BYCATCH OF ENDANGERED, THREATENED AND PROTECTED SPECIES IN THE COASTAL ARTISANAL FISHERY OF SURINAME

2015-2016

Report compiled by KIM SYS for WWF GUIANAS

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CONTENTS

1 SUMMARY

Suriname is a country located in the North of South America and due to the nutrient-rich Amazon River effluents, Surinamese coastal waters are very productive, supporting a variety of fish stocks, which constitute a valuable source of employment, income and protein supply for coastal communities. Whilst fishermen target certain species of appreciated and marketable fish, the bycatch of unwanted species is inevitable. Marine turtles, sharks and rays are prone to bycatch in fisheries. Since these species are predominantly slow-growing, late-maturing and long-lived they are vulnerable to overexploitation and slow to recover. WWF Guianas has been monitoring for bycatch of endangered, threatened and protected (ETP) species in the coastal artisanal fisheries in the Suriname since 2006. This report presents the analysis of the data for the monitoring efforts in 2015-2016.

Artisanal fishermen can fish in rivers, river mouths and close to the coast up to a depth of 9 fathoms. These fishermen apply different techniques to target a variety of fishes. This study focusses on the most common techniques: drift nets, longlines and njawarie. The artisanal fleet consists of more than 400 fishing vessels which land their catches at various landing sites along the Suriname river in Paramaribo and at small fishing harbors along the coast, which makes this sector a difficult branch in terms of data collection. For this study, a group of data collectors were especially trained to closely monitor the (by)catch of a number of ETP species by a sample of the artisanal fleet. The selected group monitored the catches and/or landings and interviewed fishermen at five different landing sites in Paramaribo.

Analysis of these data resulted in landing profiles of target species for the fishing techniques under focus in this study. The bycatch of a selection of shark, ray and sea turtle species were also analyzed. Extrapolation of these data to the entire coastal artisanal fleet of Suriname, resulted in an estimation of the annual ETP bycatch per fishing technique. Results are alarming; annually, more than 4,000 sea turtles, over 130,000 sharks and almost 130,000 rays are being entangled by the Surinamese coastal artisanal fleet. Moreover, we can assume that the extrapolated data is an underestimation of the real situation. There are signs that IUU fishing occurs in Surinamese coastal waters. Additionally, fishermen are also not likely to share accurate data when it comes to bycatch of sensitive species like sea turtles.

Based on this study, we can state that various shark, ray and sea turtle species are indeed impacted by the coastal artisanal fishery in Suriname. A reduction of this impact needs our full focus and attention. We need to take actions to find sustainable solutions to reduce the bycatch of this sensitive species, together with the fishing sector, partner NGO's, policy-makers, academics, etc. Detailed bycatch data are extremely valuable to do impact analysis and time series can give an idea if impacts are changing over time. Therefore, it is important to continue bycatch monitoring efforts by WWF Guianas and its partners.

2 INTRODUCTION

2.1 GOAL OF THE STUDY

Suriname is a country located in the North of South America; it borders Guyana, Brazil, French Guiana and the North-West Atlantic Ocean (Figure 1).Surinamese coastal waters are very productive, receiving nutrient-rich Amazon River effluents due to the Guiana Current, which flows west-ward along the coast. The Surinamese shelf waters support a variety of fish stocks, which constitute a valuable source of employment, income and protein supply for coastal communities. Whilst fishermen target certain species of appreciated and marketable fish, the bycatch of unwanted species is inevitable. This bycatch is sometimes landed, but often thrown back into the sea, either dead or alive. Marine turtles, sharks and rays are prone to bycatch in fisheries. Since these species are predominantly slow-growing, late-maturing and long-lived they are vulnerable to overexploitation and slow to recover. Survival of large juveniles and sexually mature adults is critical to maintenance or recovery of these populations.

WWF Guianas has implemented a long-standing sustainable fisheries programme in the Guianas focusing predominantly on endangered, threatened and protected (ETP) species bycatch reduction in both industrial and artisanal fisheries, and addressing illegal fishing. WWF has been monitoring for bycatch of ETP species in the coastal artisanal fishery of Suriname since 2006. This report presents the results for the monitoring efforts in 2015-2016. While all fishing activities in Suriname struggle with bycatch, the monitoring activities focus on the artisanal coastal fishery, which is responsible for most of the landings across the country. The aim of this study is to estimate the impact of this fishing sector on the ETP species occurring in Surinamese coastal waters. The results can be used to advice policy-makers on mitigation measures to protect those valuable marine species.

Figure 1: Location of Suriname.

2.2 THE COASTAL ARTISANAL FISHERY OF SURINAME

The Surinamese fishing fleet can be divided into two sectors: the artisanal sector and the industrial sector. The artisanal sector lands over 50% of the total volume of fish (Yspol 2018). The fisheries department of the ministry of agriculture, animal husbandry and fisheries (LVV) uses depth lines to define the areas where fishermen can operate, depending on their fishing technique (Figure 2). Artisanal fishermen can fish in rivers, river mouths and close to the coast up to a depth of 9 fathoms. These fishermen apply different techniques to target a variety of fishes. This study focusses on the most common techniques: drift nets, longlines and njawarie. The characteristics of these techniques are elaborated below.

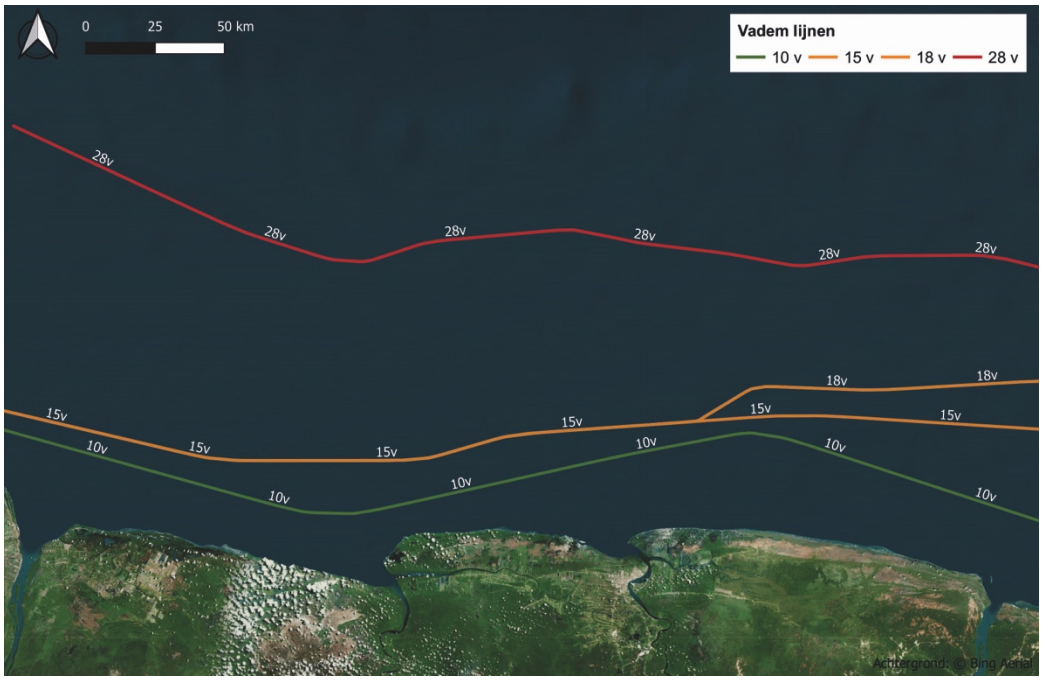

Figure 2: Depth lines used to define fishing zones for the Surinamese fishing sector.

2.2.1 DRIFT NETS

Drift nets (or drift seines) are gill nets that are kept horizontally in the water column with floats (buoys) on the headrope and weights (lead) on the groundrope. The nets drift with the current close to the surface, in the middle of the water column or close to the bottom, depending on the target species. The fish get stuck in the net with their gills or whole body when they encounter a net and want to swim through (Figure 3).

The drift nets generally have a mesh size between 5 and 8 inches. According to national legislation, maximum 30% of the net can have a mesh size of 5/6 inches. The target species of this fishery are green weakfish (local name: kandratiki), acoupa weakfish (local name: bang bang) and crucifix sea catfish (local name: koepila). The drift net technique is operated with two different types of boats: the open Guyana boat and the decked Guyana boat. Both open and decked Guyana boats have Surinamese fishing vessel license numbers that start with SK and are therefore referred as “SK boats” (Visserij, Handleiding voor visserij-inspectie op zee 2017)

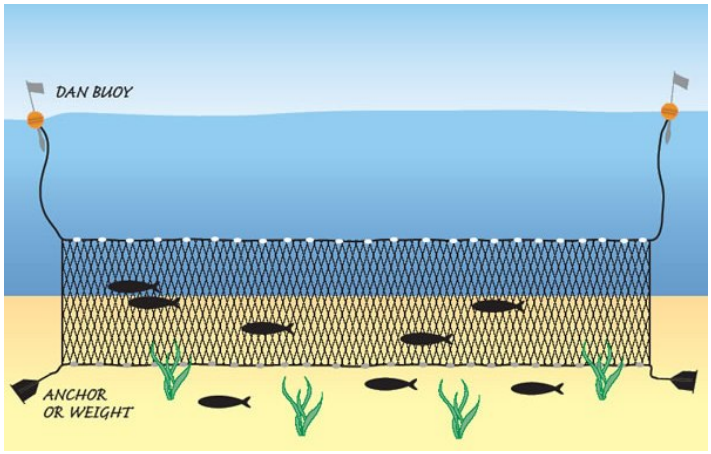

Figure 3: Illustration of a bottom set gillnet (Source: http://www.nirmalagroup.in/portfolio_category/fishing-methords/).

DRIFT NETS WITH OPEN GUYANA BOATS (gillnet SK-OG) (Figure 4 - right) are wooden boats (ca. 15 m overall length, ca. 2.8 m width) with an isolated room for ice/fish storage (avg. 3-4 ton), operating with an outboard motor (ca. 40-50 HP). According to national legislation, the drift nets of the open guyana boats must not exceed 3 km in total length and the fishing area is restricted to the zone between the 5 and the 9 fathoms depth line. When the total length of the drift does not exceed 2 km, fishermen are allowed to operate in the zone between the coast and the 5 fathoms depth line (LVV, Vastelling aantal visvergunningen, visgunningsvoorwaarden en de hoogte van de visgunningsrechten voor het dienstjaar 2018 2018). This fishing technique will be further in this study referred to as "gillnet SK-OG".

DRIFT NETS WITH DECKED GUYANA BOATS (gillnet SK-GG) (Figure 4 - left) are basically constructed the same way as the open guyana boats but have an extra enclosed cabin and are generally larger (ca. 18 m overall length, ca. 3.8 m width) and have a larger storage capacity (ca. 6 ton), operating with an inboard engine with a higher power (ca. 125 HP). Decked guyana boats make longer fishing trips due to the larger storage capacity. According to national legislation, the drift nets of the decked guyana boats must not exceed 4 km in total length and the fishing area is restricted to the zone between the 5 and the 9 fathoms depth line. When the total length of the drift does not exceed 2 km, fishermen are allowed to operate in the zone between the coast and the 5 fathoms depth line (LVV, Vastelling aantal visvergunningen, visgunningsvoorwaarden en de hoogte van de visgunningsrechten voor het dienstjaar 2018 2018). This fishing technique will be further in this study referred to as "gillnet SK-GG".

DRIFT NETS FOR BANGAMARY (gillnet SKB). There is another type of drift net fishery targeting king weakfish (local name: bangamary) and smalleye croaker (local name: botervis). These boats have Surinamese vessel license numbers that start with SKB ("B" from bangamary) and are referred to as "SKB boats". The mesh size restriction differs from the "SK boats"; the minimum mesh size is 3 inches (77.5 mm). These boats can only operate between the 3 and 5 fathoms water depth line with a maximum total net length of 1500 meters. The vessels are usuallly from the open guyana boat type (LVV, Vastelling aantal visvergunningen, visgunningsvoorwaarden en de hoogte van de visgunningsrechten voor het dienstjaar 2018 2018). This fishing technique will be further in this study referred to as "gillnet SKB".

Figure 4: Decked (left) and open (right) Guyana boats used by the Surinamese drift net fishery (Source: Madarie).

2.2.2 LONGLINES

Longlines are long fishing lines with hooked cross lines (Figure 5). The lines have a total length of circa 2000 meters. These fishermen can fish up to the 9 fathoms water depth line (LVV, Vastelling aantal visvergunningen, visgunningsvoorwaarden en de hoogte van de visgunningsrechten voor het dienstjaar 2018 2018).

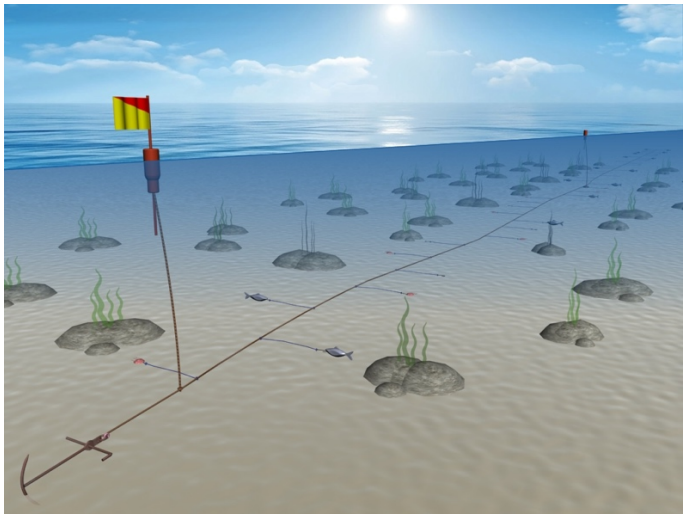

Figure 5: Illustration of demersal longlines (Source: https://seafish.org/gear/gear/profile/long-line).

2.2.3 NJAWARIE

Njawarie (or pin seine fishery) is a traditional way of fishing close to the coast. According to national legislation, nets with a total length of maximum 3000 meters may be employed parallel to the coastline; the fishing nets must have mesh sizes of minimum 2 inches (50 mm). The nets are set on mud banks during high tide close to the low water line. The nets are placed in a semi-circle using wooden sticks. When the tide changes, fish gets suck in the nets and are being collected by fishermen (Figure 6). The target species are acoupa weakfish (local name: bang bang), crucifix sea catfish (local name: koepila), king weakfish (local name: bangamary) and smalleye croaker (local name: botervis). These fishermen are allowed to operate up to the 5 fathoms water depth line. These fishermen use a korjaal or an open guyana boat type (Visserij, Handleiding voor visserij-inspectie op zee 2017) (LVV, Vastelling aantal visvergunningen, visgunningsvoorwaarden en de hoogte van de visgunningsrechten voor het dienstjaar 2018 2018).

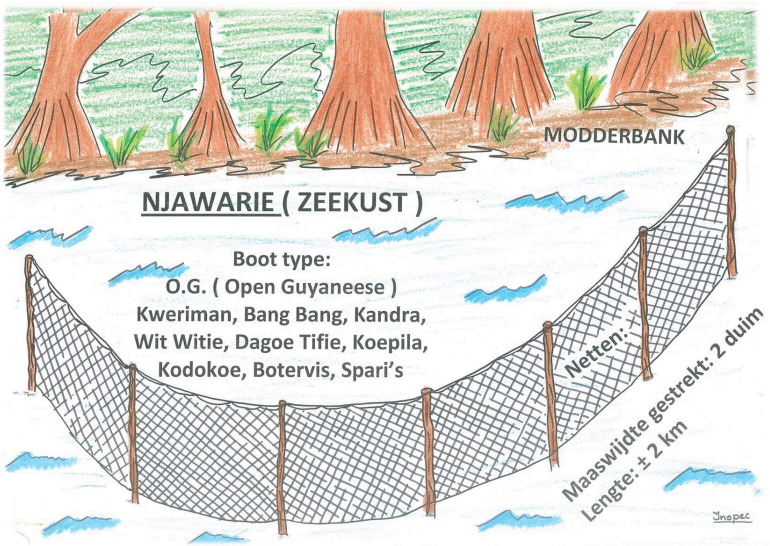

Figure 6: Illustration of the Njawarie fishing technique (Source: LVV).

3 METHODOLOGY

3.1 THE FORM "BIJVANGST MONITORING 2015-2016"

The artisanal fleet consists of more than 400 fishing vessels which land their catches at various landing sites along the Suriname river in Paramaribo and at small fishing harbors along the coast. Therefore, the artisanal fishing sector is a difficult branch of the Surinamese fishery in terms of data collection. The Fisheries Department of the Ministry of Agriculture, Animal Husbandry and Fisheries (LVV) employs several data collectors to collect catch and effort data of the artisanal fleet. These data collectors are stationed in the major landing locations. For the current study, a group of data collectors were especially trained to closely monitor the (by)catch of a number of ETP species by the artisanal fleet. The selected group monitored the landings and interviewed fishermen at five different landing sites in Paramaribo: Cevihas, Waldring, Azaad, Bisoen and Nieuw Amsterdam. The location of these landing sites is illustrated on a map in Figure 7.

Figure 7: Location of the five landing sites where data for this study was collected.

The data collectors used the form 'bijvangst monitoring 2015-2016' to collect the data in a structured way (Annex 7.1). Table 1 summarizes the data which is collected in this form. The form also includes an illustration of the coast of Suriname with the demarcation of five different fishing areas: A, B, C, D and E (Figure 8). This map is used to locate the fishing operations per fishing trip.

Table 1: Data collected in the form 'bijvangst monitoring 2015-2016'.

INFO DATA COLLECTOR	SEA TURTLE DATA
Date of the data collection	Sea turtle species
Name of the data collector	Number caught by species
Location of the landing site	Size
FISHING TRIP DATA	Condition
Vessel registration number	Location
Fishing technique	SHARK DATA
VMS present/absent	Shark species
Length of the fishing net (meter)	Number caught by species
Mesh size (inches)	Size
Length fishing trip (days)	Condition
12 -- 24	Location
Soaking time (hours)	RAY DATA
Capacity cooling facility (liter)	Ray species
Number of crew members	Number caught by species
FISH LANDING DATA	Size
Fish species	Condition
Total landings (kg) by fish species	Location
FISH BLADDER DATA	MAP WITH FISHING AREAS
Origin of fish species	
Volume (kg) by fish species	
REMARKS	

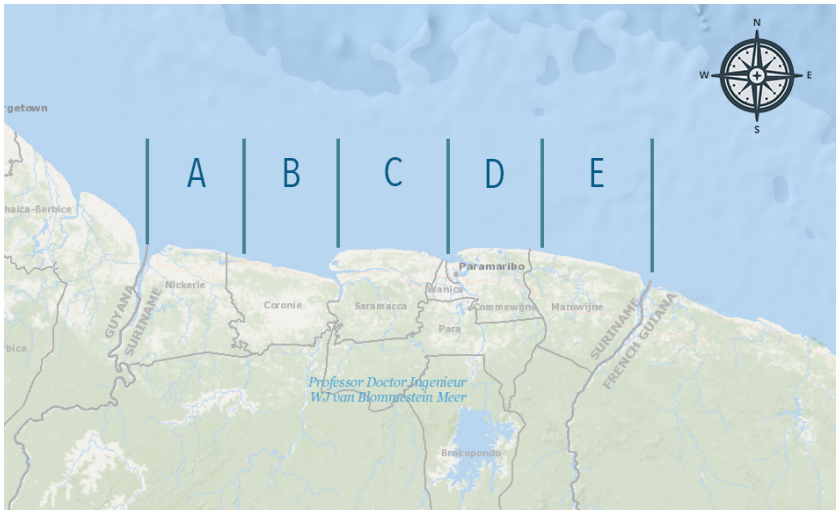

Figure 8: Map with the demarcation of the five fishing areas used in the form to identify the location of the fishing activities.

3.2 FISH SPECIES

The landings of six different fish species were monitored by the data collectors in the field: acoupa weakfish, green weakfish, crucifix sea catfish, atlantic tripletail, smalleye croaker and king weakfish. Other species were registered under the category "others". Table 2 gives on overview of these species with their local name, FAO name and scientific name. We will use the local names of these fish in the result section of this report.

Table 2: Overview of the fish species monitored in this study, with local name, FAO name and scientific name.

	SPECIES		
	LOCAL NAME	FAO NAME	SCIENTIFIC NAME
FISH	Bang bang	Acoupa weakfish	*Cynoscion acoupa*
	Kandratiki	Green weakfish	*Cynoscion virescens*
	Koepila	Crucifix sea catfish	*Hexanematichthys proops*
	Paoema	Atlantic tripletail	*Lobotes surinamensis*
	Botervis	Smalleye croaker	*Nebris microps*
	Dagoetifie	King weakfish	*Macrodon ancylodon*

3.3 BYCATCH SPECIES

The catches and/or landings of several (ETP) bycatch species were also monitored. Table 3 gives an overview of the bycatch species considered in this study with their FAO name and scientific name. The IUCN status (according to the IUCN red list taxonomy version 2017-3) of each species is mentioned.

Table 3: Overview of the bycatch species monitored in this study, with FAO name, scientific name and IUCN status.

	SPECIES		IUCN STATUS
	FAO NAME	SCIENTIFIC NAME	
SHARKS	Blacktip shark	*Carcharhinus limbatus*	NEAR THREATENED
	Silky shark	*Carcharhinus falciformis*	VULNERABLE
	Smalleye hammerhead shark	*Sphyrna tudes*	VULNERABLE
	Tiger shark	*Galeocerdo cuvier*	NEAR THREATENED
	Smalleye smoothhound	*Mustelus higmani*	LEAST CONCERN
	Nurse shark	*Ginglymostoma cirratum*	DATA DEFICIENT
RAYS	Longnose stingray	*Hypanus guttatus*	DATA DEFICIENT
	Southern stingray	*Hypanus americanus*	DATA DEFICIENT
	Sharpsnout stingray	*Fontitrygon geijskesi*	NEAR THREATENED
	Chupare stingray	*Himantura schmardae*	DATA DEFICIENT
	Smooth butterfly ray	*Gymnura micrura*	DATA DEFICIENT
SEA TURTLES	Leatherback	*Dermochelys coriacea*	LEAST CONCERN
	Green turtle	*Chelonia mydas*	ENDANGERED
	Olive ridley	*Lepidochelys olivacea*	VULNERABLE

3.4 EXTRAPOLATION OF THE DATA

To be able to extrapolate the data of this study to the entire coastal artisanal fleet of Suriname, this study uses the number of fishing licenses issued in the monitoring period and an estimation of the total number of fishing days per license per year by fishing type. These estimations were available at the Fisheries Department (personal communication, data collection unit - LVV) (Table 4). With these figures, the estimated fishing days per year by fishing type were calculated. These figures were then used to extrapolate e.g. catch per unit of effort.

Table 4: Extrapolation table.

		# fishing licenses	Estimated fishing days/license/year	Estimated fishing days/year
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	340	189	64,260
	Gillnet SKB	40	200	8,000
	Njawarie	20	189	3,780

4 RESULTS AND DISCUSSION

4.1 CHARACTERISTICS OF THE MONITORED FLEET

Between September 2015 and August 2016, a total of 568 fishing trips were monitored, resulting in a monitored effort of 6239 fishing days. The drift net fishery is mostly monitored in this study with a major contribution of the fishing type "gillnet SK – OG"; 64% of the monitored fishing trips and 69% of the monitored fishing days belong to this category (Table 5, Figure 9, Figure 10). The "longlines" and "njawarie" fishery is less studied with a share of respectively 5% and 4% of the total number of monitored trips and a share of respectively <1% and 3% of the total monitored fishing days.

Table 5: Characteristics of the monitored fishing trips.

		# monitored trips	monitored fishing days	avg. length fishing trip (days)	mesh size width (inch)	avg. soaking time (h)
FISHING TYPE	Gillnet SK - OG	362	4,302	12	5-8	6.2 h
	Gillnet SK - GG	99	1,446	15	5-8	6.5 h
	Gillnet SKB	59	269	5	3	4.0 h
	Longlines	28	30	1	N/A	4.2 h
	Njawarie	20	192	10	2	5.2 h
	TOTAL	**568**	**6,239**	N/A	N/A	N/A

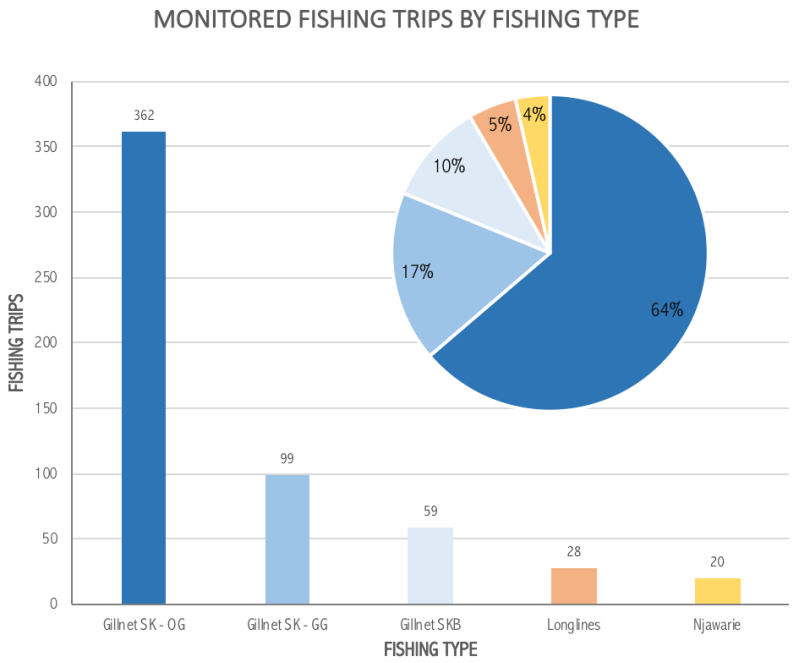

Figure 9: Distribution of the monitored fishing trips by fishing type.

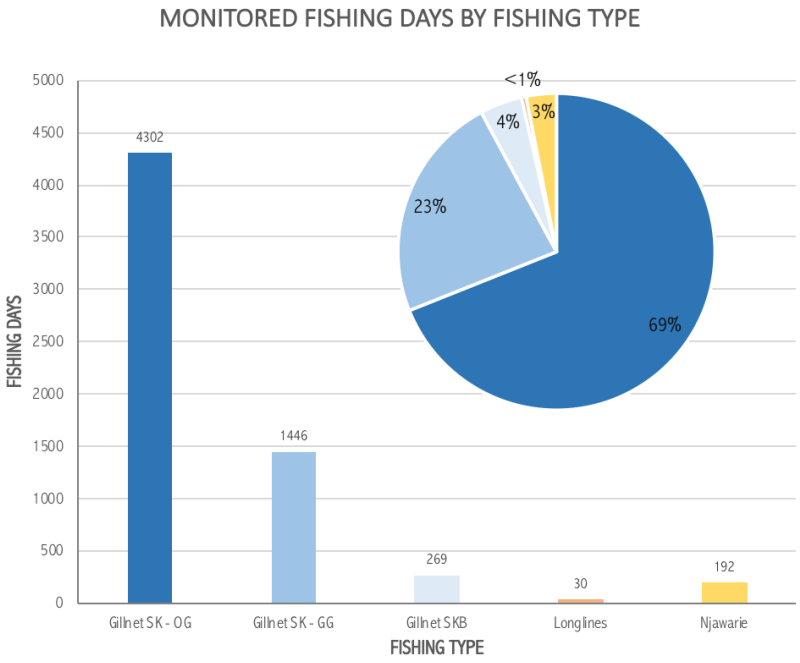

Figure 10: Distribution of the monitored fishing days by fishing type.

Fishing areas D and E are the most monitored in this study; more than 90% of the trips and fishing days originated from these areas (Table 6, Figure 11, Figure 12). Because the coverage of the others fishing areas were this low, it is not possible to analyze the influence of the location on the catch and landing data.

Table 6: Distribution of the monitored fishing trips and fishing days by fishing area.

		# monitored trips	monitored fishing days	% total monitored trip	% total monitored days
FISHING AREA	A	1	10	<1%	<1%
	B	12	137	2%	2%
	C	24	272	4%	4%
	C+D	1	5	<1%	<1%
	C+D+E	3	31	1%	<1%
	D	291	2,915	51%	47%
	D+E	88	1,139	15%	18%
	E	142	1,698	25%	27%
	ND*	6	32	1%	1%
	* ND = Not Defined; no data was provided for this parameter				

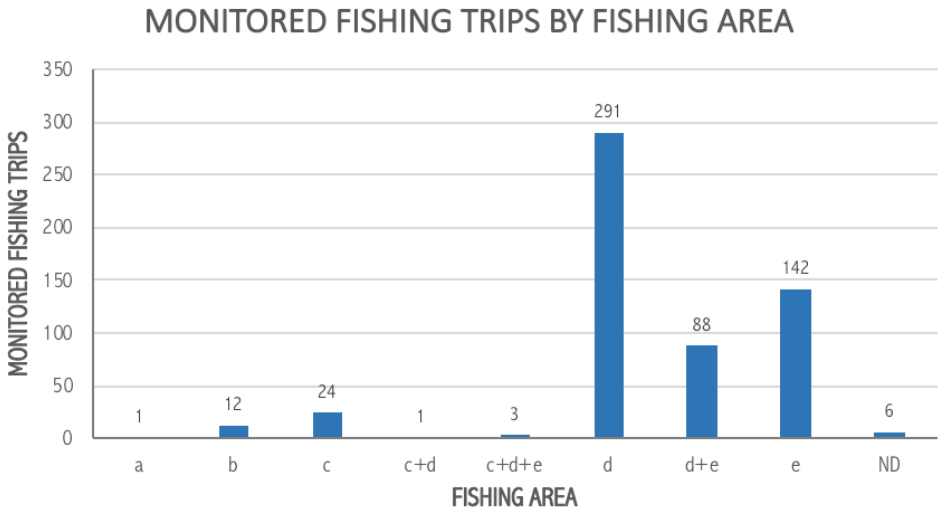

Figure 11: Distribution of the monitored fishing trips by fishing area. ND is not defined; no data was provided for this parameter.

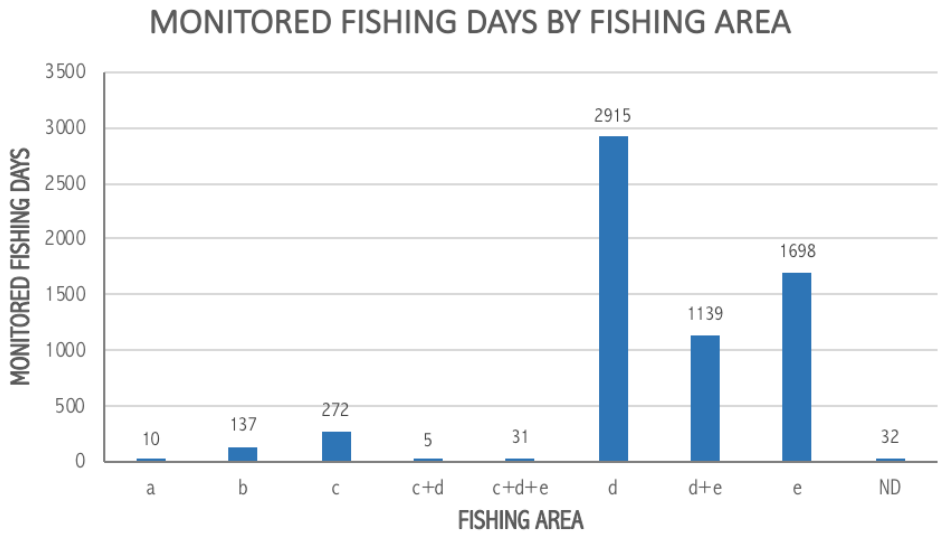

Figure 12: Distribution of the monitored fishing days by fishing area. ND is not defined; no data was provided for this parameter.

The monitoring of the fleet is rather evenly distributed over the various months (Table 7, Figure 13). September 2015 and January 2016 are less monitored then the other months of the study. The lack of monitoring in September 2015 can be explained by the start-up of the study. Due to the Christmas and New Year holidays, a lot of the Guyanese crew of the SK fleet went back to Guyana. Therefore, less vessels were active. This explains the lack of coverage in the month of January.

Table 6: Distribution of the monitored fishing trips and fishing days by fishing area.This study covers almost 10% of the total annual effort of the category “gillnet SK-OG”, “gillnet SK-GG” and “longlines”. The gillnet SKB and njawarie fishing technique are covered respectively with 3% and 5% (Table 8). It is reported that there are some irregularities in the SK fleet (Visserij, Visserij Management Plan Voor Suriname 2013). Several vessels would fish under the same license number. This results in an underestimation of the total SK fleet, their fishing effort and consequently the fishing impact.

Table 7: Distribution of the monitored fishing trips and fishing days by month.

		# monitored trips	monitored fishing days	% total monitored trips	% total monitored days
2015	SEP	28	311	5 %	5 %
	OKT	46	500	8 %	8 %
	NOV	45	456	8 %	7 %
	DEC	55	598	10 %	10 %
2016	JAN	33	334	6 %	5 %
	FEB	44	461	8 %	7 %
	MAR	58	641	10 %	10 %
	APR	49	532	9 %	9 %
	MAY	47	516	8 %	8 %
	JUN	50	592	6 %	9 %
	JUL	59	645	10 %	10%
	AUG	54	653	10 %	10 %
	TOTAL	**568**	**6,239**	**100 %**	**100 %**

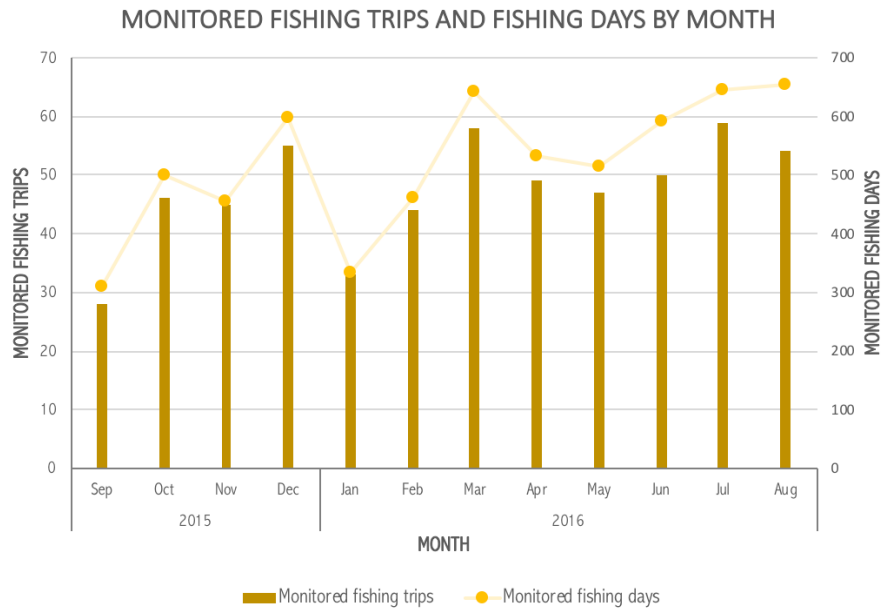

Figure 13: Distribution of the monitored fishing trips and fishing days by month.

Table 8: Number of fishing licenses, estimated fishing days and fishing effort coverage by fishing type.

		# fishing licenses	Estimated fishing days/license/year	Estimated fishing days/year	Fishing effort covered by this study
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	340	189	64,260	9%
	Gillnet SKB	40	200	8,000	3%
	Njawarie	20	189	3,780	5%

4.2 LANDING PROFILES

In the gillnet SK fishery, bang bang, kandratikie and koepila dominated the landings and represented almost 90% of the total landings (Table 9, Figure 14). The gillnet SKB fishery is targeting dagoetifie which is reflected in the landing profile. Apart from the dagoetifie, botervis is also a major fish species in the landings; together they represent almost 80% of the total landings. 42% of the catch in the artisanal longline fishery consists of koepila, 55% are other fish species. Within these other fish species, the barbaman (Coco sea catfish or *Bagre bagre*) is the most common. In the njawarie fishery, the koepila and paoema dominate the landings.

Fishermen generally collect the bladder of two fish species: bang bang and kandratikie (Table 10). In general, fish bladders are not landed with the fish, which makes estimations of landings quite difficult. The data that has been collected on fish bladder landings is therefore likely underestimated.

Table 9: Overview of the landings of fish by species and by fishing type.

		LANDINGS OF FISH							
		BANG BANG	KANDRATIKI	KOEPILA	PAOEMA	BOTERVIS	DAGOETIFIE	OTHERS	TOTAL CATCH
FISHING TYPE	Gillnet SK	239,108 kg	213,136 kg	94,987 kg	11,748 kg	0 kg	56 kg	57,600 kg	616,635 kg
		39 %	34 %	15 %	2 %	0 %	0 %	9 %	100 %
	Gillnet SKB	1,789 kg	12,366 kg	1,484 kg	306 kg	21,533 kg	56,463 kg	5,844 kg	99,785 kg
		2 %	12 %	1 %	0 %	22 %	57 %	6 %	100 %
	Longlines	357 kg	3 kg	5,116 kg	0 kg	0 kg	0 kg	6,782 kg	12,258 kg
		3 %	0 %	42 %	0 %	0 %	0 %	55 %	100 %
	Njawarie	52 kg	2,504 kg	13,292 kg	6,235 kg	25 kg	1,255 kg	820 kg	24,183 kg
		0 %	10 %	55 %	26 %	0 %	5 %	3 %	100 %

Table 10: Overview of the landings of fish bladder by species and by fishing type.

		CATCH OF FISH BLADDER		
		BANG BANG	KANDRATIKI	TOTAL CATCH
FISHING TYPE	Gillnet SK	3,840 kg	5,044 kg	8,883 kg
	Gillnet SKB	12 kg	219 kg	231 kg

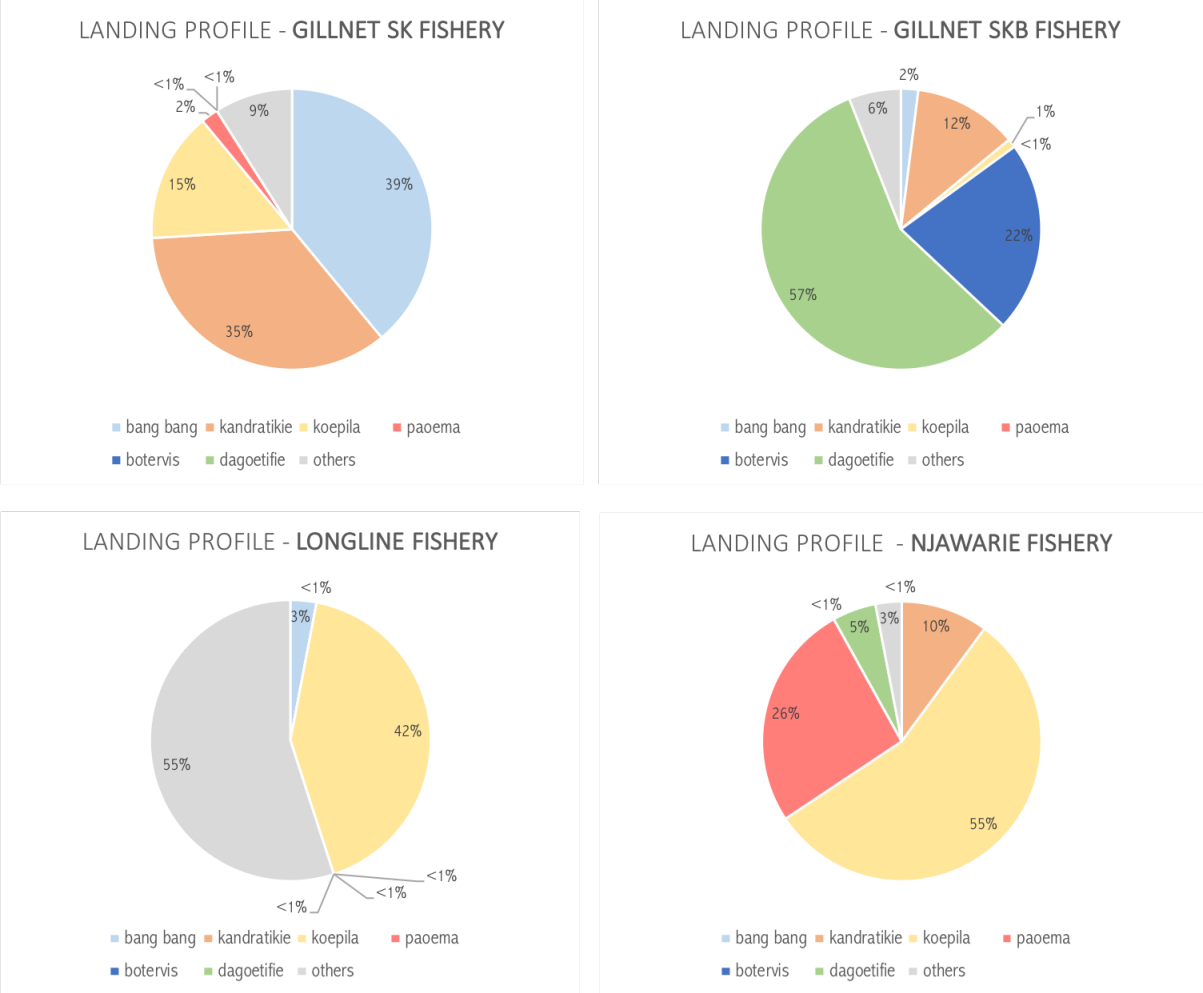

Figure 14: Landing profiles by fishing type.

4.3 BYCATCH ANALYSIS

The bycatch of 10,942 sharks, 9,239 rays and 342 turtles were reported in this study (Table 11, Figure 15). The following sections analyze these data by species group.

Table 11: Bycatch species encounters and monitored fishing days.

		NUMBER OF BYCATCH SPECIES ENCOUNTERS			MONITORED FISHING DAYS
		SHARKS	RAYS	TURTLES	
2015	SEP	745	490	6	311
	OKT	600	2,418	1	500
	NOV	1,001	859	0	456
	DEC	1,491	740	5	598
2016	JAN	518	345	22	334
	FEB	878	467	47	461
	MAR	1,435	694	86	641
	APR	754	275	83	532
	MAY	946	154	50	516
	JUN	704	550	13	592
	JUL	897	549	20	645
	AUG	973	1,662	9	653
	TOTAL	**10,942**	**9,239**	**342**	**6,239**

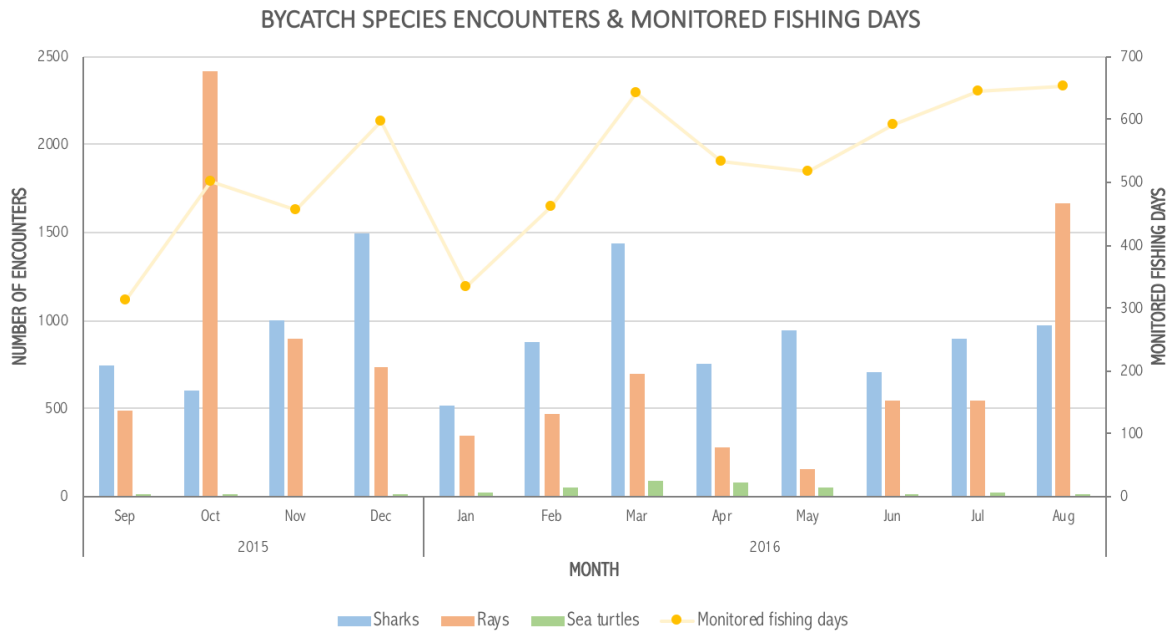

Figure 15: Bycatch species encounters and monitored fishing days.

4.3.1 BYCATCH OF SEA TURTLES

The entanglement of sea turtles peaked from March to May (Table 12, Figure 16). The peaks are also species-dependent. Most of the leatherbacks and green turtles were caught in April, whilst olive ridley was mostly caught in March. The green turtle and leatherback make up most of the sea turtles catches, the olive ridley is less encountered; 40% of the entanglements were green turtles, 37% leatherbacks and 24% olive ridleys (Figure 17).

Fishermen participating in this study also recorded the condition of the sea turtle (dead or alive). Most of them reported the sea turtles to be still alive when they were found entangled in the fishing nets. Only 7 % of the leatherback and green turtle were encountered dead, all olive ridleys were encountered alive (Figure 18).

It is estimated that the total Surinamese coastal artisanal fishing sector catches circa 4500 sea turtles per year (Table 13). If we take into consideration the sea turtle entanglements by species (Figure 17) and the condition by species (Figure 18), we can assume that more than 240 sea turtles are killed in the artisanal fishing sector annually. As the data collectors experienced a reluctance of fishermen to share the number of their sea turtle catches, this is likely to be an underestimation. Figure 19 illustrates the share in turtle entanglements by fishing type, projected for the whole Surinamese coastal artisanal fleet. The gillnet – longlines fishery is responsible for more than 86% of the entanglements, the SKB fishery for 14%. The njawarie fishery does not have a share in the turtle entanglements.

Table 12: Sea turtle entanglements and monitored fishing days by month.

		NUMBER OF SEA TURTLE ENCOUNTERS				MONITORED FISHING DAYS
		LEATHERBACK	GREEN TURTLE	OLIVE RIDLEY	**TOTAL**	
2015	SEP	0	0	6	6	311
	OKT	0	0	1	1	500
	NOV	0	0	0	0	456
	DEC	0	5	0	5	598
2016	JAN	8	7	7	22	334
	FEB	14	22	11	47	461
	MAR	19	33	34	86	641
	APR	31	41	11	83	532
	MAY	25	17	8	50	516
	JUN	8	4	1	13	592
	JUL	14	5	1	20	645
	AUG	6	2	1	9	653
	TOTAL	**125**	**136**	**81**	**342**	**6239**

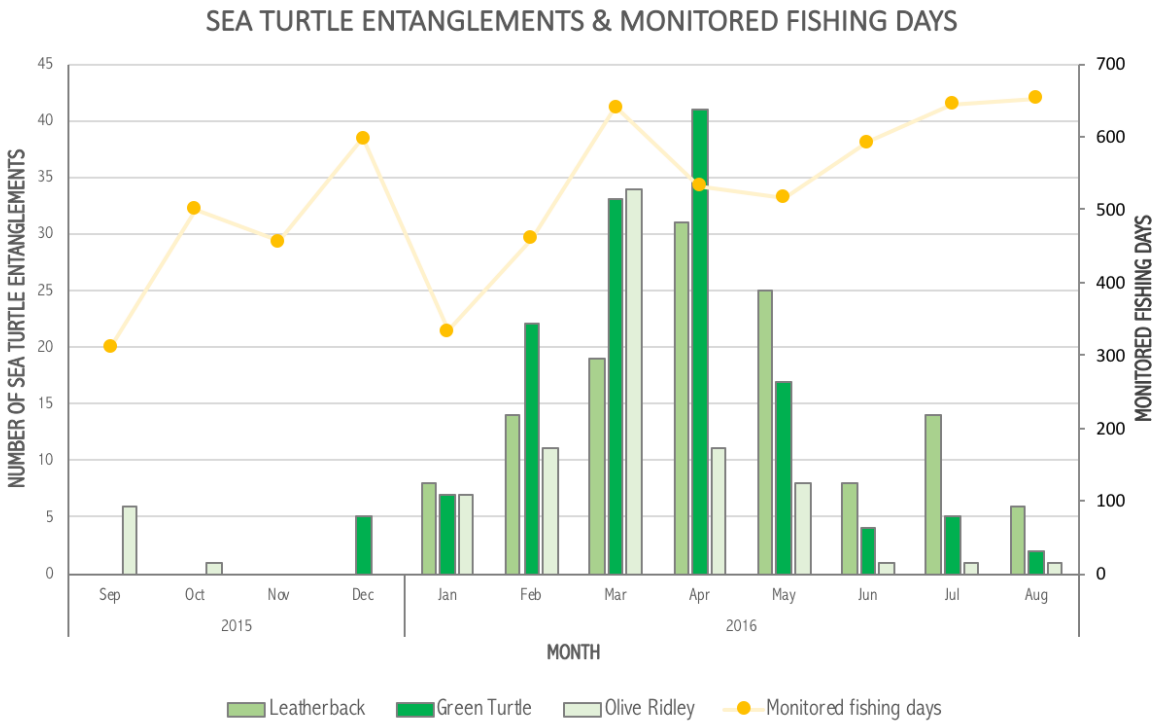

Figure 16: Sea turtle entanglements and monitored fishing days by month.

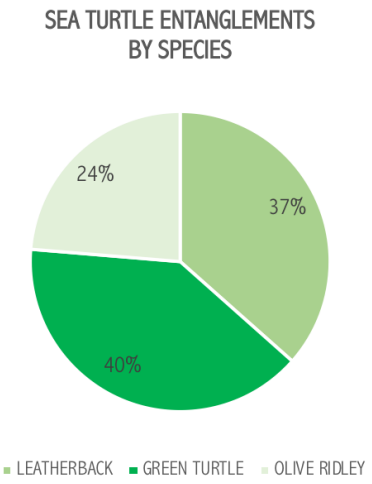

Figure 17: Sea turtle entanglements by species.

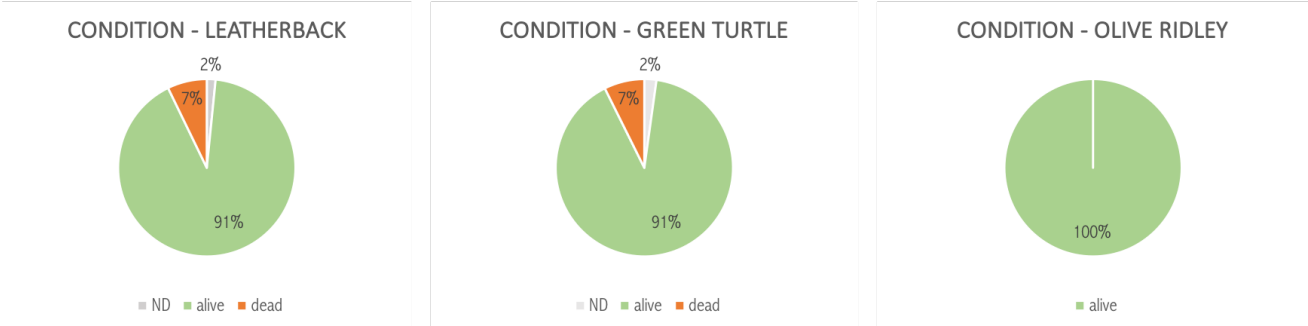

Figure 18: Condition of the sea turtles.

Table 13: Calculation table to estimate the total number of sea turtle entanglements by the Surinamese coastal artisanal fleet.

		SURVEY monitored fishing days	SURVEY total catch of sea turtles	SURVEY # sea turtles/fishing day	TOTAL FLEET # fishing days/year	TOTAL FLEET # sea turtles/year
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	5778	320	0.06	64,260	3856
	Gillnet SKB	269	22	0.08	8,000	640
	Njawarie	192	0	0.00	3,780	0
	TOTAL					**4496**

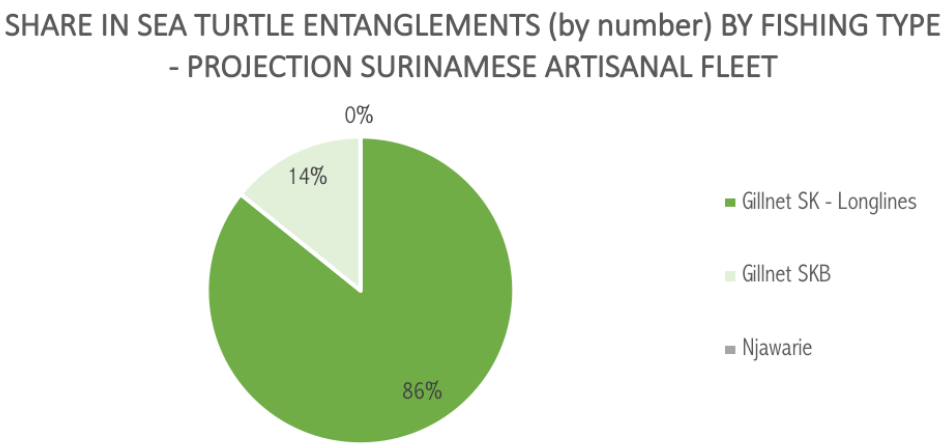

Figure 19: Share in sea turtle entanglements (by number) by fishing type – projection Surinamese coastal artisanal fleet.

4.3.2 BYCATCH OF SHARKS

The silky shark and blacktip shark are the shark species mostly encountered by the fishermen in this study, with respectively 63% and 25% of the total number of encounters over the whole monitoring period. No nurse sharks were encountered, and only two tiger sharks were caught by the fishermen. The catches of sharks are highly variable and there is no pattern or seasonality visible from the data. The blacktip shark and tiger shark are "near threatened", nevertheless, no regulations are in place to control the landings of these species (Table 14, Figure 20, Figure 21).

Table 14: Shark encounters and monitored fishing effort by month.

		NUMBER OF SHARK ENCOUNTERS							MONITORED FISHING DAYS
		Blacktip shark	Silky shark	Smalleye hammerhead shark	Tiger shark	Smalleye smoothhound	Nurse shark	TOTAL	
2015	SEP	106	624	15	0	0	0	745	311
	OKT	81	487	14	2	16	0	600	500
	NOV	280	716	5	0	0	0	1001	456
	DEC	443	965	15	0	68	0	1491	598
2016	JAN	121	294	2	0	102	0	518	334
	FEB	437	377	4	0	60	0	878	461
	MAR	397	844	10	0	184	0	1435	641
	APR	179	431	2	0	142	0	754	532
	MAY	289	551	9	0	97	0	946	516
	JUN	219	396	2	0	87	0	704	592
	JUL	91	604	11	0	191	0	897	645
	AUG	98	662	6	0	207	0	973	653
	TOTAL	**2741**	**6951**	**95**	**2**	**1154**	**0**	**10943**	**6239**

Data collectors reported the length of the landed sharks. Figure 22 illustrates the length distributions for the blacktip shark, the silky shark, the smalleye hammerhead shark and the smallye smootthound. As only two tiger sharks and zero nurse sharks were registered, these species were not considered for the length analysis. With the length-weight parameters specific for each shark species (Table 15), the weight of the sharks was calculated to compile weight frequencies (Figure 23). The tiger shark and the nurse shark were not analyzed due to a lack of data. The average length, weight and total weight of each species can be calculated from the previous length and weight distributions (Table 16). To estimate to the total weight landed for each species, the data entries without length specifications were assigned an average weight.

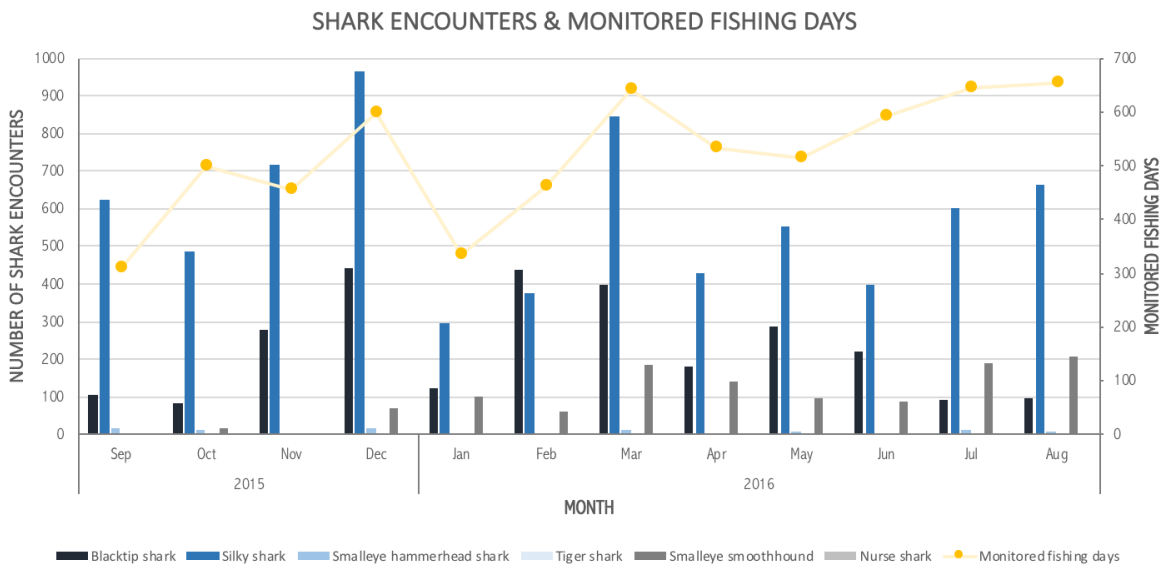

Figure 20: Shark encounters and monitored fishing fleet by month.

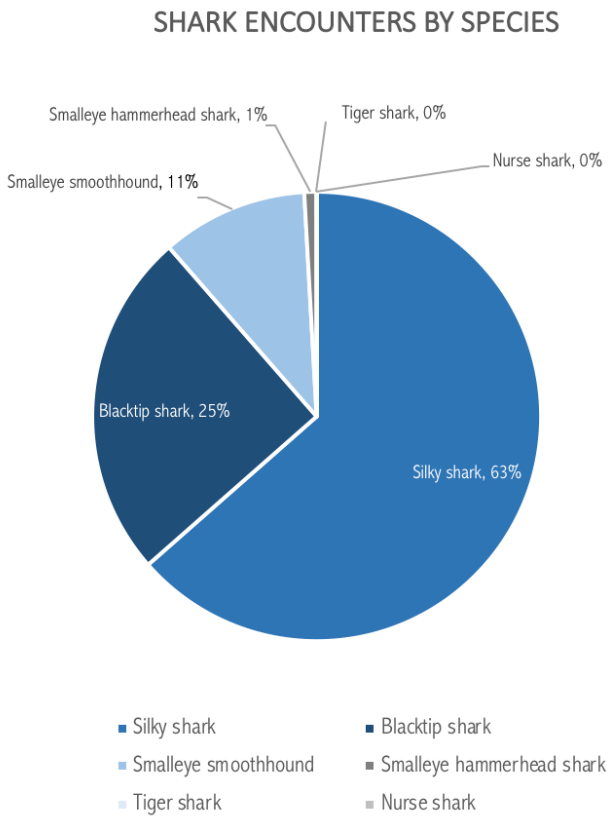

Figure 21: Shark encounters (by numbers) by species.

Table 15: Length-weight parameters by shark species (Source: fishbase).

		LENGTH-WEIGHT PARAMETERS	
		a	b
SHARK SPECIES	Blacktip shark	0.0087	2.96
	Silky shark	0.0079	3.04
	Smalleye hammerhead shark	0.0026	3.15
	Tiger shark	0.0028	3.25
	Smalleye smoothhound	0.0015	3.17
	Nurse shark	0.0055	2.88

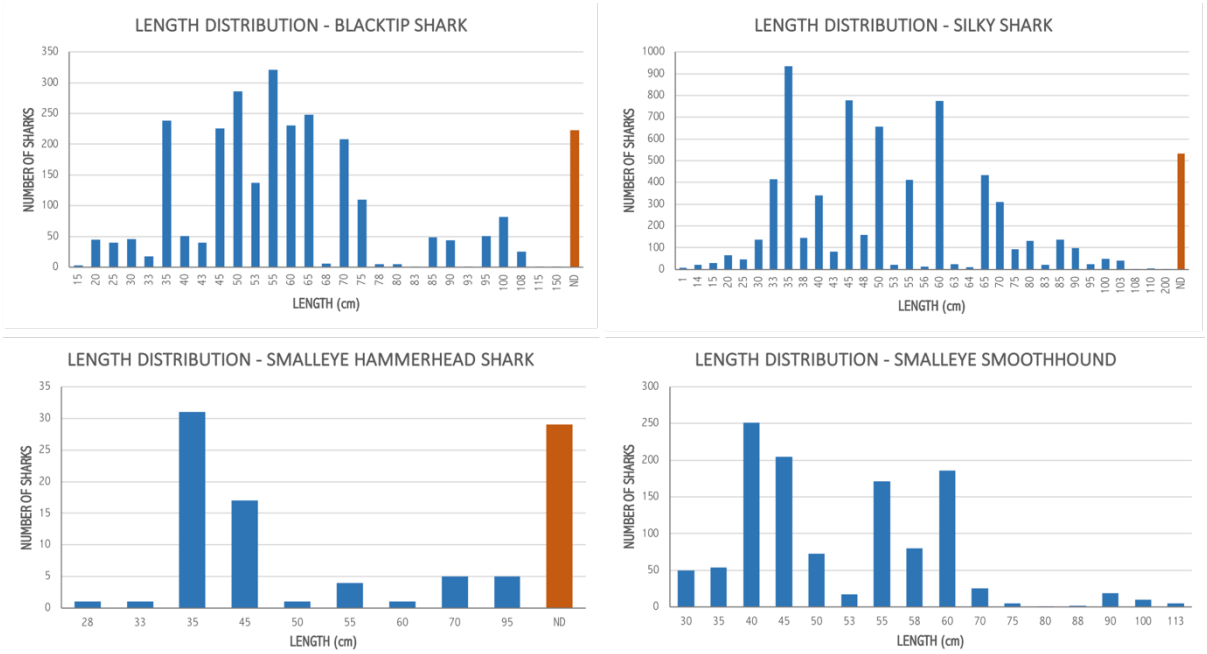

Figure 22: Length distributions of the blacktip shark, silky shark, smalleye hammerhead shark and smalleye smoothhound. ND is not defined; no data was provided for this parameter.

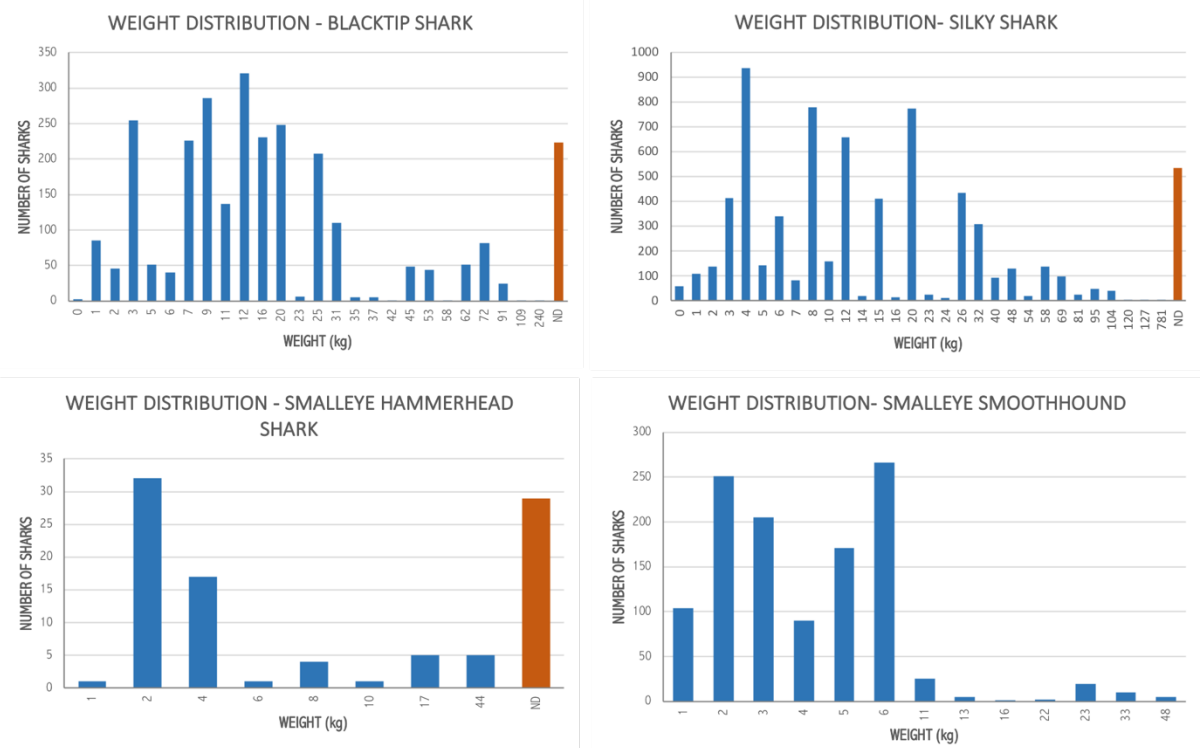

Figure 23: Weight distributions of the blacktip shark, silky shark, smalleye hammerhead shark and smalleye smoothhound. ND is not defined; no data was provided for this parameter.

Table 16: Average length, weight and estimation of the total weight by species.

		AVG. LENGTH (cm)	AVG. WEIGHT (kg)	ESTIMATION OF TOTAL WEIGHT (kg)
SHARK SPECIES	Blacktip shark	57 cm	18 kg	73,125 kg
	Silky shark	50 cm	17 kg	116,127 kg
	Smalleye hammerhead shark	46 cm	7 kg	689 kg
	Tiger shark	75 cm	70 kg	70 kg
	Smalleye smoothhound	50 cm	5 kg	5,353 kg
	Nurse shark	N/A	N/A	N/A
	TOTAL			**195,364 kg**

Table 17 and Table 18 are calculation tables to estimate to total number and weight of the sharks (species under focus in this study) caught by the artisanal Surinamese coastal fleet. Circa 139,000 sharks are estimated to be caught annually, representing a weight of more than 840 ton. Figure 24 and Figure 25 illustrate the contribution of the fishing types in total number of shark catches and total weight. The SKB fishery catches the most sharks per fishing day, but the average weight of these sharks is smaller. The SK fishery catches less sharks per fishing day, but these sharks are bigger. Overall, the SK gillnet fishery has the most impact due to its larger fishing effort.

Table 17: Calculation table to estimate the total number of sharks (species covered in this study) caught by the Surinamese coastal artisanal fleet.

		SURVEY monitored fishing effort (fishing days)	SURVEY total # sharks catches	SURVEY # sharks/fishing day	TOTAL FLEET # fishing days/year	TOTAL FLEET # sharks/year
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	5,778	9,986	1.73	64,260	111,170
	Gillnet SKB	269	882	3.28	8,000	26,240
	Njawarie	192	75	0.39	3,780	1,474
	TOTAL					**138,884**

Table 18: Calculation table to estimate the total weight of sharks (species covered in this study) caught by the Surinamese coastal artisanal fleet.

		SURVEY monitored fishing effort (fishing days)	SURVEY total weight sharks catches (kg)	SURVEY Weight sharks (kg)/fishing day	TOTAL FLEET # fishing days/year	TOTAL FLEET Weight sharks catches (kg)/year
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	5,778	71,489	12.4 kg/day	64,260	796,824 kg
	Gillnet SKB	269	1,507	5.6 kg/day	8,000	448,00 kg
	Njawarie	192	129	0.6 kg/day	3,780	2,268 kg
	TOTAL					**843,892 kg**

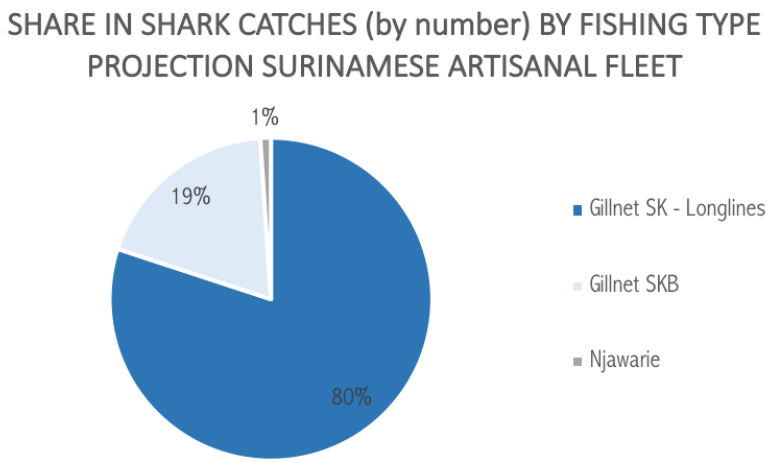

Figure 24: Share in shark catches (by number – species covered in this study) by fishing fleet – projection Surinamese artisanal fleet.

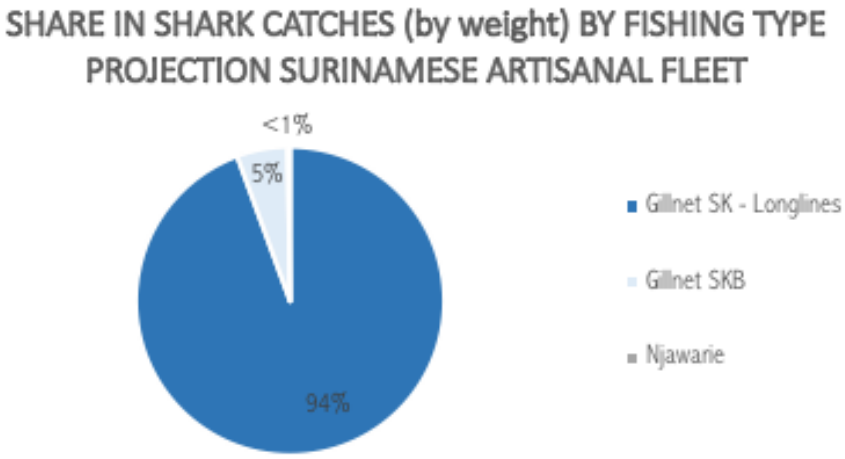

Figure 25: Share in shark catches (by weight – species covered in this study) by fishing fleet – projection Surinamese artisanal fleet.

4.3.3 BYCATCH OF RAYS

A peak in ray catches is observed in October 2015. In August 2016 there is a high peak in Southern stingray catches. Both phenomena cannot be easily explained. The catches of ray are highly variable and there is no pattern or seasonality visible from the data (Table 19, Figure 26). The Southern stingray was mostly encountered; 36% of all ray observations were Southern stingray (Figure 27). Chupare stingray was least encountered; 6% of all ray observations were Chupare stingray.

Data collectors also reported the length of the landed rays. Figure 28 illustrates the length distributions for the rays under focus in this study. It is clear from the data that most of the times, the size of the rays was not collected, possibly because rays are generally discarded. Therefore, it is not possible to do analyses on the length and weight distributions.

Table 20 is the calculation table to estimate to total number of rays (species under focus in this study) caught by the Surinamese coastal artisanal fleet. Circa 1,327,000 rays are caught annually. Figure 29 illustrates the contribution of the fishing types in total number of ray catches. The njawarie fishery catches the most rays per fishing effort. It has to be put forward that this high factor of rays/fishing day is due to the fact that an enormous number of rays were reported in the month of August 2016.

Table 19: Ray encounters and monitored fishing effort by month.

		NUMBER OF RAY ENCOUNTERS						MONITORED FISHING EFFORT (fishing days)
		Longnose stingray	Southern stingray	Sharpsnout stingray	Chupare stingray	Smooth butterfly ray	TOTAL	
2015	SEP	70	70	88	75	187	490	311
	OKT	410	661	528	180	639	2,418	500
	NOV	174	216	202	85	218	895	456
	DEC	127	279	124	81	129	740	598
2016	JAN	44	150	56	32	63	345	334
	FEB	67	161	121	21	97	467	461
	MAR	84	183	233	31	163	694	641
	APR	18	108	106	7	36	275	532
	MAY	20	24	74	7	29	154	516
	JUN	147	234	113	10	46	550	592
	JUL	186	138	150	12	63	549	645
	AUG	175	1,114	271	19	83	1,662	653
	TOTAL	**1,522**	**3,338**	**2,066**	**560**	**1,753**	**9,239**	**6,239**

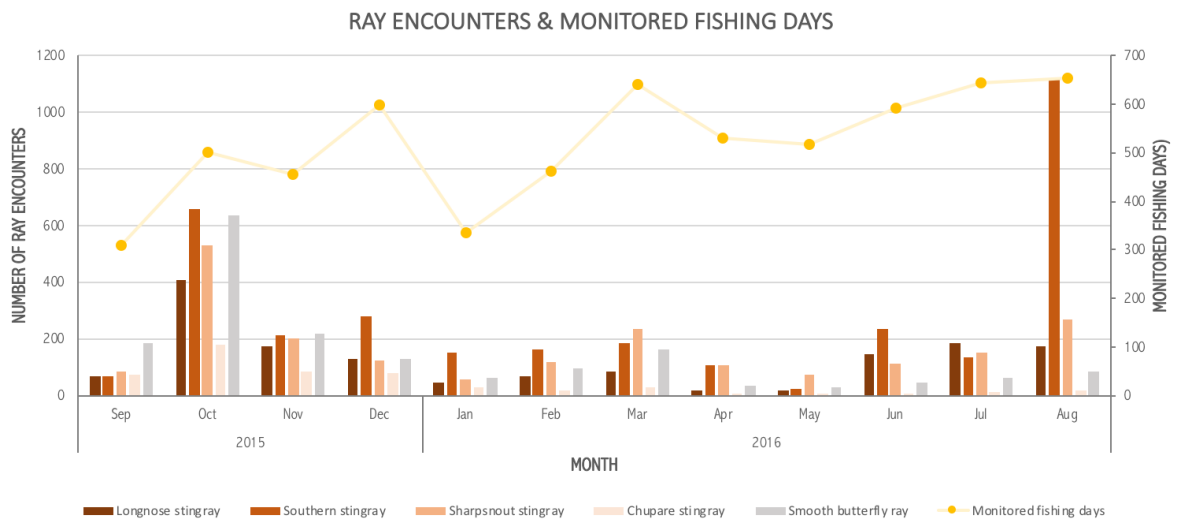

Figure 26: Ray encounters and monitored fishing effort by month.

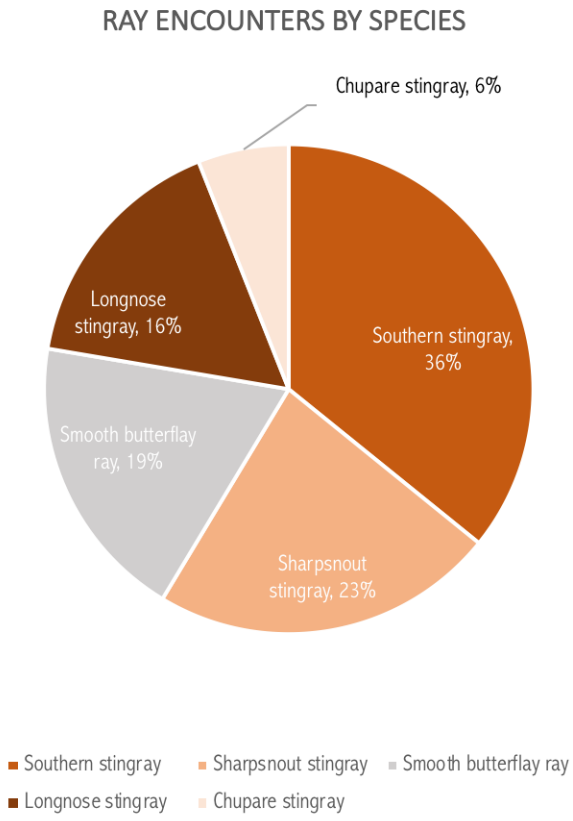

Figure 27: Ray encounters (by numbers) by species.

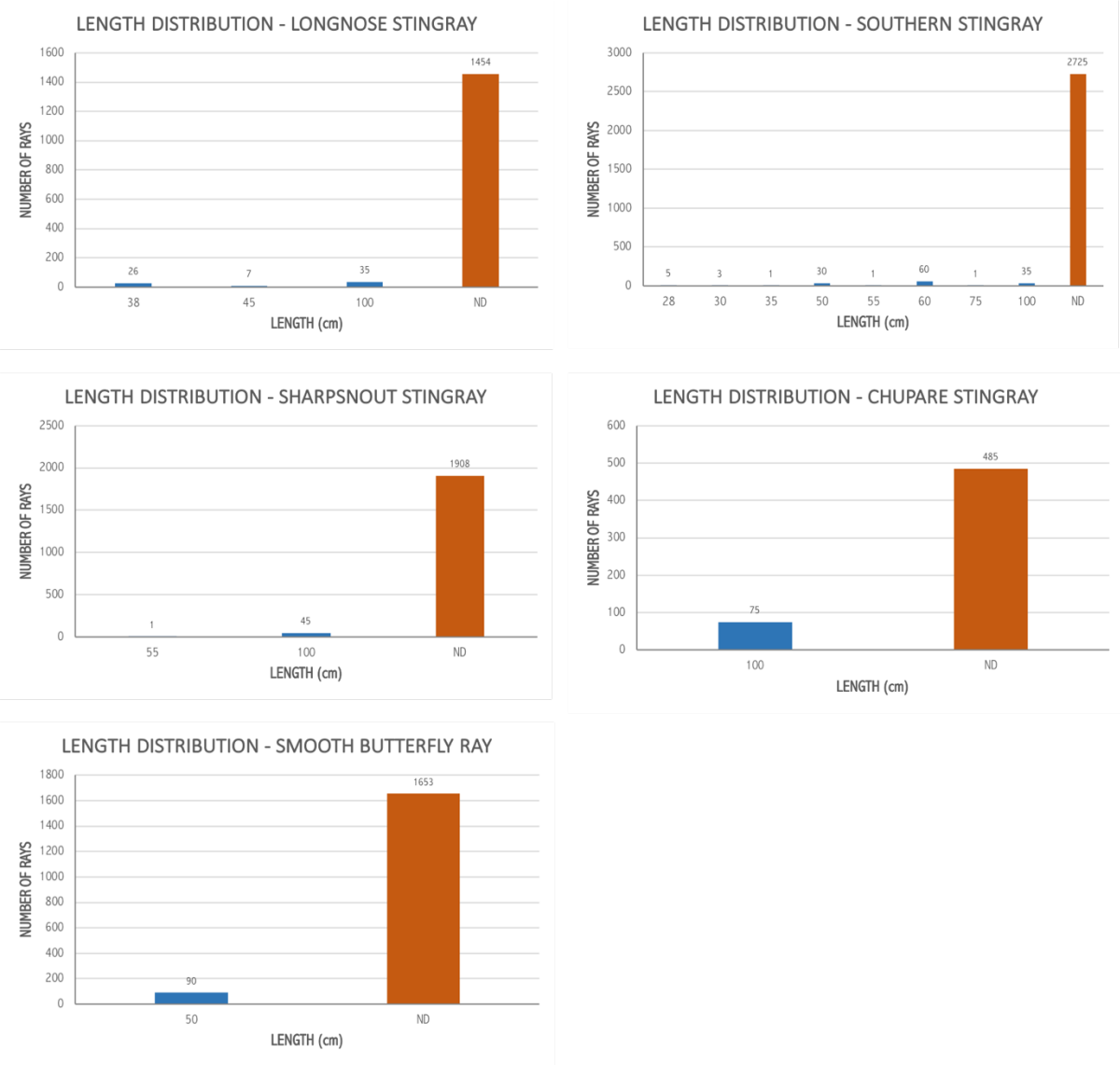

Figure 28: Length distribution of the ray species under focus in this study. ND is not defined; no data was provided for this parameter.

Table 20: Calculation table to estimate the total number of rays (species covered in this study) caught by the Surinamese coastal artisanal fleet.

		SURVEY monitored fishing days	SURVEY total # ray catches	SURVEY # rays/fishing day	TOTAL FLEET # fishing days/year	TOTAL FLEET # rays/year
FISHING TYPE	Gillnet SK – OG Gillnet SK – GG Longlines	5778	6508	1.13	64260	72614
	Gillnet SKB	269	97	0.36	8000	2880
	Njawarie	192	2634	13.72	3780	51862
				TOTAL		**127356**

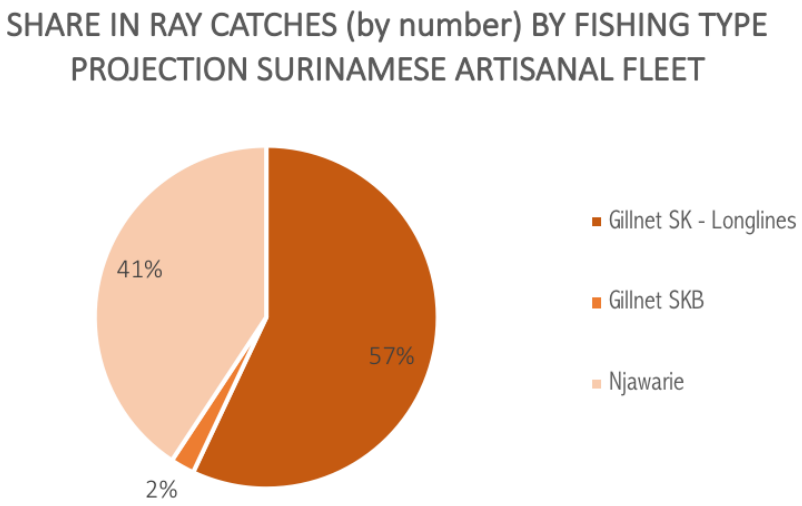

Figure 29: Share in ray catches (by number – species covered in this study) by fishing fleet – projection Surinamese coastal artisanal fleet.

5 RECOMMENDATIONS

In this study, a profound analysis on bycatch data for endangered, threatened and protected (ETP) species in the Surinamese coastal artisanal fishing sector for the monitoring period 2015-2016 is presented. The main goal of this study is to estimate the impact of this fishing sector on the ETP species occurring in Surinamese coastal waters. To do so, extrapolation of the data was necessary based on an estimation of the fishing effort for the entire coastal artisanal fleet. There are signs that IUU fishing occurs in Surinamese coastal waters; e.g. more than one fishing boat fish under the same license (Visserij, Visserij Management Plan Voor Suriname 2013). Additionally, fishermen are not likely to share accurate data when it comes to bycatch of sensitive species like sea turtles. E.g. it is probable that they did report the catch of a sea turtle, but reported it alive instead of dead. Taken these factors into account, we can assume that the extrapolated data is an underestimation of the real situation. Nevertheless, the figures for bycatch of ETP species are alarming and need our focus and full attention: it is estimated that annually more than 4,000 sea turtles, over 130,000 sharks and almost 130,000 rays are being entangled by the Surinamese coastal artisanal fleet. These marine species need extra protection as they are predominantly slow-growing, late-maturing and long-lived and therefor vulnerable to overexploitation. WWF Guianas, together with their partner NGO's, policy makers, academics, the fishing sector etc. need to look for sustainable solutions to reduce the bycatch of these sensitive species and safeguard a healthy stock in Surinamese waters.

Detailed bycatch data are extremely valuable to do impact analysis and time series can give an idea if impacts are changing over time. Therefore, it is important to continue bycatch monitoring efforts. The quality of the data collection should be improved. The initiation of a self-sampling programme, this is data collection by the fishermen themselves, can possibly improve the quality of the data.

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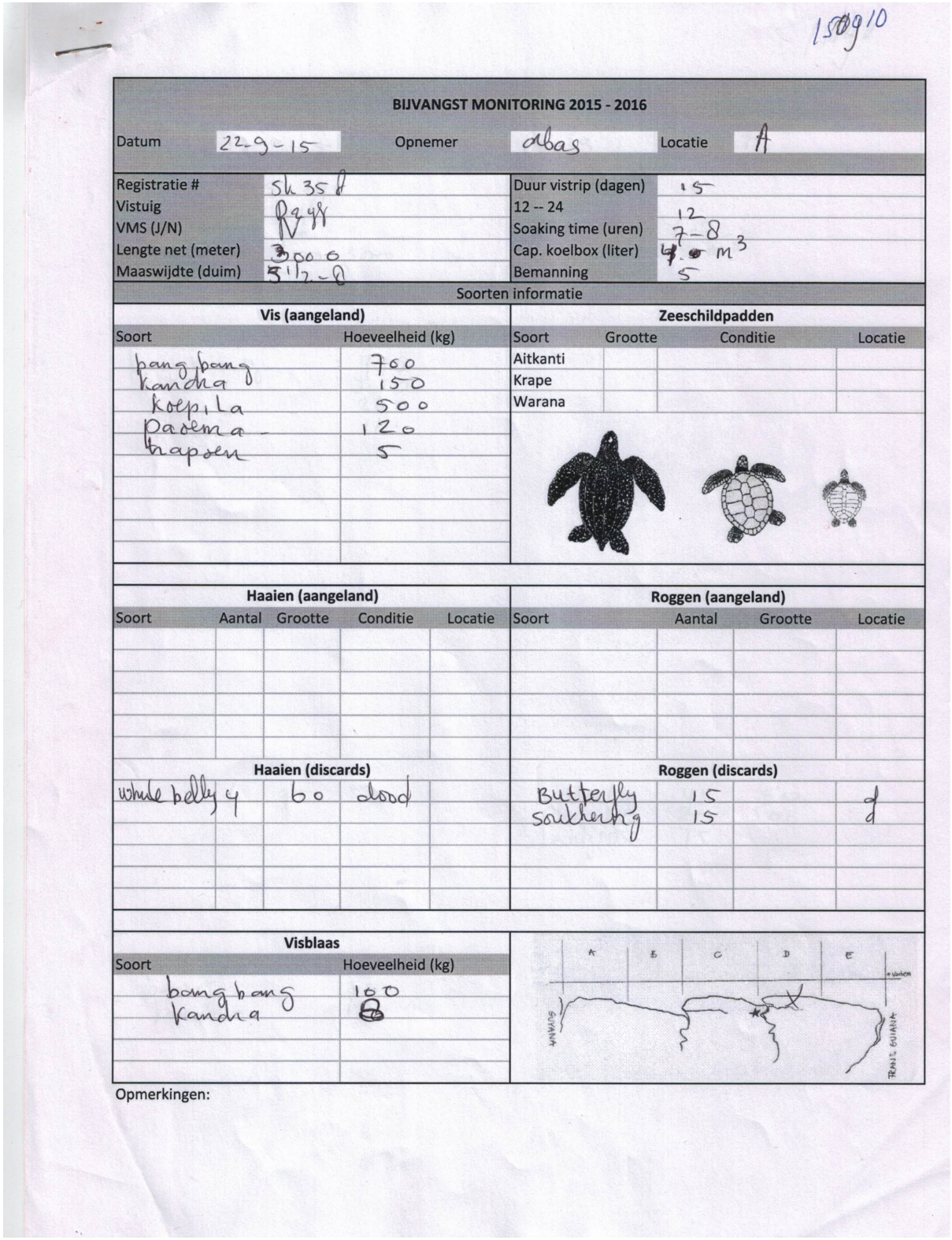
7 ANNEXES

7.1 DATA COLLECTION FORM



BIJVANGST MONITORING 2015 - 2016

Datum: 22-9-15 Opnemer: Abas Locatie: A

Registratie #	Sk 35 d	Duur vistrip (dagen)	15
Vistuig	Ryg	12 -- 24	12
VMS (J/N)	N	Soaking time (uren)	7-8
Lengte net (meter)	3000	Cap. koelbox (liter)	4 m3
Maaswijdte (duim)	5 1/2-8	Bemanning	5

Soorten informatie

Vis (aangeland)

Soort	Hoeveelheid (kg)
bangbang	700
kandra	150
koepila	500
Paoema	120
knapoen	5

Zeeschildpadden

Soort	Grootte	Conditie	Locatie
Aitkanti			
Krape			
Warana			

Haaien (aangeland)

Soort	Aantal	Grootte	Conditie	Locatie

Roggen (aangeland)

Soort	Aantal	Grootte	Locatie

Haaien (discards)

whale belly y		60	dood	

Roggen (discards)

Butterfly	15		d
soukhenng	15		d

Visblaas

Soort	Hoeveelheid (kg)
bangbang	100
kandra	

Opmerkingen:

7.2 ILLUSTRATION OF A SELECTION OF TARGET FISH SPECIES

Bang bang – Acoupa weakfish – *Cynoscion acoupa*
© Tomas Willems

Kandratiki – Green weakfish – *Cynoscion virescens*
© Tomas Willems

Botervis – Smalleye croaker – *Nebris microps*
© Tomas Willems

Paoema – Atlantic tripletail – *Lobotes surinamensis*
© Tomas Willems

Dagoetifie – King weakfish – *Macrodon anclylodon*
© Tomas Willems

7.3 ILLUSTRATION OF A SELECTION OF ETP SPECIES

Longnose stingray – *Hypanus guttatus*
© Tomas Willems

Southern stingray – *Hypanus americanus*
© Tomas Willems

Sharpsnout stingray -*Hypanus americanus*
© Tomas Willems

Smooth butterfly ray – *Gymnura micrura*
© Tomas Willems

Smalleye smoothhound – *Mustelus higmani*
© Tomas Willems

Leatherback – *Dermochelys coriacea*
© WWF - Guianas

Green turtle – *Chelonia mydas*
© WWF - Guianas

Olive ridley – *Lepidochelys olivacea*
© WWF - Guianas

7.4 OVERVIEW OF FIGURES

7.5 OVERVIEW OF TABLES