can only be separated between fin and non-fin products. Whereas in the NDF study must be conducted for each species.
8. The traceability system must be improved, starting from the landing port to the importing countries (even if it is already on derivative products).
9. The control and monitoring system in the exit points must be improved, both seaports and airports.

7. NDF RECOMMENDATIONS

Based on the assessment or study conducted by the Scientific Authority, some recommendations are formulated and then must be implemented by the Management Authority to preserve wedgefish populations in the wild and reduce the threat of species extinction due to international trade. The recommendations are as follows:

1. **Strengthening of data and information related to the data on production and potential of each species listed in CITES Appendix II**

   Data recording for CITES Appendix II species must be per species or at least genus, including the data on production, biology (length, sex, sexual maturity stage, pregnancy and juveniles) and fishing operations (fishing gear, trip, fishing grounds, vessel specifications and other information). Biological data can be collected through regular data collection activities in several primary landing sites that represent all Indonesian waters. Therefore, the process of improving the quality of shark and ray data identification and collection requires training to produce competent enumerators to allow for accurate and reliable data. Collaboration with other agencies needs enhancing to support this recommendation.

   Other data that should be considered are trade data, both domestic and international ones. The data must also be classified by species or genus and include complete information on the product origin (fishing location and landing site). The data are necessary to find out how much the potential use of a particular area or waters and can be obtained at the level of traders or exporters or collectors.

2. **Management of fishing gears and fishing grounds**

   It is necessary to identify the fishing gear used by fishers in each location. This information will later serve as a basis for determining fishing grounds by fishing gear. For example, the seine net or *cantrang* in local names may only operate in the areas > 12 miles from the shoreline. The aim is to reduce sharks and rays as by-catch from *cantrang*, because coastal areas and nearshore waters are known as the nursery ground for fish, including sharks and rays. Besides, the mesh size of the tangle net also should be regulated. The minimum mesh size allowable for a tangle net is 40 cm up. This value comes from the result of conversion with the length at first maturity (Lm), and consideration that females of wedgefishes mature at larger sizes than males.

3. **Regulation of the capture size**

The allowable wedgefishes for catch should have a size above the length at first maturity (Lm). It aims to avoid disrupting the regeneration process of wedgefishes, which threatens its sustainability. In practice, however, it is not easy to implement this regulation because the types of fishing gear used vary significantly with different characteristics and fishing grounds. Therefore, another way to regulate capture size is by releasing juvenile wedgefishes that are still alive. By doing so, we give them a chance to grow up and reproduce.

4. **Whole-body landing**

The regulation requires that a whole-body landing for sharks and rays be carried out to prevent shark finning, i.e., the cutting of fins from live fish, where the rest of the body is thrown into the sea. Additionally, this regulation will facilitate the recording of data on species and abundance as well as the implementation of the product traceability mechanism from upstream to downstream.

5. **Identification and protection of critical habitat**

It is necessary to study and explore information related to wedgefish mating and nursery grounds. Furthermore, the locations should be protected, either limited to time protection or fully protected, meaning that all fishing activities in the locations are prohibited. The protection of critical areas is particularly important to support the survival of fishes, including wedgefishes.

6. **Trade restrictions based on specific criteria**

Shark and ray derivative products are diverse. For certain products, e.g., dried or wet fins, it is necessary to limit the minimum allowable size for trade, both domestically and internationally. Through this restriction, fishers will only catch individuals of a larger size. The minimum size of the product can be adjusted to the length at first maturity (Lm) of a fish species so that fishing and trading can be interconnected. Restriction of the minimum size of shark and ray derivative products must be a common concern, given a large number of traded small-sized fins, or in other words, the fishing of juveniles is still widely practiced.

7. Implementation of fishing permit

Fishers who will make a fishing trip should have a permit either in provincial or central government administrative territories, particularly for the fishers targeting sharks and rays (including wedgefishes). Fishers are also expected to report the fishing grounds, species, and numbers of sharks and rays (in logbooks) so that this becomes supporting information in identifying shark and ray fishing activities.

8. Limiting the number of catch through a catch quota

The number of catches should be limited through a catch quota system. This quota is made for one year's use (January 1 to December 31), and the amount is decided at the end of the previous year. The quota provided takes into account many aspects to ensure that fish resource utilization is at a safe level and does not interfere with the preservation of a species in the wild. This quota will be divided based on the province or limited to specific locations. The implementation of the quota system will face a big challenge, given Indonesia is vast and the fishing is still widely practiced on small and remote islands. Apart from that, the fishers do not always land their catches at auction sites or official ports, making the actual number of catches unrecorded and the likelihood of catches exceeding the quota very high.

9. Development of the traceability system for trading in wedgefish products

Traceability system for shark and ray products need to be developed, starting from fishing grounds to consumers (at the domestic level and to the importing country level). This mechanism should be integrated with the fish species quota system to allow for proper and accurate recording of the actual utilization. It should be noted that the traffic of shark and ray products can be done via land, sea and air, so the implementation of this system needs to be closely monitored.

8. CLOSING REMARK

Based on the available data and information on the condition of wedgefishes capture fisheries in Indonesia in the last decade, LIPI (Indonesian Institute of Sciences) found that, at present, the wedgefishes population in Indonesian waters will not face a severe threat if appropriately managed. Therefore, a positive NDF can be provided with some management recommendations (attached in Chapter 7). International trade in wedgefishes and its derivative products can continue if the Management Authority implements all these recommendations. NDF recommendations will be reviewed after five years to ensure that the utilization does not lead to extinction. Therefore, monitoring of wedgefishes stock status, populations, capture fisheries and trade must continue.

REFERENCES

Anung A & Widodo J. 2002. Artisanal shark fisheries in South of Java and Lombok of Indian Ocean (in Bahasa). *Jurnal Penelitian Perikanan Indonesia Sumberdaya dan Penangkapan,* 8 (1):75-81.

Bonfil, R. 2002.Trends and patterns in world and Asian elasmobranch fisheries. In Fowler SLT, Reed M &. Dipper FA (Eds). *Elasmobranchi biodiversity, conservation, and management*. Proceedings of the International seminar and Workshop, Sabah, Malaysia, July 1997 (15-24 pp). Gland. Switzerland and Cambridge. UK: IUCN SSC Shark Specialist Group.

BPSPL Pontianak. 2019. *Report of provision shark and ray population data series in PPN Pemangkat, PPI Sungai Kakap, PPI Muara Kintap and PPI Manggar* (in Bahasa), 153 pp.

Camhi M, Fowler S, Musick J, Brautigam A & Fordham S. 1998. *Sharks and their Relatives-Ecology and Conservation.* Gland. Switzerland and Cambridge. UK: IUCN/SSC Shark Specialist Group, 39 pp.

Cavanagh RD, Kyne PM, Fowler SL, Musick JA & Bennett MB. 2003. *The conservation status of Australasian chondrichthyans: Report of the IUCN shark specialist group Australia and oceania regional red list workshop. Queensland. Australia. 7-9 March 2003*. Bisbane: The University of Queensland. School of Biomedical Sciences, 170 pp.

CITES. 2020a. “What is CITES”. https://cites.org/eng/disc/what.php (accessed on March, 20th 2020).

CITES. 2020b. “How CITES works?” https://cites.org/eng/disc/how.php (accessed on March, 20th 2020).

Coleman N. 1996. *Australia’s sharks and rays.* NSW Australia: National Book Distributors and Publishers, 63 pp.

Compagno LJV & Last PR. 1999. Rhinidae. 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 3. Batoid fishes, chimaeras and bony fishes part 1 (Elopidae to Linophyrnidae)*, pp. 1418-1422. FAO, Rome.

Compagno LJV & Last PR. 2010. A new species of wedgefish, *Rhynchobatus springeri* (Rhynchobatoidei, Rhynchobatidae), from the Western Pacific. 77-88 pp. *In* Last PR, White WT & Pogonoski JJ (eds.): Descriptions of new sharks and rays from Borneo. CSIRO Marine and Atmospheric Research Paper no. 32.

D'Alberto, B.M., Carlson, J.K., Pardo, S.A., and Simpfendorfer, C.A., Population productivity of shovelnose rays: Inferring the potential for recovery. *PloS ONE*, 2019, vol. 14, no. 11, pp. e0225183.

Decree of Minister of Marine Affairs and Fisheries Number 14 of 2011 on Capture Fisheries Bussiness.

Decree of Minister of Marine Affairs and Fisheries Number 4 of 2014 on Determination of Full Protection Status for Manta Ray.

Devadoss P & Batcha H. 1995. Some observations on the rare bow-mouth guitarfish *Rhina ancylostoma*. Marine Fisheries Information Service, 138: 10-11.

Dharmadi & Prasetyo Ap. 2019. *Marketing and trade of sharks and rays in Java and Sumatera Indonesia*. SEAFDEC: Malaysia, 32 pp.

Fahmi & Dharmadi. 2013. *A review of the status of shark fisheries and shark conservation in Indonesia*. Directorate of Marine Aquatic Resources Conservation, Ministry of Marine Affairs and Fisheries, Jakarta, 203 pp.

FAO. 2019. *Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species*, Rome, 21–25 January 2019. FAO Fisheries and Aquaculture Report No. 1255. Rome. Licence: CC BY-NC-SA 3.0 IGO.

Heupel MR, Carlson JK, Simpfendorfer CA.2007. Shark nursery areas: concepts, definition, characterization and assumptions. *Marine Ecology Progress Series*, 337: 287–297

Hylton S, White WT & Chin A. 2017. The sharks and rays of the Solomon Islands: a synthesis of their biological diversity, values and conservation status. *Pacific Conservation Biology*, 23: 324–334.

Jabado RW. 2019. *Wedgefishes and Giant Guitarfishes: A Guide to Species Identification*. Wildlife Conservation Society, New York, United States. 30 pp.

Kyne, P.M. 2019. *Rhynchobatus springeri*. The IUCN Red List of Threatened Species 2019: e.T60182A124448942.http://dx.doi.org/10.2305/IUCN.UK.2019.2.RLTS.T60182A124448942.en

Kyne PM, Rigby CL, Dharmadi & Jabado RW. 2019. *Rhina ancylostoma*. The IUCN Red List of Threatened Species 2019: e.T41848A124421912. http://dx.doi.org/10.2305/IUCN.UK.20192.RLTS.T41848A124421912.en

Kyne PM & Jabado RW. 2019. *Rhynchobatus laevis*. The IUCN Red List of Threatened Species 2019: e.T41854A124422344. http://dx.doi.org/10.2305/IUCN.UK.20192.RLTS.T41854A124422344.en

Kyne PM, Jabado RW, Rigby CL, Dharmadi, Gore MA, Pollock CM, Herman KB, Cheok J, Ebert DA, Simpfendorfer CA, Dulvy BK. 2020. The thin edge of the wedge: Extremely high extinction risk in wedgefishes and gian guitarfishes. *Aquatic Conserv: Mar Freshw Ecosyst*: 1–25.

Last PR & Stevens JD. 2009. *Sharks and rays of Australia (second edition)*. CSIRO Publishing. Collingwood, Australia.

Last PR, White WT & Seret B. 2016. Wedgefishes: Family Rhinidae. In: Last PR, White WT, de Carvalho MR, Seret B, Stehmann MFW, Naylor GJP (eds), *Rays of the world* (pp. 65-76). CSIRO Publishing

Masuda H, Araga C & Yoshino T. 1975. *Coastal fishes of southern Japan*. Tokai University Press, Tokyo, Japan.

Ministry of Marine Affairs and Fisheries [MMAF]. 2016. Statistik Perikanan Tangkap Laut Menurut Area Pengelolaan Perikanan. Ministry of Marine Affairs and Fisheries. Jakarta (in Bahasa).

Mundy-Taylor, V., Crook. V., Foster, S., Fowler, S., Sant, G. and Rice, J. (2014). CITES Nondetriment Findings Guidance for Shark Species *(2, Revised Version)*. A Framework to assist Authorities in making Non-detriment Findings (NDFs) for species listed in CITES Appendix II. Report prepared for the Germany Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN).

Muttaqin E., Simeon B.M., Ichsan M., Dharmadi, Prasetyo A.P., Booth H., Yulianto I., Friedman K., 2018 [The scale, value and importance of non-fin shark and ray commodities in Indonesia]. Food and Agriculture Organization of the United Nations, Ministry of Marine Affairs and Fisheries.

Oktaviyani S. 2018*. Report on data collection and biological aspects of sharks and rays Appendix CITES and endangered species in Indonesia* (in Bahasa), 35 pp.

Oktaviyani S. 2019. *Report on data collection and biological aspects of sharks and rays Appendix CITES and endangered species in Indonesia* (in Bahasa), 72 pp.

Oktaviyani S, Kurniawan K & Fahmi. 2020. Species composition and catch size distribution of sharks and rays in Bali Strait and surrounding waters, and relation to fisheries management (in Bahasa). *Jurnal Iktiologi Indonesia.* 20 (1).

Presidential Decree Number 103 of 2001 on Position, Task, Function, Authority, Organization Structure and Working Procedures for Non-Departmental Government Agencies.

Regulation of Minister of Marine Affairs and Fisheries Number 1 of 2013 on Observer of Fishing Vessels and Fish Transport Vessels.

Regulation of Minister of Marine Affairs and Fisheries Number 48 of 2014 on Log Book for Fishing.

Regulation of Minister of Marine Affairs and Fisheries Number 2 of 2015 on Prohibition of Trawl and Seine Nets in the Fisheries Management Area of the Republic of Indonesia.

Regulation of Minister of Marine Affairs and Fisheries Number 71 on 2016 on Fishing Routes in Fishery Management Areas.

Regulation of Minister of Environment and Forestry of the Republic of Indonesia Number 106 of 2018 on Second Amendment to Ministerial Regulation of Environment and Forestry Number 20 of 2018 on Protected Types of Plants and Animals.

Regulation of Minister of Marine Affairs and Fisheries Number 61 of 2018 on Utilization of Protected Fish Species and/or Fish Types Listed in the Appendix to the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Regulation of the Directorate General of Marine Spatial Management Number 13 of 2018 on Procedures for Issuance of Trading Recommendations for Shark and Ray Species.

Raje SG. 2006. Skate fishery and some biological aspects of five species of skates off Mumbai. *Indian J Fish*, 53 (4): 431-439.

Sadri, Yuneni RR. 2019. Technical Report Wedgefishes and Guitarfishes Conservation: Fisheries Baseline and Identifying Species Threats Trough Observer and Enumerator Program. WWF Indonesia. 65 pp.

Simeon BM, Muttaqin E, Ichsan M, Tarigan S, Hernawati, Yulianto I. 2018. Technical report: Study of the important habitat for sharks and rays in Lunyuk, Sumbawa, West Nusa Tenggara Province (in Bahasa). Wildlife Conservation Society-Indonesia Program. Bogor. Indonesia.

Simeon BM, Muttaqin E, Ichsan M, Tarigan S, Hernawati, Yulianto I. 2019. Technical report: Fisheries profile of Wedgefish in Indonesia, case study in West Nusa Tenggara and Aceh (in Bahasa). Wildlife Conservation Society-Indonesia Program. Bogor. Indonesia.

Simeon BM, Ula S, Supadminingsih FN, Muhsin, Kohar A, Ali M, Agustina S, Muttaqin E. 2020. Technical report: Data Collection for sharks and rays landed in Tanjung Luar 2017 – 2019 (in Bahasa). Wildlife Conservation Society-Indonesia Program. Bogor. Indonesia.

Weigmann S. 2011. Contribution to the taxonomy and distribution of eight ray species (Chondrichthyes, Batoidea) from coastal waters of Thailand. Verh Naturwiss Ver Hamburg 46: 249-312.

White WT, Last PR, Stevens JD, Fahmi & Dharmadi. 2006. *Economically important sharks and rays of Indonesia.* ACIAR Publishing. Canberra, Australia.

White J, Simpfendorfer CA, Tobin AJ & Heupel MR. 2014. Age and growth parameters of shark-like batoids. *J Fish Biol*, 84 (5): 1340-1353.

White WT & Dharmadi. 2007. Species and size compositions and reproductive biology of rays (Chondrichthyes, Batoidea) caught in target and non-target fisheries in eastern Indonesia. *J Fish Biol,* 70:1809-1837.

Whitely, G. P. (1939). Taxonomic notes on sharks and rays. *Aust Zool*, 10:167–187.

Yuwandana DW, Agustina S, Anshory MFI, Haqqi MB, Muttaqin E & Simeon BM. 2019. Preliminary Study of Wedgefish and Giant Guitarfish Fisheries in North Coast of Java (in Bahasa), 43 pp.

ANNEXES

CITES Non-Detriment Findings (NDF) Worksheet for Wedgefishes in Indonesia

<table>
<tr><th colspan="4">Worksheet for Step 1</th></tr>
<tr><th colspan="4">Question 1.1 (a)
Is the specimen subject to CITES controls?
(How did you identify the species?)</th></tr>
<tr><td colspan="4">See pages 64–65 of Annex 1 for additional Guidance Notes on completing this Worksheet.</td></tr>
<tr><td>Species Name</td><td>Product Form</td><td>CITES Appendix</td><td>Source of Identification</td></tr>
<tr><td>Rhynchobatus australiae
Rhynchobatus springeri
Rhynchobatus laevis
Rhina ancylostoma</td><td>Fins
Meat
Skin
Cartilage
Snout
Living specimen (Ornament)</td><td>II</td><td>Muttaqin et al., 2018
Dharmadi and Prasetyo, 2019
MMAF, 2017, Primary data from Quarantine
Yuwandana et al., 2019
BPSPL Pontianak, 2019
Oktaviyani et al., 2018</td></tr>
<tr><td colspan="4"><u>NEXT STEPS</u></td></tr>
<tr><td rowspan="3">In view of the above, is the specimen subject to CITES controls?
Consult ‘Decision and Next Steps’ guidance in Annex 1</td><td>YES</td><td colspan="2">GO TO Question 1.1 (b)</td></tr>
<tr><td>NOT CERTAIN</td><td colspan="2">Describe concerns in more detail below, and GO TO Question 1.1 (b)</td></tr>
<tr><td>NO</td><td colspan="2">NDF is not required</td></tr>
<tr><td>Concerns and uncertainties:</td><td colspan="3">Look-alike species and has an overlap habitat.
Some derivates products of wedgefishes cannot be identified to the species level</td></tr>
</table>

Worksheet for Step 1 (continued)		
Question 1.1 (b) **From which stock will the specimen be taken/was the specimen taken?** **(Can origin and stock be confidently identified)**		
See pages 66–67 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**		
	Description/comments	**Sources of information**
Ocean basin	Pacific Ocean, Indo-Pacific, and the Indian Ocean Shallow Water in Sunda and Sahul Shelf	Last et al., 2016 Kyne et al., 2020 White et al., 2006 Fahmi and Dharmadi, 2013
Stock location/ distribution/ boundaries (attach a map)	Indo-Pacific	
Is this a shared stock (i.e. occurring in more than one EEZ[1] and/or the high seas)?	Not sure, probably yes	
If the stock occurs in more than one EEZ, which other Parties share this stock?	Stock in the Sunda Shelf has a high probability of shared stock with Malaysia, Singapore, Andaman Island, Myanmar, and Thailand. Stock in the Sahul shelf has a high probability of shared stock with Australia and Papua New Guinea.	Last et al., 2016
If high seas stock, which other Parties shark this stock?	It is not high seas stock, mostly from shallow water area (the shelf of Sunda and Sahul)	
Which, if any, RFB[2](s) cover(s) the range of this stock?	Indonesia is parties of IOTC, WCPFC, CCSBT, but these RFB did not cover shallow water area especially these commodities	
Are all Parties listed above (which fish or share the stock concerned) members of the relevant RFBs?	No	
Are there geographical management gaps?	Not known	
How reliable is the information on origin?	Reliable	
NEXT STEPS		
Is information on origin sufficiently detailed for Question 1.2 to be answered?		**YES**
Consult "Decision and Next Steps" guidance in **Annex 1**. **(Apply this answer at end of Question 1.2)**		**NO**

[1] Exclusive Economic Zone

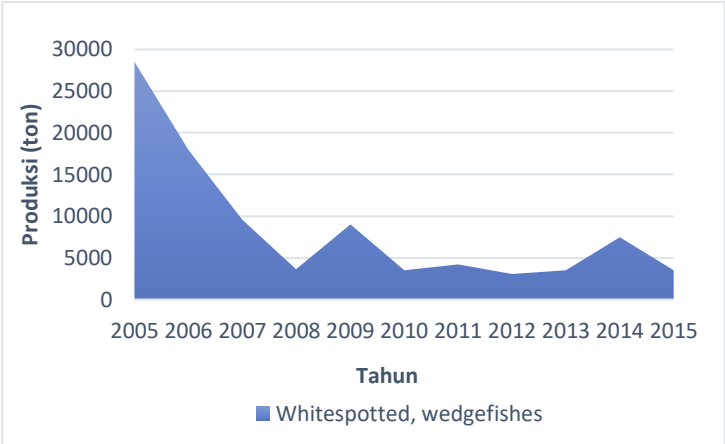
[2] Regional Fisheries Body

Worksheet for Step 1 (continued)		
Question 1.2 **Was (will) the specimen (be) legally obtained and is export allowed?**		
See pages 67–68 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**		
Is the species:	**Description/comments**	**Sources of information**
Protected under wildlife legislation, a regional biodiversity Agreement, or (for a CMS[3] Party) listed in CMS Appendix 1?	No	CMS website (http://www.cms.int/en/page/appendix-i-ii-cms)
Sourced from illegal fishing activities (e.g. in contravention of finning regulations, or where a TAC[4] is zero or exceeded)?	Not sure, but shark finning still happens in Eastern Indonesia from artisanal fisheries	Jaiteh et al., 2016
Taken from a no-take marine protected area or during a closed season?	No	
Taken in contravention of RFB recommendations, if any?	No	
Listed as a species whose export is prohibited?	No	
Of concern for any other reason?	No	
NEXT STEPS		
In view of the above and the final section of the Worksheet for Question 1.1(b), was the specimen legally acquired and can exports be permitted? Consult "Decision and Next Steps" guidance in **Annex 1.**	**YES**	**GO TO Question 1.3**
	SOME DOUBT	Describe concerns in more detail below, and **GO TO Question 1.3**
	NO	Export cannot be permitted, **NDF is not required**
Concerns and uncertainties:	Indonesia government make a postponement for Minister Regulation about beach seine and mini trawl Number 2 of 2015. Mostly wedgefishes are caught using mini trawl by fishers of North Coast of Java Sea. Stock status and species specific trade data not available.	

[3] Convention on Migratory Species

[4] Total Allowable Catch

Worksheet for Step 1 (continued)		
Question 1.3 **What does the available management information tell us?**		
See pages 69 and Table A of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**		
Part 1. Global-level information		
	Description/comments	**Sources of information**
Reported global catch	Limited information, only from Indonesia	FAO, 2019
Species distribution	In Pacific Ocean, Indian Ocean and Indo-Pacific, 9 species foun. Indonesian waters highly possible being habitat for at least 4 species of wedgefishes. In Atlantic Ocean, 2 species found.	Last et al., 2016 Simeon et al., 2019 Yuwandana et al., 2019 Oktaviyani et al., 2018 Sadri & Yuneni, 2019
Known stocks/populations	Limited information about stocks/populations. But it was estimated to decrease by 5-90% globally.	Kyne et al., 2020 FAO, 2019.
Main catching countries	Indonesia, Senegal and UAE	FAO, 2019
Main gear types by which the species is taken	Gillnet/tangle net (targeted fishery) Trawl, bottom longline (by-catch)	FAO, 2019 Kyne et al., 2020 Simeon et al., 2019 Yuwandana et al., 2019
Global conservation status	Critically Endangered (CR)	IUCN redlist, July 2019
Multilateral Environmental Agreements	None	
Part 2. Stock/context-specific information		
Stock assessments	Not available	
Main management bodies	Not available	
Cooperative management arrangements	Not available	
Non-membership of RFBs	Not available	
Nature of harvest	Targeted and by-catch	
Fishery types	Artisanal fisheries, with fishing ground mostly located in shallow waters	
Management units	Not available	

Products in trade	Fins Meat Skin Skin thorns Cartilage vertebrate Cartilage skull Snout Living specimen (Ornament)	Muttaqin et al., 2018 Dharmadi and Prasetyo, 2019 MMAF ,2017, Primary data from Quarantine Yuwandana et al., 2019 BPSPL Pontianak, 2019 Oktaviyani et al., 2018
Part 3. Data and data sharing		
Reported national catch(es)	Production for *Rhynchobatus spp.* (Wedgefishes) 	MMAF, 2016
Are catch and/or trade data available from other States fishing this stock?	76% wedgefishes in Singapore imported from Indonesia	Pei Pei, 2019, unpublished
Reported catches by other States	Low fishing pressure for *Rhynchobatus palpebratus* as one of the species from the wedgefish group, caught in Australia, is not listed as critically endangered.	Kyne et al., 2020
Catch trends and values	Decreasing significantly in the last decade in many countries, including Indonesia	MMAF, 2016 FAO, 2019 Kyne et al., 2020
Have RFBs and/or other States fishing this stock been consulted during or contributed data during this process?	No	

BPSPL Pontianak. 2019. *Report of provision shark and ray population data series in PPN Pemangkat, PPI Sungai Kakap, PPI Muara Kintap and PPI Manggar* (in Bahasa), 153 pp.
Dharmadi & Prasetyo Ap. 2019. *Marketing and trade of sharks and rays in Java and Sumatera Indonesia*. SEAFDEC: Malaysia, 32 pp.

Fahmi & Dharmadi. 2013. *A review of the status of shark fisheries and shark conservation in Indonesia*. Directorate of Marine Aquatic Resources Conservation, Ministry of Marine Affairs and Fisheries, Jakarta, 203 pp.

FAO. 2019. Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019. FAO Fisheries and Aquaculture Report No. 1255. Rome. Licence: CC BY-NC-SA 3.0 IGO

Jaiteh V.F., Hordyk A.R., Braccini M., Warren C., Loneragan N.R., 2017 Shark finning in eastern Indonesia: assessing the sustainability of a data-poor fishery. ICES Journal of Marine Science, 74(1), 242-253. doi:10.1093/icesjms/fsw170

Kyne PM, Jabado RW, Rigby CL, Dharmadi, Gore MA, Pollock CM, Herman KB, Cheok J, Ebert DA, Simpfendorfer CA, Dulvy BK. 2020. The thin edge of the wedge: Extremely high extinction risk in wedgefishes and gian guitarfishes. *Aquatic Conserv: Mar Freshw Ecosyst*: 1–25.

Last PR & Stevens JD. 2009. *Sharks and rays of Australia (second edition)*. CSIRO Publishing.

Last PR, White WT & Seret B. 2016. Wedgefishes: Family Rhinidae. In: Last PR, White WT, de Carvalho MR, Seret B, Stehmann MFW, Naylor GJP (eds), *Rays of the world* (pp. 65-76). CSIRO Publishing.

Ministry of Marine Affairs and Fisheries [MMAF]. 2016. Statistik Perikanan Tangkap Laut Menurut Area Pengelolaan Perikanan. Ministry of Marine Affairs and Fisheries. Jakarta (in Bahasa).

Ministry of Marine Affairs and Fisheries. 2017. Fish Quarantine Data. Indonesia (unpublished).

Muttaqin E., Simeon B.M., Ichsan M., Dharmadi, Prasetyo A.P., Booth H., Yulianto I., Friedman K., 2018 [The scale, value and importance of non-fin shark and ray commodities in Indonesia]. Food and Agriculture Organization of the United Nations, Ministry of Marine Affairs and Fisheries.

Oktaviyani S. 2018*. Report on data collection and biological aspects of sharks and rays Appendix CITES and endangered species in Indonesia* (in Bahasa), 35 pp.

Pei Pei, CH. 2019. Regulating trade in guitarfishes and wedgefishes (Rhinidae species) in Singapore. Unpublish master thesis.

Sadri, Yuneni RR. 2019. Technical Report Wedgefishes and Guitarfishes Conservation: Fisheries Baseline and Identifying Species Threats Trough Observer and Enumerator Program. WWF Indonesia. 65 pp.

Simeon BM, Muttaqin E, Ichsan M, Tarigan S, Hernawati, Yulianto I. 2019. Technical report: Fisheries profile of Wedgefishin Indonesia, case study in West Nusa Tenggara and Aceh (in Bahasa). Wildlife Conservation Society-Indonesia Program. Bogor. Indonesia.

White WT, Last PR, Stevens JD, Fahmi & Dharmadi. 2006. *Economically important sharks and rays of Indonesia.* ACIAR Publishing. Canberra, Australia.

www.iucnredlist.org

Yuwandana DW, Agustina S, Anshory MFI, Haqqi MB, Muttaqin E & Simeon BM. 2019. Preliminary Study of Wedgefish and Giant Guitarfish Fisheries in North Coast of Java (in Bahasa), 43 pp.

NEXT STEPS

The information collated in the above worksheets can now be passed to the Scientific Authority, so that the NDF process can begin with Step 2

Rhynchobatus australiae

Worksheet for Step 2		
Question 2.1 **What is the level of intrinsic biological vulnerability of the species?**		
● **See pages 73–75 of Annex 1 for additional Guidance Notes on completing this Worksheet.** ● **In the Worksheet below, circle the level of vulnerability associated with each Intrinsic Biological Factor. Default indicator/metric figures for listed shark and ray species are provided in Annex 4 (pages 111-131). These may be inserted here, but they are derived from international standardised data and may not reflect local stock characteristics. Wherever possible, verified local data on stocks should be utilised.**		
Intrinsic biological factors *(see page 73 of the Guidance Notes)*	**Level of vulnerability** *(circle or highlight as appropriate)*	**Indicator/metric** *(see page 73 of the Guidance Notes)*
a) Median age at maturity	Low	
	Medium	See Section 2.1
	High	
	Unknown	
b) Median size at maturity	Low	
	Medium	See Section 2.1 (males)
	High	See Section 2.1 (females)
	Unknown	
c) Maximum age/longevity in an unfished population	Low	
	Medium	
	High	See Section 2.1
	Unknown	
d) Maximum size	Low	
	Medium	
	High	See Section 2.1
	Unknown	
e) Natural Mortality rate (M)	Low	
	Medium	See Section 2.1
	High	

	Unknown	
f) Maximum annual pup production (per mature female)	Low	
	Medium	See Section 2.1
	High	
	Unknown	
g) Intrinsic rate of population increase (r)	Low	
	Medium	See Section 2.1
	High	
	Unknown	
h) Geographic distribution of stock	Low	
	Medium	Regional; partially restricted; relatively fragmented
	High	
	Unknown	
i) Current stock size relative to historic abundance	Low	
	Medium	
	High	
	Unknown	No data at the species level, but the total production of wedgefishes reported to decline by about 80% over recent decades in Indonesia
j) Behavioral factors	Low	
	Medium	
	High	Schooling, coastal waters as a nursery ground and feeding ground, frequent juvenile captures from the coastal waters.
	Unknown	
k) Trophic level	Low	
	Medium	3.54 (Froese & Pauly, 2019)
	High	

	Unknown	

SUMMARY for Question 2.1 Intrinsic biological vulnerability of species Provide an assessment of the overall intrinsic biological vulnerability of the species (tick appropriate box below). Explain how these conclusions were reached and the main information sources used.			
High	**Medium**	Low	Unknown
Biological data for *R. australiae* is still limited in Indonesian waters. However, from available data and information, it is considered to have medium vulnerability in Indonesia. The primary consideration is its behavior, low fecundity, late maturity, and slow growth.			
NEXT STEPS ● Go to **Section 2.2**			

Rhynchobatus laevis

Worksheet for Step 2		
Question 2.1 **What is the level of intrinsic biological vulnerability of the species?**		
● See pages 73–75 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.** ● In the Worksheet below, circle **the level of vulnerability** associated with each **Intrinsic Biological Factor**. Default indicator/metric figures for listed shark and ray species are provided in **Annex 4** (pages 111-131). These may be inserted here, but they are derived from international standardised data and may not reflect local stock characteristics. Wherever possible, verified local data on stocks should be utilised.		
Intrinsic biological factors *(see page 73 of the Guidance Notes)*	**Level of vulnerability** *(circle or highlight as appropriate)*	**Indicator/metric** *(see page 73 of the Guidance Notes)*
a) Median age at maturity	Low	
	Medium	
	High	
	Unknown	Limited information
b) Median size at maturity	Low	
	Medium	See Section 2.2
	High	
	Unknown	
c) Maximum age/longevity in an unfished population	Low	
	Medium	See Section 2.2
	High	

	Unknown	
d) Maximum size	Low	
	Medium	See Section 2.2
	High	
	Unknown	
e) Natural Mortality rate (M)	Low	
	Medium	
	High	
	Unknown	Limited information
f) Maximum annual pup production (per mature female)	Low	
	Medium	
	High	
	Unknown	Limited information
g) Intrinsic rate of population increase (r)	Low	
	Medium	
	High	
	Unknown	Limited information
h) Geographic distribution of stock	Low	
	Medium	Regional; partially restricted; relatively fragmented
	High	
	Unknown	
i) Current stock size relative to historic abundance	Low	
	Medium	
	High	
	Unknown	No data at the species level, but the total production of wedgefishes reported to decline by about 80% over recent decades in Indonesia
j) Behavioral factors	Low	

	Medium	
	High	Schooling, coastal waters as a nursery ground and feeding ground, frequent juvenile captures from the coastal waters.
	Unknown	
k) Trophic level	Low	
	Medium	
	High	
	Unknown	Limited information

SUMMARY for Question 2.1
Intrinsic biological vulnerability of species

Provide an assessment of the overall intrinsic biological vulnerability of the species (tick appropriate box below). Explain how these conclusions were reached and the main information sources used.

High	**Medium**	Low	Unknown

Limited studies and lack of data on *R. laevis* in Indonesian waters. However, it is estimated to have a similar biological characteristics as *R. australiae* and then considered to have medium vulnerability in Indonesia. The primary consideration is its behavior, low fecundity, late maturity, and slow growth.

NEXT STEPS

- Go to **Section 2.2**

Rhynchobatus springeri

Worksheet for Step 2		
Question 2.1 **What is the level of intrinsic biological vulnerability of the species?**		
● See pages 73–75 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.** ● In the Worksheet below, circle **the level of vulnerability** associated with each **Intrinsic Biological Factor**. Default indicator/metric figures for listed shark and ray species are provided in **Annex 4** (pages 111-131). These may be inserted here, but they are derived from international standardised data and may not reflect local stock characteristics. Wherever possible, verified local data on stocks should be utilised.		
Intrinsic biological factors *(see page 73 of the Guidance Notes)*	**Level of vulnerability** *(circle or highlight as appropriate)*	**Indicator/metric** *(see page 73 of the Guidance Notes)*
a) Median age at maturity	Low	
	Medium	
	High	

	Unknown	Limited information
b) Median size at maturity	Low	
	Medium	See Section 2.3 (males)
	High	See Section 2.3 (females)
	Unknown	
c) Maximum age/longevity in an unfished population	Low	
	Medium	See Section 2.3
	High	
	Unknown	
d) Maximum size	Low	
	Medium	See Section 2.3
	High	
	Unknown	
e) Natural Mortality rate (M)	Low	
	Medium	
	High	
	Unknown	Limited information
f) Maximum annual pup production (per mature female)	Low	
	Medium	
	High	
	Unknown	Limited information
g) Intrinsic rate of population increase (r)	Low	
	Medium	
	High	
	Unknown	Limited information
h) Geographic distribution of stock	Low	
	Medium	Regional; partially restricted; relatively fragmented

	High	
	Unknown	
i) Current stock size relative to historic abundance	Low	
	Medium	
	High	
	Unknown	No data at the species level, but the total production of wedgefishes reported to declined about 80% over recent decades in Indonesia
j) Behavioral factors	Low	
	Medium	
	High	Schooling, coastal waters as a nursery ground and feeding ground, frequent juvenile captures from the coastal waters.
	Unknown	
k) Trophic level	Low	
	Medium	
	High	
	Unknown	Limited information

SUMMARY for Question 2.1
Intrinsic biological vulnerability of species
Provide an assessment of the overall intrinsic biological vulnerability of the species (tick appropriate box below). Explain how these conclusions were reached and the main information sources used.

High	**Medium**	Low	Unknown

Limited studies and lack of data on *R. springeri* in Indonesian waters. However, it is estimated to have a similar biological characteristics as *R. australiae* and then considered to have medium vulnerability in Indonesia. The primary consideration is its behavior, low fecundity, late maturity, and slow growth.

NEXT STEPS

- Go to **Section 2.2**

Rhina ancylostoma

Worksheet for Step 2
Question 2.1

What is the level of intrinsic biological vulnerability of the species?		
● See pages 73–75 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.** ● In the Worksheet below, circle **the level of vulnerability** associated with each **Intrinsic Biological Factor**. Default indicator/metric figures for listed shark and ray species are provided in **Annex 4** (pages 111-131). These may be inserted here, but they are derived from international standardised data and may not reflect local stock characteristics. Wherever possible, verified local data on stocks should be utilised.		
Intrinsic biological factors *(see page 73 of the Guidance Notes)*	**Level of vulnerability** *(circle or highlight as appropriate)*	**Indicator/metric** *(see page 73 of the Guidance Notes)*
a) Median age at maturity	Low	
	Medium	
	High	
	Unknown	Limited information
b) Median size at maturity	Low	
	Medium	See Section 2.4
	High	See Section 2.4
	Unknown	
c) Maximum age/longevity in an unfished population	Low	
	Medium	See Section 2.4
	High	
	Unknown	
d) Maximum size	Low	
	Medium	See Section 2.4
	High	
	Unknown	
e) Natural Mortality rate (M)	Low	
	Medium	
	High	
	Unknown	Limited information
f) Maximum annual pup production (per mature female)	Low	
	Medium	See Section 2.4

	High	
	Unknown	
g) Intrinsic rate of population increase (r)	Low	
	Medium	
	High	
	Unknown	Limited information
h) Geographic distribution of stock	Low	
	Medium	Regional; partially restricted; relatively fragmented
	High	
	Unknown	
i) Current stock size relative to historic abundance	Low	
	Medium	
	High	
	Unknown	No data at the species level, but the total production of wedgefishes reported to decline by about 80% over recent decades in Indonesia
j) Behavioral factors	Low	
	Medium	
	High	Inhabits coastal areas and on coral reefs, close inshore. Juveniles sometimes caught as bycatch
	Unknown	
k) Trophic level	Low	
	Medium	3.55 (Froese & Pauly, 2019)
	High	
	Unknown	

SUMMARY for Question 2.1
Intrinsic biological vulnerability of species

Provide an assessment of the overall intrinsic biological vulnerability of the species (tick appropriate box below). Explain how these conclusions were reached and the main information sources used.

High	**Medium**	Low	Unknown
Limited information on *Rhina ancylostoma* in Indonesian waters. However, based on their biological characteristics, then they are considered to have medium vulnerability in Indonesia. The primary consideration is its behavior, low fecundity, late maturity, and slow growth.			
NEXT STEPS ● Go to **Section 2.2**			

Worksheet for Step 2 (continued)		
Question 2.2 **What is the severity and geographic extent of the conservation concern?**		
● See pages 76–80 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.** ● Based on existing stock assessments or conservation status assessments, evaluate the severity and geographic extent/scope of conservation concern, including reasons for the conclusions drawn and information on sources used. ● In the Worksheet below, circle the **level of severity/scope of concern** associated with each **Factor** using the descriptions in the indicator column in **Table B** in the Guidance Notes (**Annex 1**). In the column entitled Indicator in the Worksheet below, note briefly the reason for this assessment of level of severity/scope of concern. Further explanation (including information on sources used) can be provided in the boxes entitled '*Comments*'.		
Conservation concern factors *(see page 78 of the Guidance Notes)*	**Level of severity/scope of concern** *(circle as appropriate)*	**Indicator/metric** *(see page 78 of the Guidance Notes)*
Conservation or stock assessment status	Low	
	Medium	
	High	See Section 2.1 to 2.4
	Unknown	
	Comments: At least, there are four species of wedgefishes inhabitting Indonesian waters, i.e., *Rhynchobatus australiae, R. laevis, R. springeri* and *Rhina ancylostoma*. Formal stock assessment for these species has not been done yet. However, based on the observed decline of global catch, they are listed as critically endangered in IUCN red list (Kyne et al., 2020).	
Population trend	Low	
	Medium	
	High	
	Unknown	No stock/population data
	Comments: There is no population trend data for these species from Indonesian waters. However, the national production data shows decline of about 80% over recent decades in Indonesia (MMAF, 2016; FAO, 2019). Data contained all species of wedgefishes, not separated yet at the species level.	
Geographic extent/scope of conservation concern	Low	
	Medium	

	High	Habitat hotspots of wedgefishes are in the Pacific Ocean, Indo-Pacific, and the Indian Ocean.
	Unknown	
	Comments: Indo-Pacific is one of the habitat hotspots of wedgefishes which are intensively utilized by Asian countries. This information is obtained from the data of importing countries of Indonesian wedgefish products (MMAF, 2017, unpublished).	

SUMMARY for Question 2.2

Severity and geographic extent of the conservation concern

Provide an assessment of the overall severity and geographic extent of the conservation concern for this species or stock (tick appropriate box below). Explain how these conclusions were reached and the main information sources used.

High	Medium	Low	Unknown

FAO. 2019. Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019. FAO Fisheries and Aquaculture Report No. 1255. Rome. License: CC BY-NC-SA 3.0 IGO

Kyne PM, Jabado RW, Rigby CL, Dharmadi, Gore MA, Pollock CM, Herman KB, Cheok J, Ebert DA, Simpfendorfer CA, Dulvy BK. 2020. The thin edge of the wedge: Extremely high extinction risk in wedgefishes and gian guitarfishes. *Aquatic Conserv: Mar Freshw Ecosyst*: 1–25.

Ministry of Marine Affairs and Fisheries [MMAF]. 2016. Statistik Perikanan Tangkap Laut Menurut Area Pengelolaan Perikanan. Ministry of Marine Affairs and Fisheries. Jakarta (in Bahasa).

Ministry of Marine Affairs and Fisheries. 2017. Fish Quarantine Data. Indonesia (unpublished).

NEXT STEPS

- Go to **Step 3**

Worksheet for Step 3

Question 3.1
What is the severity of trade pressure on the stock of species concerned?

- See pages 81–84 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**
- In the Worksheet below, circle the **level of severity** associated with each trade pressure **Factor** using the descriptions in the Indicator column in **Table C** in the Guidance Notes (**Annex 1**). In the column entitled **Indicator/metric** in the Worksheet below, note briefly the reason for this assessment of level of trade pressure severity. Consider **all products in both domestic and international trade.**
- For each Factor, circle the **level of confidence** associated with each assessment of trade pressure severity. This involves an assessment of the **quality of the information** used to evaluate the severity of trade pressure on the stock of the species concerned.
- In the box entitled '*Reasoning*', provide reasons to justify the evaluation of severity of trade pressure and assessment of confidence level (i.e. quality of information used). Here, comments/information should also be provided on:
  - the sources of information used to evaluate severity of trade pressure;
  - whether a precautionary approach was taken to the evaluation of trade pressure severity (e.g. due to a lack of robust trade information to inform the evaluation);
  - whether the evaluation of trade pressure was adjusted (i.e. severity increased to a higher level) to take into account high intrinsic biological vulnerability/conservation concern assessed in **Step 2**;
  - whether information is particularly lacking and, if so, how this data availability may be improved (see also **Section 6.1** of the Guidance Notes in **Annex 1** for further advice).

Factor *(see page 84 of the Guidance Notes)*	**Level of severity of trade pressure** *(highlight or circle as appropriate)*	**Indicator/metric** *(see page 84 of the Guidance Notes)*
a) Magnitude of legal trade	Low	
	Medium	
	High	Multiple uses in commercial trade, high trade volume/market demand and high prices per unit product (especially its fins).
	Unknown	
	Level of confidence *(circle as appropriate)* Low Medium **High**	

Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of trade pressure been increased in light of the assessment in Step 2?)

Multiple-use in commercial trade (domestic market demands meat products, such as fresh, salted, smoked meat as well as skins for crackers; meanwhile, fins, cartilage and meat are exported to Asian countries). Trade volume from some area of origin (example: Kalimantan region) increased in recent years. It means that there is a high demand for wedgefish products. The price is different depending on the type of products, size, and level of freshness (for meat). However, fins of wedgefishes (especially for *Rhynchobatus* spp.) have the highest price among elasmobranchs species. In general, for one product, collectors or traders mixed all wedgefish species (except fins for *R. ancylostoma*), they do not separate each product at the species level. So, if it is already in derivative products, such as fillet or cartilage, it will be challenging to identify.

b) Magnitude of illegal trade	Low	

	Medium	Moderate documentation of international trade, trade chain is long and complicated, some concern about substation for look-alike species.
	High	
	Unknown	
	Level of confidence *(circle as appropriate)* Low **Medium** High	

Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of trade pressure been increased in light of the assessment in Step 2?)

Fish quarantine of MMAF documented international trade of wedgefishes. Unfortunately, it is reported only as one specific product, such as salted fish or meat of rays. However, it will be checked first by the staff of the Coastal and Marine Resources Unit, MMAF. The result of an inspection is a basis for issuing a recommendation letter, which is required by Fish quarantine. The inspection information must include species name, volume, type of products, origin and destination. Identifying derivative products of wedgefishes is still the biggest challenge for staff on recording trade data. So far, data of volume and trade in the domestic market is still lacking, both for wedgefishes or elasmobranch in general.

NEXT STEPS

- Add notes in the Worksheet for **Section 6.1** on improvements in trade data availability/monitoring required to evaluate trade pressure under **Section 3.1**.
- GO TO **Section 3.2** to evaluate fishing pressures.

Worksheet for Step 3

Question 3.2
What is the severity of fishing pressure on the stock of species concerned?

- See pages 85–90 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**
- In the Worksheet below, circle the **level of severity** associated with each fishing pressure **Factor** using the descriptions in the Indicator column in **Table D** in the Guidance Notes (**Annex 1**). In the column entitled **Indicator/metric** in the Worksheet below, note briefly the reason for this assessment of level of fishing pressure severity. Consider **all fishing methods and gears that** interact with the shark stock concerned.
- For each Factor, circle the **level of confidence** associated with each assessment of fishing pressure severity. This involves an assessment of the **quality of the information** used to evaluate the severity of fishing pressure on the stock of the species concerned.
- In the box entitled '*Reasoning*', provide reasons to justify the evaluation of severity of fishing pressure and assessment of confidence level (i.e. quality of information used). Here, comments/information should also be provided on:
  - the sources of information used to evaluate severity of fishing pressure;
  - whether a precautionary approach was taken to the evaluation of fishing pressure severity (e.g. due to a lack of robust information to inform the evaluation);
  - whether the evaluation of fishing pressure was adjusted (i.e. severity increased to a higher level) to take into account high intrinsic biological vulnerability/conservation concern assessed in **Step 2**;
  - whether information is particularly lacking and, if so, how this data availability may be improved (see also **Section 6.1** of the Guidance Notes in **Annex 1** for further advice).

Factor *(see page 89 of the Guidance Notes)*	**Level of severity of fishing pressure** *(highlight or circle as appropriate)*	**Indicator/metric** *(see page 89 of the Guidance Notes)*
a) Fishing mortality (retained catch)	Low	
	Medium	Medium proportion of stock removed by all fishing activities (targeted and by-catch).
	High	
	Unknown	
	Level of confidence *(circle as appropriate)* Low **Medium** High	
Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of fishing pressure been increased in light of the assessment in Step 2?) Wedgefishes are caught as target or by-catch. Fishers who targeted wedgefishes use a tangle net, meanwhile, other fishing gears catch wedgefishes as by-catch, such as bottom longline, shark bottom longline, bottom gillnet, seine net and trammel net (See section 3.2) .		
b) Discard mortality	Low	
	Medium	Moderate proportion of total catch is thrown back.
	High	
	Unknown	
	Level of confidence *(circle as appropriate)* Low **Medium** High	
Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of fishing pressure been increased in light of the assessment in Step 2?) So far, there is no information about discard of the species if caught. These species is either consumed or traded, both domestically or internationally. However, Jaiteh et al. (2016) reported that the finning activities still happened in Eastern Indonesia. Despite only mentioning shark fisheries, it probably includes wedgefishes.		
c) Size/age/sex selectivity	Low	
	Medium	Fisheries moderately selective for any size-age classes for female and male.
	High	
	Unknown	

	Level of confidence *(circle as appropriate* Low Medium **High**	
Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of fishing pressure been increased in light of the assessment in Step 2?) Fishers who targeted wedgefishes used a tangle net, which has a medium mesh size. So, mostly they caught wedgefishes in a larger size (more than Lm). However, juvenile or immature individual are also caught by other fishing gears as by-catch (See Section 3.4).		
d) Magnitude of illegal, unreported and unregulated (IUU) fishing	Low	
	Medium	Moderate documentation of catch and trade chain is long and complicated.
	High	
	Unknown	
	Level of confidence *(circle as appropriate)* Low Medium **High**	
Reasoning (e.g. has this assessment involved the exercise of precaution, and/or has severity of fishing pressure been increased in light of the assessment in Step 2?) Moderate documentation of catch data (mixed into a wedgefish group, limited on certain landing ports, etc). Trade chain of elasmobranch product is long and complicated, so the tracebility system must be improved.		
NEXT STEPS ● Add notes in the Worksheet for **Section 6.1** on improvements in fisheries data availability/monitoring required to evaluate fishing pressure under **Section 3.2**. ● GO TO **Section 4** to evaluate the extent to which existing management measures are effective in mitigating the risks/pressures/concerns identified in **Steps 2 and 3**.		

Worksheet for Step 4		
Preliminary stage **Compile information on existing management measures**		
In the table below, provide a list of existing generic and species-specific management measures in place for the stock or population of the species concerned. Consider measures implemented at the **(sub-) national, regional and international level** (i.e. including any measures implemented by relevant RFBs). Include a brief description of each measure, the sources of information used and any other comments if appropriate. A table of commonly used generic and species-specific fisheries management measures is provided in **Annex 5** (page 132). It is **advisable to consult Annex 5 prior to completing the Worksheets in this section, in conjunction with context-specific fisheries management advice.**		
Existing management measures *(see Annex 5 for examples)*	**Is the measure generic or species-specific?**	**Descriptions/comments/sources of information**
(SUB-)NATIONAL		
NPOA for the Conservation and Management of Sharks. **See Section 5**	Generic	It was issued in 2010 by the Directorate General of Capture Fisheries, MMAF. NPOA extended up to now.
Minister of Marine Affairs and Fisheries Regulation No. 14 of 2011 on Capture Fisheries Business. **See Section 5**	Generic	This regulation stipulates that every fishing vessel operating both in the Indonesian FMA and in the high seas must have a permit.
Minister of Marine Affairs and Fisheries Regulation No. 48 of 2014 on Fishing Logbooks **See Section 5**	Generic	This regulation requires every fishing vessel over 5 GT, which is licensed, Indonesian-flagged, and operating in Indonesian territorial waters to have a logbook, fill it out, and hand it over to the harbormaster of the fishing port. For the vessels catching the wedgefishes, this regulation is quite relevant since the wedgefish fishing grounds are in Indonesian waters.
Minister of Marine Affairs and Fisheries Regulation No. 71 of 2016 on the Fishing Routes and Placement of Fishing Gears in Fisheries Management Areas **See Section 5**	Generic	A net that catches wedgefishes is gillnet. This fishing gear has a fishing route of at least 12 nautical miles. The permit to use this net is only given to fleets with a size of more than 30 GT. The allowable mesh size is 8 inches with a maximum rope length of 2,500 m.
Minister of Marine Affairs and Fisheries Regulation No. 1 of 2013 on the Monitors of Fishing Vessels and Fish Transporting Vessels	Generic	Every vessel with a size above 30 GT must place a fishing monitor to monitor, measure, record, and report fishing activities. This monitoring aims to obtain objective and accurate data on fishing and fish transfer activities directly on fishing vessels and fish transporting vessels. The role of the monitor is

See Section 5		required, particularly in preventing Illegal, Unreported, and Unregulated (IUU) Fishing.
Minister of Marine Affairs and Fisheries Regulation No. 2 of 2015 on the Prohibition of Trawls and Seine Nets in the Indonesian Fisheries Management Areas **See Section 5**	Generic	Prohibition of Trawls and Seine Nets in the Indonesian Fisheries Management Areas. This regulation could be used to reduce the by-catch of wedgefishes.
Minister of Marine Affairs and Fisheries Regulation No. 61 of 2018 on the Utilization of Protected Fish Species and/or Fish Species Listed in the CITES Appendix. **See Section 5**	Generic	The regulation stipulates the procedures for the use of protected fish species and the species listed in the CITES appendix, which include wedgefishes. The utilization under this regulation includes six components: research and development, breeding, trade, aquaria, exchange, and maintenance for pleasure.
Regulation of the Director-General of Marine Space Management Number 13 of 2018 concerning Procedures for the Issuance of Shark and Ray Trading Recommendations. **See Section 5**	Generic	The monitoring mechanism for shark and ray product trading refers to this regulation to ensure the traceability of the products traded domestically and internationally. Authorized officers will check the information on every shark and ray product to be traded between provinces, which includes the name of shark and species, product name, product volume, product origin (landing and city), and destination.
Governor of Raja Ampat, Indonesia Regency Regulation No 9 of 2012. **See Section 5**	Generic	Prohibiting to catch sharks, rays and other marine protected species
The Instruction of West Manggarai Regent No. 18 of 2019. **See Section 5**	Generic for sharks and manta rays	Prohibition to catch sharks and manta rays in West Manggarai Regency.
Governor Decree of West Nusa Tenggara Province No. 523 - 222 of 2019 **See Section 5**	Generic	Management and zonation plan of Marine Conservation Area, Coastal and Small Islands in West Nusa Tenggara Province. Lunyuk Coastal Park is identified as critical habitat for juvenile wedgefishes.
REGIONAL/INTERNATIONAL		
-		

NEXT STEPS

- GO TO **Question 4.1(a).**

Worksheet for Step 4 (continued)

Question 4.1(a)
Are existing management measures appropriately designed and implemented to mitigate the pressures affecting the stock/population of the species concerned?

- See pages 91–92 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**
- Firstly assess whether **appropriately designed** management measures are in place to mitigate the pressures affecting the stock/population of the species concerned:
  - From the '**Preliminary stage**' Worksheet above, transfer information on existing management measures into the Worksheet below, alongside the relevant fishing and trade pressure Factor(s) the measures(s) can help to mitigate (as evaluated in **Step 3**).
  - Use the information in the table of commonly used generic and species-specific fisheries management measures in **Annex 5** to determine which pressures the existing management measures in place can help to address/mitigate.
- Next, assess whether the existing management measures in place are being **implemented**:
  - In the column entitled "Relevant Monitoring, Control and Surveillance (MCS) measure(s)", include information on existing MCS measures that are relevant to the implementation of the existing management measures identified. **Annex 5** provides information on MCS measures that can help to secure compliance with commonly used fisheries management measures.
  - Second, based on the explanations provided in the column in the Worksheet below entitled "Overall assessment of compliance regime", make a judgement as to whether the existing management measure(s) identified is/are being implemented (i.e. adequately enforced/complied with).
  -

NOTE: in some circumstances where the fishing/trade pressure severity was assessed as "Low" for any of the Factors in **Step 3**, mitigation may not be required (see also the Guidance Notes for Question 4(a) in **Annex 1**). In such cases, "Not applicable" can be noted under the "Existing management measure(s)" and "Relevant MCS measure(s)" columns in the Worksheet (for that trade/fishing pressure Factor).

- Provide reasons to justify the assessments made in this Worksheet in the box entitled "Reasoning/comments", including any sources used.
- Where certain management measures are being implemented but others are not, this information can also be included under "Reasoning/comments". Also note down any considerations, issues or shortcomings relating to any of the management measures identified that will need to be kept in mind when completing the Worksheet for **Question 4.1(b)** below

Factor	**Existing management measure(s)**	**Relevant monitoring, control and surveillance (MSC) measure(s)**	**Overall assessment of compliance regime** *(tick as appropriate)*	
TRADE PRESSSURE				
a) Magnitude of legal trade	**Procedure Utilization of Protected Fish Species and/or Listed in the CITES Appendices**	**Trade data recorded by Fish Quarantine and Coastal and Marine Research Agency of Ministry of Marine Affairs and Fisheries**	Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	
			Moderate (some relevant compliance measures in place)	√

	Procedure for the Issurance of Sharks and Rays Trading Recommendation		Good (comprehensive relevant compliance measures in place)	
	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) Trade data between provinces sometimes is not recorded accurately. Moreover, it is sent by land.			
b) Magnitude of illegal trade	**Procedure Utilization of Protected Fish Species and/or Listed in the CITES Appendices** **Procedure for the Issurance of Sharks and Rays Trading Recommendation**	**Trade data recorded by Fish Quarantine and Coastal and Marine Research Agency of Ministry of Marine Affairs and Fisheries**	Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	
			Moderate (some relevant compliance measures in place)	
			Good (comprehensive relevant compliance measures in place)	√
	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) No illegal activity is recorded due to this species still legal to be caught.			
FISHING PRESSSURE				
a) Fishing mortality (retained catch)	**Fishing regulation** **MPA**	- **Fishing permit** - **Logbook** - **Fishing route and placement of fishing gears** - **Monitor of the fishing vessel** - **Prohibition of trawl and seine net** - **Prohibition to catch sharks and rays in several area**	Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	
			Moderate (some relevant compliance measures in place)	√
			Good (comprehensive relevant compliance measures in place)	

	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) These management measures have not complied yet and are not specific for wedgefishes.			
b) Discard mortality			Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	
			Moderate (some relevant compliance measures in place)	
			Good (comprehensive relevant compliance measures in place)	
	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) So far, there is no regulation for whole body landing. Those species are either consumed or traded, both domestically or internationally. However, Jaiteh et al. (2016) reported that finning activities still happened in Eastern Indonesia. Although they only mentioned shark fisheries, however it probably includes wedgefishes.			
c) Size/age/sex selectivity			Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	
			Moderate (some relevant compliance measures in place)	
			Good (comprehensive relevant compliance measures in place)	
	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) Management measures regarding size limits are lacking. However, fishers, who targeted wedgefishes used a tangle net, which has a medium-mesh size. So, mostly they caught wedgefishes in a larger size (more than Lm). On the other hand, the juvenile or immature individual is also caught by other fishing gears as by-catch (See Section 3.4).			
d) Magnitude of IUU fishing	**Marine patrolling Placement a monitor in fishing vessel**	**Marine patrolling Placement a monitor in fishing vessel**	Unknown (no information on compliance)	
			Poor (limited relevant compliance measures in place)	

			Moderate (some relevant compliance measures in place)	
			Good (comprehensive relevant compliance measures in place)	√
	Reasoning/comments (e.g. Are management measures being implemented to varying degrees? Which compliance measures are lacking?) Wedgefshes are still legal to catch by fishers. So, there is no report of IUU fishing for these species.			
NEXT STEPS ● **Go to Question 4.1(b)**				

Worksheet for Step 4 (continued)

Question 4.1(b)
Are existing management measures effective (or likely to be effective) in mitigating the pressures affecting the stock/population of the species concerned?

- See pages 93–94 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**
- From the **Worksheet for Question 4.1(a)** above, transfer information on existing management measures currently in place into the column in the table below entitled "Existing management measure(s)", alongside the relevant fishing/trade pressure Factor.

NOTE as above for **Question 4.1(a)**: in some circumstances where the fishing/trade pressure severity was assessed as "Low" for any of the Factors in **Step 3**, mitigation may not be required (see also the Guidance Notes for **Question 4(b)** in **Annex 1**). In such cases, "Not applicable" can be noted under the "Existing management measure(s)" and "Relevant MCS measure(s)" columns in the Worksheet (for that trade/fishing pressure Factor).

- In the relevant columns in the table below, for each management measure indicate with a tick in the appropriate box whether:
  1. Data are collected and analysed to inform management decisions?
  2. Management is consistent with expert advice?

- Based on the responses to these questions, make a judgement as to whether the management measures(s) identified is/are effective/likely to be effective. Provide reasons to justify this assessment. For example, is effectiveness being compromised by poor design of the management measures or by their inadequate implementation (see responses in the Worksheet for **Question 4.1(a)** above)? Include information on any sources used in the box entitled "Reasoning/comments".

- Note that for each fishing/trade pressure identified, there may be more than one management measure currently in place aimed at mitigating the pressure. When assessing whether the management of a particular fishing/trade pressure is effective/likely to be effective, the aim should be to consider the combined effect of all relevant measures in mitigating the pressure identified.

Factor	**Existing management measure(s)**	**Are relevant data collected and analysed to inform management decisions? (e.g. landings, effort, fisheries independent data)** *Tick as appropriate*		**Is management consistent with expert advice?** *(tick as appropriate)*	
TRADE PRESSSURE					
a) Magnitude of legal trade		No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	

		Limited relevant data are collected AND analysed to inform management		Not consistent	
	All products recorded by Procedure Utilization of Protected Fish Species and/or Listed in the CITES Appendices **Procedure for the Issurance of Sharks and Rays Trading Recommendation quarantine and checked by Coastal and Marine Resources for issuing recommendation**	Some relevant data are collected AND analysed to inform management	√	Expert advice partially implemented	√
		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?) The trade data has been recorded but is not yet species-specific. The traceability system must be improved, starting from landing port to the importing country (even if it is already derivative products). Many information should be collected in detail, such as catch data, fishing activity information, trade volume, and so on.				
TRADE PRESSSURE					
b) Magnitude of illegal trade		No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	

		Limited relevant data are collected AND analysed to inform management		Not consistent	
	Procedure Utilization of Protected Fish Species and/or Listed in the CITES Appendices **Procedure for the Issurance of Sharks and Rays Trading Recommendation**	Some relevant data are collected AND analysed to inform management	√	Expert advice partially implemented	√
		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?) So far, wedgefishes are still legal to catch and trade, both domestically or internationally. Furthermore, it should be supported by a strict monitoring system in the exit points, both seaports and airports.				
FISHING PRESSSURE					
a) Fishing mortality (retained catch)		No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	
		Limited relevant data are collected AND analysed to inform management		Not consistent	
	Fishing regulation **MPA**	Some relevant data are collected AND analysed to inform management	√	Expert advice partially implemented	√

		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?) The implementation of these management measures is lacking, such as the seine net is still allowed to operate on the North Coast of Java. The other regulation could be implemented, for instance, increasing the mesh size of the tangle net, managing fishing ground depending on the characteristic and specification of each gear type, etc.				
FISHING PRESSSURE					
b) Discard mortality		No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	
		Limited relevant data are collected AND analysed to inform management		Not consistent	√
		Some relevant data are collected AND analysed to inform management	√	Expert advice partially implemented	
		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?)				

	No measure is in place to reduce discard mortality, such as regulation on whole-body landing in all or specific landing sites.				
FISHING PRESSSURE					
c) Size/age/sex selectivity		No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	
		Limited relevant data are collected AND analysed to inform management		Not consistent	√
		Some relevant data are collected AND analysed to inform management	√	Expert advice partially implemented	
		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?) No measure is in place to manage fishing of juvenile wedgefishes in Indonesia. However, data related to this measure has been collected.				
d) Magnitude of IUU fishing	**Marine patrolling Placement a monitor in fishing vessel**	No data OR data are of poor quality OR data are not analysed (adequately) to inform management		No expert advice on management identified	
		Limited relevant data are collected AND analysed to inform management	√	Not consistent	
		Some relevant data are collected AND analysed to inform management		Expert advice partially implemented	√

		Comprehensive data collected AND analysed to inform management		Consistent	
	Management measure(s) effective/likely to be effective? (circle as appropriate) Yes Partially No Insufficient information				
	Reasoning/comments (e.g. Is effectiveness compromised by poor design and/or implementation, or is a greater diversity or amount of management required? What data are required to better inform and evaluate management decisions? How is management inconsistent with expert advice?) There is no information on IUU fishing of those species in Indonesian waters				

NEXT STEPS

- Add notes in the Worksheet for **Section 6.1** on improvements in data availability/monitoring required to evaluate the effectiveness/likely effectiveness of management under **Question 4.1(b**).
- Add notes in the Worksheet for **Section 6.2** on improvements in management (including compliance systems) required to more fully mitigate the pressures impacting the stock/population of the shark species concerned.
- Go to **Step 5**

Worksheet for Step 5

Question 5.1
Based on the outcomes of the previous steps, is it possible to make a positive NDF (with or without associated conditions) or is a negative NDF required?

- See pages 95–97 of **Annex 1** for additional Guidance Notes on completing this Worksheet**.**
- Transfer all results from **Steps 2–4** to the Table below by circling the appropriate descriptors.
    - From the **Worksheets for Questions 2.1 and 2.2** above, transfer the **level of vulnerability** and **level of severity/scope of conservation concern** into the Worksheet below.
    - From the **Worksheets for Questions 3.1 and 3.2** above, transfer the **level of severity** for each trade and fishing pressure Factor into the second column in the Worksheet below and the **level of confidence** associated with each evaluation of severity into the third column in the Worksheet below.
    - Based on the information contained in the **Worksheets for Questions 4.1(a) and 4.1(b),** state in the Worksheet below whether the **existing management measures are effective/likely to be effective** at mitigating each of the pressures identified (taking into account whether they are **appropriately designed** and **being implemented**), or whether there is insufficient information to make such an assessment.
- Based on the information generated and evaluations made in the previous **Steps**, the Scientific Authority now has to decide whether to make a positive NDF for the export (with or without mandatory conditions), or a negative NDF. A decision tree to assist in this decision-making process is provided in the Guidance Notes in **Annex 1**.
- The final decision regarding the NDF should be indicated in the relevant box at the end of this Worksheet. Under "Reasoning/comments" include justification for the decision made and describe any **mandatory conditions** (for a positive NDF) and/or **recommendations as to further measures** (e.g. improvements in monitoring and/or management required – relevant for both positive and negative NDF).

Step 2: Intrinsic biological vulnerability and conservation concern

Intrinsic biological vulnerability (Question 2.1)	High	**Medium**	Low	Unknown
Conservation concern (Question 2.2)	**High**	Medium	Low	Unknown

Step 3: Pressures on species			**Step 4: Existing management measures**
Pressure	**Level of severity (Questions 3.1 and 3.2)**	**Level of confidence (Questions 3.1 and 3.2)**	**Are the management measures effective* at addressing the concerns/pressures/impacts identified? (Question 4.1b)** **Taking into account the evaluation of management appropriateness and implementation under Question 4.1a*
Trade pressures			
a) Magnitude of legal trade	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable

a) Magnitude of illegal trade	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
** Only to be used where the trade pressure severity was assessed as "Low" for any of the Factors in **Step 3** and a judgement is made that the impacts on the shark stock/population concerned are so low that mitigation is not required.			
Fishing pressures			
a) Fishing mortality (retained catch)	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
b) Discard mortality	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
c) Size/age/sex selectivity of fishing	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
d) Magnitude of IUU fishing	High Medium Low Unknown	High Medium Low	Yes Partially No Insufficient Information **Not applicable
** Only to be used where the fishing pressure severity was assessed as "Low" for any of the Factors in **Step 3** and a judgement is made that the impacts on the shark stock/population concerned are so low that mitigation is not required.			
A) Can a positive NDF be made?	**YES** – *go to B*	**NO** – *go to **Step 6** and list recommendations for measures to improve monitoring/management under Reasoning/comments below*	

B) Are there any mandatory conditions to the positive NDF?	**YES -** *list under Reasoning/comments below and go to C*	**NO** – *go to C*
C) Are there any other further recommendations? *(e.g. for improvements to monitoring/management)*	**YES** – *go to **Step 6** and list recommendations for measures to improve monitoring/management under Reasoning/comments below*	**NO**
Reasoning/comments (include justification for decision made and information on mandatory conditions and/or further recommendations)		

NEXT STEPS

- OPTION 1: If improvements in monitoring or management are required (whether in the case of a **positive or negative NDF**) go to **Step 6**
- OPTION 2: If no improvements in monitoring or management are required, make a **positive NDF** and stipulate any **mandatory conditions**, if appropriate, to the Management Authority and any other relevant bodies.

Worksheet for Step 6
Further measures

Section 6.1
Improvement in monitoring or information required

In the space below, authorities are encouraged to list the improvements in monitoring or information that are required to address cases where:

(i) The severity of trade/fishing pressures has been assessed as unknown.
(ii) The level of confidence in the evaluation of trade/fishing pressures is low.
(iii) There is insufficient information on the effectiveness of management.
(iv)

Recommendations should be made in **consultation with the national fisheries management agency** and should be as **specific as possible** to address any gaps/shortcomings identified with **clearly defined objectives**. Time-frames for implementation should be specified where possible, including with regard to the review of progress on implementation.

See pages 98-99 of **Annex 1** for additional Guidance Notes on completing this Worksheet.

See section 7

Section 6.2 **Improvement in management is required**
In the space below, authorities are encouraged to list the improvements in management that are required to address cases where management has been assessed as partially effective or ineffective at addressing any of the concerns/pressures/impacts identified, particularly where a fishing or trade pressure is assessed as medium or high (confidence levels: low, medium or high). As noted above for **Section 6.1**, recommendations should be made in **consultation with the national fisheries management agency** and should be as **specific as possible** to address any gaps/shortcomings identified with **clearly defined objectives**. Time-frames for implementation should be specified where possible, including with regard to the review of progress on implementation. See page 100 of **Annex 1** for additional Guidance Notes on completing this Worksheet.
See Section 7