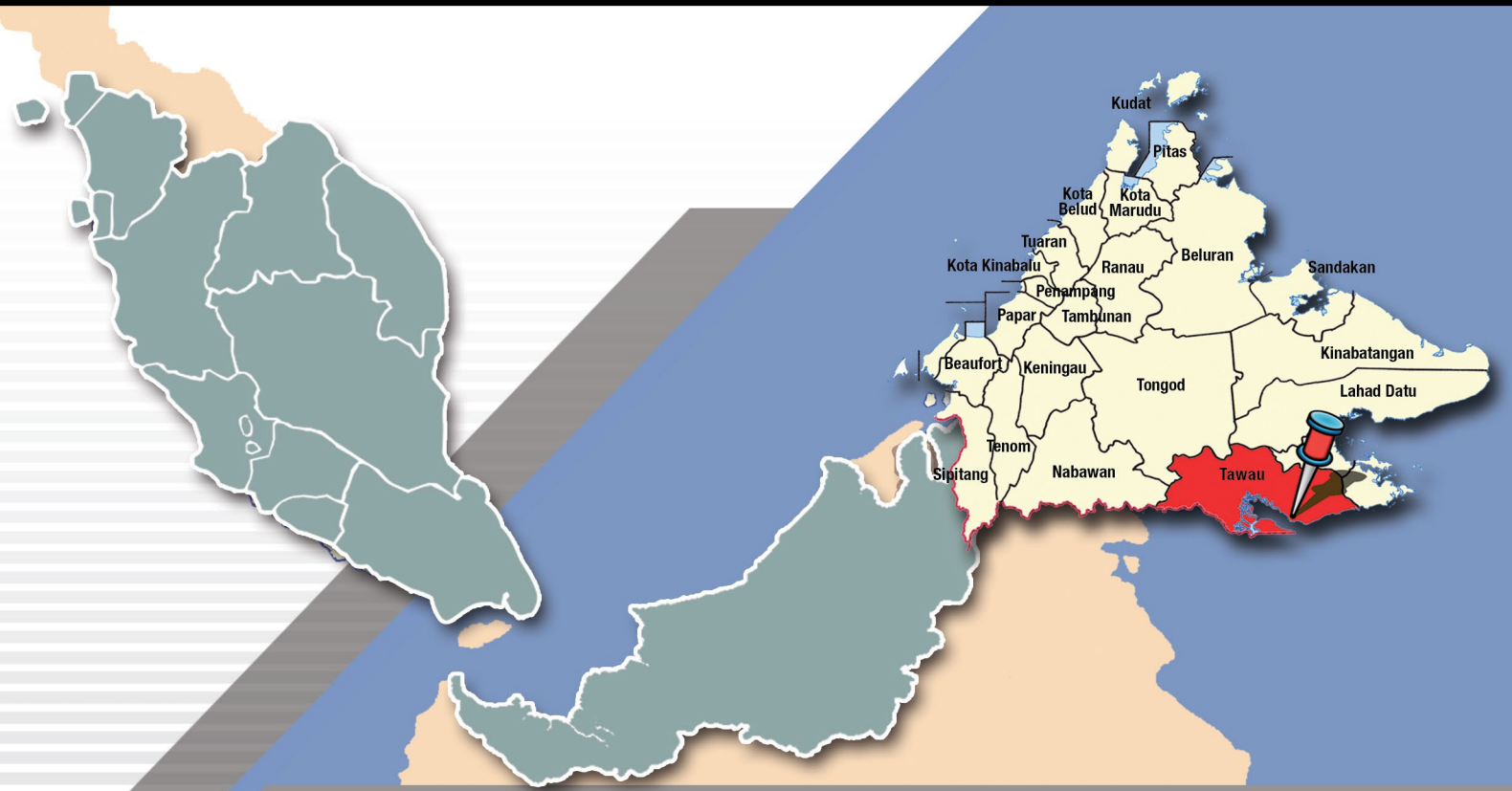




TERMINAL REPORT DATA COLLECTION ON SHARKS AND RAYS BY SPECIES IN TAWAU, SABAH (PHASE 1)

OCTOBER 2018 - SEPTEMBER 2019



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2020

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By
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Marine Fishery Resources Development and Management Department
Southeast Asian Fisheries Development Center

2020

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TERMINAL REPORT DATA COLLECTION ON SHARKS AND RAYS BY SPECIES IN
TAWAU, SABAH (PHASE 1) OCTOBER 2018-SEPTEMBER 2019 / By: Abd. Haris
Hilmi bin Ahmad Arshad, Hamizah Nadia binti Alias@Yusof, Ahmad bin Ali,
Lawrence Kissol Jr, Rosdi bin Mohd Nor, Mohd Sukri bin Muda.

ISBN 978-976-0633-72-5

1. Sharks–Malaysia–Statistics.
 2. Rays (Fishes)–Malaysia–Statistics.
 3. Government publications–Malaysia.
- I. Hamizah Nadia Alias@Yusof. II. Ahmad Ali.
III. Lawrence Kissol Jr. IV. Rosdi Mohd. Nor.
V. Mohd Sukri Muda. VI. Title.
597.309595

Published by:

Jabatan Perikanan Malaysia

Kementerian Pertanian dan Industri Makanan

Wisma Tani, Aras 1-6, Blok Menara 4G2, Presint 4

62628 Putrajaya.

Tel: 03-8870 4000

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Email: hqhelp@dof.gov.my

<http://www.dof.gov.my>



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This publication should be cited as follows;

Abd Haris Hilmi, A.A., Hamizah, N.A., Ahmad, A., Kissol, L., Rosdi, M.N. and Sukri, M. (2020). Terminal Report Data Collection on Sharks and Rays by Species in Tawau, Sabah (Phase I) October 2018 – September 2019. SEAFDEC/MFRDMD/SP/48.34pp.

ACKNOWLEDGEMENTS

The authors would like to thank The Honourable Dato' Haji Munir bin Haji Mohd Nawi, former Director-General of Fisheries Malaysia, Dato' Dr. Bah Piyon Tan, former Deputy Director-General of Fisheries Malaysia and Dr. Ahemad bin Sade, Director of the Department of the Fisheries Sabah for their continuous support in the implementation of this project as well as the conservation and management of sharks and rays in Sabah, Malaysia.

We would particularly like to thank Dr. Kom Silapajarn, former Secretary-General of SEAFDEC, Ms. Malinee Smithrithee, Secretary-General of SEAFDEC, Mr. Isara Chanrachkij, Research and Development Division Head (SEAFDEC TD) and Mr. Sukchai Arnupapboon, Fishing Ground and Oceanography Section Head (SEAFDEC TD) for supporting this project especially for securing funding from the SEAFDEC Japanese Trust Fund VI.

We are grateful to all people for their encouragement and support in the implementation of this project especially Mr. Raja Bidin bin Raja Hassan, former Chief of SEAFDEC/MFRDMD; Dr. Kenji Taki, former Deputy Chief of SEAFDEC/MFRDMD and Dr. Masaya Katoh, Deputy Chief of SEAFDEC/MFRDMD.

Last but not least we appreciated the services provided by enumerators Mr. Razman bin Rahman, Mr. Mohd Hairul bin Suraidi and the late Mr. Mangunsidi bin Ishak and supporting staff from the Department of Fisheries Sabah; Mr. Hyrie bin Gotisin, Ms. Angelene Lojutan, Ms. Midah Gintin, and Ms. Norsimah binti Kassim.

EXECUTIVE SUMMARY

This project was sponsored by Training Department SEAFDEC (SEAFDEC TD) from October 2018-September 2019 under project 'Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region'. SEAFDEC TD had agreed to fund a one-year activity for 'Data Collection on Sharks and Rays by Species in Tawau, Sabah' with budget amounted to US\$3,000. Apart from that, the Department of Fisheries Sabah provided two officers as enumerators. MFRDMD researchers were appointed as technical advisors for this project especially on research methodology, verification of data, and preparation of the report.

The project aimed to enhance human resource development in elasmobranch taxonomy, to improve landing data recording from generic 'sharks' and 'rays' to species level, to increase awareness on conservation, and to use data for Non-Detriment Findings (NDFs) study for sharks and rays in Sabah in future.

During the period of 12 months from October 2018 to September 2019, recording of landings data was conducted at two landing sites namely Tawau Fish Market and Batu 4 Jetty in districts of Tawau. Two staff from the Department of Fisheries Sabah trained in shark taxonomy were involved in the endeavor, collecting data at least 12 days per month.

A total of 19 species of chondrichthyans belonging to two orders of sharks (Carcharhiniformes and Orectolobiformes) comprising three families (five species) and two orders of rays (Myliobatiformes and Rhinopristiformes) comprising six families (14 species) were recorded. The most abundant rays were from family Dasyatidae comprising of seven species followed by Rhinidae and Rhinopterae with two species for each family and Myliobatidae, Gymnuridae, and Aetobatidae with one species. In case of sharks, only three families recorded namely Carcharhinidae with three species and, Hemiscylliidae and Sphyrnidae with one species. The details are as shown in **Appendix II**.

This study was found that the landing of sharks and rays ranged between 0.1 – 1.7% and 1.1 - 4.8% respectively from total landings. The details are shown in **Table 4**. These figures confirmed earlier data as published in Malaysian National Statistics that rays and sharks were only by-catch and not targeted and contributed less than 2% of the total annual marine landings.

The most common and abundant shark species recording in 12 months were *Sphyrna lewini* and *Carcharhinus sorrah*. Other shark species *Carcharhinus leucas*, *Carcharhinus melanopterus*, and *Chiloscyllium plagiosum* were only landed between 1 - 2 months. The most common and abundant ray species were *Neotrygon orientalis*, *Taeniura lymma*, *Maculabatis gerrardi*, *Gymnura zonura*, and *Rhynchobatus australiae*. All these species were landed throughout the year. Other ray species *Aetobatus ocellatus*, *Himantura leoparda*, *Himantura uarnak*, *Himantura undulata*, *Myliobatis hamlyni*, *Pateobatis jenkinsii*, *Rhina ancylostoma*, *Rhinoptera javanica* and *Rhinoptera jayakari* were only landed between 1 - 3 months. The details are as shown in **Table 5**.

The top five catch per unit effort (CPUE) ray species captured by otter trawl net at Tawau were *Maculabatis gerrardi*, *Neotrygon orientalis*, *Taeniura lymma*, *Gymnura zonura* and *Rhynchobatus*

australiae. Details are shown in **Table 11**. The top three CPUE of shark species were *Sphyrna lewini*, *Carcharhinus sorrah* and *Chiloscyllium plagiosum*. Details are shown in **Table 12**.

Finally, based on the usage and marketing information gathered, this study confirmed that all sharks and rays were landed whole, indicated of these species full utilization with no finning activities on board of vessels.

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1.0 INTRODUCTION

Malaysia is home to a rich diversity of sharks, rays, skate, and chimaeras (Class Chondrichthyes). However, sharks and rays landings contribute only about 1% and 2% of total marine landings respectively. Until 2016, Malaysia recorded 162 species of Chondrichthyans comprising 70 sharks, 85 rays, six skates, and one chimaera, belonging to 18 families of sharks, 12 rays, two skates, and one chimaera. The high diversity of sharks was recorded from the Order Carcharhiniformes with 50 species and Orectolobiformes with 10 species. However, low diversity was recorded for the Orders Hexanchiformes with three species, and Lamniformes and Squatiniformes with two species respectively. Species diversity in the Order Heterodontiformes was scanty where only one species was recorded. As for batoids, high diversity was recorded for the Order Myliobatiformes with 62 species followed by Torpediniformes with 12 species and Rhinopristiformes with 11 species. Only six species were recorded from the Order Rajiformes. Even though the number of chondrichthyans species recorded in Malaysia was more than 160, the actual status of its biodiversity is still unknown. With new species continuously discovered, the number is expected to increase in the future. At present, the deepwater species are mostly unknown due to limited research activities. Most sharks and rays species landed especially from the Families Carcharhinidae and Dasyatidae and are very difficult to identify up to species level by untrained and inexperienced enumerators. Only well-trained staff will be able to make the right and valid identification of species (Ahmad and Annie Lim, 2012).

1.1 Objective

The objectives of this project were:

- to enhance human resource development in elasmobranch taxonomy,
- to improve landing data recording from generic 'sharks' and 'rays' to species level,
- to increase awareness on conservation, and
- to use data for Non-Detriment Findings (NDFs) study for sharks and rays in Sabah in the future.

1.2 Data Collection at Landing Sites

1.2.1 Selection of Study Sites

Sabah is the second largest state in Malaysia and occupying the northern part of Borneo. The total land area of Sabah is about 73,631 square kilometers, serene beaches, virgin rainforest, coral reefs, and abundant flora and fauna species. Surrounded by South China Sea in the west, Sulu Sea in the northeast, and Celebes (Sulawesi) Sea in the northeast, Sabah is indeed blessed with its marine resources. In 2018, the landing of marine fish in the state was 163,055 metric tonnes (mt) with a value of RM945.3 million.

There are 16 coastal districts in Sabah and for the purpose of this project, Tawau in the south was selected as the study site, since the district is a fisheries landing point in Sabah, other than Kota Kinabalu and Sandakan (**Figure 1**).



Figure 1: Location of Study Sites in the State of Sabah

1.2.2 Fishery Structure and Background of Study Sites

Jetty Batu 4 and Jetty Pasar Ikan were selected as study sites to collect landing data of sharks and rays. There are 155 trawler operators in Tawau compare to purse seines which are only around 30. The operation duration per trip of trawl nets is up to five days while the purse seine's operations only take up to one day. The details of commercial fishing vessels in Tawau are shown in Table 1.

Table 1: Number of Licensed Fishing Vessels by Gears and Number of Fishers in Tawau

Gear Type	Fishing Zone	Fishing Operation from Coastline (Nautical Mile)	No. of Vessels	No. of Fishers
Trawlers				
< 10 GRT	East Coast	> 3 nm	4	24
10 – 24.9 GRT	East Coast	> 3 nm	96	642
25 – 39.9 GRT	East Coast	> 3 nm	54	477
40 – 69.9 GRT	East Coast	> 3 nm	1	9
> 70 GRT	East Coast	> 30 nm	-	-
Total			155	1,152
Purse Seiners				
< 10 GRT	East Coast	> 3 nm	1	4
10 – 24.9 GRT	East Coast	> 3 nm	12	95
25 – 39.9 GRT	East Coast	> 3 nm	16	144
40 – 69.9 GRT	East Coast	> 3 nm	1	9
> 70 GRT	East Coast	> 30 nm	-	-
Total			30	252
Grand Total			185	1,404

1.3 Appointment of Enumerators and Project Coordinators

Two staff from the Department of Fisheries Sabah were appointed as enumerators for a study site in Tawau. The national coordinator is from the Department of Fisheries Malaysia and the state coordinator is from the Department of Fisheries Sabah. Their names and addresses are as follows:

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1.4 Materials and Methods

1.4.1 Sampling Methods

The sampling activity started in October 2018 until September 2019. All enumerators were requested to record landing data and other related information a standard form at least 12 days per month. A standard SOP entitled 'SOP Sharks and Rays Data Collection in the Southeast Asian Waters' was produced. The content included Standard Operation Procedure and instructions to enumerators on how to measure, weigh, record sharks and rays species at sampling sites, name of the enumerator, name of the landing site, date of sampling, vessel registration number, vessel GRT, fishing area, the price at landing sites, name of species (common name and scientific name), the total catch of sharks, rays, commercial and low-value species from each sampling vessel. The details of the standard form are shown in **Appendix I**. The completed data in excel were then submitted to the respective National Coordinator before submitted to SEAFDEC/MFRDMD before the second week of the following month for verification. The data were analysed at the end of each quarter.

1.4.2 Selection of Fishing Vessels and Sampling Activities

Between 1 - 3 fishing vessels were selected for sampling each day for 12 days per month at each landing site. Measurement of Total length (TL) was taken for all skates, sharks and rays species from the Families Rhynchobatidae, Rhinobatidae and Narcinidae. While Disc Length (DL) were taken for all ray species where the tail is frequently absent or damaged (mainly from the Families Dasyatidae, Gymnuridae and Mobulidae). All sharks and rays specimens were measured and weighed individually if the total number was less than 50 tails per vessel. If the total number was more than 50 tails, only 10-50% were measured. The maturity stage for each individual was estimated according to Yano *et al.* (2005), and Ahmad and Annie Lim (2012). The total catch of all sharks and rays by species as well as the total catch of commercial and low-value species were also recorded for each sampling vessel. Larger specimens were photographed, and their basic taxonomic and biological characteristics noted.

1.4.3 Classification

The classification (scientific names) used in this report follows that of Compagno (1999), Yano *et al.* (2005), Ahmad and Annie Lim (2012), Ahmad *et al.* (2013) and Ahmad *et al.* (2014), and Ebert *et al.* (2013) and Last *et al.* (2016).

2.0 RESULTS

2.1 Landing Samples

A total of 170 landings were sampled during the study period. The highest by month was 25 in December 2018 followed by 19 in January 2019. The highest by gear type was Otter Trawl Net with 164 landings followed by drift net and longline. Due to the limited transportation available at the Tawau Fisheries Office, data collection for drift net and longline was only taken for three months (October-December 2018) at Jetty Batu 4. The details are shown in **Table 2**.

Table 2: Number of Landings Sampled During the Study at Tawau

Type of Gear	Year/Month												Grand Total
	2018			2019									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Drift Net		1	2										3
Longline	1		2										3
Otter Trawl Net	9	11	21	19	18	13	12	12	12	13	12	12	164
Grand Total	10	12	25	19	18	13	12	12	12	13	12	12	170

2.2 Fishing Ground and Catch Composition by Gear Type

The main gear landing sharks at Tawau was otter trawl net at 1341.9 kg (20.8%) followed by drift net at 2.8 kg and longline at 1.6 kg. The highest landing of rays by month was from otter trawl net at 1194.5 kg in December 2018, while in February and January 2019 were 573.5 kg and 525.4 kg respectively. The highest landing of sharks by month came from otter trawl net in December 2018 at 258.6 kg followed by 251.4 kg in February 2019 and 207.1 kg in January 2019. The details are shown in Table 3.

Table 3: Weight of Sharks and Rays (in kg) Caught by Different Types of Gear

Type of Gear	Year/Month												Grand Total			
	2018						2019									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep				
Drift Net		3.2	32.2													35.4
Longline	14		56.7													70.7
Offter Trawl Net	435.3	237.3	1,194.5	525.4	573.5	218.1	324.4	257.1	228.4	322.4	309.1	360				4,985.5
Total Catch Ray	449.3	240.5	1,283.4	525.4	573.5	218.1	324.4	257.1	228.4	322.4	309.1	360				5,091.6
Drift Net		1.4	1.4													2.8
Longline			1.6													1.6
Offter Trawl Net	158	19.9	258.6	207.1	251.4	76.7	101.7	63.3	44.4	62.3	54.8	43.8				1,341.9
Total Catch Shark	158	21.3	261.6	207.1	251.4	76.7	101.7	63.3	44.4	62.3	54.8	43.8				1,346.3
Grand Total	607.3	261.8	1,545.0	732.5	824.9	294.8	426.1	320.4	272.8	384.6	363.9	403.8				6,437.8

2.3 Sharks and Rays Composition

A total of 191,410.7 kg of fish was landed from 170 landings during the study period. Rays and sharks made up 5,091.6 kg and 1,346.3 kg (2.7% and 0.7%) from the total landing respectively. Landings of bony fish were 184,972.9 kg or 96.6%. Average landings per month for sharks and rays were 112.2 kg and 424.3 kg respectively. The highest landing by month for rays was 1,283.4 kg in December 2018, followed by 573.5 kg in February and 525.4 kg in January 2019. However, the highest landing for sharks was 261.6 kg in December 2018 followed by 251.4 kg in February and 207.1 kg in January 2019. This study was found that the landing of sharks and rays ranged between 0.1 - 1.7% and 1.1 - 4.8% respectively from total landing. The details are shown in **Table 4**.

Table 4: Catch Composition of Sharks, Rays, and Bony Fish by Month from 170 Landings at Tawau, Sabah. All Weights in Kilogram

Year	Month	Weight of Ray	% Ray	Weight of Shark	% Shark	Weight of Bony Fish	% Bony Fish	Total Catch
2018	Oct	449.3	4.8	158	1.7	8,814	93.6	9,421.3
	Nov	240.5	1.1	21.3	0.1	22,414.9	98.8	22,676.7
	Dec	1,283.4	2.2	261.6	0.4	56,738	97.3	58,283
2019	Jan	525.4	3.2	207.1	1.3	15,608	95.5	16,340.5
	Feb	573.5	4	251.4	1.7	13,600	94.3	14,424.9
	Mar	218.1	2.3	76.7	0.8	9,121	96.9	9,415.7
	Apr	324.4	3.4	101.7	1.1	9,244.3	95.6	9,670.4
	May	257.1	2.6	63.3	0.7	9,389.9	96.7	9,710.3
	Jun	228.4	2.5	44.4	0.5	8,722.9	97	8,995.6
	Jul	322.4	2.8	62.3	0.5	10,964.7	96.6	11,349.3
	Aug	309.1	3	54.8	0.5	10,024.1	96.5	10,388
	Sep	360	3.4	43.8	0.4	10,331.2	96.2	10,735
Grand Total		5,091.6		1,346.3		184,972.9		191,410.7
Average		424.3	2.7	112.2	0.7	15,414.4	96.6	15,950.9

2.4 Sample Size

A total of 1,550 tails belonging to 1,096 rays and 454 sharks were sampled comprising 14 species of rays and five species of sharks during the study period. The most common and abundant ray species were *Neotrygon orientalis*, *Taeniura lymma*, *Maculabatis gerrardi*, *Gymnura zonura* and *Rhynchobatus australiae*. All these species were landed throughout the year. Other ray species *Aetobatus ocellatus*, *Himantura leoparda*, *Himantura uarnak*, *Himantura undulata*, *Myliobatis hamlyni*, *Pateobatis jenkinsii*, *Rhina ancylostoma*, *Rhinoptera javanica* and *Rhinoptera jayakari* were only landed between 1 - 3 months. The highest number of rays sampled by month was 142 tails in December 2018 followed by 125 tails in September 2019 and 107 tails in August 2019.

The most common and abundant shark species recording in 12 months were *Sphyrna lewini* and *Carcharhinus sorrah*. Other shark species *Carcharhinus leucas*, *Carcharhinus melanopterus* and *Chiloscyllium plagiosum* were only landed between 1 - 2 months. The highest number of sharks sampled by month was 68 tails in December 2019, followed by 62 tails in February 2019 and 46 tails in January 2019. The details are as shown in Table 5.

Table 5: Sample Size of Sharks and Rays by Species

Species	Year/Month												Grand Total
	2018			2019									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
<i>Aetobatus ocellatus</i>			1										1
<i>Gymnura zonura</i>	5	3	9	16	15	10	27	26	14	24	18	18	185
<i>Himantura leoparda</i>			6	1									7
<i>Himantura uarnak</i>	2				4					6			12
<i>Himantura undulata</i>			1										1
<i>Maculabatis gerrardi</i>	16	18	42	9	20	23	15	9	21	17	20	22	232
<i>Myliobatis hamlyni</i>						1							1
<i>Neotrygon orientalis</i>	13	13	33	14	29	13	15	24	42	32	26	39	293
<i>Pateobatis jenkinsii</i>			1										1
<i>Rhina ancylostoma</i>		2					1						3
<i>Rhinoptera javanica</i>				9									9
<i>Rhinoptera jayakari</i>			1										1
<i>Rhynchobatus australiae</i>	9	3	17	17	20	3	7	4	9	3	11	13	116
<i>Taeniura lymma</i>	11	8	31	16	16	13	13	30	16	15	32	33	234
Total Rays	56	47	142	82	104	63	78	93	102	97	107	125	1,096
<i>Carcharhinus leucas</i>				1									1
<i>Carcharhinus melanopterus</i>			1										1
<i>Carcharhinus sorrah</i>	10	12	36	9	21	1	7	10	14	8	8	6	142
<i>Chiloscyllium plagiosum</i>	2	1	15	1									19
<i>Sphyrna lewini</i>	19	2	16	35	41	26	27	32	24	26	20	23	291
Total Sharks	31	15	68	46	62	27	34	42	38	34	28	29	454
Grand Total	87	62	210	128	166	90	112	135	140	131	135	154	1,550

2.5 Weight of Sharks and Rays by Species

A total of 6,437.8 kg was landed from 170 landings comprising 5,091.6 kg of rays and 1,346.3 kg of sharks. For rays, the highest landing by weight was 1,592.8 kg for *Maculabatis gerrardi* followed by 1,060 kg for *Neotrygon orientalis* and 833.4 kg for *Taeniura lymma*. The highest landing by month for *Maculabatis gerrardi* was in December 2018 with 621.4 kg, followed by October 2018 (159.7 kg) and February 2019 with 133.5 kg. For *Neotrygon orientalis*, the highest landing was in December 2018 with 235.2 kg, followed by February 2019 (138.3 kg) and January 2019 with 110 kg. For *Taeniura lymma*, the highest landing was 140 kg in December 2018 followed by 94.2 kg in January 2019. Other important species based on high landing were *Gymnura zonura* with 822.7 kg and *Rhynchobatus australiae* with 567.1 kg. The landings of other species were below 100 kg.

The highest landing of shark species was *Sphyrna lewini* with 882.2 kg followed by *Carcharhinus sorrah* (417.3 kg), *Chiloscyllium plagiosum* (30.9 kg), *Carcharhinus melanopterus* (12 kg) and *Carcharhinus leucas* with 3.9 kg. The highest landing by month for *Sphyrna lewini* was 185.2 kg in January 2019 followed by 174.7 kg in February 2019 and 112.7 kg in October 2018. For *Carcharhinus sorrah*, the highest landing was 154.4 kg in December 2018 followed by 76.7 kg in February 2019 and 43 kg in October 2018. The details are shown in **Table 6**.

Table 6: Weight of Sharks and Rays (in kg) by Species from 170 Landings at Tawau

Species	Year/Month												Grand Total			
	2018						2019									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep				
<i>Aetobatus ocellatus</i>			9													9
<i>Gymnura zonura</i>	52	8	45	142.2	101.4	38.6	120.5	88.6	43.6	88.9	41.2	52.9				822.7
<i>Himantura leoparda</i>			56.7	10												66.7
<i>Himantura uarnak</i>	10.4				8					26						44.4
<i>Himantura undulata</i>			16.3													16.3
<i>Maculabatis gerrardi</i>	159.7	128	621.4	43.4	133.5	70.6	67.2	28.6	44.7	87.5	113.8	94.4				1,592.8
<i>Myliobatis hamlyni</i>						1.7										1.7
<i>Neotrygon orientalis</i>	91.5	49.6	235.2	110	138.3	38.1	70	50.5	67.6	63	44.8	101.5				1,060
<i>Pateobatis jenkinsii</i>			12													12
<i>Rhina ancylostoma</i>		24					6.1									30.1
<i>Rhinoptera javanica</i>				21.9												21.9
<i>Rhinoptera jayakari</i>			13.5													13.5
<i>Rhynchobatus australiae</i>	75	8	134.3	103.8	114.5	5.1	23.7	11.4	29.1	10	22.6	29.6				567.1
<i>Taeniura lymma</i>	60.7	23	140	94.2	77.8	64	36.9	78.1	43.4	47	86.7	81.6				833.4
Total Weight Rays	449.3	240.5	1283.4	525.4	573.5	218.1	324.4	257.1	228.4	322.4	309.1	360				5,091.6
<i>Carcharhinus leucas</i>				3.9												3.9
<i>Carcharhinus melanopterus</i>			12													12
<i>Carcharhinus sorrah</i>	43	16.6	154.4	16.4	76.7	6.7	15.3	24.7	23.8	18.7	14	7				417.3
<i>Chiloscyllium plagiosum</i>	2.3	1.1	25.9	1.6												30.9
<i>Sphyrna lewini</i>	112.7	3.6	69.3	185.2	174.7	70	86.5	38.6	20.6	43.6	40.8	36.8				882.2
Total Weight Sharks	158	21.3	261.6	207.1	251.4	76.7	101.7	63.3	44.4	62.3	54.8	43.8				1,346.3
Grand Total	607.3	261.8	1,545.0	732.5	824.9	294.8	426.1	320.4	272.8	384.6	363.9	403.8				6,437.8

2.6 Size Range of Sharks and Rays

In general, from October 2018 to September 2019, both mature and immature rays species were sampled. Generally, rays species sampled were mature except for *Himantura leoparda*, *Himantura uarnak*, *Maculabatis gerrardi*, *Myliobatis hamlyni*, *Rhina ancylostoma*, *Rhinoptera javanica* and *Rhynchobatus australiae*.

The average size of *Himantura leoparda* ranged between 45 - 55.4 cm disc length, *Himantura uarnak* 35.5 - 50.8 cm, and *Maculabatis gerrardi* 24 - 46.6 cm. However, almost all samples of *Gymnura zonura*, *Neotrygon orientalis*, *Pateobatis jenkinsii*, *Rhinoptera jayakari* and *Taeniura lymma* were matured. Details are shown in **Table 7A (i)** and **Table 7A (ii)**.

Shark species sampled between October 2018 to September 2019 were mature except for *Carcharhinus leucas*, *Carcharhinus sorrah* and *Sphyrna lewini*. However, *Carcharhinus sorrah* sampled in March 2019 was matured. Mature size for *Chiloscyllium plagiosum* is about 50 cm and *Carcharhinus melanopterus* is about 91 cm. The first maturing size for a female for *C. leucas* is ranged between 180 - 230 cm total length and for a male between 197 - 226 cm. For *Carcharhinus sorrah*, a female is matured when the total length is between 110 - 118 cm and a male between 103 - 128 cm. The size range of all sharks species sampled are shown in **Table 7B (i)** and **Table 7B (ii)**.

Table 7A (i): Size Range of Rays (Disc Length) Except for *Rhynchobatus australiae* and *Rhina ancylostoma* (Total Length) from October 2018 to March 2019. All measurements in cm

Species	Year/Month																		
	2018									2019									
	Oct			Nov			Dec			Jan			Feb			Mar			
Ray	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Aetobatus ocellatus</i>				53	53	53													
<i>Gymnura zonura</i>	27	45	35.9	22	27	24.7	18	32	25.6	20	46	30.8	21	44	29.9	19	45	25.3	
<i>Himantura leoparda</i>				45	72	55.4	45	45	45										
<i>Himantura uarnak</i>	42	59.5	50.8										26	43	35.5				
<i>Himantura undulata</i>				78	78	78													
<i>Maculabatis gerrardi</i>	23	58	41.7	33.5	88	46.6	21.5	75	45.6	20	69.5	33.4	23	78	45.3	18	39	24	
<i>Myliobatis hamlyni</i>																31	31	31	31
<i>Neotrygon orientalis</i>	23	38	31.4	18	37	29.6	18.5	49	32.1	19	49	26.5	18	38	29.9	16	30	24.7	
<i>Pateobatis jenkinsii</i>				66	66	66													
<i>Rhina ancylostoma</i>				104	106	105													
<i>Rhinoptera javanica</i>										29	32	30.7							
<i>Rhinoptera jayakari</i>				48	48	48													
<i>Rhynchobatus australiae</i>	53	87	72.8	76	87	79.7	28	98	80.6	46	115	71.1	58	100	79.2	52	82	70.3	
<i>Taeniura lymma</i>	21	36	27.9	22	33	27.4	21.5	35	27.4	20	31	27.2	20	33	26.6	20	36	28.5	

Table 7A (ii): Size Range of Rays (Disc Length) Except for *Rhynchobatus australiae* and *Rhina ancylostoma* (Total Length) from April to September 2019. All measurements in cm

Species	Year/Month																			
	2019																			
	Apr			May			Jun			Jul			Aug			Sep				
Ray	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av		
<i>Aetobatus ocellatus</i>																				
<i>Gymnura zonura</i>	20	44	29.3	20	45	30.1	26	45	34.3	22	45	30.1	18	44	28	15	32	23.8		
<i>Himantura leoparda</i>																				
<i>Himantura uarnak</i>							20	65	39.2											
<i>Himantura undulata</i>																				
<i>Maculabatis gerrardi</i>	20	45	27.7	21	51	35.9	20	60	29	20	55	36.9	20	87	43.3	21	64	40.4		
<i>Myliobatis hamlyni</i>																				
<i>Neohygon orientalis</i>	17	35	25.5	16	38	27.9	17.8	39	23.4	17	38	25.7	20	38	29.1	18	38	30.3		
<i>Pateobatis jenkinsii</i>																				
<i>Rhina ancylostoma</i>	86	86	8																	
<i>Rhinoptera javanica</i>																				
<i>Rhinoptera jayakari</i>																				
<i>Rhynchobatus australiae</i>	54	85	71.9	52	79	68.8	54	115	76.3	77	87	81	53	88	73.4	21	92	72.5		
<i>Taeniura lymna</i>	21	31	27.1	21	32	27.2	20	32	26.5	23	32	28.4	18	36	27	22	36	27.4		

Table 7B (i): Size Range of Sharks (Total Length) from October 2018 to March 2019. All measurements in cm

Species	Year/Month											
	2018						2019					
	Oct		Nov		Dec		Jan		Feb		Mar	
Shark	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av
<i>Carcharhinus leucas</i>							77	77	77			
<i>Carcharhinus melanopterus</i>				126	126	126						
<i>Carcharhinus sorrah</i>	55	86.5	67.5	48	80	63.8	45	88	68.9	56	72	63.2
<i>Chiloscyllium plagiosum</i>	65	67	66	69	69	69	48	77.5	63.7	65.5	65.5	65.5
<i>Sphyrna lewini</i>	45	87.5	60.8	74	87	80.5	46.7	93	71.3	47	76	60.4
							33	94	62.6	46	77	61.9

Table 7B (ii): Size Range of Sharks (Total Length) from April to September 2019. All measurements in cm

Species	Year/Month											
	2019											
	Apr		May		Jun		Jul		Aug		Sep	
Shark	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av
<i>Carcharhinus leucas</i>												
<i>Carcharhinus melanopterus</i>												
<i>Carcharhinus sorrah</i>	60	86	72.4	61	134	70.4	50	80.4	67.2	48	112	73.1
<i>Chiloscyllium plagiosum</i>										85	70.5	48
<i>Sphyrna lewini</i>	46	87	60.6	46	86	58.7	50.5	65	56	45	94	63.4
										86	65	34
										94	76	69.7

2.7 Usage and Marketing

Information on marketing at this landing site indicated that all sharks and rays meat were consumed locally. Ray's skin (denticle part) was salted and sold to Kota Kinabalu by local collectors. The price was according to the width of the denticle. The price (RM/kg) varied according to species, size, and season. The highest price was RM6/kg for *Myliobatis hamlyni*. Other species such as *Gymnura zonura*, *Rhina ancylostoma*, *Rhinoptera javanica* and *Taeniura lymma* range between RM4.5 - RM5/kg. Details are shown in **Table 8**.

The highest price for all species of sharks at this landing site was RM5/kg. The lowest shark price was for *Carcharhinus leucas*, *Carcharhinus sorrah*, *Chiloscyllium plagiosum* and *Sphyrna lewini* which was sold at RM0.5 - RM1/kg. Details are shown in **Table 8**.

Normally the price in wet markets was about 100% higher than at landing site. The price was almost consistent for the whole year for all species but can fluctuate when supply was limited and during festive seasons such as Chinese New Year and Hari Raya. All sharks and rays were landed whole with fins.

Table 8: Price of Sharks and Rays at Fish Market Jetty, Nearby Fish Market by Species and Market Destination at Tawau. All Prices in RM per Kilogram

Species	Range Price at Jetty RM/kg	Range Price at Market RM/kg	Parts	Market Destination
Rays				
<i>Aetobatus ocellatus</i>	4 - 5	8 - 10	Whole-body	Tawau market
<i>Gymnura zonura</i>	3 - 4.5	6 - 9	Whole-body	Tawau market
<i>Himantura leoparda</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Himantura uarnak</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Himantura undulata</i>	4.5 - 5	9 - 10	Whole-body	Tawau market
<i>Maculabatis gerrardi</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Myliobatis hamlyni</i>	4.5-6	9-10	Whole-body	Tawau market
<i>Neotrygon orientalis</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Pateobatis jenkinsii</i>	4.5 - 5	9 - 10	Whole-body	Tawau market
<i>Rhina ancylostoma</i>	3 - 4.5	6 - 9	Whole-body	Tawau market
<i>Rhinoptera javanica</i>	3 - 4.5	6 - 9	Whole-body	Tawau market
<i>Rhinoptera jayakari</i>	4.5 - 5	9 - 10	Whole-body	Tawau market
<i>Rhynchobatus australiae</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Taeniura lymma</i>	3 - 4.5	6 - 9	Whole-body	Tawau market
Sharks				
<i>Carcharhinus leucas</i>	3 - 5	8 - 10	Whole-body	Tawau market
<i>Carcharhinus melanopterus</i>	4.5 - 5	9 - 10	Whole-body	Tawau market
<i>Carcharhinus sorrah</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Chiloscyllium plagiosum</i>	3 - 5	6 - 10	Whole-body	Tawau market
<i>Sphyrna lewini</i>	3 - 5	6 - 10	Whole-body	Tawau market

2.8 Catch Per Unit Effort (CPUE)

Table 9: Days at Operation by Gears Sampled During the Study Period in Tawau, Sabah

Type of Gear	Year/Month												Grand Total	
	2018						2019							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Drift Net		1	2											3
Longline	1		2											3
Offter Trawl Net	45	55	105	95	90	60	60	60	60	65	60	60	60	815
Grand Total	46	56	109	95	90	60	60	60	60	65	60	60	60	821

Table 10: Numbers of Operation by Gears Sampled During the Study Period in Tawau, Sabah

Type of Gear	Year/Month												Grand Total	
	2018						2019							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Drift Net		4	8											12
Longline	4		8											12
Offter Trawl Net	225	246	525	475	450	300	300	300	300	325	300	300	300	4,046
Grand Total	229	250	541	475	450	300	300	300	300	325	300	300	300	4,070

The top 10 catch per unit effort (CPUE) ray species captured by otter trawl net at Tawau were *Maculabatis gerrardi* (0.37 kg/haul), *Neotrygon orientalis* (0.26 kg/haul), *Taeniura lymma* (0.21 kg/haul), *Gymnura zonura* (0.20 kg/haul), *Rhynchobatus australiae* (0.14 kg/haul), *Himantura leoparda* (0.2 kg/haul), *Himantura uarnak* (0.01 kg/haul), *Rhina ancylostoma* (0.01 kg/haul), *Rhinoptera javanica* (0.01 kg/haul) and *Rhinoptera jayakari* (0.003 kg/haul). Details are shown in Table 11.

The top three CPUE of shark species were *Sphyrna lewini*, *Carcharhinus sorrah* and *Chiloscyllium plagiosum*. CPUE for *Sphyrna lewini* was 0.22 kg/hauls followed by *Carcharhinus sorrah* with 0.10 kg/hauls and *Chiloscyllium plagiosum* with 0.01 kg/hauls. Details are shown in Table 12.

Table 11: Top 10 CPUE Ray Species Captured by Otter Trawl Net During the Study Period in Tawau, Sabah

No.	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1.	<i>Maculabatis gerrardi</i>	2,154.96	1.86	0.37
2.	<i>Neotrygon orientalis</i>	1,622.03	1.29	0.26
3.	<i>Taeniura lymma</i>	1,348.95	1.02	0.21
4.	<i>Gymnura zonura</i>	1,398.28	1.01	0.2
5.	<i>Rhynchobatus australiae</i>	813.17	0.7	0.14
6.	<i>Himantura leoparda</i>	66.70	0.08	0.02
7.	<i>Himantura uarnak</i>	78.34	0.05	0.01
8.	<i>Rhina ancylostoma</i>	36.2	0.04	0.01
9.	<i>Rhinoptera javanica</i>	21.85	0.03	0.01
10.	<i>Rhinoptera jayakari</i>	13.50	0.02	0.003

Table 12: Top 5 CPUE shark species captured by Otter Trawl Net during the study period in Tawau, Sabah

No.	Scientific Name	Total Weight (kg) by Species	CPUE (kg/days)	CPUE (kg/haul)
1.	<i>Sphyrna lewini</i>	1,391.99	1.08	0.22
2.	<i>Carcharhinus sorrah</i>	601.36	0.51	0.1
3.	<i>Chiloscyllium plagiosum</i>	30.90	0.04	0.01
4.	<i>Carcharhinus melanopterus</i>	12	0.01	0.003
5.	<i>Carcharhinus leucas</i>	3.89	0.005	0.001

3.0 CONCLUSION

A total of 19 species of chondrichthyans belonging to two orders of sharks (Carcharhiniformes and Orectolobiformes) comprising three families and five species; and two orders of rays (Myliobatiformes and Rhinopristiformes) comprising of six families (14 species) were recorded during the study period. The most abundant rays were from family Dasyatidae followed by Rhinidae, Rhinopteridae, Myliobatidae, Gymnuridae, and Aetobatidae. Only three families of sharks were recorded namely Carcharhinidae, Hemiscylliidae, and Sphrynidae.

This study was found that the landing of sharks and rays ranged between 0.1 - 1.7% and 1.1 - 4.8% respectively from total landings. These findings confirmed earlier data as published in Malaysian National Statistics that rays and sharks were only by-catch and not targeted and contributed less than 2% of the total annual marine landings. Sharks and rays were mainly caught by otter trawl net.

The most common and abundant shark species were *Sphyrna lewini* and *Carcharhinus sorrah*. Other shark species *Carcharhinus leucas*, *Carcharhinus melanopterus* and *Chiloscyllium plagiosum* were only landed between 1 - 2 months. The most common and abundant ray species were *Neotrygon orientalis*, *Taeniura lymma*, *Maculabatis gerrardi*, *Gymnura zonura* and *Rhynchobatus australiae*. All these species were landed throughout the year. Other ray species *Aetobatus ocellatus*, *Himantura leoparda*, *Himantura uarnak*, *Himantura undulata*, *Myliobatis hamlyni*, *Pateobatis jenkinsii*, *Rhina ancylostoma*, *Rhinoptera javanica* and *Rhinoptera jayakari* were only landed between 1 - 3 months.

The top five catch per unit effort (CPUE) ray species captured by otter trawl net at Tawau were *Maculabatis gerrardi*, *Neotrygon orientalis*, *Taeniura lymma*, *Gymnura zonura* and *Rhynchobatus australiae*. The top three CPUE of shark species were *Sphyrna lewini*, *Carcharhinus sorrah* and *Chiloscyllium plagiosum*. This study confirmed that all sharks and rays were landed whole, indicated of these species full utilization with no finning activities on board of vessels.

4.0 FUTURE ACTIVITIES

Recommendations:

1. SEAFDEC should allocate a budget to carry out this study proposed in JTF VI-phase II until 2024 to ensure the estimation of sharks and rays stock assessment by species could be achieved.
2. Marketing and socio-economy study should be conducted at this study site to understand the marketing channel, especially the ray's skin.
3. The budget should be allocated to conduct on-site training for local staff.

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Sample of Standard Form

Data Collection Project on Sharks and Rays (SEAFDEC)

Country		State/Province	
Landing Site		Day/Month/Year	
Name of Enumerator		Record No	

Vessel Information

Type of Fishing Gear			
Vessel Name		Registration No	
GRT		No of Crew	

Trip Information

Days at Sea		Days at Operation	
Total Number of Operation			

Fishing Ground Information

Fishing Zone		Depth (average)	
Distance from port		Distance from coastline	
Longitude		Latitude	

Gear Information (Select and Check One Gear below)

Trawl Net

Width of Mouth	(m)	Height of Mouth	(m)
Length of Net	(m)	Mesh Size (Cod End)	(cm)
No of Operation/day	(times)	Time of Operation/haul	(hours)
Vessel Speed	(knot)	Fishing Layer	Mid / Bottom

Gill Net/Drift Net

Length of Net	(m)	Height of Net	(m)
Fishing Layer		Mesh Size	(cm)
No of Operation/day		Time of Operation/haul	(hours)

Hook and Line / Troll

No of Hooks		Size of Hook	Cm
Time of Operation/day	(hours)	Vessel Speed	(knot)

Longline

Total No of Hooks		Size of Hook	Cm
Length of Mainline	(km)	Fishing Layer	Mid /Bottom
No of Operation/day	(times)	Time of Operation/set	(hours)

Purse Seine

Length of Net	(m)	Mesh Size (Bunt)	(cm)
No of Operation/day	(times)	Duration of Operation	(hours)
Fish Searching	Luring / FADs / Wild / Others ()		

Other gears:

A. Standard Operation Procedure:

1. This form is for a single sampling vessel.
2. Collect all fish (sharks and rays) if the catch is less than 50 tails or 10-20% of the landed catch if more than 50 tails. Take samples randomly.
3. Separate them by species and sex.
4. Record Total Length-Weight for all sharks, rays, and skates from the Family Pristidae, Rhynchobatidae, Rhinidae, Rhinobatidae, Narcinidae and Narkidae. Measure Disc Length-Weight for other ray species.
5. Measured Precaudal Length (PCL) for Alopias spp or other sharks and rays (Rhynchobatidae, Rhinidae, Rhinobatidae) if tail damage or cut.
6. Record the total weight of all sharks and rays by species.
7. Record the total weight of commercial bony fish and trash fish.

B. Length-weight of sharks

No	Species	Sex	TL	Wgt (kg)

Note:

All sharks and rays specimens should be measured and weighed if total number are less than 50 tails/boat

If total numbers are more than 50 tails, only 10 – 20% (multi size and sex) should be selected for length – weight measurement.

C. Actual Weight of Sharks by Species

No	Species	Weight (Kg)

D. Length-weight of rays

No	Species	Sex	DL or DW	Wgt (kg)

E. Actual Weight of Rays by Species

No	Species	Weight (Kg)

F. Total Catch of Sampling Vessel (kg)

No.	All Sharks	All Rays	Commercial Bony Fish	Trash Fish	TOTAL

G. Price of Sharks and Marketing Information (Local Currency)

Species	Price/Kg (Small size)	Price/Kg (Medium size)	Price/Kg (Big size) (Peso)	Market Destination	Utilization

Please record:

Small Size (TL/PCL): cm ~ cm *ca*
 Medium Size (TL/PCL): cm ~ cm *ca*
 Big Size (TL/PCL): cm ~ cm *ca*
 Small Size (kg): kg ~ kg *ca*
 Medium Size (kg): kg ~ kg *ca*
 Big Size (TL/PCL): kg ~ kg *ca*

H. Price of Rays and Marketing Information (Local Currency)

Name of Rays	Price/Kg (Small size)	Price/Kg (Medium size)	Price/Kg (Big size)	Market Destination	Utilization

Please record:

Small Size (DL/TL/PCL): cm ~ cm *ca*
 Medium Size (DL/TL/PCL): cm ~ cm *ca*
 Big Size (DL/TL/PCL): cm ~ cm *ca*

Small Size (kg): kg ~ kg *ca*
 Medium Size (kg): kg ~ kg *ca*
 Big Size (TL/PCL): kg ~ kg *ca*

Note: _____

Checklist of Sharks and Rays Species Recorded During the Study Period

Batoids/Rays		
ORDER MYLIOBATIFORMES		
	Family Dasyatidae	English name
1	<i>Maculabatis gerrardi</i>	Whitespotted whipray
2	<i>Pateobatis jenkinsii</i>	Jenkin's whipray
3	<i>Himantura leoparda</i>	Leopard whipray
4	<i>Himantura uarnak</i>	Reticulate whipray
5	<i>Himantura undulata</i>	Honeycomb whipray
6	<i>Neotrygon orientalis</i>	Oriental bluespotted maskray
7	<i>Taeniura lymma</i>	Bluespotted fantail ray
	Family Gymnuridae	
1	<i>Gymnura zonura</i>	Zonetail butterfly ray
	Family Rhinopteridae	
1	<i>Rhinoptera javanica</i>	Javanese cownose ray
2	<i>Rhinoptera jayakari</i>	Short-tail cownose ray
	Family Myliobatidae	
1	<i>Myliobatis hamlyni</i>	Purple eagle ray
	Family Aetobatidae	
1	<i>Aetobatus ocellatus</i>	Whitespotted eagle ray
ORDER RHINOPRISTIFORMES		
	Family Rhinidae	
1	<i>Rhina ancylostoma</i>	Shark ray
2	<i>Rhynchobatus australiae</i>	Whitespotted wedgefish
Total ray species = 14		
Sharks		
ORDER CARCHARHINIFORMES		
	Family Carcharhinidae	
1	<i>Carcharhinus leucas</i>	Bull shark
2	<i>Carcharhinus sorrah</i>	Spot-tail shark
3	<i>Carcharhinus melanopterus</i>	Blacktip reef shark
	Family Sphyrnidae	
1	<i>Sphyrna lewini</i>	Scalloped hammerhead shark
ORDER ORECTOLOBIFORMES		
	Family: Hemiscylliidae	
1	<i>Chiloscyllium plagiosum</i>	Whitespotted bamboo shark
Total shark species = 5		

Photos of Activity

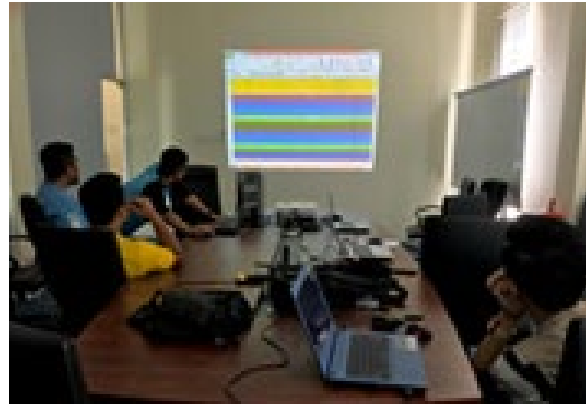


Photo 1: Workshop on data verification between MFRDMD and SEAFDEC TD officers, National and State Coordinators with local enumerators at Department of Fisheries Sabah Officers in Tawau (19-20 December 2019).



Photo 2: Activities at the Tawau market landing site.

Range Size of Small, Medium, and Big by Species (In Cm). Disc Length for All Rays (Except for Species in Family Rhinidae) and Total Length for All Shark Species.

Batoids/Rays		Small	Medium	Big
ORDER MYLIOBATIFORMES				
Family Dasyatidae				
1	<i>Maculabatis gerrardi</i>	< 18	18 – 88	> 88
2	<i>Pateobatis jenkinsii</i>	< 66	66	> 66
3	<i>Himantura leoparda</i>	< 45	45 – 72	> 72
4	<i>Himantura uarnak</i>	< 20	20 – 65	> 65
5	<i>Himantura undulata</i>	< 78	78	> 78
6	<i>Neotrygon orientalis</i>	< 16	16 – 49	> 49
7	<i>Taeniura lymma</i>	< 18	18 – 36	> 36
Family Gymnuridae				
1	<i>Gymnura zonura</i>	< 15	15 – 46	> 46
Family Rhinopteridae				
1	<i>Rhinoptera javanica</i>	< 29	29 – 32	> 32
2	<i>Rhinoptera jayakari</i>	< 48	48	> 48
Family Myliobatidae				
1	<i>Myliobatis hamlyni</i>	< 31	31	> 31
Family Aetobatidae				
1	<i>Aetobatus ocellatus</i>	< 53	53	> 53
ORDER RHINOPRISTIFORMES				
Family Rhinidae				
1	<i>Rhina ancylostoma</i>	< 86	86 – 106	> 106
2	<i>Rhynchobatus australiae</i>	< 21	21 – 115	> 115
Sharks				
ORDER CARCHARHINIFORMES				
Family Carcharhinidae				
1	<i>Carcharhinus leucas</i>	< 77	77	> 77
2	<i>Carcharhinus sorrah</i>	< 45	45 – 134	> 134
3	<i>Carcharhinus melanopterus</i>	< 126	126	> 126
Family Sphyrnidae				
1	<i>Sphyrna lewini</i>	< 33	33 – 94	> 94
ORDER ORECTOLOBIFORMES				
Family: Hemiscylliidae				
1	<i>Chiloscyllium plagiosum</i>	< 48	48 – 77.5	> 77.5

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ISBN 978-967-0633-72-5



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