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**DATA COLLECTION ON SHARKS AND
RAYS BY SPECIES IN MALAYSIA**
(AUGUST 2018 – JULY 2019)

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SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

2021

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EXECUTIVE SUMMARY

This project was the outcome of 'The Regional Technical Working Group on Data Collection for Sharks in Southeast Asia' held in Phuket, Thailand on 22 – 24 April 2014. The European Union and The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) through the Southeast Asian Fisheries Development Center (SEAFDEC) had agreed to fund a one-year project for conducting activities in Malaysia with a grant of US\$6,000. Apart from that, the Malaysian Government allocated RM70,000 (about US\$19,000) more to ensure the smooth implementation of this project. With the funding in place, eight districts were identified with four fully sponsored by SEAFDEC and four more by the Malaysia Government.

The project aimed to enhance human resource development in elasmobranch taxonomy, to increase awareness on conservation, to improve landings data recording from generic 'sharks' and 'rays' to species level and as preparation for Malaysia to conduct Non-Detriment Findings (NDFs) study for sharks and rays in the near future. During the period of 12 months from August 2018 to July 2019, recording of landings data were conducted in one district in Perak and one district in Sabah. Twelve staffs from the Department of Fisheries Malaysia and the Department of Fisheries Sabah trained in shark taxonomy were involved in the endeavor, collecting data at least 12 days per month. Larut Matang, Perak and Kota Kinabalu, Sabah were selected as the study sites under sponsorship of SEAFDEC and Malaysian Government. These districts are the main landing sites of sharks and rays in both states and the landing data were collected at seven jetties in Perak and one jetty in Sabah.

A total of 76 species of chondrichthyans belonging to nine families of rays (46 species) and nine families of sharks (30 species) were recorded during the study period. In Larut Matang, Perak a total of 19 species of rays from four Families, and 10 species of sharks from four families were recorded. For Sabah, Kota Kinabalu recorded the highest number of species with 27 species of rays from nine families and 20 species of sharks from nine families. The details is as shown in **Appendix II**. In term of percentage of total marine landings, rays and sharks contributed 1.4% and 0.5% at Larut Matang and; 0.9% and 0.3% at Kota Kinabalu respectively. 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 abundance of sharks and rays species varied between the study sites. The most abundant rays species in Larut Matang were *Neotrygon orientalis* followed by *Brevitrygon heterura*, *Maculabatis gerrardi*, *Telatrygon zugei*, *Maculabatis pastinacoides*, and *Hemitrygon akajei* while for sharks were *Chiloscyllium hasseltii*, *Chiloscyllium punctatum*, and *Atelomycterus marmoratus*. The most abundant rays species in Kota Kinabalu were *Neotrygon orientalis* followed by *Telatrygon zugei* and *Maculabatis gerrardi*; and the most common ray species were *Brevitrygon heterura* followed by *Rhinobatos borneensis*, and *Gymnura poecilura*. For sharks, the most abundant species were *Chiloscyllium punctatum* followed by *Chiloscyllium plagiosum* and *Atelomycterus marmoratus*.

The top three catch per unit effort (CPUE) (kg/hauls) for rays species captured by trawl net operated in Zone C at Larut Matang, Perak were dominated by *Neotrygon orientalis*, *Maculabatis gerrardi*, and *Brevitrygon heterura* while for sharks were *Chiloscyllium hasseltii*, *Chiloscyllium punctatum*, and *Carcharhinus sorrah*. The top three CPUE rays and sharks species captured by trawl net operated both in Zone 3 and Zone 4 at Kota Kinabalu were in the same order. For rays, *Neotrygon orientalis* topped the list followed by *Maculabatis gerrardi*, and *Telatrygon zugei*. Whilst for sharks, *Chiloscyllium punctatum* topped the list followed by *Chiloscyllium plagiosum*, and *Carcharhinus sorrah*.

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.

CONTENTS

No.	Contents	Page
	ACKNOWLEDGEMENT	i
	EXECUTIVE SUMMARY	ii
	List of Tables	v
	List of Figures and Appendices	vii
1.0	INTRODUCTION	1
1.1	Objective	1
1.2	Data Collection at Landing Sites	1
1.2.1	Selection of Study Sites	1
1.2.2	Fisheries Structure and Background of Study Sites	3
1.2.2.1	Larut Matang	3
1.2.2.2	Kota Kinabalu	3
1.3	Appointment of Enumerators and Project Coordinators	4
1.4	Materials and Methods	5
1.4.1	Sampling Methods	5
1.4.2	Selection of Fishing Vessels and Sampling Activities	6
1.4.3	Classification	6
2.0	RESULTS	6
2.1	Larut Matang	6
2.1.1	Landing Samples	6
2.1.2	Fishing Ground and Catch Composition by Gear Type	7
2.1.3	Rays and Sharks Composition	9
2.1.4	Sample Size	9
2.1.5	Weight of Rays and Sharks by Species	12
2.1.6	Size Range of Rays and Sharks	14
2.1.7	Usage and Marketing	18
2.1.8	Fishing Effort and CPUE (Catch per Unit Effort)	20
2.2	Kota Kinabalu	22
2.2.1	Landing Samples	22
2.2.2	Fishing Ground and Catch Composition by Gear Type	22
2.2.3	Rays and Sharks Composition	24
2.2.4	Sample Size	24
2.2.5	Weight of Rays and Sharks by Species	26
2.2.6	Size Range of Rays and Sharks	29
2.2.7	Usage and Marketing	34
2.2.8	Fishing Effort and CPUE (Catch per Unit Effort)	36
3.0	OUTPUT AND OUTCOME	38
4.0	CONCLUSION	39
5.0	FUTURE ACTIVITIES	40
	References	42

LIST OF TABLES

Table 1	: Number of Licensed Fishing Vessels by Gears and Number of Fishers at Larut Matang, Perak	3
Table 2	: Number of Licensed Fishing Vessels by Gears and Number of Fishers at Kota Kinabalu, Sabah	4
Table 3	: Number of Landings by Gear Sampled During Study at Larut Matang, Perak	6
Table 4	: Weight of Rays and Sharks (in kg) Caught by Different Types of Gear at Larut Matang, Perak	8
Table 5	: Catch Composition of Rays, Sharks, and Bony Fish by Month from 296 Landings at Larut Matang, Perak. All Weight in kg	9
Table 6	: Sample Size of Rays and Sharks by Species at Larut Matang, Perak	11
Table 7	: Weight of Rays and Sharks (in kg) by Species from 296 Landings at Larut Matang, Perak	13
Table 8A (i)	: Size Range of Rays (Disc Length in cm) Except for Species <i>Rhinobatos borneensis</i> , <i>Rhynchobatus australiae</i> , and <i>Rhynchobatus springeri</i> (Total Length in cm) from August 2018 to January 2019	15
Table 8A (ii)	: Size Range of Rays (Disc Length in cm) Except for Species <i>Rhinobatos borneensis</i> , <i>Rhynchobatus australiae</i> , and <i>Rhynchobatus springeri</i> (Total Length in cm) from February to July 2019.	16
Table 8B (i)	: Size Range of Sharks (Total Length in cm) from August 2018 to January 2019	17
Table 8B (ii)	: Size Range of Sharks (Total Length in cm) from February to July 2019	17
Table 9	: Price (RM/kg) of Rays and Sharks by Species and Market Destination at Larut Matang, Perak	18
Table 10	: Days at Operation by Gear Sampled During Study Period at Larut Matang, Perak	20
Table 11	: Total Number of Operations by Gear Sampled During Study Period at Larut Matang, Perak	20
Table 12	: Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone C During Study Period at Larut Matang, Perak (kg/fishing effort)	21
Table 13	: Top Nine CPUE Sharks Species Captured by Trawl Net Operated in Zone C During Study Period at Larut Matang, Perak (kg/fishing effort)	21
Table 14	: Number of Landings by Gear Sampled During Study at Kota Kinabalu (SAFMA Jetty)	22
Table 15	: Weight of Rays and Sharks (in kg) Caught by Different Types of Gear at Kota Kinabalu (SAFMA Jetty)	23
Table 16	: Catch Composition of Rays, Sharks, and Bony Fish by Month from 331 Landings at Kota Kinabalu (SAFMA Jetty). All Weight in kg	24

Table 17	: Sample Size of Rays and Sharks by Species at Kota Kinabalu (SAFMA Jetty)	25
Table 18	: Weight of Rays and Sharks (in kg) by Species from 331 Landings at Kota Kinabalu (SAFMA Jetty)	27
Table 19A (i)	: Size Range of Rays (Disc Length in cm) Except for Species <i>Narcine brevilabiata</i> , <i>Rhinobatos borneensis</i> , and <i>Rhynchobatus australiae</i> (Total Length in cm) from August 2018 to January 2019	30
Table 19A (ii)	: Size Range of Rays (Disc Length in cm) Except for Species <i>Narcine brevilabiata</i> , <i>Rhinobatos borneensis</i> , and <i>Rhynchobatus australiae</i> (Total Length in cm) from February to July 2019	31
Table 19B (i)	: Size Range of Sharks (Total Length in cm) from August 2018 to January 2019	32
Table 19B (ii)	: Size Range of Sharks (Total Length in cm) from February to July 2019	33
Table 20	: Price (RM/kg) of Rays and Sharks by Species and Market Destination at Kota Kinabalu (SAFMA Jetty)	34
Table 21	: Days at Operation by Gear Sampled During Study Period at Kota Kinabalu (SAFMA Jetty)	36
Table 22	: Total Number of Operations by Gear Sampled During Study Period at Kota Kinabalu (SAFMA Jetty)	36
Table 23	Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone 3 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)	37
Table 24	: Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone 4 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)	37
Table 25	: Top 10 CPUE Sharks Species Captured by Trawl Net Operated in Zone 3 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)	38
Table 26	: Top 10 CPUE Sharks Species Captured by Trawl Net Operated in Zone 4 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)	38
Table 27	: Output and Outcome	38

LIST OF FIGURES AND APPENDICES

Figure 1	: Location of Study Site in the State of Perak	2
Figure 2	: Location of Study Site in the State of Sabah	2
Appendix I	: Sample of Standard Form	43
Appendix II	: Checklist of Rays and Sharks Species Recorded During Study Period	46
Appendix III	: List of Range Size of Small, Medium, and Big by Species (in cm)	48

1.0 INTRODUCTION

Malaysia is a home to a rich diversity of sharks, rays, skates and chimaeras (Class Chondrichthyes). However, shark and ray landings contribute only about 1% and 2% of total marine landings respectively. Until 2016, Malaysia had 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, the order Hexanchiformes recorded a low diversity 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 Rhinobatiformes with eight species. Only six species were recorded from the order Rajiformes and three species from Pristiformes. 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 deep water species are mostly unknown due to limited research activities. Most sharks and rays species landed especially from the families Carcharhinidae and Dasyatidae 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

1.2 Data Collection at Landing Sites

1.2.1 Selection of Study Sites

The State of Perak on the west coast of Peninsular Malaysia is a major landing state for sharks and rays. One district facing the Straits of Malacca, namely Larut Matang was selected as the study sites as it was one of the main landing sites of sharks and rays in the state. The landing data were collected at seven jetties in Larut Matang. The landing sites are private enterprises with most of the sharks and rays landing coming from trawlers. The location of the landing site is shown in **Figure 1**.



Figure 1: Location of Study Site in the State of Perak

Sabah, with the population of 3.544 million (2015 census) is the second largest state in Malaysia, nicknamed 'Negeri Di Bawah Bayu' or Land Below The Wind and occupying the northern part of Borneo. The total land area of Sabah is about 73,631 square kilometres and famed for its 4,095 meter-tall Mount Kinabalu, the highest peak in the country, as well as for its ethnic diversity, 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 2015, the landing marine fish in the state was 175,443 metric tonnes (mt) with the value of RM902.5 million. Sabah maintained its status as a net exporter of fisheries commodities, amounting 74,973 metric tonnes with the value of RM851.7 million in 2014.

There are 16 coastal districts in Sabah and for the purpose of this project, Kota Kinabalu in the west, was selected as the study site, due to the fact that this district is a major fisheries landing point in Sabah (**Figure 2**).

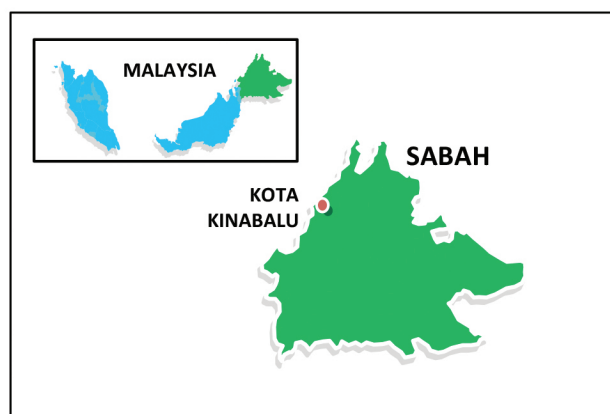


Figure 2: Location of Study Site in the State of Sabah

1.2.2 Fisheries Structure and Background of Study Sites

1.2.2.1 Larut Matang

Larut Matang is one of the major landing sites for sharks and rays in Perak. All jetties belong to private enterprises. The major gears were trawl nets (545), followed by drift nets (165) and purse seine (33). All trawlers are normally operated by 4 – 5 crew members. Almost all of the sharks and rays were landed by trawlers operating beyond eight nautical miles from the coastline. Fishing operation normally between 5 – 12 days per trip. All catches were landed from 0500hr – 1000hr. The details of fishing vessels registered in this district are shown in **Table 1**.

Table 1: Number of Licensed Fishing Vessels by Gears and Number of Fishers at Larut Matang, Perak

Gear Type	Fishing Zone	Fishing Operation (from costline)	No. of Vessels	No. of Fishers
Trawlers				
10 – 24.9 GRT	B	> 5 miles	302	604
25 – 39.9 GRT	B1	> 8 miles	21	52
39.9 – 69.9 GRT	C	> 15 miles	214	856
> 70 GRT	C2	> 15 miles	8	40
Total			545	1,552
Purse Sciners				
40 – 69.9 GRT	C			
> 70 GRT	C2	> 15 miles	33	820
Total			33	820
Drift Nets	A	All areas	165	206
Long Line	A	All areas	27	41
Others (B.Ketam, Bubu, Gombang, P.Surung, Siput/kerang, Pancing)	A	All areas	738	1,245
Grand Total			1,508	6,236

1.2.2.2 Kota Kinabalu

Sabah Fisheries Marketing Authority (SAFMA) Jetty is the biggest fish landing jetty in Kota Kinabalu district. Commercial fishing vessels mainly operating trawl nets and purse seines landed their catch here on a daily basis. There are estimated around 30 fishing vessels utilizing the jetty during a particular period of landing time allowed, which is from 12 midnight until early morning in the same day.

There are 215 trawlers in Kota Kinabalu compare to purse seines which are only around 41. The operation duration per trip of trawl nets is up to a week while the purse seine's operations only take up to three days the most. The details of commercial fishing vessels at Kota Kinabalu are shown in **Table 2**.

Table 2: Number of Licensed Fishing Vessels by Gears and Number of Fishers at Kota Kinabalu, Sabah

Gear Type	Fishing Zone	Fishing Operation (from coastline)	No. of Vessels	No. of Fishers
Trawlers				
< 10 GRT	West Coast	> 3 nm	4	12
10 – 24.9 GRT	West Coast	> 3 nm	50	183
25 – 39.9 GRT	West Coast	> 3 nm	123	738
39.9 – 69.9 GRT	West Coast	> 3 nm	27	195
> 70 GRT	West Coast	> 30 nm	11	88
Total			215	1,216
Purse Seiners				
25 – 39.9 GRT	West Coast	> 3 nm	17	170
39.9 – 69.9 GRT	West Coast	> 3 nm	23	230
> 70 GRT	West Coast	> 3 nm	1	12
Total			41	412
Grand Total			256	1,628

1.3 Appointment of Enumerators and Project Coordinators

One Assistant Fisheries Officer from the State Fisheries Office of Perak and two Assistant Fisheries Officers from the Department of Fisheries Sabah were appointed as enumerators for each district or study site. Their names and addresses are as follows:

Study site 1: Larut Matang, Perak
Mr. Abdul Rahman bin Haji Ali Hasan Pejabat Perikanan Daerah Taiping Tingkat 6, Wisma Persekutuan, Jalan Istana Larut 34000 Taiping, Perak. Tel: +6 058075311 Email: abd.rahman0865@gmail.com
Study site 2: Kota Kinabalu, Sabah
Mr. Justin Agon Senior Assistant Fisheries Officer Department of Fisheries Sabah Jalan Haji Saman 88000 Kota Kinabalu, Sabah. Tel: +6 088 262359 Email: justin.agon@sabah.gov.my

<p>Mr. Norhairul bin Nordin Assistant Fisheries Officer Department of Fisheries Sabah Wisma Pertanian Sabah, Jalan Tasik Luyang (Off Jalan Maktab Gaya) 88624 Kota Kinabalu, Sabah. Tel: +6 088 235966 Email: hairul_elut@yahoo.com</p>
<p>National Coordinator and Project Coordinator for Perak</p>
<p>Mr. Abd Haris Hilmi bin Ahmad Arshad Senior Researcher Institut Sumber Marin Asia Tenggara (ISMAT) Taman Perikanan Chendering, 21080 Kuala Terengganu, Terengganu. Tel: +6 096175940 Email: haris_arshad@seafdec.org.my</p>
<p>Project Coordinator for Sabah</p>
<p>Mr. Lawrence Kissol Jr. Senior Assistant Director (Licensing and Permit) Department of Fisheries Sabah Wisma Pertanian Sabah, Jalan Tasik Luyang (Off Jalan Maktab Gaya) 88624 Kota Kinabalu, Sabah. Tel: +6 088 235966 Email: lawrence.kissol@sabah.gov.my</p>

1.4 Materials and Methods

1.4.1 Sampling Methods

The sampling activity started in August 2018 until July 2019. All enumerators were requested to record landing data and other related information in 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 enumerator, name of landing site, date of sampling, vessel registration number, vessel GRT, fishing area, price at landing site, name of species (common name and scientific name), 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 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) were taken for all skates, sharks, and rays species from the families Rhinidae, 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 individuals per vessel. If the total number was more than 50 individuals, only 10 – 5% 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. Some samples were brought back to the Fisheries Research Institute, Capture Fisheries Division, Kg. Acheh, Sitiawan, Perak and Fisheries Research Center, Likas, Kota Kinabalu for preservation and future references. Larger specimens were photographed and their basic taxonomic and biological characteristics were 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).

2.0 RESULTS

2.1 Larut Matang

2.1.1 Landing Samples

A total of 296 landings were sampled during the study period. The highest landing by month was 28 landings each in March and July 2019 followed by 27 landings in June 2019. The highest landing by gear type was using trawl net operated in Zone C with 182 landings followed by longline (96 landings) and trawl net operated in Zone C2 with 14 landings. The details are shown in **Table 3**.

Table 3: Number of Landings by Gear Sampled During Study at Larut Matang, Perak

Type of Gear	Year/Month												Total
	2018					2019							
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Drift Net	1	0	0	0	0	0	0	0	0	0	0	1	2
Longline	8	10	4	4	6	7	10	11	11	12	8	5	96
Trawl Net B	0	0	0	0	0	1	0	0	0	0	0	1	2
Trawl Net C	13	14	18	18	12	15	14	15	13	13	17	20	182
Trawl Net C2	3	1	0	1	1	1	1	2	1	0	2	1	14
Grand Total	25	25	22	23	19	24	25	28	25	25	27	28	296

2.1.2 Fishing Ground and Catch Composition by Gear Type

The main gear with highest landing of rays was trawl net with 8,658.7 kg (49.2%) comprising Zone B (7.5 kg), Zone C (7,802.2 kg), and Zone C2 (849 kg). Longline gear recorded 4,316 kg landing of rays. As for sharks, trawl net was the main gear with highest landing at 4,608.2 kg (26.2%) comprising Zone B (3.9 kg), Zone C (4,225.3 kg), and Zone C2 (379 kg). While drift net only recorded 11 kg of landing. The highest landings of rays by month was from trawl net operated in Zone C with 1,173.5 kg in June 2019 followed 1,020.4 kg in December 2018 and 756.38 kg in November 2018. The highest landing of sharks by month was from trawl net operated in Zone C with 600.1 kg in July 2019 followed by 489.9kg in September 2018 and 471.3 kg in May 2019. The details are shown in **Table 4**.

Table 4: Weight of Rays and Sharks (in kg) Caught by Different Types of Gear at Larut Matang, Perak

Type of Gear	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Longline	415.1	634.8	150	332.4	194	357.4	509.9	393.5	452.9	572.3	173.8	130.1	4,316.2
Trawl Net B	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	5.1	7.5
Trawl Net C	433.8	472.4	562.6	756.4	1,020.4	593.9	596	644.9	243.6	601.4	1,173.5	703.3	7,802.2
Trawl Net C2	206.8	16	0.0	49.7	53.7	10.3	30.8	47.8	22	0.0	319.8	92.1	849
Total Ray	1,055.7	1,123.2	712.6	1,138.5	1,268.1	964.0	1,136.7	1,086.2	718.5	1,173.7	1,667.1	930.6	12,974.9
Drift Net	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	11
Trawl Net B	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9
Trawl Net C	237.1	489.9	432.5	289.4	244.9	316.4	334.8	251	191.4	471.3	366.5	600.1	4,225.3
Trawl Net C2	150.2	2.9	0.0	4.3	53	38.9	11.9	50.7	7.1	0.0	40.8	19.2	379
Total Shark	393.1	492.8	432.5	293.7	297.9	359.2	346.7	301.7	198.5	471.3	407.3	624.5	4,619.2
Grand Total	1,448.8	1,616	1,145.1	1,432.2	1,566	1,323.2	1,483.4	1,387.9	917	1,645	2,074.4	1,555.1	17,594.1

2.1.3 Rays and Sharks Composition

A total of 927,309.3 kg of fish was landed from 296 landings during the study period. Rays and sharks made up 12,974.5 kg and 4,619 kg (1.4% and 0.5%) from the total landing respectively. Landing of bony fish was 909,715.8 kg with 98.1%. Average landing for rays and sharks were 1,081.2 kg and 384.9 kg respectively. The highest landing of rays by month was 1,667 kg in June 2019 followed by 1,268 kg in December 2018 and 1,173.7 kg in May 2019. Whilst the highest landing of sharks was 624.5 kg in July 2019 followed by 492.8 kg in September 2018 and 471.3 kg in May 2019. In general, the landing of rays and sharks ranged between 0.8 – 2.4% and 0.4 – 0.6% from the total landing respectively. The details are shown in Table 5.

Table 5: Catch Composition of Rays, Sharks, and Bony Fish by Month from 296 Landings at Larut Matang, Perak. All Weight in kg

Year	Month	Weight of Rays	% Rays	Weight of Sharks	% Sharks	Weight of Bony Fish	% Bony Fish	Total Catch
2018	Aug	1,055.7	1.5	393.0	0.6	66,787.7	97.9	68,236.5
	Sep	1,123.2	1.4	492.8	0.6	79,353.3	98	80,969.3
	Oct	712.6	0.8	432.5	0.5	82,721	98.6	83,866.1
	Nov	1,138.5	1.4	293.7	0.4	78,702.9	98.2	80,135.1
	Dec	1,268	2.4	297.9	0.6	51,779.4	97.1	53,345.3
2019	Jan	964	1.5	359.2	0.6	62,038.7	97.9	63,361.9
	Feb	1,136.6	1.6	346.6	0.5	67,420.1	97.8	68,903.4
	Mar	1,086.1	1.4	301.7	0.4	78,451.6	98.3	79,839.4
	Apr	718.5	1.4	198.5	0.4	49,036.5	98.2	49,953.4
	May	1,173.7	1.5	471.3	0.6	75,139.1	97.9	76,784.1
	Jun	1,667	1.5	407.3	0.4	106,804.4	98.1	108,878.7
	Jul	930.6	0.8	624.5	0.6	111,481.1	98.6	113,036.2
Grand Total		12,974.5		4,619		909,715.8		927,309.3
Average		1,081.2	1.4	384.9	0.5	75,809.7	98.1	77,275.8

2.1.4 Sample Size

A total of 5,351 individuals consist of 3,292 rays and 2,059 sharks were sampled. There were 19 species of rays and 10 species of sharks recorded during the study period. The most common and abundant ray species were *Neotrygon orientalis*, *Brevitrygon heterura*, and *Maculabatis gerrardi*. Other common ray species were *Maculabatis pastinacoides*, *Telatrygon zugei*, and *Hemitrygon akajei*. All these species were landed monthly throughout the year. Other ray species such as *Gymnura japonica*, *Pateobatis fai*, *Gymnura poecilura*, *Pateobatis uarnacoides*, *Rhynchobatus springeri*, *Himantura leoparda*, *Pastinachus solocirostris*, *Pastinachus stellurostris*, and *Taeniura lymma* were only landed one time during study period. The highest number of rays sampled by month was 342 individuals in June 2019 followed by 300 individuals in July and 296 individuals in March 2019.

The most common and abundant species of sharks were *Chiloscyllium hasseltii*, *Chiloscyllium punctatum*, and *Atelomycterus marmoratus*. All these species were landed throughout the year. Other common shark species were *Carcharhinus sorrah*, *Atelomycterus erdmanni*, and *Chiloscyllium indicum*. These species were landed between 7 – 11 months. Other shark

species such as *Sphyrna lewini*, *Carcharhinus leucas*, *Carcharhinus brevipinna*, and *Galeocerdo cuvier* were only landed between 1 – 3 months. The highest number of sharks sampled by month was 274 individuals in July 2019 followed by 202 individuals in June and 196 individuals in May 2019. The details are shown in **Table 6**.

Table 6: Sample Size of Rays and Sharks by Species at Larut Matang, Perak

Species	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
<i>Brevitrygon heterura</i>	65	58	72	79	61	67	62	75	64	58	71	67	799
<i>Gymnura japonica</i>	9	0	0	0	0	0	0	0	0	0	0	0	9
<i>Gymnura poecilura</i>	3	0	0	0	0	0	0	0	0	0	0	0	3
<i>Hemitrygon akajei</i>	14	34	6	7	4	2	11	14	5	2	9	4	112
<i>Himantura leoparda</i>	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Himantura undulata</i>	1	1	0	0	1	0	2	3	0	0	0	0	8
<i>Maculabatis gerrardi</i>	49	40	47	45	42	43	51	56	31	57	79	76	616
<i>Maculabatis pastinacoides</i>	14	20	3	16	14	28	38	19	39	50	20	8	269
<i>Neotrygon orientalis</i>	61	75	77	92	58	74	71	72	43	56	88	86	853
<i>Pastinachus solocirostris</i>	0	0	0	0	1	0	0	0	0	0	0	0	1
<i>Pastinachus stellurostris</i>	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Pateobatis fai</i>	0	0	0	0	7	0	0	0	0	0	0	0	7
<i>Pateobatis jenkinsii</i>	0	0	0	0	1	0	0	0	0	1	0	0	2
<i>Pateobatis uarnacoides</i>	2	0	0	0	0	0	0	0	0	0	0	0	2
<i>Rhinobatos borneensis</i>	0	0	0	0	3	0	0	0	0	0	2	0	5
<i>Rhynchobatus australiae</i>	2	10	6	4	1	7	3	5	1	10	30	14	93
<i>Rhynchobatus springeri</i>	0	0	0	0	0	0	0	0	0	0	2	0	2
<i>Taeniura lymna</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Telatrygon zugei</i>	57	49	50	44	30	37	40	52	30	33	41	45	508
Total Rays	277	288	261	287	223	258	279	296	213	268	342	300	3,292
<i>Atelomycterus erdmanni</i>	1	3	6	2	0	4	4	3	0	0	0	11	34
<i>Atelomycterus marmoratus</i>	5	23	20	17	4	26	30	18	6	12	15	30	206
<i>Carcharhinus brevipinna</i>	4	0	0	0	0	0	0	0	0	0	0	0	4
<i>Carcharhinus leucas</i>	2	0	0	0	0	1	0	0	0	0	0	1	4
<i>Carcharhinus sorrah</i>	10	5	3	2	3	4	4	1	35	83	38	53	237
<i>Chiloscyllium hasseltii</i>	62	84	75	74	62	83	75	70	64	46	85	78	858
<i>Chiloscyllium indicum</i>	5	0	5	6	5	0	1	8	2	0	0	0	32
<i>Chiloscyllium punctatum</i>	67	66	58	46	47	45	46	54	34	45	53	88	649
<i>Galeocerdo cuvier</i>	0	0	0	0	0	0	1	0	0	0	0	1	2
<i>Sphyrna lewini</i>	0	0	0	0	0	0	0	0	0	10	11	12	33
Total Sharks	156	181	167	147	121	163	157	154	141	196	202	274	2,059
Grand Total	433	469	428	434	344	421	436	450	354	464	544	574	5,351

2.1.5 Weight of Rays and Sharks by Species

A total of 17,593.5 kg was landed from 296 landings comprising 12,974.5 kg of rays and 4,619.1 kg of sharks. The highest weight for rays landing was *Neotrygon orientalis* with 3,276.1 kg followed by *Maculabatis pastinacoides* (3,171.7 kg), and *Maculabatis gerrardi* with 2,716.3 kg. The highest landing by month for *Neotrygon orientalis* was 521.1 kg in June 2019 followed 484.2 kg in November 2018 and 418.6 kg in July 2019. The highest landing for *Maculabatis pastinacoides* was 504.7 kg in May 2019 followed by 443.1 kg in February 2019 and 427.9 kg in April 2019. For *Maculabatis gerrardi*, the highest landing was 612.7 kg in June 2019 followed by 369.2 kg in May 2019 and 285.5 kg in July 2019. Other species with higher landings were *Brevitrygon heterura* with 1,309.9 kg, *Hemitrygon akajei* (652.4 kg), *Telatrygon zugei* (504.9 kg), *Pateobatis fai* (428.2 kg), *Himantura undulata* (344.5 kg), *Rhynchobatus australiae* (285.5 kg) and *Rhynchobatus springeri* with 161.4 kg. Landing of other species were below 100 kg.

The highest landing for shark was 2,211.7 kg for species *Chiloscyllium hasseltii* followed by 1,367.9 kg for *Chiloscyllium punctatum*, 642 kg for *Carcharhinus sorrah*, and 166.6 kg for *Atelomycterus marmoratus*. The highest landing by month for *Chiloscyllium hasseltii* was 266.9 kg in October 2018 followed by 258.9 kg in September 2018 and 237.2 kg in February 2019. For *Chiloscyllium punctatum*, the highest landing was 197.7 kg in July 2019 followed by 190.3 kg in September 2018 and 160 kg in August 2018. Landing of other shark species were below 100 kg. The details are shown in **Table 7**.

Table 7: Weight of Rays and Sharks (in kg) by Species from 296 Landings at Larut Matang, Perak

Species	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
<i>Brevitrygon heterura</i>	187.3	90.8	119.07	107.4	274.6	51.7	73.8	156.2	71	65.2	65.7	47.3	1,309.9
<i>Gymnura japonica</i>	30.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.6
<i>Gymnura poecilura</i>	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
<i>Hemitrygon akajei</i>	73.1	282.9	42.7	40.9	12.1	6.5	43.5	56.9	25	11	36.4	21.5	652.4
<i>Himantura leoparda</i>	0.0	0.0	0.0	0.0	0.0	0.0	51.4	0.0	0.0	0.0	0.0	0.0	51.4
<i>Himantura undulata</i>	104	73	0.0	0.0	32	0.0	23.3	112.2	0.0	0.0	0.0	0.0	344.5
<i>Maculabatis gerrardi</i>	162.4	113.8	181.3	132.6	100.1	165.5	214.7	284.1	94.4	369.2	612.7	285.5	2,716.3
<i>Maculabatis pastinacoides</i>	225.7	278.9	71.7	291.5	130.2	334.8	443.1	223.5	427.9	504.7	137.4	102.4	3,171.7
<i>Neotrygon orientalis</i>	186.6	211.8	251.6	484.2	185.2	320.9	242	195.1	78.7	180.4	521.1	418.6	3,276.1
<i>Pastinachus solocirostris</i>	0.0	0.0	0.0	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2
<i>Pastinachus stellurostris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	2.2
<i>Pateobatis fai</i>	0.0	0.0	0.0	0.0	428.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	428.2
<i>Pateobatis jenkinsii</i>	0.0	0.0	0.0	0.0	14.1	0.0	0.0	0.0	0.0	1	0.0	0.0	15.1
<i>Pateobatis uarnacoides</i>	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6
<i>Rhinobatos borneensis</i>	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	1.8	0.0	5.7
<i>Rhynchobatus australiae</i>	6.2	25.5	11	11.2	4.52	60.5	19.2	6.8	3.5	17.1	90	29.8	285.5
<i>Rhynchobatus springeri</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	161.4	0.0	161.4
<i>Taeniura lymna</i>	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
<i>Telatrygon zugei</i>	73.2	45.8	35.4	70.7	71.96	24.1	25.7	51.4	18	22.7	40.5	25.5	504.9
Total Weight Rays	1,055.7	1,123.2	712.6	1,138.5	1,268	964	1,136.6	1,086.1	718.5	1,173.7	1,667	930.6	12,974.5
<i>Atelomycterus erdmanni</i>	0.5	2.1	3.8	0.8	0.0	1.7	1.7	1.2	0.0	0.0	0.0	5	16.7
<i>Atelomycterus marmoratus</i>	2.2	21.3	24.9	15	1.8	24.2	26.7	9.4	2.6	7.1	8.5	23	166.6
<i>Carcharhinus brevipinna</i>	15.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2
<i>Carcharhinus leucas</i>	32.6	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	5.2	41.7
<i>Carcharhinus sorrah</i>	26.7	20.2	10.9	6.1	18.6	17.8	0.0	5	31.6	272.3	64.2	168.6	642
<i>Chiloscyllium hasseltii</i>	153.4	258.9	266.9	172.6	154.6	227	237.2	152.2	112.5	104.2	197.1	175.1	2,211.7
<i>Chiloscyllium Indicum</i>	2.5	0.0	2.1	4.3	39	0.0	0.5	7.3	1	0.0	0.0	0.0	56.5
<i>Chiloscyllium punctatum</i>	160	190.3	124	95	83.9	84.6	77.7	126.6	50.9	74.2	102.9	197.7	1,367.9
<i>Galeocerdo cuvier</i>	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	3.9	6.8
<i>Sphyrna lewini</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	34.6	46	94.1
Total Weight Sharks	393	492.8	432.5	293.7	297.9	359.2	346.6	301.7	198.5	471.3	407.3	624.5	4,619.1
Grand Total	1,448.8	1,616	1,145.1	1,432.2	1,565.9	1,323.1	1,483.2	1,387.8	916.9	1,645	2,074.3	1,555.1	17,593.5

2.1.6 Size Range of Rays and Sharks

In general, both mature and immature rays species were sampled from August 2018 to July 2019. Samples for ray species *Himantura leorpada*, *Himantura undulata*, *Pastinachus solocirostris*, *Pastinachus stellurostris*, and *Rhynchobatus springeri* were all matured. Samples for ray species *Gymnura japonica*, *Gymnura poecilura*, *Pateobatis jenkinsii*, and *Pateobatis uarnacoides* were all immatured. While samples from others species were mostly matured except for species *Maculabatis gerrardi*, *Maculabatis pastinacoides*, and *Rhynchobatus australiae*. Size range of rays by species from August 2018 to January 2019 are shown in **Table 8A (i)** and from February to July 2019 are shown in **Table 8A (ii)**.

Shark species of *Atelomycterus erdmanni* and *Chiloscyllium indicum* sampled from August 2018 to July 2019 were all matured. While shark species *Carcharhinus brevipinna*, *Carcharhinus leucas*, *Galeocerdo cuvier*, and *Sphyrna lewini* were all immatured. Samples for species *Carcharhinus sorrah* were mostly immatured and for species *Atelomycterus marmoratus*, *Chiloscyllium hasseltii*, and *Chiloscyllium punctatum* were mostly matured. Size range of sharks by species from August 2018 to January 2019 are shown in **Table 8B (i)** and from February to July 2019 are shown in **Table 8B (ii)**.

Table 8A (i): Size Range of Rays (Disc Length in cm) Except for Species *Rhinobatos borneensis*, *Rhynchobatus australiae*, and *Rhynchobatus springeri* (Total Length in cm) from August 2018 to January 2019

Species	Year/Month																	
	2018												2019					
	Aug			Sep			Oct			Nov			Dec			Jan		
Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Brevitrygon heterura</i>	16	25	20.5	15	26	21	15	26.0	20.8	13.5	25	20.6	17	25	21.1	17	24	21
<i>Gymnura japonica</i>	20	39	31.3															
<i>Gymnura poecilura</i>	15	26	20.7															
<i>Hemitrygon akajei</i>	27	62	45.7	31	64	51.7	33	64	51.8	45	54	49.4	34	45	39.5	37	46	41.5
<i>Himantura undulata</i>	142	142	142	128	128	128							96	96	96			
<i>Maculabatis gerrardi</i>	17	69	33.1	18	58	30.7	18	95	34.7	18.5	72	33.9	17	67	31.8	19	73	36.4
<i>Maculabatis pastinacoides</i>	45	89	69.1	26	91	63.1	70	89	81	34	74	59.1	37	73	57.3	39	86	60.3
<i>Neotrygon orientalis</i>	15	30	21.9	14	30	21.9	16.5	30	22.3	16	31	22.4	17	31	22.4	17	31	22.7
<i>Pastinachus solocirostris</i>													71	71	71			
<i>Pateobatis fai</i>													69	125	109			
<i>Pateobatis jenkinsii</i>													65	65	65			
<i>Pateobatis uarnacoides</i>	35	43	39															
<i>Rhinobatos borneensis</i>													58	87	72.7			
<i>Rhynchobatus australiae</i>	75	95	85	54	97	73.1	50	91	69.7	60	106	79	98	98	98	89	160	112.9
<i>Taeniura lymna</i>				26	26	26												
<i>Telatrygon zugei</i>	17	32	24.4	16	31	24.5	20	30	24.3	18	31	25.1	20	31	24.9	18	29	23.9

Table 8A (ii): Size Range of Rays (Disc Length in cm) Except for Species *Rhinobatos borneensis*, *Rhynchobatus australiae*, and *Rhynchobatus springeri* (Total Length in cm) from February to July 2019

Species	Year/Month																	
	2019																	
	Feb			Mar			Apr			May			Jun			Jul		
Ray	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av
<i>Brevitrygon heterura</i>	15	25	21	15	24	20.6	17	29	21	17	24	20.6	15.5	25	21	17	24	21
<i>Hemitrygon akajei</i>	34	55	42.9	26	55	42.9	39	58	46.4	36	60	48	35	50	43.8	39	56	48.5
<i>Himantura leoparda</i>	103	103	103															
<i>Himantura undulata</i>	65	75	70	100	108	104.7												
<i>Maculabatis gerrardi</i>	17	57	37.3	20	84	37.1	19	67	33.6	21	88	38.3	23	81	44	17	69	34.1
<i>Maculabatis pastinacoides</i>	44	86	61.4	40	93	59.9	37	89	59.1	36	79	57.4	39	72	52.4	54	75	65.6
<i>Neotrygon orientalis</i>	15.5	30	22.7	15	32	22.5	15	32	22.9	15	31	22.3	15.5	32	23.2	14	33	22.5
<i>Pastinachus stellurostris</i>										36	36	36						
<i>Pateobatis jenkinsii</i>										27	27	27						
<i>Rhinobatos borneensis</i>													65	71	68			
<i>Rhynchobatus australiae</i>	95	133	108	49	79	67.3	92	92	92	48	116	64.5	58	127	77.5	47	108	71.6
<i>Rhynchobatus springeri</i>													140	295	217.5			
<i>Telatrygon zugei</i>	18	34	24.4	18	31	24.9	20	30	24.5	20	34	24.6	20	32	24.9	19	32	24.8

Table 8B (i): Size Range of Sharks (Total Length in cm) from August 2018 to January 2019

Species	Year/Month														
	2018						2019								
	Aug		Sep		Oct		Nov		Dec		Jan				
Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Atelomycterus erdmanni</i>	52	52	52	48	53	50.3	47	52	50.2	48	49	48.5	48	54	50.3
<i>Atelomycterus marmoratus</i>	48	54	51.2	40	57	50	36	57	50	42	55	50.2	51	56	49.7
<i>Carcharhinus brevipinna</i>	78	97	86.5												
<i>Carcharhinus leucas</i>	90	148	119											82	82
<i>Carcharhinus sorrah</i>	70	104	79.9	78	113	87.2	86	91	89	81	86	83.5	93	121	94.5
<i>Chiloscyllium hasseltii</i>	42	79	61.1	38	79	60	42	78	62.5	45	80	61.4	39	85	60.1
<i>Chiloscyllium indicum</i>	53	58	55.4				46	58	53	47	55	52.3	46	55	52
<i>Chiloscyllium punctatum</i>	43	86	71	42	91	69.8	32	91	68.4	47	90	69.6	47	95	67.4

Table 8B (ii): Size Range of Sharks (Total Length in cm) from February to July 2019

Species	Year/Month														
	2019														
	Feb		Mar		Apr		May		Jun		Jul				
Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Atelomycterus erdmanni</i>	48	52	50.8	48	52	50.3							47	55	51.7
<i>Atelomycterus marmoratus</i>	41	60	50.9	36	54	47.9	48	55	51.2	46	53	50.3	41	56	50.4
<i>Carcharhinus leucas</i>														90	90
<i>Carcharhinus sorrah</i>				98	98	98	51	62	57.5	47	109	60.8	42	74	72.7
<i>Chiloscyllium hasseltii</i>	49	84	61.6	44	84	61.9	43	81	61.4	47	82	61.4	42	76	63.2
<i>Chiloscyllium indicum</i>	55	55	55	46	58	51.5	52	56	54						
<i>Chiloscyllium punctatum</i>	47	92	68.3	40	92	72.8	46	89	68	40	86	67.6	44	91	71.1
<i>Galeocerdo cuvier</i>	77	77	77												99
<i>Sphyrna lewini</i>										45	58	53	48	70	58.4

2.1.7 Usage and Marketing

Based on marketing information at this landing site, most sharks and rays meat were consumed locally. The major markets were in Perak, Johor, Penang, and Kuala Lumpur. The price (RM/kg) varied depending on species, size, and season. The most expensive ray species was *Pateobatis jenkinsii* sold at RM6 – RM20/kg followed by *Maculabatis gerrardi* (RM5 – RM20/kg), *Neotrygon orientalis* (RM3 – RM18/kg), *Maculabatis pastinacoides* (RM12 – RM15/kg), and *Himantura undulata* sold at RM10 – RM15/kg. The cheapest rays species were *Telatrygon zugei* sold at range RM3 – RM6/kg. All rays were sold as a whole body where fins, tails, and skin were not separated from the body during marketing process. In general, rays at bigger size were expensive than the smaller ones.

The most expensive shark species was *Carcharhinus leucas* sold at range RM10 – RM35/kg followed by *Carcharhinus sorrah* (RM8 – RM13/kg), and *Galeocerdo cuvier* at range RM10 – RM12/kg. Market destinations for sharks and rays were similar. Some species such as *Chiloscyllium hasseltii* and *Chiloscyllium punctatum* were marketed to Penang where they are mainly used in traditional Indian cuisine. Some shark species were marketed to food processing factory for surimi production. Fins, tails, and cartilage were not separated from the body during marketing process and all sharks were sold as a whole.

Normally the price at wet market was about 20 – 50% higher than at landing site. The price was almost consistent the whole year for all species but some ray species such as *Maculabatis gerarrdi*, *Brevitrygon heterura*, *Neotrygon orientalis*, *Telatrygon zugei*, *Hemitrygon akajei*, and *Rhynchobatus australiae* and shark species such as *Carcharhinus leucas* and *Carcharhinus sorrah* can fluctuate up to 50% especially when supply was limited and during festive seasons such as Chinese New Year and Hari Raya. The details are shown in **Table 9**.

Table 9: Price (RM/kg) of Rays and Sharks by Species and Market Destination at Larut Matang, Perak

Species	Range Price (RM/kg)	Part	Market Destination
Ray			
<i>Brevitrygon heterura</i>	5 – 12	Whole body	Local Market, Bukit Mertajam, Ipoh, Kuala Lumpur, Seri Manjung.
<i>Gymnura japonica</i>	4 – 12	Whole body	Local Market, Bukit Mertajam.
<i>Gymnura poecilura</i>	4 – 12	Whole body	Local Market.
<i>Hemitrygon akajei</i>	4 – 12	Whole body	Local Market, Bukit Mertajam, Alor Star, Juru, Seberang Perai, Pulau Pinang.
<i>Himantura leoparda</i>	6 – 16	Whole body	Kuala Lumpur.
<i>Himantura undulata</i>	10 – 15	Whole body	Local Market.
<i>Maculabatis gerrardi</i>	5 – 20	Whole body	Local Market, Bukit Mertajam, Ipoh, Johor Bahru, Kuala Lumpur, Alor Star, Pulau Pinang.
<i>Maculabatis pastinacoides</i>	12 – 15	Whole body	Local Market, Bukit Mertajam, Ipoh, Alor Star, Kulim, Juru, Seberang Perai, Pulau Pinang.

<i>Neotrygon orientalis</i>	3 – 18	Whole body	Local Market, Bukit Mertajam, Ipoh, Kuala Lumpur, Seri Manjung.
<i>Pastinachus solocirostris</i>	12 – 14	Whole body	Alor Star, Kedah.
<i>Pastinachus stellurostris</i>	8 – 12	Whole body	Local Market.
<i>Pateobatis fai</i>	5 – 10	Whole body	Local Market, Bukit Mertajam.
<i>Pateobatis jenkinsii</i>	6 – 20	Whole body	Local Market, Seri Manjung.
<i>Pateobatis uarnacooides</i>	5 – 13	Whole body	Local Market.
<i>Rhinobatos borneensis</i>	6 – 10	Whole body	Bukit Mertajam.
<i>Rhynchobatus australiae</i>	4 – 13	Whole body	Local Market, Bukit Mertajam, Pantai Remis, Kuala Lumpur.
<i>Rhynchobatus springeri</i>	9 – 13	Whole body	Local Market, Bukit Mertajam.
<i>Taeniura lymma</i>	5 – 10	Whole body	Bukit Mertajam.
<i>Telatrygon zugei</i>	3 – 6	Whole body	Local Market, Bukit Mertajam, Ipoh, Kuala Lumpur, Seri Manjung.
Shark			
<i>Atelomycterus erdmanni</i>	5 – 11	Whole body	QL Surimi at Hutan Melintang.
<i>Atelomycterus marmoratus</i>	5 – 11	Whole body	Local Market, Bukit Mertajam, QL Surimi at Hutan Melintang.
<i>Carcharhinus brevipinna</i>	9 – 10	Whole body	Bukit Mertajam.
<i>Carcharhinus leucas</i>	10 – 35	Whole body	Local Market, Bukit Mertajam.
<i>Carcharhinus sorrah</i>	8 – 13	Whole body	Local Market, Bukit Mertajam.
<i>Chiloscyllium hasseltii</i>	3 – 5	Whole body	Local Market, Bukit Mertajam, QL Surimi at Hutan Melintang, Pantai Remis, Kuala Lumpur, Penang.
<i>Chiloscyllium indicum</i>	2 – 4	Whole body	Local Market, Bukit Mertajam, QL Surimi at Hutan Melintang.
<i>Chiloscyllium punctatum</i>	3 – 5	Whole body	Local Market, Bukit Mertajam, Pantai Remis, Kuala Lumpur, Penang.
<i>Galeocerdo cuvier</i>	10 – 12	Whole body	Local Market.
<i>Sphyrna lewini</i>	8 – 12	Whole body	Local Market.

2.1.8 Fishing Effort and CPUE (Catch per Unit Effort)

Monthly fishing efforts (days at operation and total number of operation during the cruises) of the sampled vessels are summarized in **Table 10** and **Table 11**.

Table 10: Days at Operation by Gear Sampled During Study Period at Larut Matang, Perak

Type of Gear	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mac	Apr	May	Jun	Jul	
Drift Net	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1
Longline	4	5	2	2	3	3.5	5	5.5	5.5	6	4	3.5	49
Trawl Net B	0.0	0.0	0.0	0.0	0.0	3	0.0	0.0	0.0	0.0	0.0	0.5	3.5
Trawl Net C	78	88	109	105	74	90	88	92	78	82	99	124	1,107
Trawl Net C2	20	6	0.0	6	8	7	7	14	7	0.0	15	8	98
Grand Total	102.5	99	111	113	85	103.5	100	111.5	90.5	88	118	136.5	1,258.5

Table 11: Total Number of Operations by Gear Sampled During Study Period at Larut Matang, Perak

Type of Gear	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mac	Apr	May	Jun	Jul	
Drift Net	1	0	0	0	0	0	0	0	0	0	0	1	2
Longline	8	10	4	4	6	7	10	11	11	12	8	7	98
Trawl Net B	0	0	0	0	0	10	0	0	0	0	0	3	13
Trawl Net C	235	264	327	315	212	270	264	279	235	246	302	364	3,313
Trawl Net C2	60	18	0	18	25	21	21	42	21	0	45	24	295
Grand Total	304	292	331	337	243	308	295	332	267	258	355	399	3721

Trawl net operated in Zone C was the main gear with highest landing of rays and sharks. The top 10 catch per unit effort (CPUE) of rays species captured by this gear is shown in **Table 12**. The top three CPUE for rays were *Neotrygon orientalis* with 0.89 kg/haul (2.66 kg/day) followed by *Maculabatis gerrardi* with 0.69 kg/haul (2.08 kg/day), and *Brevitrygon heterura* with 0.35 kg/haul (1.05 kg/day).

The top three CPUE for sharks were *Chiloscyllium hasseltii* with 0.61 kg/haul (1.82 kg/day) followed by *Chiloscyllium punctatum* with 0.38 kg/haul (1.13 kg/day), and *Carcharhinus sorrah* with 0.19 kg/haul (0.56 kg/day). The top nine CPUE of sharks species captured by trawl net operated in Zone C is shown in **Table 13**

Table 12: Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone C During Study Period at Larut Matang, Perak (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Neotrygon orientalis</i>	2,949.3	2.66	0.89
2	<i>Maculabatis gerrardi</i>	2,297.7	2.08	0.69
3	<i>Brevitrygon heterura</i>	1,160.7	1.05	0.35
4	<i>Telatrygon zugei</i>	465.6	0.42	0.14
5	<i>Pateobatis fai</i>	428.2	0.39	0.13
6	<i>Rhynchobatus australiae</i>	250.8	0.23	0.08
7	<i>Rhynchobatus springeri</i>	161.5	0.15	0.05
8	<i>Himantura leoparda</i>	51.4	0.05	0.02
9	<i>Pateobatis jenkinsii</i>	15.1	0.01	0.005
10	<i>Gymnura japonica</i>	11	0.01	0.003

Table 13: Top Nine CPUE Sharks Species Captured by Trawl Net Operated in Zone C During Study Period at Larut Matang, Perak (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Chiloscyllium hasseltii</i>	2,017.4	1.82	0.61
2	<i>Chiloscyllium punctatum</i>	1,246.7	1.13	0.38
3	<i>Carcharhinus sorrah</i>	618.7	0.56	0.19
4	<i>Atelomycterus marmoratus</i>	161.2	0.15	0.05
5	<i>Sphyrna lewini</i>	94.1	0.09	0.03
6	<i>Chiloscyllium indicum</i>	56.5	0.05	0.02
7	<i>Atelomycterus erdmanni</i>	16.7	0.02	0.01
8	<i>Carcharhinus brevipinna</i>	7	0.01	0.002
9	<i>Galeocerdo cuvier</i>	6.8	0.01	0.002

2.2 Kota Kinabalu

2.2.1 Landing Samples

A total of 331 landings were sampled during the study period. The highest landing by month was 30 in July 2019 followed by 29 landings both in September 2018 and March 2019. The highest landing by gear type was using trawl net operated in Zone 3 with 157 landings followed by trawl net operated in Zone 4 with 120 and trawl net operated in Zone 2 with 54 landings. The details are shown in **Table 14**.

Table 14: Number of Landings by Gear Sampled During Study at Kota Kinabalu (SAFMA Jetty)

Types of Gear	Year/Month												Total
	2018					2019							
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Trawl Net Zone 2	3	1	0	4	4	5	8	6	7	6	4	6	54
Trawl Net Zone 3	13	11	16	8	14	11	12	16	13	14	15	14	157
Trawl Net Zone 4	11	17	11	15	10	9	7	7	8	7	8	10	120
Grand Total	27	29	27	27	28	25	27	29	28	27	27	30	331

2.2.2 Fishing Ground and Catch Composition by Gear Type

The total catch from trawl nets were 21,366.4 kg comprising 16,778.7 kg rays (78.5%) and 4,587.7 kg of sharks, which is only 21.5% from the total catch. The highest weight of rays was landed by trawl net operated in Zone 4 with 9,523.2 kg followed by Zone 3 (6,129.7 kg), and Zone 2 with 1,125.8 kg. As for sharks, trawl net operated in Zone 3 landed the highest catch with 2,119 kg followed by Zone 4 (1,909.3 kg), and Zone 2 with 559.4 kg. The highest landing of rays by month were from Zone 4 with 1,623.7 kg in September 2018 followed by 1,064.5 kg in August 2018 and 871.7 kg in July 2019. The highest and second highest landing of sharks by month was 342.5 kg in November 2018 and 269.3 kg in September 2018 from Zone 4 followed by 255.2.1 kg (Zone 3) in December 2018, and 216.4 kg (Zone 4) in October 2018. The details are shown in **Table 15**.

Table 15: Weight of Rays and Sharks (in kg) Caught by Different Types of Gear at Kota Kinabalu (SAFMA Jetty)

Types of Gear	Year/Month												Total
	2016						2017						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Trawl Net Zone 2	75.1	33	0.0	66.2	115.6	122.1	120.7	75.3	174.9	87.1	90.5	165.3	1,125.8
Trawl Net Zone 3	608.6	538.3	831.5	334.4	708.4	461.2	330.8	397.3	400	355.2	593.5	570.5	6,129.7
Trawl Net Zone 4	1,064.5	1,623.7	931	1,041.4	813.2	738.8	438.8	304.1	554.6	560.4	581	871.7	9,523.2
Total Ray	1,748.2	2,195	1,762.5	1,442	1,637.2	1,322.1	890.3	776.7	1,129.5	1,002.7	1,265	1,607.5	16,778.7
Trawl Net Zone 2	61.7	8.9	0.0	56.8	60.5	84.8	51.7	32.5	56.4	44	25.4	76.7	559.4
Trawl Net Zone 3	187.3	137.7	173.1	97.4	255.2	200.3	213.9	158.3	128.2	215.3	181.8	170.5	2,119.0
Trawl Net Zone 4	155.6	269.3	216.4	342.5	100.4	174	76	161.2	82.7	124.5	79.5	127.2	1,909.3
Total Shark	404.6	415.9	389.5	496.7	416.1	459.1	341.6	352	267.3	383.8	286.7	374.4	4,587.7
Grand Total	2,152.8	2,610.9	2,152	1,938.7	2,053.3	1,781.2	1,231.9	1,128.7	1,396.8	1,386.5	1,551.7	1,981.9	21,366.4

2.2.3 Rays and Sharks Composition

A total of 1,768,167.7 kg of fish was landed from 331 landings during the study period. Rays and sharks made up of 16,778.7 kg and 4,586 kg (0.9% and 0.3%) from the total landing respectively. Landing of bony fish was 1,746,803 kg with 98.8%. Average landing for rays and sharks were 1,398.2 kg and 382.2 kg respectively. The highest landing of rays by month was 1,762.5 kg in October 2018 followed by 1,748.2 kg in August 2018 and 1,637.2 kg in December 2018. Whilst the highest landing of sharks was 496.7 kg in November 2018 followed by 459.1 kg in January 2019 and 415.9 kg in September 2018. In general, the landing of rays and sharks ranged between 0.6 – 1.4% and 0.2 – 0.4% from the total landing respectively. The details are shown in **Table 16**.

Table 16: Catch Composition of Rays, Sharks, and Bony Fish by Month from 331 Landings at Kota Kinabalu (SAFMA Jetty). All Weight in kg

Year	Month	Weight of Rays	% Rays	Weight of Sharks	% Sharks	Weight of Bony Fish	% Bony Fish	Total Catch
2018	Aug	1,748.2	1.1	404.6	0.3	152,895	98.6	155,047.8
	Sep	2,195	1.4	415.9	0.3	156,959	98.4	159,569.9
	Oct	1,762.5	1.2	389.5	0.3	150,416	98.6	152,568
	Nov	1,442	0.9	496.7	0.3	150,980	98.7	152,918.7
	Dec	1,637.2	1.1	414.4	0.3	142,800	98.6	144,851.6
2019	Jan	1,322.1	1.2	459.1	0.4	112,725	98.4	114,506.2
	Feb	890.3	0.8	341.6	0.3	106,454	98.9	107,685.9
	Mar	776.7	0.6	352	0.3	138,988	99.2	140,116.7
	Apr	1,129.5	0.6	267.3	0.2	175,415	99.2	176,811.8
	May	1,002.7	0.7	383.8	0.3	144,639	99.1	146,025.5
	Jun	1,265	0.9	286.7	0.2	144,800	98.9	146,351.7
	Jul	1,607.5	0.9	374.4	0.2	169,732	98.8	171,713.9
Grand Total		16,778.7		4,586		1,746,803		1,768,167.7
Average		1,398.2	0.9	382.2	0.3	145,566.9	98.8	147,347.3

2.2.4 Sample Size

A total of 9,863 individuals consist of 7,087 rays from 27 species and 2,776 sharks from 20 species were sampled. The most common and abundant ray species were *Neotrygon orientalis*, *Telatrygon zugei*, and *Maculabatis gerrardi*. All these species were landed throughout the year. Other common ray species were *Brevitrygon heterura*, *Rhinobatos borneensis*, and *Gymnura poecilura*. Other ray species such as *Aetomylaeus vespertilio*, *Bathytoshia cf lata*, *Mobula thurstoni*, and *Narcine brevilibiata* were only landed one time during study period. The highest number of rays sampled by month was 688 individuals in July 2019 followed by 634 individuals in December and 630 individuals in September 2018.

The most common and abundant species of sharks were *Chiloscyllium punctatum*, *Chiloscyllium plagiosum*, and *Atelomycterus marmoratus*. These species landed throughout the year during study period. Other common shark species were *Carcharhinus sorrah*, *Sphyrna lewini*, *Hemipristis elongata*, and *Hemigaleus microstoma*. These species were landed between 9 – 11 months. Other shark species such as *Carcharhinus brevipinna*,

Carcharhinus amblyrhynchoides, *Galeocerdo cuvier*, *Nebrius ferrugineus*, and *Triaenodon obesus* were only landed one time during study period. The highest number of sharks sampled by month was 290 individuals in November 2018, followed by 288 individuals in December 2018 and 279 individuals in October 2018. The details are shown in **Table 17**.

Table 17: Sample Size of Rays and Sharks by Species at Kota Kinabalu (SAFMA Jetty)

Species	Year/Month												Total
	2018					2019							
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
<i>Aetobatus ocellatus</i>	4	1	2	0	5	1	3	1	3	0	2	2	24
<i>Aetomylaeus vespertilio</i>	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Bathytoshia cf lata</i>	1	0	0	0	0	0	0	0	0	0	0	0	1
<i>Brevitrygon heterura</i>	6	13	25	23	23	48	21	27	27	26	22	11	272
<i>Gymnura japonica</i>	5	1	3	8	0	9	2	0	3	4	8	10	53
<i>Gymnura poecilura</i>	4	10	21	10	6	21	2	1	12	23	15	9	134
<i>Hemitrygon akajei</i>	1	0	1	1	1	4	1	6	1	2	1	1	20
<i>Hemitrygon parvonigra</i>	17	15	1	11	11	4	1	0	2	5	1	0	68
<i>Himantura leoparda</i>	0	1	0	2	1	0	0	2	1	1	1	1	10
<i>Himantura uarnak</i>	5	4	1	1	0	2	0	2	1	1	1	2	20
<i>Himantura undulata</i>	1	1	1	0	0	0	0	0	1	0	1	1	6
<i>Maculabatis gerrardi</i>	99	117	123	92	133	110	113	113	124	102	127	138	1,391
<i>Mobula japonica</i>	0	0	0	1	0	1	1	1	0	0	0	0	4
<i>Mobula thurstoni</i>	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Narcine breviliabiata</i>	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Neotrygon orientalis</i>	172	275	219	219	231	222	224	255	218	209	204	224	2,672
<i>Pastinachus ater</i>	0	0	0	0	0	0	0	0	0	0	4	10	14
<i>Pastinachus gracilicaudus</i>	21	17	8	3	6	4	3	0	1	8	3	0	74
<i>Pateobatis fai</i>	5	0	0	0	0	0	0	0	0	0	1	0	6
<i>Pateobatis jenkinsii</i>	4	6	5	5	7	0	4	3	1	0	2	4	41
<i>Rhinobatos borneensis</i>	20	6	26	12	8	2	8	19	27	6	18	34	186
<i>Rhinoptera javanica</i>	2	0	1	0	0	0	0	0	0	0	0	0	3
<i>Rhinoptera jayakari</i>	1	1	3	0	1	0	0	0	0	0	1	1	8
<i>Rhynchobatus australiae</i>	4	4	3	4	1	10	6	5	6	3	7	2	55
<i>Taeniura lymma</i>	2	2	0	1	2	2	6	0	1	3	2	2	23
<i>Telatrygon zugei</i>	102	156	159	139	197	162	185	161	194	156	146	236	1,993
<i>Urolophus expansus</i>	0	0	0	5	1	0	0	0	0	0	0	0	6
Total Rays	476	630	602	538	634	602	580	597	623	549	568	688	7,087
<i>Alopias pelagicus</i>	0	0	0	2	0	0	0	0	2	0	0	1	5
<i>Atelomycterus marmoratus</i>	13	36	49	67	33	55	20	2	8	17	6	19	325
<i>Carcharhinus amblyrhynchoides</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Carcharhinus brevipinna</i>	0	0	0	0	0	0	0	0	0	2	0	0	2
<i>Carcharhinus melanopterus</i>	0	4	0	0	0	0	0	0	0	1	1	1	7
<i>Carcharhinus plumbeus</i>	1	0	0	1	0	0	0	1	4	0	1	0	8
<i>Carcharhinus sealei</i>	1	0	0	0	1	0	0	3	0	1	0	1	7
<i>Carcharhinus sorrah</i>	23	6	6	4	2	0	1	4	28	62	22	19	177
<i>Chiloscyllium plagiosum</i>	44	37	47	94	110	63	41	44	44	46	36	84	690
<i>Chiloscyllium punctatum</i>	87	113	147	106	133	137	128	132	88	92	57	100	1,320

<i>Galeocerdo cuvier</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Halaehurus buergeri</i>	0	1	1	0	0	0	0	0	0	0	0	0	2
<i>Hemigaleus microstoma</i>	0	0	1	1	6	1	2	2	1	0	1	5	20
<i>Hemipristis elongata</i>	9	1	7	5	1	1	1	0	0	0	2	0	27
<i>Loxodon macrorhinus</i>	2	0	7	5	0	0	0	1	0	0	0	0	15
<i>Mustelus manazo</i>	3	0	0	0	0	0	0	3	0	0	0	0	6
<i>Nebrius ferrugineus</i>	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Sphyrna lewini</i>	17	9	14	4	2	7	0	2	3	32	36	22	148
<i>Squalus altipinnis</i>	13	0	0	0	0	0	0	0	0	0	0	0	13
<i>Triaenodon obesus</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
Total Sharks	213	209	279	290	288	264	193	194	178	253	162	253	2,776
Grand Total	689	839	881	828	922	866	773	791	801	802	730	941	9,863

2.2.5 Weight of Rays and Sharks by Species

A total of 21,366.4 kg was landed from 331 landings comprising 16,778.7 kg of rays and 4,587.7 kg of sharks. Species of ray with the highest landing by weight was *Neotrygon orientalis* with 5,498.4 kg followed by *Maculabatis gerrardi* (3,765.1 kg), and *Telatrygon zugei* with 3,573.2 kg. The highest weight of landing by month for *Neotrygon orientalis* was 866.1 kg in September 2018 followed by 713 kg in October 2018, and 604.6 kg in November 2018. The highest landing for *Maculabatis gerrardi* was 518.7 kg in September 2018 followed by 432.8 kg in July 2019, and 414 kg in June 2019. For *Telatrygon zugei*, the highest landing was 483.3 kg in July 2019 followed by 353.8 kg in December 2018, and 344.3 kg in October 2018. Other species with high weight of landings were *Pastinachus gracilicaudus* with 844.3 kg, *Aetobatus ocellatus* (382.1 kg), *Gymnura poecilura* (348.2 kg), *Pateobatis fai* (336.9 kg), *Pateobatis jenkinsii* (288.9 kg), *Rhinobatos borneensis* (266.7 kg), and *Hemistrygon parvonigra* with 257.5 kg. Landing of other species were below 200 kg.

For shark species, the landing of *Chiloscyllium punctatum* recorded the highest weight with 2,670.2 kg followed by *Chiloscyllium plagiosum* (680.6 kg), and *Carcharhinus sorrah* with 498.6 kg. The highest weight of landing by month for *Chiloscyllium punctatum* was 361.8 kg in January 2019 followed by 279.3 kg in December 2018, and 275.1 kg in February 2019. The highest landing by month of *Chiloscyllium plagiosum* was 93.3 kg in November 2018 followed by 92.4 kg in July 2019, and 81.7 kg in December 2018. The highest weight of *Carcharhinus sorrah* by month was 134 kg in May 2019 followed by 102.7 kg in August 2018 and 60.7 kg in June 2019. The total landing of *Carcharhinus melanopterus*, *Nebrius ferrugineus*, and *Alopias pelagicus* during this study was 56 kg, 50 kg, and 42.9 kg respectively. Whilst other species recorded weight of landing below 40 kg. The details are shown in **Table 18**.

Table 18: Weight of Rays and Sharks (in kg) by Species from 331 Landings at Kota Kinabalu (SAFMA Jetty)

Species	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
<i>Aetobatus ocellatus</i>	59.3	16.5	26.2	0.0	85.9	21	66.5	19.7	62.2	0.0	3.5	21.3	382.1
<i>Aetomylaeus vesperitilo</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	8.4
<i>Bathytoshia cf lata</i>	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
<i>Brevitrygon heterura</i>	2	5.8	15.1	9.9	9	23	8.3	9.9	10.2	12.5	16.4	3.8	125.9
<i>Gymnura japonica</i>	11.2	2	5.9	24.7	0.0	14.9	6.5	0.0	10.9	11.1	12.2	16.2	115.6
<i>Gymnura poecilura</i>	6.8	40	44.6	28.6	19.8	50.6	1.7	6.3	24.9	64.9	37.3	22.7	348.2
<i>Hemistrygon akajei</i>	4.1	0.0	1.8	5.4	1.3	20.6	2.6	13.1	1.8	9	2.2	1	62.9
<i>Hemistrygon parvonigra</i>	68.2	47.5	4	31	73.7	19.3	3.3	0.0	2.5	7.3	0.7	0.0	257.5
<i>Himantura leoparda</i>	0.0	18.8	0.0	48.8	38	0.0	0.0	39.3	21.2	25.3	9.6	26	227
<i>Himantura uarnak</i>	15.2	23.2	0.8	17.3	0.0	2.4	0.0	29.1	30	1.1	1	3	123.1
<i>Himantura undulata</i>	23.2	26	40	0.0	0.0	0.0	0.0	0.0	35	0.0	36	6.7	166.9
<i>Maculabatis gerrardi</i>	281.1	518.7	348.6	325.7	403.8	282.7	186.7	150.1	218.1	202.8	414	432.8	3,765.1
<i>Mobula japonica</i>	0.0	0.0	0.0	14.5	0.0	10.4	14.8	21.5	0.0	0.0	0.0	0.0	61.2
<i>Mobula thurstoni</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	10.1
<i>Narcine brevitaliata</i>	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
<i>Neotrygon orientalis</i>	426.6	866.1	713	604.6	526	463.1	280.3	270	353	247.5	308.1	440.1	5,498.4
<i>Pastinachus ater</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	66.8	77.9
<i>Pastinachus gracilicaudus</i>	195.8	219.8	101.1	47.1	63.1	58.2	40.6	0.0	17.4	51.5	49.7	0.0	844.3
<i>Pateobatis fai</i>	332.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	336.9
<i>Pateobatis jenkinsii</i>	38.3	48.4	29.9	37.7	42.9	0.0	28	25.4	4.5	0.0	11.9	21.9	288.9
<i>Rhinobatos borneensis</i>	50.2	7.4	38.7	13.3	10	2.9	12.8	20.7	34.9	14.9	22.5	38.4	266.7
<i>Rhinoptera javanica</i>	0.9	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5
<i>Rhinoptera jayakari</i>	11.7	12	34	0.0	1.2	0.0	0.0	0.0	0.0	0.0	2.6	5.8	67.3
<i>Rhynchobatus australiae</i>	9.2	7.7	3.9	7.8	3.4	11.7	9.1	5.9	12.6	3	11.5	15.9	101.7
<i>Taeniura lymna</i>	3.4	3	0.0	1.1	4.5	2.1	7.5	0.0	0.8	4.6	2.8	1.8	31.6
<i>Telatrygon zugei</i>	186.4	332.1	344.3	221	353.8	339.2	221.6	155.6	289.5	347.2	299.2	483.3	3,573.2

2.2.6 Size Range of Rays and Sharks

In general, most of rays species sampled from August 2018 to July 2019 were matured except for *Bathytoshia cf lata*, *Mobula japonica*, *Mobula thurstoni*, *Pateobatis fai*, *Rhinoptera jayakari*, and *Rhynchobatus australiae*. Other rays species were either immaturred or juveniles. Samples of *Taeniura lymma* landed throughout the study were immaturred except for samples landed on February 2019. Whilst, all samples of *Aetobatus ocellatus* were immaturred but samples landed on May 2019 were matured. Details on size range of rays by species from August 2018 to January 2019 are shown in **Table 19A (i)** and from February to July 2019 are shown in **Table 19A (ii)**.

Most of shark species sampled from August 2018 to July 2019 were matured compared to immaturred and juveniles. Species *Carcharhinus amblyrhynchoides*, *Carcharhinus brevipinna*, *Carcharhinus limbatus*, *Carcharhinus plumbeus*, *Galeocerdo cuvier*, *Hemipristis elongata*, and *Sphyrna lewini* landed during study period were all juveniles and immaturred. Whilst, samples for *Halaelurus buergeri*, *Mustelus manazo*, and *Nebrius ferrugineus* were all matured. Samples for *Hemigaleus microstoma* were all immaturred except for samples landed on November 2018 and June 2019. Samples for *Loxodon macrorhinus* were all immaturred except on August 2018. Whilst, species *Carcharhinus melanopterus* landed during study period were all matured except on June 2019. Details on size range of sharks by species sampled from August 2018 to January 2019 are shown in **Table 19B (i)** and from February to July 2019 are shown in **Table 19B (ii)**.

Table 19A (i): Size Range of Rays (Disc Length in cm) Except for Species *Narcine brevilabiata*, *Rhinobatos borneensis*, and *Rhynchobatus australiae* (Total Length in cm) from August 2018 to January 2019

Species	Year/Month																
	2018						2019										
	Aug		Sep		Oct		Nov		Dec		Jan						
Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave			
<i>Aetobatus ocellatus</i>	52.2	72.8	62.3	76.5	76.5	76.5	51.5	63.9	57.7			50.7	85.2	66.1	72.6		
<i>Bathytoshia cf lata</i>	76.7	76.7	76.7														
<i>Brevitrygon heterura</i>	17.2	22.7	21.1	19.2	25.8	23	18	24.8	22.1	19.3	25.3	21.8	26.3	22.7	18.2	26.5	22.3
<i>Gymnura japonica</i>	25.6	39.6	32	31	31	31	25	38	30.5	20.6	42.8	34.3			20.2	33.5	27.9
<i>Gymnura poecilura</i>	23.7	33.8	29.2	29	48.6	38.1	17.8	42	30	24.3	40.3	33.9	44.5	36.4	19.4	44.5	31.4
<i>Hemitrygon akajei</i>	46.8	46.8	46.8				31.6	31.6	31.6	50.6	50.6	50.6	29.8	29.8	35.5	66.8	45.7
<i>Hemitrygon parvonigra</i>	28.6	50.5	39.4	29.8	49.6	38.4	43.2	43.2	43.2	19.2	54	35.1	63.3	33.6	32.3	51	44.7
<i>Himantura leoparda</i>				77	77	77				74.6	89.5	82.1	106	106			
<i>Himantura uarnak</i>	22.6	63.5	35	41.5	57.3	49.2	27.1	27.1	27.1	72.5	72.5	72.5			28.6	32.5	30.6
<i>Himantura undulata</i>	82.3	82.3	82.3	85.7	85.7	85.7	112	112	112								
<i>Maculabatis gerrardi</i>	17.3	67.1	32.6	16.6	78.5	29.9	15.9	71.3	30	17.5	84.2	31.1	67	28.8	18.2	65.3	31.1
<i>Mobula japonica</i>										68	68	68			56.3	56.3	56.3
<i>Narcine brevilabiata</i>										39.8	39.8	39.8					
<i>Neotrygon orientalis</i>	14.3	31.5	20.8	13.2	35.3	20.1	13.1	32.6	20.1	13.5	30.8	20.1	33.2	20	12.6	28.5	20.1
<i>Pastinachus gracilicaudus</i>	32.4	76.1	51.8	32.6	75.3	56.2	45.5	87.6	59.7	51.2	71	62.6	64.4	51.2	49.2	56.1	52.9
<i>Pateobatis fai</i>	64	78.7	69.8														
<i>Pateobatis jenkinsii</i>	45.5	68.8	58	30.5	81.7	51.9	41.3	60.3	49.8	38.2	64.3	51.4	53.5	50.5			
<i>Rhinobatos borneensis</i>	40.3	93.8	70.1	66	88.5	75.4	60.5	94.5	79.7	56.1	88.2	72.9	90	76.5	75.6	78.8	77.2
<i>Rhinoptera javanica</i>	17.3	19.2	18.3				53	53	53								
<i>Rhinoptera jayakari</i>	55.8	55.8	55.8	58.7	58.7	58.7	28.6	67.8	51.2				28.3	28.3			
<i>Rhynchobatus australiae</i>	50.3	113	70	55.6	97.8	71	59.8	70.3	64.4	58.8	85.2	72.7	94.2	94.2	49.9	95	62.3
<i>Taeniura lymna</i>	29.6	35.3	32.5	28.3	32.8	30.6				26	26	26	39.6	32.5	27.3	29.7	28.5
<i>Telatrygon zugei</i>	16.7	32.6	24.3	19.3	31.3	24.2	15.8	30.7	23.8	17	32	23.9	33	24.3	16.6	33	24.2
<i>Urolophus expansus</i>										18.7	22.8	20.7	24.5	24.5			

Table 19A (ii): Size Range of Rays (Disc Length in cm) Except for Species *Narcine brevilabiata*, *Rhinobatos borneensis*, and *Rhynchobatus australiae* (Total Length in cm) from February to July 2019

Species	Year/Month																	
	2019																	
	Feb			Mar			Apr			May			Jun			Jul		
Rays	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av
<i>Aetobatus ocellatus</i>																		
<i>Aetomylaeus vespertilio</i>	48.8	72.5	59.1	44.3	71.5	59.5	38.2	69.3	56.9	167.9	170.3	169.1						
<i>Gymnura japonica</i>	62	62	62							88.1	88.1	88.1						
<i>Gymnura poecilura</i>	79.5	79.5	79.5															
<i>Hemirhynchus akajei</i>	72.4	121	83.2	82.5	111.3	89.3	85.5	115.2	95.1	91.1	134.5	115.1	82.2	82.2	82.2			
<i>Hemirhynchus parvonigra</i>				116.5	134.2	121.9												
<i>Himantura leoparda</i>	53.3	79.9	68.8	45.5	87.2	70.8	43.6	84	64.8	48.5	83.7	66.8	36	80.3	64.1	48	81	63.8
<i>Himantura uarnak</i>	43.5	103	75.2	45	97.3	73.1	41.7	101.5	70.6	51.5	103	74.7	42.1	98.6	70.8	42	97.5	74.2
<i>Himantura undulata</i>				147.1	147.1	147.1												
<i>Maculabatis gerrardi</i>				42.3	42.3	42.3	45.6	45.6	45.6									
<i>Mobula japonica</i>							45.9	45.9	45.9	95.3	95.3	95.3	54.3	100.8	65.2	48.6	48.6	48.6
<i>Mobula thurstoni</i>	46.8	99.1	70.4	49.7	49.7	49.7	45.3	96.8	77.4	50.4	58	53.3	52.5	52.5	52.5	99.5	99.5	99.5
<i>Narcine brevilabiata</i>	76.8	89.5	83.2				50.5	107.5	66.6	56	68	60.7						
<i>Neotrygon orientalis</i>	64.3	102.3	78.7															
<i>Pastinachus ater</i>										238	238	238						
<i>Pastinachus gracilicandus</i>	53.6	80.3	68.7	56.7	88	76	50.1	96.7	61.1	52.5	106.8	91.4	56.7	100	78.4	46.2	103.3	74
<i>Pateobatis fai</i>	35.8	75.3	55.8															
<i>Pateobatis jenkinsii</i>				70	70	70												
<i>Rhinobatos borneensis</i>										167.9	170.3	169.1						
<i>Rhinoptera javanica</i>	48.8	72.5	59.1	44.3	71.5	59.5	38.2	69.3	56.9	45	70.3	59.6	43.4	70.3	61.2	46.8	69.2	58.2
<i>Rhynchobatus australiae</i>	59	74	68.5	56.1	73.5	64.4	54	99.5	76.9	59.3	62.8	60.9	49.5	81.4	68.8	77	130	104
<i>Taeniura lymna</i>	16.3	34.5	28.8				26.2	26.2	26.2	30.3	33	31.6	29.5	31.3	30.4	24.3	31.4	27.9
<i>Telatrygon zugei</i>	15.5	30.5	24	16.7	32.5	24	17.3	32.7	24.6	16.3	32.3	24.6	16.8	31.6	23.4	16.6	31.8	23.7
<i>Urolophus expansus</i>	68.5	77	72.5	65.7	65.7	65.7	66.7	77	71.5				28	28.9	28.5	30.5	77.3	53.9

Table 19B (i): Size Range of Sharks (Total Length in cm) from August 2018 to January 2019

Species	Year/Month														
	2018						2019								
	Aug		Sep		Oct		Nov		Dec		Jan				
Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Alopias pelagicus</i>									167.9	170.3	169.1				
<i>Atelomycteris marmoratus</i>	48.8	72.5	59.1	44.3	71.5	59.5	38.2	69.3	56.9	70.3	59.6	43.4	70.3	61.2	58.2
<i>Carcharhinus melanopterus</i>				116.5	134.2	121.9									
<i>Carcharhinus plumbeus</i>	62	62	62						88.1	88.1	88.1				
<i>Carcharhinus sealiei</i>	79.5	79.5	79.5									82.2	82.2	82.2	
<i>Carcharhinus sorrah</i>	72.4	121	83.2	82.5	111.3	89.3	85.5	115.2	95.1	134.5	115.1	119	127	123	
<i>Chiloscyllium plagiosum</i>	53.3	79.9	68.8	45.5	87.2	70.8	43.6	84	64.8	83.7	66.8	36	80.3	64.1	63.8
<i>Chiloscyllium punctatum</i>	43.5	103	75.2	45	97.3	73.1	41.7	101.5	70.6	103	74.7	42.1	98.6	70.8	74.2
<i>Galeocerdo cuvier</i>				147.1	147.1	147.1									
<i>Halaeturus buergeri</i>				42.3	42.3	42.3	45.6	45.6	45.6						
<i>Hemigaleus microstoma</i>							45.9	45.9	45.9	95.3	95.3	54.3	100.8	65.2	48.6
<i>Hemipristis elongata</i>	46.8	99.1	70.4	49.7	49.7	49.7	45.3	96.8	77.4	58	53.3	52.5	52.5	99.5	99.5
<i>Loxodon macrorhinus</i>	76.8	89.5	83.2				50.5	107.5	66.6	68	60.7				
<i>Mustelus manazo</i>	64.3	102.3	78.7												
<i>Nebrius ferrugineus</i>										238	238				
<i>Sphyrna lewini</i>	53.6	80.3	68.7	56.7	88	76	50.1	96.7	61.1	106.8	91.4	56.7	100	78.4	103.3
<i>Squalus altipinnis</i>	35.8	75.3	55.8												74
<i>Triacnodon obesus</i>				70	70	70									

Table 19B (ii): Size Range of Sharks (Total Length in cm) from February to July 2019

Species	Year/Month																	
	2019																	
	Feb			Mar			Apr			May			Jun			Jul		
Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	Min	Max	Av	
<i>Alopias pelagicus</i>						166	167.5	166.8										
<i>Atelomycterus marmoratus</i>	46.5	66	57.2	46.6	55.5	51.1	61.9	57.5	46.5	68.3	58.1	53.8	66.1	60.9	46	72.5	58.1	
<i>Carcharhinus amblyrhynchooides</i>															61.8	61.8	61.8	
<i>Carcharhinus brevipinna</i>									89	91.7	90.4							
<i>Carcharhinus melanopterus</i>									91.3	91.3	91.3	47.5	47.5	47.5	135.5	135.5	135.5	
<i>Carcharhinus plumbeus</i>				55.5	55.5	55.5	107.8	90.8				73.4	73.4	73.4				
<i>Carcharhinus sealei</i>				58.3	67	62.6			43.7	43.7	43.7				46	46	46	
<i>Carcharhinus sorrah</i>	124.1	124.1	124.1	51	126.5	73.2	63.3	58.2	51.3	126.5	65.8	64.6	124.5	76.6	65	118.2	77.4	
<i>Chiloscyllium plagiosum</i>	49	81.7	68.8	50.5	82.3	66.7	82.1	67.9	48.9	79.7	67.9	46	83.6	67.1	47	88.6	67.6	
<i>Chiloscyllium punctatum</i>	46.7	105.5	77.1	44.5	99.5	75.8	93	72.7	48	90	71.1	46.6	91.4	71.6	46.7	97.8	72	
<i>Hemigaleus microstoma</i>	49	90	69.5	53.3	56.7	55	49.6	49.6				89.5	89.5	89.5	48.7	95	71.3	
<i>Hemipristis elongata</i>	53	53	53									57.0	66.3	61.7				
<i>Loxodon macrorhinus</i>				69.4	69.4	69.4												
<i>Mustelus manazo</i>				80.1	107.6	96.7												
<i>Sphyrna lewini</i>				53.2	102.1	77.7	60.6	57.5	48.7	60.8	54.1	49	97.8	60.6	49.4	77.4	63	

2.2.7 Usage and Marketing

All shark and ray species landed at this site were marketed and consumed locally. The price (RM/kg) were varied depending on species, size, and season. Grilled rays are special delicacies that highly enjoyed by locals and tourists alike. All sharks and rays were sold as a whole at this landing site where fins, tails, cartilage, and skin were not separated from the body during marketing process. The supply at SAFMA Jetty were not as limited as in Peninsular Malaysia. The wholesale price of rays at SAFMA landing jetty were in the range of RM0.80 – RM6/kg, quite cheaper compared to the price in Peninsular Malaysia. The price for rays species such as *Maculabatis gerrardi*, *Neotrygon orientalis*, and *Rhynchobatus australiae* can fetch up to RM6/kg. However, the price were possibly doubled or even more once the rays sold at the fish markets. The favourite species among consumers were *Himantura uarnak* and *Maculabatis gerrardi*. The range price for *Himantura uarnak* was RM3 – RM4/kg.

All part of sharks were fully utilized. Shark meat were mainly sold at fish wet markets in Kota Kinabalu and some were brought to interior part of Sabah. Shark teeth and jaws were used as souvenirs and shark head's skin were considered as a new delicacy. Whole body of shark were sold at the average price of RM3/kg at SAFMA landing jetty in Kota Kinabalu. The highest price for shark species of *Carcharhinus sorrah* and *Sphyrna lewini* were sold at RM6/kg. Other species were mostly sold at range price RM2 – RM5/kg. However, the prices could increase to double or even triple once it reaches the fish markets. The details of price range and market destination by species is shown in **Table 20**.

Table 20: Price (RM/kg) of Rays and Sharks by Species and Market Destination at Kota Kinabalu (SAFMA Jetty)

Species	Range Price (RM/kg)	Part	Market Destination
Ray			
<i>Aetobatus ocellatus</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Aetomylaeus vespertilio</i>	4	Whole body	Local Market Kota Kinabalu
<i>Bathytoshia cf lata</i>	4	Whole body	Local Market Kota Kinabalu
<i>Brevitrygon heterura</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Gymnura japonica</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Gymnura poecilura</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Hemitrygon akajei</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Hemitrygon parvonigra</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Himantura leoparda</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Himantura uarnak</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Himantura undulata</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Maculabatis gerrardi</i>	2 – 6	Whole body	Local Market Kota Kinabalu
<i>Mobula japonica</i>	3 – 5	Whole body	Local Market Kota Kinabalu
<i>Mobula thurstoni</i>	5	Whole body	Local Market Kota Kinabalu

<i>Narcine brevilabiata</i>	2	Whole body	Local Market Kota Kinabalu
<i>Neotrygon orientalis</i>	2 – 6	Whole body	Local Market Kota Kinabalu
<i>Pastinachus ater</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Pastinachus gracilicaudus</i>	3 – 5	Whole body	Local Market Kota Kinabalu
<i>Pateobatis fai</i>	4	Whole body	Local Market Kota Kinabalu
<i>Pateobatis jenkinsii</i>	3 – 5	Whole body	Local Market Kota Kinabalu
<i>Rhinobatos borneensis</i>	3 – 5	Whole body	Local Market Kota Kinabalu
<i>Rhinoptera javanica</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Rhinoptera jayakari</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Rhynchobatus australiae</i>	2 – 6	Whole body	Local Market Kota Kinabalu
<i>Taeniura lymma</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Telatrygon zugei</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Urolophus expansus</i>	2 – 3	Whole body	Local Market Kota Kinabalu
Shark			
<i>Alopias pelagicus</i>	3 – 4	Whole body	Local Market Kota Kinabalu
<i>Atelomycterus marmoratus</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus amblyrhynchoides</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus brevipinna</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus melanopterus</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus plumbeus</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus sealei</i>	2 – 4	Whole body	Local Market Kota Kinabalu
<i>Carcharhinus sorrah</i>	2 – 6	Whole body	Local Market Kota Kinabalu
<i>Chiloscyllium plagiosum</i>	2 – 3.5	Whole body	Local Market Kota Kinabalu
<i>Chiloscyllium punctatum</i>	2 – 3.5	Whole body	Local Market Kota Kinabalu
<i>Galeocerdo cuvier</i>	4	Whole body	Local Market Kota Kinabalu
<i>Halaaelurus buergeri</i>	2	Whole body	Local Market Kota Kinabalu
<i>Hemigaleus microstoma</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Hemipristis elongata</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Loxodon macrorhinus</i>	2 – 5	Whole body	Local Market Kota Kinabalu
<i>Mustelus manazo</i>	3 – 5	Whole body	Local Market Kota Kinabalu
<i>Nebrius ferrugineus</i>	5	Whole body	Local Market Kota Kinabalu
<i>Sphyrna lewini</i>	2 – 6	Whole body	Local Market Kota Kinabalu
<i>Squalus altipinnis</i>	2 – 3.5	Whole body	Local Market Kota Kinabalu
<i>Triaenodon obesus</i>	2 – 3.5	Whole body	Local Market Kota Kinabalu

2.2.8 Fishing Effort and CPUE (Catch per Unit Effort)

Monthly fishing efforts (days at operation and total number of operation during the cruise) of the sampled vessels are summarized in **Table 21** and **Table 22**.

Table 21: Days at Operation by Gear Sampled During Study Period at Kota Kinabalu (SAFMA Jetty)

Types of Gear	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Trawl Net Zone 2	24	7	0	28	28	37	60	43	58	38	26	39	388
Trawl Net Zone 3	97	83	127	62	108	82	88	123	99	99	102	102	1,172
Trawl Net Zone 4	86	144	87	121	80	70	56	55	65	56	61	83	964
Grand Total	207	234	214	211	216	189	204	221	222	193	189	224	2,524

Table 22: Total Number of Operations by Gear Sampled During Study Period at Kota Kinabalu (SAFMA Jetty)

Types of Gear	Year/Month												Total
	2018						2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Trawl Net Zone 2	72	21	0	84	84	111	180	129	174	114	78	117	1,164
Trawl Net Zone 3	291	249	381	186	324	246	264	369	297	297	306	306	3,516
Trawl Net Zone 4	258	432	261	363	240	210	168	165	195	168	183	249	2,892
Grand Total	621	702	642	633	648	567	612	663	666	579	567	672	7,572

The highest landing of rays and sharks were mostly recorded from trawl net operated in Zone 3 and Zone 4 at SAFMA Jetty. The top 10 CPUE for ray species captured by these two zones were different. However, the top three species were the same for both zone where *Neotrygon orientalis* topped the list (0.63 kg/haul for Zone 3 and 0.99 kg/haul for Zone 4) followed by *Maculabatis gerrardi* (0.39 kg/haul for Zone 3 and 0.76 kg/haul for Zone 4), and *Telatrygon zugei* (0.37 kg/haul for Zone 3 and 0.65 kg/haul for Zone 4).

As for sharks, the top three species were in the same order for both Zone 3 and Zone 4. *Chiloscyllium punctatum* topped the list with 0.36 kg/haul (1.07 kg/day) for Zone 3 and 0.37 kg/haul (1.12 kg/day) for Zone 4 followed by *Chiloscyllium plagiosum* with 0.09 kg/haul (0.26 kg/day) for Zone 3 and 0.09 kg/haul (0.28 kg/day) for Zone 4; and *Carcharhinus sorrah* with 0.08 kg/haul (0.23 kg/day) for Zone 3 and 0.06 kg/haul (0.17 kg/day) for Zone 4. The top 10 CPUE of rays and sharks species captured by trawl net operated in Zone 3 and Zone 4 are shown in Table 23, Table 24, Table 25, and Table 26.

Table 23: Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone 3 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Neotrygon orientalis</i>	2,208.9	1.88	0.63
2	<i>Maculabatis gerrardi</i>	1,356.8	1.16	0.39
3	<i>Telatrygon zugei</i>	1,313.0	1.12	0.37
4	<i>Pastinachus gracilicaudus</i>	252.6	0.22	0.07
5	<i>Rhinobatos borneensis</i>	165.5	0.14	0.05
6	<i>Aetobatus ocellatus</i>	139.5	0.12	0.04
7	<i>Gymnura poecilura</i>	128.3	0.11	0.04
8	<i>Hemistrygon parvonigra</i>	83.5	0.07	0.02
9	<i>Pateobatis jenkinsii</i>	74.3	0.06	0.02
10	<i>Gymnura japonica</i>	57.7	0.05	0.02

Table 24: Top 10 CPUE Rays Species Captured by Trawl Net Operated in Zone 4 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Neotrygon orientalis</i>	2,868.5	2.98	0.99
2	<i>Maculabatis gerrardi</i>	2,195.6	2.28	0.76
3	<i>Telatrygon zugei</i>	1,884.3	1.95	0.65
4	<i>Pastinachus gracilicaudus</i>	583.7	0.61	0.20
5	<i>Pateobatis fai</i>	332.6	0.35	0.12
6	<i>Aetobatus ocellatus</i>	242.6	0.25	0.08
7	<i>Himantura leoparda</i>	217.4	0.23	0.08
8	<i>Gymnura poecilura</i>	210.3	0.22	0.07
9	<i>Pateobatis jenkinsii</i>	203.7	0.21	0.07
10	<i>Hemistrygon parvonigra</i>	149.4	0.15	0.05

Table 25: Top 10 CPUE Sharks Species Captured by Trawl Net Operated in Zone 3 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Chiloscyllium punctatum</i>	1,254.2	1.07	0.36
2	<i>Chiloscyllium plagiosum</i>	305.0	0.26	0.09
3	<i>Carcharhinus sorrah</i>	265.5	0.23	0.08
4	<i>Atelomycterus marmoratus</i>	110.7	0.09	0.03
5	<i>Sphyrna lewini</i>	88.2	0.08	0.03
6	<i>Carcharhinus melanopterus</i>	19.8	0.02	0.01
7	<i>Galeocerdo cuvier</i>	15.2	0.01	0.004
8	<i>Alopias pelagicus</i>	14.7	0.01	0.004
9	<i>Hemigaleus microstoma</i>	9.1	0.01	0.003
10	<i>Hemipristis elongata</i>	8.6	0.01	0.002

Table 26: Top 10 CPUE Sharks Species Captured by Trawl Net Operated in Zone 4 During Study Period at Kota Kinabalu (SAFMA Jetty) (kg/fishing effort)

Number	Scientific Name	Total Weight (kg) by Species	CPUE (kg/day)	CPUE (kg/haul)
1	<i>Chiloscyllium punctatum</i>	1,076.9	1.12	0.37
2	<i>Chiloscyllium plagiosum</i>	272.0	0.28	0.09
3	<i>Carcharhinus sorrah</i>	168.6	0.17	0.06
4	<i>Sphyrna lewini</i>	105.8	0.11	0.04
5	<i>Atelomycterus marmoratus</i>	85.1	0.09	0.03
6	<i>Nebrius ferrugineus</i>	50.0	0.05	0.02
7	<i>Carcharhinus melanopterus</i>	36.2	0.04	0.01
8	<i>Hemipristis elongata</i>	24.8	0.03	0.01
9	<i>Carcharhinus plumbeus</i>	23.7	0.02	0.01
10	<i>Alopias pelagicus</i>	20.5	0.02	0.01

3.0 OUTPUT AND OUTCOME

The project outputs and outcomes are summarized in **Table 27** as shown below.

Table 27: Output and Outcome

No	Output	Outcome
1.	Twelve (12) trained personnels in sharks and rays taxonomy from the Department of Fisheries Malaysia and Fisheries Department of Sabah.	Trained staffs are now able to make the right and valid identification of species. Training materials stored electronically and easy to excess.
2.	A standardized format for data collection for national activity produced.	Improved technique of data collection for implementation at national level.
3.	Detailed information on the percentage of sharks and rays from the total landing	Confirmed earlier data published in Malaysian National Statistics. Sharks

	at project sites.	and rays were not targeted and contributed to less than 2% of total marine landing.
4.	Information on relative dominance of the different species of sharks and rays obtained.	Increased awareness of needs and measures of shark conservation and management on specific species.
5.	Information on the monthly fluctuation of the different species of sharks and rays obtained.	Trends of landings by species analysed for national level management.
6.	Information on usage and marketing of the landed sharks and rays were obtained from the project.	Confirmed earlier report in current NPOA-Shark that all sharks and rays are landed whole, fully utilized with no finning activities onboard vessels.
7.	A report on landing of sharks and rays up to species level from two sites in Perak and Sabah respectively.	Data recording on sharks and rays will be improved from generic terms 'sharks' and 'rays' to species level.
8.	Issues and problems arising from this activity identified and improvements made especially with the data collection format.	Development of the comprehensive national data collection system for sharks and rays as part of the National Plan of Action Shark.
9.	Specimens collected from sampling activities deposited for future reference.	A national repository for elasmobranchs has been established at the Fisheries Research Institute, Kg. Acheh, Perak and Fisheries Research Centre, Likas, Kota Kinabalu.

4.0 CONCLUSION

A project on recording landing data of sharks and rays up to species level was conducted in one district in the state of Perak and Sabah respectively. During this project, 12 staffs from Department of Fisheries Malaysia and Department of Fisheries Sabah trained in taxonomy and in data collection using the agreed regional format. One facing the Straits of Malacca, namely Larut Matang in Perak and Kota Kinabalu in Sabah were selected as the study sites, as they were the main landing sites of sharks and rays in the states. The landing data were collected at seven jetties in Perak and one jetty in Sabah.

A total of 19 species of rays from two orders and four families while 10 species of sharks from two orders and four families were recorded during the study in Larut Matang, Perak. Details are shown in **Appendix II**. In terms of percentage of total marine landings, rays and sharks contributed 1.4% and 0.5% respectively.

The most abundant rays species in Larut Matang were *Neotrygon orientalis*, *Brevitrygon heterura*, *Maculabatis gerrardi*, *Telatrygon zugei*, *Maculabatis pastinacoides*, and *Hemitrygon akajei* while for sharks were *Chiloscyllium hasseltii*, *Chiloscyllium punctatum*, *Carcharhinus sorrah*, and *Atelomycterus marmoratus*.

A total of 27 species of rays from three orders and nine families while 20 species of sharks from four orders and nine families were recorded during the study period in Kota Kinabalu, Sabah. Details are shown in **Appendix II**. The landings of rays and sharks were also minimal, with the contribution of 0.9% and 0.3% respectively from the total marine landings. These figures confirmed earlier data as published in Malaysian National Statistics that sharks and rays were only by-catch and not targeted and contributed less than 2% of the total marine landings.

The most abundant rays species in Kota Kinabalu were *Neotrygon orientalis* followed by *Telatrygon zugei*, and *Maculabatis gerrardi* while the most common rays species were *Brevitrygon heterura* followed by *Rhinobatos borneensis*, and *Gymnura poecilura*. For sharks, the most abundant species were *Chiloscyllium punctatum* followed by *Chiloscyllium plagiosum*, and *Atelomycterus marmoratus*.

In Perak, sharks and rays were mainly caught by trawl nets. Other gears used were longlines and drift nets. Whilst in Sabah, trawl net is the main gear used by fishers where sharks and rays were caught together with other marine catches.

The top three CPUE (kg/haul) for rays species captured by trawl net operated in Zone C in Perak were dominated by *Neotrygon orientalis*, *Maculabatis gerrardi*, and *Brevitrygon heterura* while for sharks were dominated by *Chiloscyllium hasseltii*, *Chiloscyllium punctatum*, and *Carcharhinus sorrah*.

The top 10 CPUE for rays and sharks captured by trawl net in Kota Kinabalu were determined in Zone 3 and Zone 4 separately. However, the top three ray species were in the same order for both zones where *Neotrygon orientalis* topped the list followed by *Maculabatis gerrardi*, and *Telatrygon zugei*. The top three CPUE for shark species were also in the same order for both Zone 3 and Zone 4. Species *Chiloscyllium punctatum* topped the list followed by *Chiloscyllium plagiosum*, and *Carcharhinus sorrah*.

Usage and marketing information from this study confirmed that all sharks and rays were landed whole, fully utilized without finning activities on board of vessels.

5.0 FUTURE ACTIVITIES

Malaysia is highly committed in managing and conserving its sharks and rays. Some future activities had been underlined, as follows;

- i. Continuing to record landing data up to species level at the existing sites.
- ii. Extending the program to other states in Malaysia.
- iii. Seeking national funding to:
 - a. Continue the sharks data collection program.
 - b. Conduct training/courses at national level.
 - c. Attend meetings and seminars at national and international level.
 - d. Conduct public awareness.

- e. Publish materials (posters, templates, identification manuals).
- iv. Using the current program finding to:
 - a. Conduct Non-Detriment Findingd (NDFs) study on sharks.
 - b. Rectify various issues concerning sharks management at national and international level.
 - c. Provide input for the next Malaysia NPOA-Shark.
- v. Conducting training for fisheries staff on sharks data collection (SEAFDEC, Terengganu and on-sites).
- vi. Continuing public awareness campaign, such as on the current regulation on listing on endangered species, government policy on not serving shark fin soup during official events and rectifying the misconception of ‘shark finning’ and ‘shark fishing’ terms.
- vii. Enhancing enforcement capacity through relevant training, such as the identification of sharks and rays species and its parts.
- viii. Expending the ongoing study on the usage and marketing, as well as the socioeconomy related to sharks and rays in Sabah, to other states of Malaysia.

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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		Mild/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		(m)	Size of Hook		(cm)
Time of Operation/day		(hours)	Vessel Speed		(knot)

 Longline

Total No of Hooks		(m)	Size of Hook		(cm)
Length of Mainline		(km)	Fishing Layer		Mild/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 (shark and ray) if catch is less than 50 tails or 10 – 20% of the landed catch if more than 50 individuals. 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 Nurkidae. Measure Disc Length-Weight for other ray species.
5. Measure Pre Caudal Length (PCL) for Alopias spp or other sharks and rays (Rhynchobatidae, Rhinidae, Rhinobatidae) if tail damage or cut.
6. Record total weight of all sharks and rays by species.
7. Record total weight of commercial bony fish and trash fish.

B. Length-weight of sharks

No	Species	Sex	TL	Weight (kg)

C. Actual Weight of Sharks by Species

No	Species	Weight (kg)

D. Length-weight of Rays

No	Species	Sex	DL or DW	Weight (kg)

E. Actual Weight of Rays by Species

No	Species	Weight (kg)

Note:

All sharks and rays specimens should be measured and weighted if total number are less than 50 individuals/boat.

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

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 Rays and Sharks Species Recorded During Study Period

Batoids/Rays			
No.	ORDER MYLIOBATIFORMES	Larut Matang	Kota Kinabalu
	Family Dasyatidae		
1	<i>Bathytoshia cf lata</i>		+
2	<i>Brevitrygon heterura</i>	+	+
3	<i>Hemitrygon akajei</i>	+	+
4	<i>Hemitrygon parvonigra</i>		+
5	<i>Himantura leoparda</i>	+	+
6	<i>Himantura uarnak</i>		+
7	<i>Himantura undulata</i>	+	+
8	<i>Maculabatis gerrardi</i>	+	+
9	<i>Maculabatis pastinacoides</i>	+	
10	<i>Neotrygon orientalis</i>	+	+
11	<i>Pastinachus ater</i>		+
12	<i>Pastinachus gracilicaudus</i>		+
13	<i>Pastinachus solocirostris</i>	+	
14	<i>Pastinachus stellurostris</i>	+	
15	<i>Pateobatis fai</i>	+	+
16	<i>Pateobatis jenkinsii</i>	+	+
17	<i>Pateobatis uarnacoides</i>	+	
18	<i>Taeniura lymma</i>	+	+
19	<i>Telatrygon zugei</i>	+	+
	Family Gymnuridae		
20	<i>Gymnura japonica</i>	+	+
21	<i>Gymnura poecilura</i>	+	+
	Family Mobulidae		
22	<i>Mobula japonica</i>		+
23	<i>Mobula thurstoni</i>		+
	Family Myliobatidae		
24	<i>Aetobatus ocellatus</i>		+
25	<i>Aetomylaeus vespertilio</i>		+
	Family Rhinopteridae		
26	<i>Rhinoptera javanica</i>		+
27	<i>Rhinoptera jayakari</i>		+
	Family Urolophidae		
28	<i>Urolophus expansus</i>		+
	ORDER RHINOPRISTIFORMES		
	Family Rhinidae		
29	<i>Rhynchobatus australiae</i>	+	+
30	<i>Rhynchobatus springeri</i>	+	
	Family Rhinobatidae		
31	<i>Rhinobatos borneensis</i>	+	+
	ORDER TORPEDINIFORMES		
	Family Narcinidae		
32	<i>Narcine brevilabiata</i>		+
	Total ray species	19	27

Sharks			
No.	ORDER CARCHARHINIFORMES	Larut Matang	Kota Kinabalu
	Family Carcharhinidae		
1	<i>Carcharhinus amblyrhynchoides</i>		+
2	<i>Carcharhinus brevipinna</i>	+	+
3	<i>Carcharhinus leucas</i>	+	
4	<i>Carcharhinus melanopterus</i>		+
5	<i>Carcharhinus plumbeus</i>		+
6	<i>Carcharhinus sealei</i>		+
7	<i>Carcharhinus sorrah</i>	+	+
8	<i>Galeocerdo cuvier</i>	+	+
9	<i>Loxodon macrorhinus</i>		+
10	<i>Triaenodon obesus</i>		+
	Family Hemigaleidae		
11	<i>Hemipristis elongata</i>		+
12	<i>Hemigaleus microstoma</i>		+
	Family Scyliorhinidae		
13	<i>Atelomycterus erdmanni</i>	+	
14	<i>Atelomycterus marmoratus</i>	+	+
15	<i>Halaehurus buergeri</i>		+
	Family Sphyrnidae		
16	<i>Sphyrna lewini</i>	+	+
	Family Triakidae		
17	<i>Mustelus manazo</i>		+
	ORDER LAMNIFORMES		
	Family Alopiidae		
20	<i>Alopias pelagicus</i>		+
	ORDER ORECTOLOBIFORMES		
	Family Ginglymostomatidae		
19	<i>Nebrius ferrugineus</i>		+
	Family Hemiscylliidae		
20	<i>Chiloscyllium hasseltii</i>	+	
21	<i>Chiloscyllium indicum</i>	+	
22	<i>Chiloscyllium plagiosum</i>		+
23	<i>Chiloscyllium punctatum</i>	+	+
	ORDER SQUALIFORMES		
	Family Squalidae		
24	<i>Squalus altipinnis</i>		+
	Total shark species	10	20

List of Range Size of Small, Medium, and Big by Species (in cm)

Disc length for all rays (except for species in family Narcinidae, Rhinidae, and Rhinobatidae) and total length for all sharks species.

No.	Species	Larut Matang, Perak			Kota Kinabalu, Sabah		
		Small	Medium	Big	Small	Medium	Big
	Rays						
	Family Dasyatidae						
1	<i>Bathytoshia cf lata</i>				< 76.7	76.7	> 76.7
2	<i>Brevitrygon heterura</i>	< 13.5	13.5 – 29	> 29	< 17.2	17.2 – 25.8	> 25.8
3	<i>Hemitrygon akajei</i>	< 26	26 – 64	> 64	< 29.8	29.8 – 134.5	> 134.5
4	<i>Hemitrygon parvonigra</i>				< 19.2	19.2 – 134.2	> 134.2
5	<i>Himantura leoparda</i>	< 103	103	> 103	< 36	36 – 106	> 106
6	<i>Himantura uarnak</i>				< 22.6	22.6 – 103	> 103
7	<i>Himantura undulata</i>	< 65	65 – 142	> 142	< 82.3	82.3 – 147.1	> 147.1
8	<i>Maculabatis gerrardi</i>	< 17	17 – 95	> 95	< 15.9	15.9 – 84.2	> 84.2
9	<i>Maculabatis pastinacoides</i>	< 26	26 – 93	> 93			
10	<i>Neotrygon orientalis</i>	< 14	15 – 33	> 33	< 12	12 – 102.3	> 102.3
11	<i>Pastinachus ater</i>				< 238	238	> 238
12	<i>Pastinachus gracilicaudus</i>				< 31	31 – 106.8	> 106.8
13	<i>Pastinachus solocirostris</i>	< 71	71	> 71			
14	<i>Pastinachus stellurostris</i>	< 36	36	> 36			
15	<i>Pateobatis fai</i>	< 69	69 – 125	> 125	< 35.8	35.8 – 78.7	> 78.7
16	<i>Pateobatis jenkinsii</i>	< 27	27 – 65	> 65	< 30.5	30.5 – 81.7	> 81.7
17	<i>Pateobatis uarnacoides</i>	< 35	35 – 43	> 43			
18	<i>Taeniura lymma</i>	< 26	26	> 26	< 16.3	16.3 – 39.6	> 39.6
20	<i>Telatrygon zugei</i>	< 16	16 – 34	> 34	< 15.5	15.5 – 33	> 33
	Family Gymnuridae						
21	<i>Gymnura japonica</i>	< 20	20 – 39	> 39	< 20.2	20.2 – 88.1	> 88.1
22	<i>Gymnura poecilura</i>	< 15	15 – 26	> 26	< 17.8	17.8 – 82.2	> 82.2
	Family Mobulidae						
23	<i>Mobula japanica</i>				< 45.9	45.9 – 100.8	> 100.8
24	<i>Mobula thurstoni</i>				< 45.3	45.3 – 99.5	> 99.5
	Family Myliobatidae						
25	<i>Aetobatus ocellatus</i>				< 50.7	50.7 – 170.3	> 170.3
26	<i>Aetomylaeus vespertilio</i>				< 38.2	38.2 – 72.5	> 72.5
	Family Narcinidae						
27	<i>Narcine brevilibiata</i>				< 39.8	39.8 – 107.5	> 107.5
	Family Rhinopteridae						
28	<i>Rhinoptera javanica</i>				< 17.3	17.3 – 72.5	> 72.5
29	<i>Rhinoptera jayakari</i>				< 28.3	28.3 – 67.8	> 67.8
	Family Urolophidae						
30	<i>Urolophus expansus</i>				< 18.7	18.7 – 24.5	> 24.5
	Family Rhinidae						
21	<i>Rhynchobatus australiae</i>	< 47	47 – 160	> 160	< 49.5	49.5 – 130	> 130
32	<i>Rhynchobatus springeri</i>	< 140	140 – 295	> 295			
	Family Rhinobatidae						
33	<i>Rhinobatos borneensis</i>	< 58	58 – 87	> 87	< 40.3	40.3 – 170.3	> 170.3

No.	Sharks	Larut Matang, Perak			Kota Kinabalu, Sabah		
	Family Carcharhinidae	Small	Medium	Big	Small	Medium	Big
1	<i>Carcharhinus amblyrhynchoides</i>				< 61.8	61.8	> 61.8
2	<i>Carcharhinus brevipinna</i>	< 78	78 – 97	> 97	< 89	89 – 91.7	> 91.7
3	<i>Carcharhinus leucas</i>	< 82	82 – 148	> 148			
4	<i>Carcharhinus melanopterus</i>				< 47.5	116.5 – 135.5	> 135.5
5	<i>Carcharhinus plumbeus</i>				< 55.5	55.5 – 107.8	> 107.8
6	<i>Carcharhinus sealei</i>				< 43.7	43.7 – 82.2	> 82.2
7	<i>Carcharhinus sorrah</i>	< 42	42 – 147	> 147	< 51	51 – 127	> 127
8	<i>Galeocerdo cuvier</i>	< 77	77 – 99	> 99	< 147.1	147.1	> 147.1
9	<i>Loxodon macrorhinus</i>				< 50.5	50.5 – 107.5	> 107.5
10	<i>Triaenodon obesus</i>				< 70	70	> 70
	Family Hemigaleidae						
11	<i>Hemipristis elongata</i>				< 45.3	45.3 – 99.5	> 99.5
12	<i>Hemigaleus microstoma</i>				< 45.9	45.9 – 100.8	> 100.8
	Family Scyliorhinidae						
13	<i>Atelomycterus erdmanni</i>	< 47	47 – 55	> 55			
14	<i>Atelomycterus marmoratus</i>	< 36	36 – 60	> 60	< 38.2	38.2 – 72.5	> 72.5
15	<i>Halaelurus buergeri</i>				< 42.3	42.3 – 45.6	> 45.6
	Family Sphyrnidae						
16	<i>Sphyrna lewini</i>	< 45	45 – 70	> 70	< 48.7	48.7 – 106.8	> 106.8
	Family Triakidae						
17	<i>Mustelus manazo</i>				< 64.3	64.3 – 107.6	> 107.6
	Family Alopiidae						
18	<i>Alopias pelagicus</i>				< 162.5	162.5 – 170.3	> 170.3
	Family Ginglymostomatidae						
19	<i>Nebrius ferrugineus</i>				< 238	238	> 238
	Family Hemiscylliidae						
20	<i>Chiloscyllium hasseltii</i>	< 38	42 – 85	> 85			
21	<i>Chiloscyllium indicum</i>	< 46	46 – 58	> 58			
22	<i>Chiloscyllium plagiosum</i>				< 36	36 – 88.6	> 88.6
23	<i>Chiloscyllium punctatum</i>	< 32	32 – 95	> 95	< 41.7	41.7 – 105.5	> 105.5
	Family Squalidae						
24	<i>Squalus altipinnis</i>				< 35.8	35.8 – 75.3	> 75.3

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