

Shark and ray (Class Chondrichthyes) survey outcomes in Kavieng District, New Ireland Province, Papua New Guinea, with a focus on sawfishes and rhino rays (Order Rhinopristiformes)

January 2019 – March 2020



Conservation and Environment
Protection Authority



Wildlife Conservation
Society



Tawny shark (*Nebrius ferrugineus*), Mussau; Uali Kalu

Sawfish and rhino rays (Order Rhinopristiformes) and other shark and ray (Class Chondrichthyes) survey outcomes in Kavieng District, New Ireland Province, Papua New Guinea

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Background

Sawfish (Family Pristidae), wedgefish (Rhinidae), guitarfish (Rhinobatidae) and giant guitarfish (Glaucostegidae) comprise the Order Rhinopristiformes, a group of rays that inhabit inshore waters of the tropics and subtropics. Sawfishes and their allies (also known as rhino rays) are among the world's most threatened group of vertebrates, with current studies (Dulvy *et al.*, 2014) indicating that sawfishes, wedgefishes and guitarfishes all fall in the top six-most threatened families of cartilaginous fishes (Class Chondrichthyes, including sharks, rays and chimaeras); recent studies by Kyne *et al.* (2020) placed wedgefish and giant guitarfish in a higher extinction-risk category than sawfish. Rhinopristids are large in size, inhabit shallow coastal waters, take time to reach maturity, produce few young and have high value body parts*, making them susceptible to overfishing. Recognising their high extinction risk and need to control the commercial exploitation of such species all five sawfish species were added to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2007, and all but one species of giant guitarfish and wedgefish, respectfully, were uplifted to CITES Appendix II at the 18th CITES Conferences of the Parties (CoP) in 2019.

With large-scale population declines, few rhinopristid population strongholds remain. However, the tropical inshore waters of the Indo-West Pacific Ocean represent one such stronghold, with extant resident populations of several species well-documented off northern Australia (Harrison & Dulvy 2014) and eastern New Guinea (Leeney *et al.*, 2018; White *et al.*, 2017). The inshore waters of Papua New Guinea (PNG) support ten described species of rhinopristids, including four sawfish, three wedgefish, two guitarfish, and one giant guitarfish species (Figure 1). As such, PNG is a global geographic priority for conserving this highly threatened species group, as acknowledged in the IUCN Shark Specialist Group's global strategy for sawfish conservation (Harrison & Dulvy 2014). Moreover, the Sawfish Conservation Strategy, which is part of the IUCN Shark Specialist Group, aims to survey historic and current abundances and distributions of sawfishes in key geographies where sawfish population strongholds are known, such as PNG (Harrison & Dulvy, 2014, Leeney *et al.*, 2018).

According to recent studies conducted in PNG, there are known sawfish population strongholds in the Sepik River and adjacent large rivers and tributaries, and the Fly River delta and inshore waters of Western and Gulf provinces in south-western PNG (White *et al.*, 2017; Leeney *et al.*, 2018). Moreover, sawfish sightings and captures are documented in Milne Bay, Madang, Manus, East New Britain and the Autonomous Region of Bougainville provinces. However, no documented sawfish sightings were recorded in New Ireland Province. In view of this, the Wildlife Conservation Society (WCS), with the assistance of the MacArthur Foundation, conducted the first sawfish and other rhinopristid scoping surveys in Kavieng District,

IMPORTANCE OF SHARKS IN PAPUA NEW GUINEA

Sharks and rays constitute the fifth-most important export fishery in PNG, valued at approximately US\$ 2.5 million per year, which supplement local incomes and the nutritional requirements of many coastal communities. The tourism value of sharks in PNG is unclear but likely to be significant, with established dive tourism in various locations (for example, Kavieng, New Ireland; Alotau, Milne Bay; and Rabaul, New Britain) and several companies offering dive liveaboards for at least US\$ 4,000 per person per trip. Sharks are an iconic and culturally important species in some areas of New Ireland (notably, 'shark calling' in Kontu).

* The fins of wedgefish and giant guitarfish species are considered the most valuable of all sharks and rays due to the needle-like cartilaginous filaments (known as ceratotrichia) that support the fins and maintain their form. It has been reported that some wedgefish and giant guitarfish fins have been sold for as much as USD\$964 per kilogramme in specialist Hong Kong, Guangzhou, and other East Asian markets, where the cartilaginous fin-filaments are prized in order to produce shark fin soup (Jabado, 2019; Hau *et al.*, 2018), a Han Chinese and Cantonese delicacy that is symbolic of wealth and high social status in certain traditional East Asian customs.

ORDER	FAMILY	SPECIES	COMMON NAME	IMAGE	CITES APPENDIX	IUCN RED LIST STATUS
Rhinopristiformes	Pristidae	<i>Anoxypristis cuspidata</i> (Latham, 1794)	Narrow sawfish		Appendix I	Endangered
		<i>Pristis clavata</i> (Garman, 1906)	Dwarf sawfish		Appendix I	Endangered
		<i>Pristis pristis</i> (Linnaeus, 1758)	Large-tooth sawfish		Appendix I	Critically endangered
		<i>Pristis zijsron</i> (Bleeker, 1851)	Green sawfish		Appendix I	Critically endangered
	Rhinidae	<i>Rhina ancylostoma</i> (Bloch & Schneider, 1801)	Shark ray		Appendix II	Critically endangered
		<i>Rhynchobatus australiae</i> (Whitley, 1836)	Bottlenose wedgefish		Appendix II	Critically endangered
		<i>Rhynchobatus palpebratus</i> (Compagno & Last, 2008)	Eye-brow wedgefish		Appendix II	Near threatened
	Rhinobatidae	<i>Rhinobatos manai</i> (White, Last & Naylor, 2016)	Papuan guitarfish		Not listed	Data deficient
		<i>Rhinobatos</i> cf. <i>shlegelii</i>	Enigma guitarfish		Not listed	Data deficient
	Glaucostegidae	<i>Glaucostegus typus</i> (Bennett, 1830)	Giant guitarfish		Appendix II	Critically endangered

Figure 1: The ten documented species of Order Rhinopristioformes that inhabit in the inshore waters of Papua New Guinea. The Convention for the International Trade on Endangered Species of Wild Fauna and Flora (CITES) and International Union for the Conservation of Nature (IUCN) conservation status of each species has also been provided. Images were taken from White et al. (2017).

New Ireland Province, to assess whether such animals inhabit the coastal waters of the region, and if so, to implement the first management and protection laws in PNG.*

Methods

Since 2019, WCS conducted an extensive outreach and education programme to coastal communities in Lovongai (population, 29,000, PNG National Population Census, 2011), Murat (population, 4,200) and Tikana LLGs, which concerned the biology, threats and management of cartilaginous fishes, and particularly rhinopristids.† Figure 2 shows the locations of the three LLGs in Kavieng District. WCS conducted key informant surveys to individuals from communities that had seen or caught sawfish or other rhino rays in their community customary waters (see Appendix I for a copy of the survey form). For ease of community identification, only sawfish (with a distinctive rostrum), wedgefish (with a gap between the pectoral and pelvic fins) and guitarfish (with no visible gap between the pectoral and pelvic fins) were presented to the participants; giant guitarfish were grouped with the other guitarfish due to difficulties in species group identification. Questionnaire surveys were only issued to individuals who claimed to have caught or observed rhinopristids during their lifetimes and within their customary waters. The surveys were conducted by trained community facilitators using the free, prior and informed consent (FPIC) process, and all participants had to give consent before the survey began.

In late 2019, baited remote underwater video systems were deployed at selected sites in Lovongai, Murat and Tikana LLGs, the locations of which were determined according to regular sightings of rhinopristids, as indicated by the key informant survey outcomes, and whether suitable habitat type (estuaries, mangroves and turbid waters for sawfish; sandflats and clearer waters for wedgefish, guitarfish and giant guitarfish) existed in areas where key informant sightings were prevalent. The BRUVS were deployed in areas of suitable habitat substratum and at depths of <10m. Pulverised fragments of fresh tuna, reef fish and mud crabs were used as bait, and a *GoPro* (*Hero 7* model) underwater digital camera was used to record any demersal or pelagic fish that were attracted to the bait. The design specifications for the BRUVS are outlined in Appendix II. Attempts were made in 2020 to conduct environmental DNA (eDNA) assessments at selected sites in Lovongai and Murat LLGs where sawfish and rhino ray sightings were more frequent; yet at the time of writing, the COVID-19 pandemic restrictions delayed such assessments. In addition, some local community members in Kavieng District brought photographs and sawfish rostra findings to the WCS team for further evidence.

Results

Data were collected from January 2019 to March 2020 from coastal communities in Lovongai, Murat and Tikana LLG jurisdictions in Kavieng District, New Ireland Province, PNG. The results have been split into two parts: Part I concerns the outcomes of the key informant questionnaire surveys, and Part II focuses on the baited remote underwater video system (BRUVS) assessments. Due to the small number of respondents that took part, no statistical analysis was employed to analyse the results.

* Since 2017, WCS has worked with communities, government and other stakeholders in Kavieng District to facilitate the establishment of two marine protected areas (MPAs). After large-scale community consultations and feedback from an MPA Technical Working Group (meeting biannually and comprising representatives from government, private sector, other NGOs and key stakeholders) decisions were made to focus the two MPAs on Lovongai and Murat Local Level Government (LLG) areas, which will be enforced with LLG laws. The communities will decide on all MPA rules and penalties; following an extensive education and awareness programme, focused on the biology, threats and management of sharks and rays, it is anticipated that the first rhinopristid management and protection laws in PNG will be integrated into the rules of the two MPAs.

† The MPAs will be based in Lovongai and Murat LLGs; however, additional outreach programmes and questionnaire surveys were conducted in Tikana LLG.

Approximate locations of the two marine protected areas in Kavieng District, New Ireland Province, Papua New Guinea

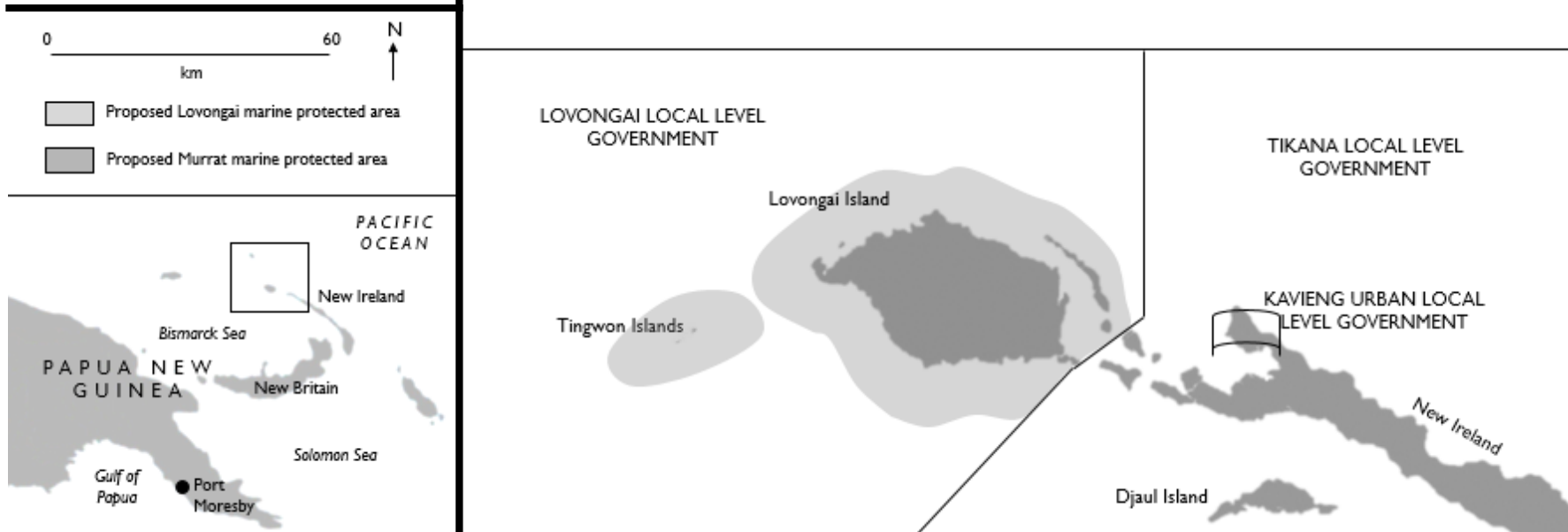


Figure 2: New Ireland is located in the north-eastern region of Papua New Guinea, roughly perpendicular to the island of New Britain. To the south of New Ireland lies the Bismarck Sea, while the Pacific Ocean lies to the north. New Ireland Province is split into two districts, Nemateni District in the east and Kavieng District in the west. Kavieng District is divided into four Local Level Government (LLG) jurisdictions: Tikana LLG, Lovongai LLG, Murat LLG and Kavieng Urban LLG. Since 2017, the Wildlife Conservation Society has been working with communities in Lovongai and Murat LLGs to facilitate the establishment of two community-driven marine protected areas (MPAs), the approximate areas of which are indicated in grey: light grey for the Lovongai LLG MPA and darker grey for the Murat LLG MPA.

PART I: Outcomes from the key informant questionnaire surveys

From January 2019 to March 2020, 111 respondents completed key informant questionnaire surveys in 49 communities in Kavieng District, New Ireland Province. The respondents observed a total of 144 sawfish, wedgefish, guitarfish and giant guitarfish in Kavieng District during their lifetimes. Across all communities, the key informant surveys were completed by 97 males and 13 females (Table 1). Respondents were aged between 20 and 82, with the majority of respondents (31%) in the 40 to 49 age range (Figure 3).

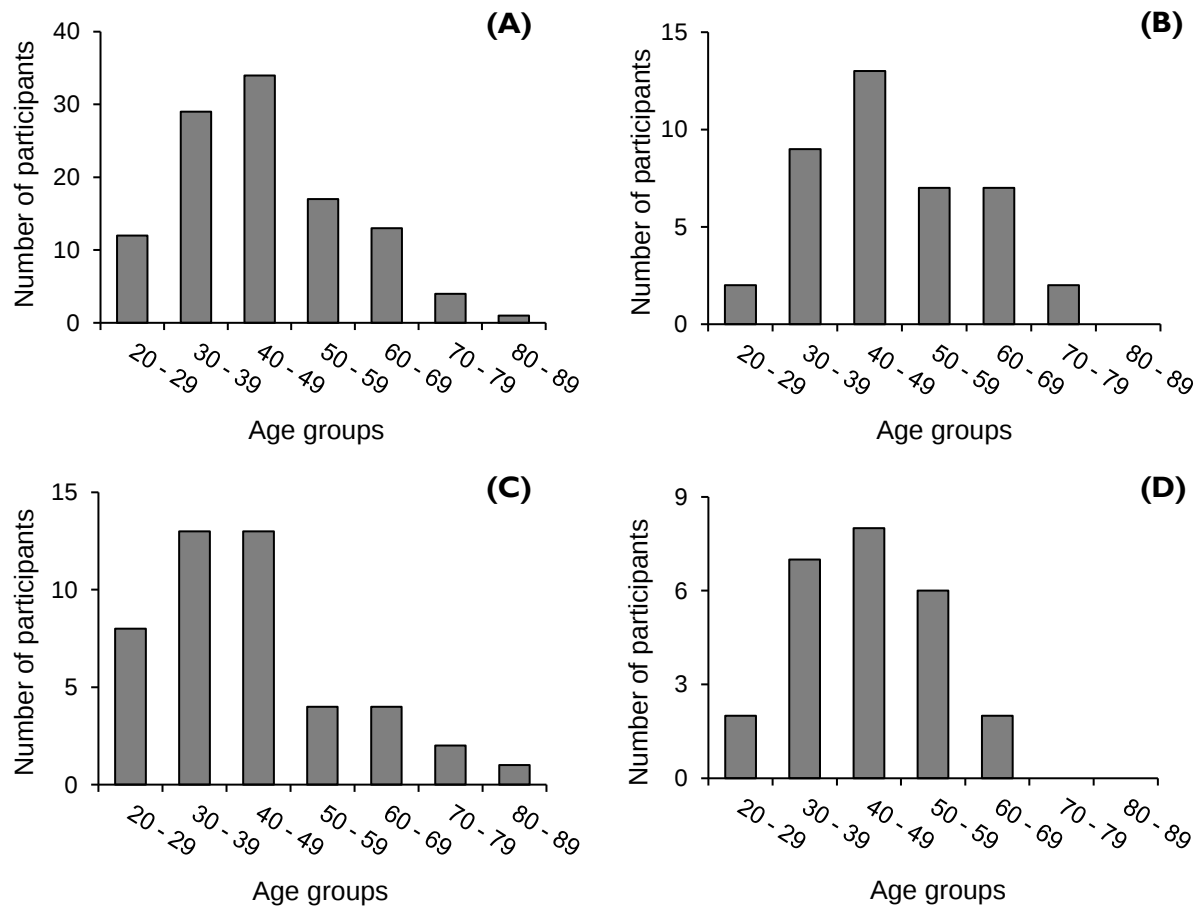


Figure 3: The age groups of the participants that took part in the key informant questionnaire surveys in Kavieng District, New Ireland Province, Papua New Guinea, from January 2019 to March 2020. A total of 111 participants took part in the survey. (A) The age groups of all the participants that took part in the key informant surveys across all of Kavieng District, (B) the age groups of the participants that took part in the key informant surveys in Tikana Local Level Government jurisdiction, (C) the age groups of the participants that took part in the key informant surveys in Lovongai Local Level Government jurisdiction, and (D) the age groups of the participants that took part in the key informant surveys in Murat Local Level Government jurisdiction.

According to the key informant surveys, a total of 144 observations of rhinoprists were made by the participants during their lifetimes, including 23 sawfish observations, 85 wedgefish observations and 36 guitarfish and giant guitarfish observations. The majority of wedgefish observations (44 observations, 52%) were made in Lovongai LLG. Although no sawfish observations were documented in Murat LLG,

Table 1: The total number of key informant questionnaire survey forms that were completed in the three Local Level Government jurisdictions of Kavieng District. The number of communities in each jurisdiction is included, as well as the number of male and female participants in each community and the dates of data collection.

Local Level Government jurisdiction	Number of communities surveyed	Number of people surveyed	Number of male participants	Number of female participants	Year and month of data collection
Tikana LLG	23	40	37	3	Jan. – Jun. 2019
Lovongai LLG	16	46	36	10	Jan. – Jun. 2019
Murat LLG	10	25	25	-	Feb. - Mar. 2020

14 (39%) observations of guitarfish and giant guitarfish were observed by the residents of Murat LLG (Table 2). The distribution of sawfish and other rhino ray sightings in Tikana and Lovongai LLGs has been presented in Figure 4. Sawfish can become entangled in gillnets, while spear guns can be used to capture juvenile wedgefish and guitarfish. Across all three LLGs in Kavieng District, 68 respondents (61%) used spear guns when fishing while 42 participants (38%) used gillnets (Table 3). 91 of the fishers that took part in the surveys (82%) went fishing in areas of coral reef, where typically sawfish and rhino rays are not found. A total of 49 fishers (44%) went fishing in areas with sandy substratum, where wedgefish, guitarfish and giant guitarfish dwell, while fewer respondents fished in areas of mangroves (22%), estuaries (19%) or freshwater systems (8%), where sawfish are often found (Table 4).

Table 2: The total number of observations of sawfishes, wedgefishes and guitarfishes in Kavieng District, according to the key informant questionnaire participants. The total number of observations in Local Level Government (LLG) jurisdictions of Kavieng District, notable Tikana, Lovongai and Murat LLGs, have also been included.

Family name	Common name	Sightings in Tikana LLG	Sightings in Lovongai LLG	Sightings in Murat LLG	Total sightings
Pristidae	Sawfishes	11	12	-	23
Rhinidae	Wedgefishes	28	44	13	85
Rhinobatidae & Glaucostegidae	Guitarfishes & giant guitarfishes	14	8	14	36

Table 3: Fishing gears and fishing methods typically used by the community members, according to each of the three Local Level Government (LLG) jurisdictions in Kavieng District, New Ireland Province. The total number of fishing gears and fishing methods for Kavieng District has also been included.

Fishing gear or fishing method	Lovongai LLG	Murat LLG	Tikana LLG	Total
Gill-net fishing	16	9	17	42
Handline fishing	25	7	33	65
Spear gun fishing	22	22	24	68
Troll line fishing	14	2	14	30
Shellfish gleaning	3	-	16	19
Other fishing methods	-	-	3	3

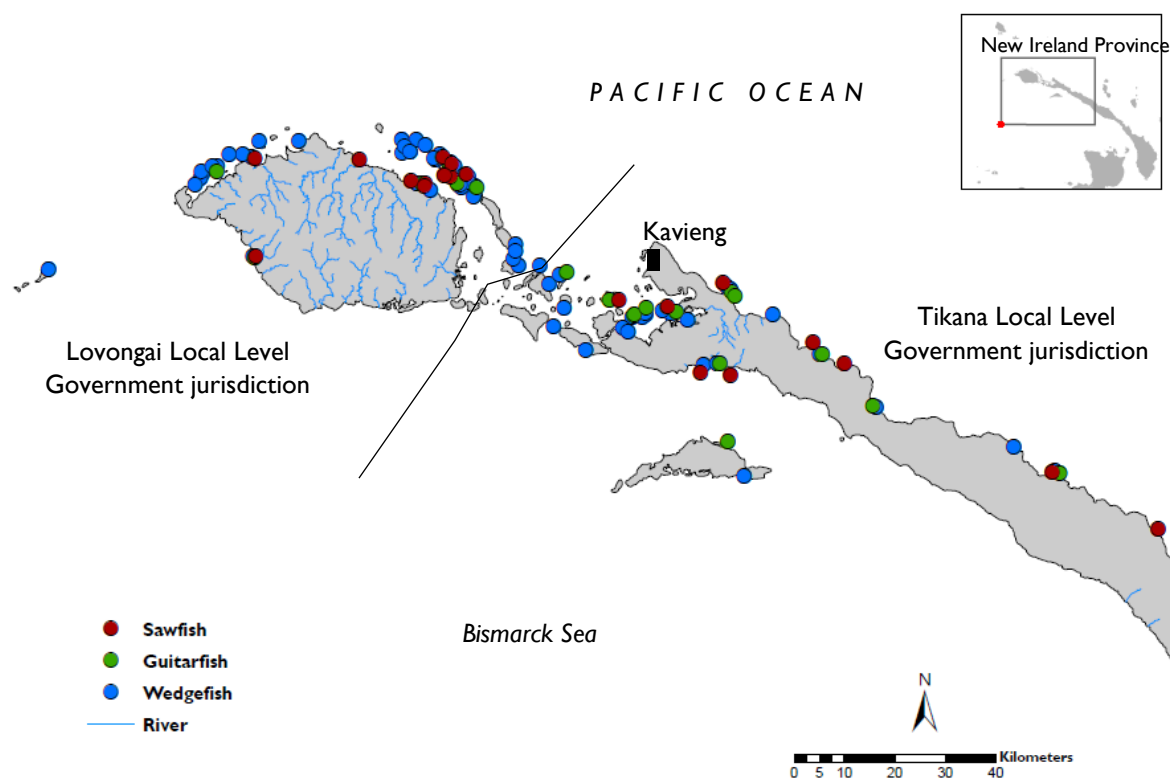


Figure 4: Distribution of sawfish, wedgefish and guitarfish sightings in Lovongai and Tikana Local Level Government jurisdictions in Kavieng District, New Ireland Province, Papua New Guinea; a total of 117 observations were made in the two jurisdictional areas. The Murat Local Level Government data are not included. Red denotes sawfish sightings; green indicates guitarfish and giant guitarfish observations; and blue represents wedgefish sightings. Blue lines indicate river channels, the estuaries of which sawfish are known to inhabit.

Table 4: Habitat types in which respondents typically go fishing, according to Local Level Government (LLG) jurisdiction in Kavieng District, New Ireland Province. Muddy substratum refers to fine grain sediments such as mud, silt and clay; open water refers to pelagic and deep waters systems; estuaries and deltas refers to brackish water environments; and rivers and freshwater systems includes freshwater bodies of water, such as lakes.

Habitat type	Lovongai LLG	Murat LLG	Tikana LLG	Total
Coral reefs	30	24	37	91
Sea grass beds	17	-	28	45
Sand flats	20	3	26	49
Muddy substratum	7	-	13	20
Rocky bottoms, hard substrate	8	9	20	37
Open water	16	5	18	39
Mangroves, mangrove swamps	9	-	15	24
Estuaries and deltas	5	4	12	21
Rivers and freshwater systems	3	-	6	9
Other	-	2	-	2

Of the 111 respondents that took part in the surveys, 144 observations of sawfish, wedgefish and guitarfish were made. The majority of the observations were of living animals in their natural environment: 13 sawfish, 67 wedgefish and 30 guitarfish and giant guitarfish (Figure 5). 115 of the respondents also indicated how frequently they observed the animals during their lifetimes. 21 of wedgefish observations (18%) and 13 guitarfish (11%) observations were described as quite frequently. However, the majority of sawfish observations (16) were very rare (13%) across Kavieng District (Figure 6). The 115 participants that had stated how frequently they had viewed sawfish also indicated when they last observed the animals. The majority of sawfish observations ($n=11$; 61%) were viewed over a decade prior to when the survey was conducted while most wedgefish ($n=22$; 33%) observations were during the previous year (Figure 7).

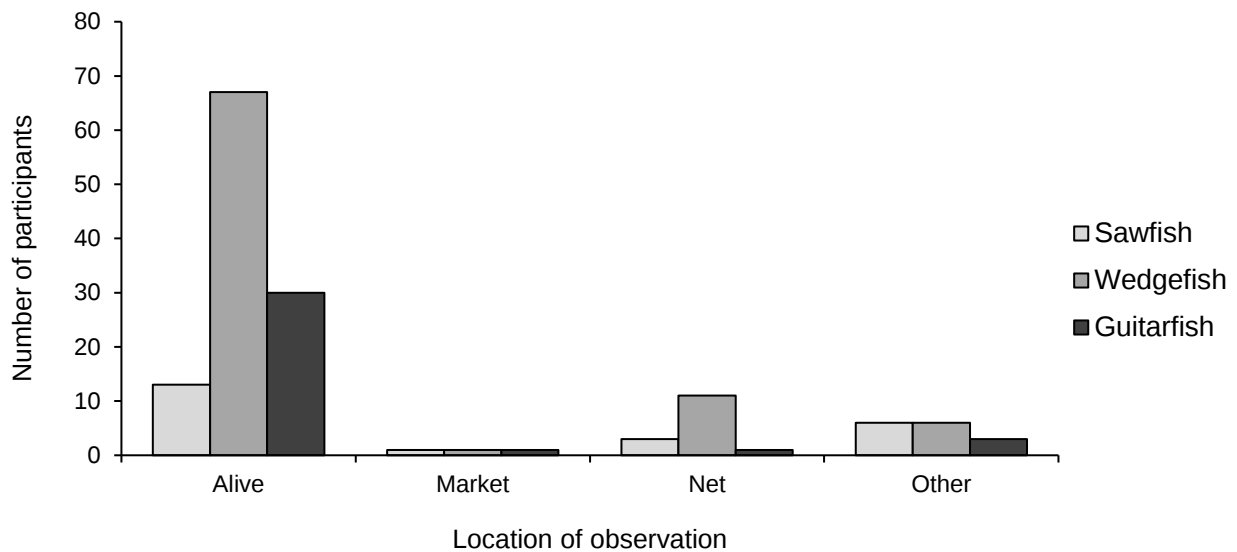


Figure 5: The locations were survey respondents ($n=143$) observed sawfish and rhino rays. Alive refers to animals that were viewed in their natural environment, market denotes animals that were seen on sale at local markets, and net refers to animals that were captured in gillnets. Guitarfish includes true guitarfish and giant guitarfish.

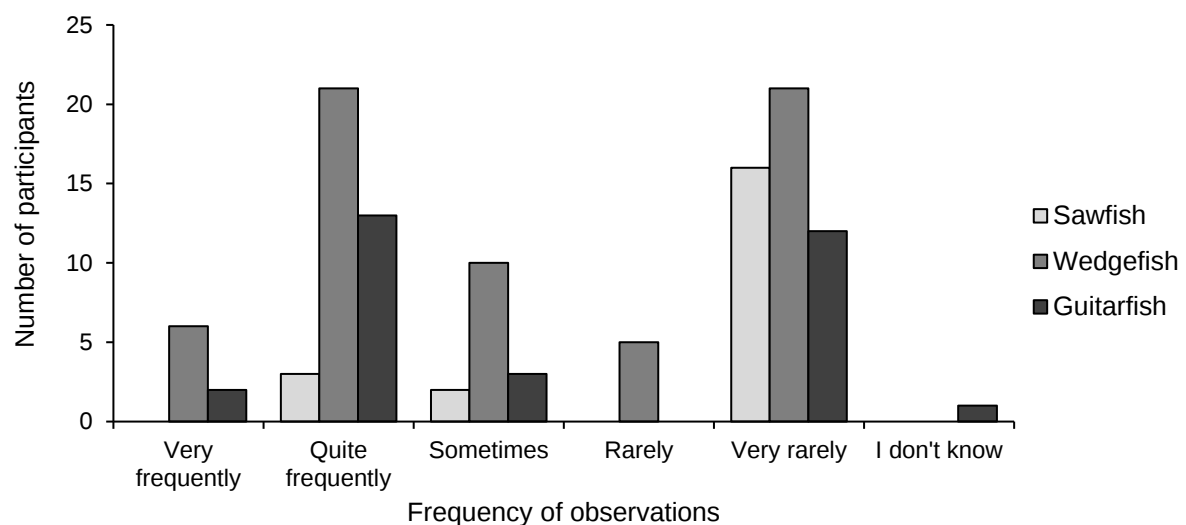


Figure 6: Frequency of sawfish and rhino ray of recent and historical observations across all sites in Kavieng District, New Ireland Province, during the lifetimes of the participants ($n=115$). Guitarfish includes true guitarfish and giant guitarfish.

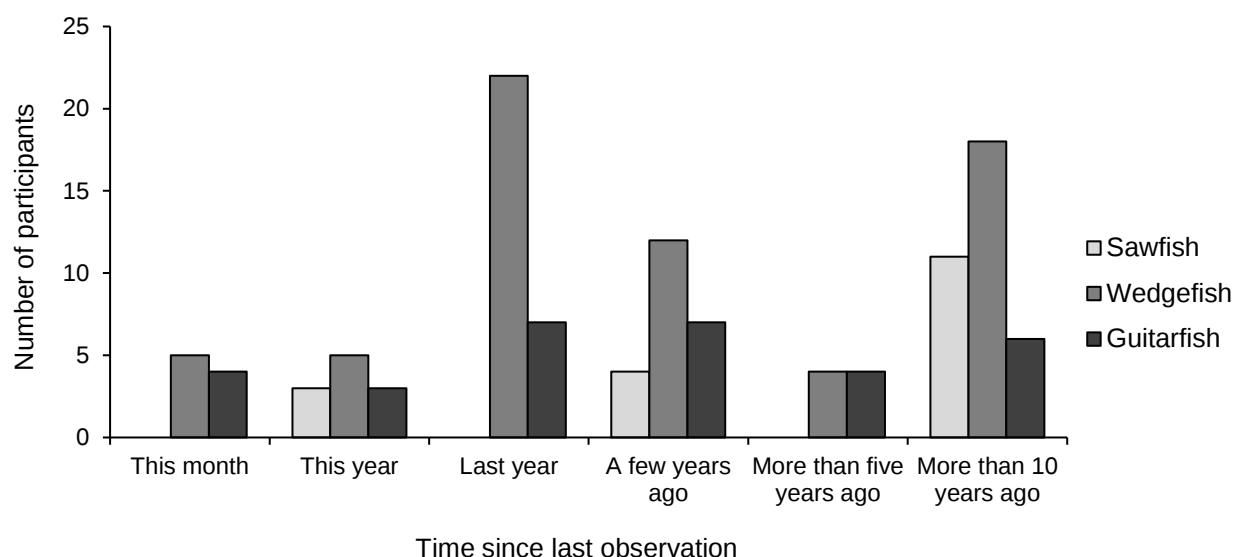


Figure 7: Respondent outcomes according to the time since the last sawfish or rhino ray observation was made ($n=115$). Guitarfish includes true guitarfish and giant guitarfish.

Respondents provided information on whether the animals are targeted or accidentally caught. In both Lovongai (69%) and Tikana (68%) LLGs, most sawfish and rhino rays were caught accidentally, while only 16% and 20% were deliberately targeted, respectively (Figure 8: A). The participants also indicated how the animals are utilised once caught. In both Lovongai (59%) and Tikana (41%) LLGs, most animals were used for home consumption; only 10% of the animals were sold in Lovongai and no animals were sold in Murat or Tikana LLGs. No sawfish or rhino rays were deliberately targeted or utilised in Murat LLG (Figure 8: B).

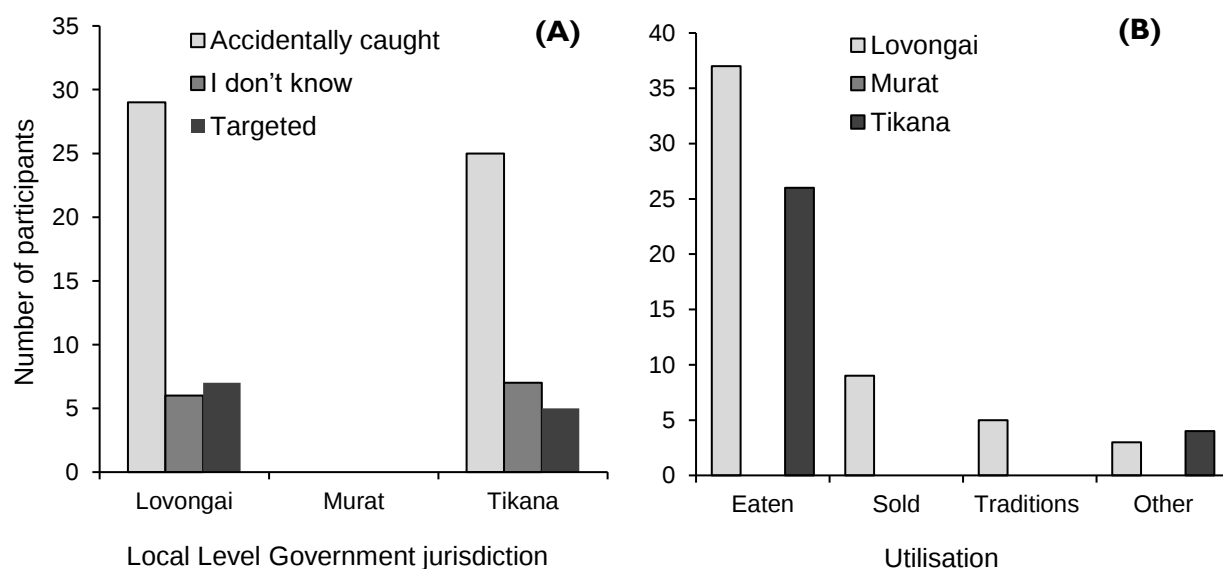


Figure 8: Participant responses (A) to whether sawfish and rhino rays are targeted or accidentally caught in Kavieng District, New Ireland Province, according to Local Level Government jurisdictions. Accidentally caught refers to animals that are not deliberately targeted. Responses to how sawfish and rhino rays are utilised (B) in Kavieng District, according to Local Level Government jurisdiction: Eaten refers to animals that are consumed at home; sold indicates animals that are destined for market sales, and traditions denotes animals or animal body parts that are used for customary or traditional purposes.

PART II: Baited remote underwater video system assessments

A total of 59 baited remote underwater video systems (BRUVS) were deployed at 14 sites between October 2019 and March 2020, during both morning and afternoon deployment sessions (Table 5). In total, 243 individuals of fish including sharks, rays and eels and other marine megafauna (turtles) were recorded, of which 206 were identified to species level. The identified individuals ($n=206$) belong to 108 species which comprised 31 families and 14 orders.

There were 19 individual cartilaginous fishes (class: Chondrichthyes) that were recorded, with 7 species or possible species (as well as one unidentified ray) belonging to 3 families and 3 orders. These orders are Orectolobiformes (nurse sharks) Carcharhiniformes (requiem sharks) and Myliobatiformes (nesting rays). A species list of all the cartilaginous fishes that were observed with the BRUVS has been presented in Table 6, and selected photograph stills taken of cartilaginous fishes in Murat LLG have been displayed in Figure 9.

Table 5: The total number of baited remote underwater video systems (BRUVS) that were deployed at each location in the three Local Level Government jurisdictions of Kavieng District, New Ireland Province. The number of morning and afternoon BRUVS, as well as the year and month of deployment, are also included.

Local Level Government jurisdiction	Community deployment locations	Number of BRUVS deployed	Morning BRUVS deployed	Afternoon BRUVS deployed	Year and month of deployment
Tikana LLG	Laraibina	6	3	3	October 2019
	Tome	9	4	5	October 2019
	Salapiu	6	3	3	November 2019
	Limanak	6	3	3	November 2019
	Tugalop	6	3	3	November 2019
Lovongai LLG	Kavitongong	6	3	3	November 2019
	Sosson	6	3	3	November 2019
	Tsoilik	6	3	3	November 2019
Murat LLG	Pomanai	1	1	-	February 2020
	Bangalu	1	-	1	February 2020
	Tarairai	1	1	-	February 2020
	Lomaku	4	3	1	February 2020
	Pakena	1	1	-	February 2020
	Loaua	5	2	3	March 2020

Table 6: List of the cartilaginous fish species that were captured with the baited remote underwater video systems (BRUVS) between September 2019 and March 2020 in Kavieng District, New Ireland Province, Papua New Guinea, including the number of sightings of each species.

Class	Order	Family	Species	Common name	No. of sightings
Chondrichthyes	Orectolobiformes	Ginglymostomatidae	<i>Nebrius ferrugineus</i>	Tawny shark	3
			<i>Carcharhinus melanopterus</i>	Blacktip reef shark	9
	Carcharhiniformes	Carcharhinidae	<i>Carcharhinus</i> spp.*	Could not be identified	1
			<i>Triaenodon obesus</i>	Whitetip reef shark	2
			<i>Neotrygon annotata</i>	Plain mask ray	1
	Myliobatiformes	Dasyatidae	<i>Pateobatis</i> spp.†	Could not be identified	1
			<i>Taeniura lessoni</i>	Oceania fantail ray	1

* Possibly *Carcharhinus sorrah* (spot-tail shark)

† Possibly *Pateobatis jenkinsii* (Jenkins whipray)

Additional evidence

During this study, two sawfish rosters were observed in Kavieng District, both belonging to largetooth sawfish (*Pristis pristis*). One roster, measuring 89cm in length, was located in Meterankasing village on the northern coast of Lovongai. A second roster was brought to the WCS Office by a local tourism centre, which measured 76cm long, which originated from the Tigak Islands that lie between Lovongai Island and the mainland of New Ireland. Photographs of a shark ray (*Rhina ancylostoma*, a type of wedgefish) were brought to the WCS Office; the animal was caught in Ungalabu Harbour in north-western Lovongai. Further photographs of wedgefish and guitarfish were also captured by the local scuba-diving training facility. In 2016, *Global FinPrint* conducted BRUVS assessments in Kavieng District, during which wedgefishes were observed, and there are also anecdotal reports of scuba divers in the region who witnessed rhino rays, including the manager of Scuba Ventures, based in Kavieng (incidentally, silvertip reef sharks, blacktip reef sharks, grey reef sharks, nurse sharks and several ray species are regularly seen by scuba divers). There are also anecdotal reports of juvenile sawfish capture in Tome, on the eastern coast of mainland New Ireland in late-2019, and of sawfish sightings of Nango Island, in January 2020. In 2011, the author observed a large sawfish rostrum (*P. pristis*) in Laribina village, in central New Ireland.

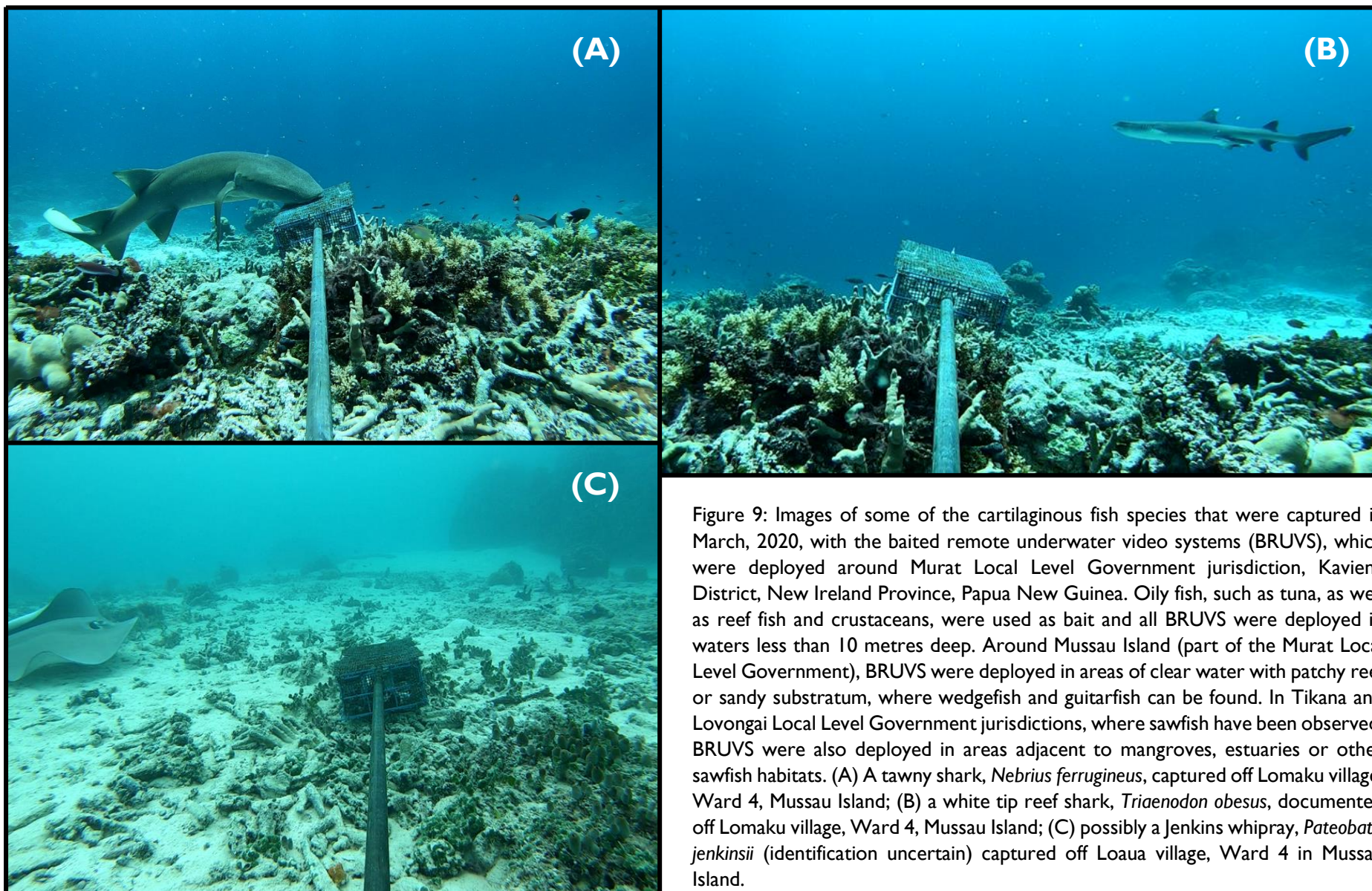


Figure 9: Images of some of the cartilaginous fish species that were captured in March, 2020, with the baited remote underwater video systems (BRUVS), which were deployed around Murat Local Level Government jurisdiction, Kavieng District, New Ireland Province, Papua New Guinea. Oily fish, such as tuna, as well as reef fish and crustaceans, were used as bait and all BRUVS were deployed in waters less than 10 metres deep. Around Mussau Island (part of the Murat Local Level Government), BRUVS were deployed in areas of clear water with patchy reef or sandy substratum, where wedgfish and guitarfish can be found. In Tikana and Lovongai Local Level Government jurisdictions, where sawfish have been observed, BRUVS were also deployed in areas adjacent to mangroves, estuaries or other sawfish habitats. (A) A tawny shark, *Nebrius ferrugineus*, captured off Lomaku village, Ward 4, Mussau Island; (B) a white tip reef shark, *Triaenodon obesus*, documented off Lomaku village, Ward 4, Mussau Island; (C) possibly a Jenkins whipray, *Pateobatis jenkinsii* (identification uncertain) captured off Loaua village, Ward 4 in Mussau Island.

Shark catch-per-unit-effort data from 2015 to 2017 in Kavieng District

From 2015 to 2018, fisheries catch-and-effort data were collected annually from thirteen communities in Kavieng District, New Ireland Province, to enable fisheries catch-per-unit-effort (CPUE) assessments to be made. As well as reef fish and invertebrates, a number of sharks and rays were also caught. In total, shark and ray catches were recorded in 11 out of the 13 surveyed villages. The majority of chondrichthyan species caught in these fisheries were coastal reef-associated species, with almost half of the total catch consisting of black tip reef sharks (*Carcharhinus melanopterus*) followed by blue-spotted sting rays (*Neotrygon kuhlii*) and plain mask rays (*Neotrygon annotata*). Figure 10 lists the species of sharks and rays that occurred in the surveys and the numbers of each species from all thirteen communities and across all three years.

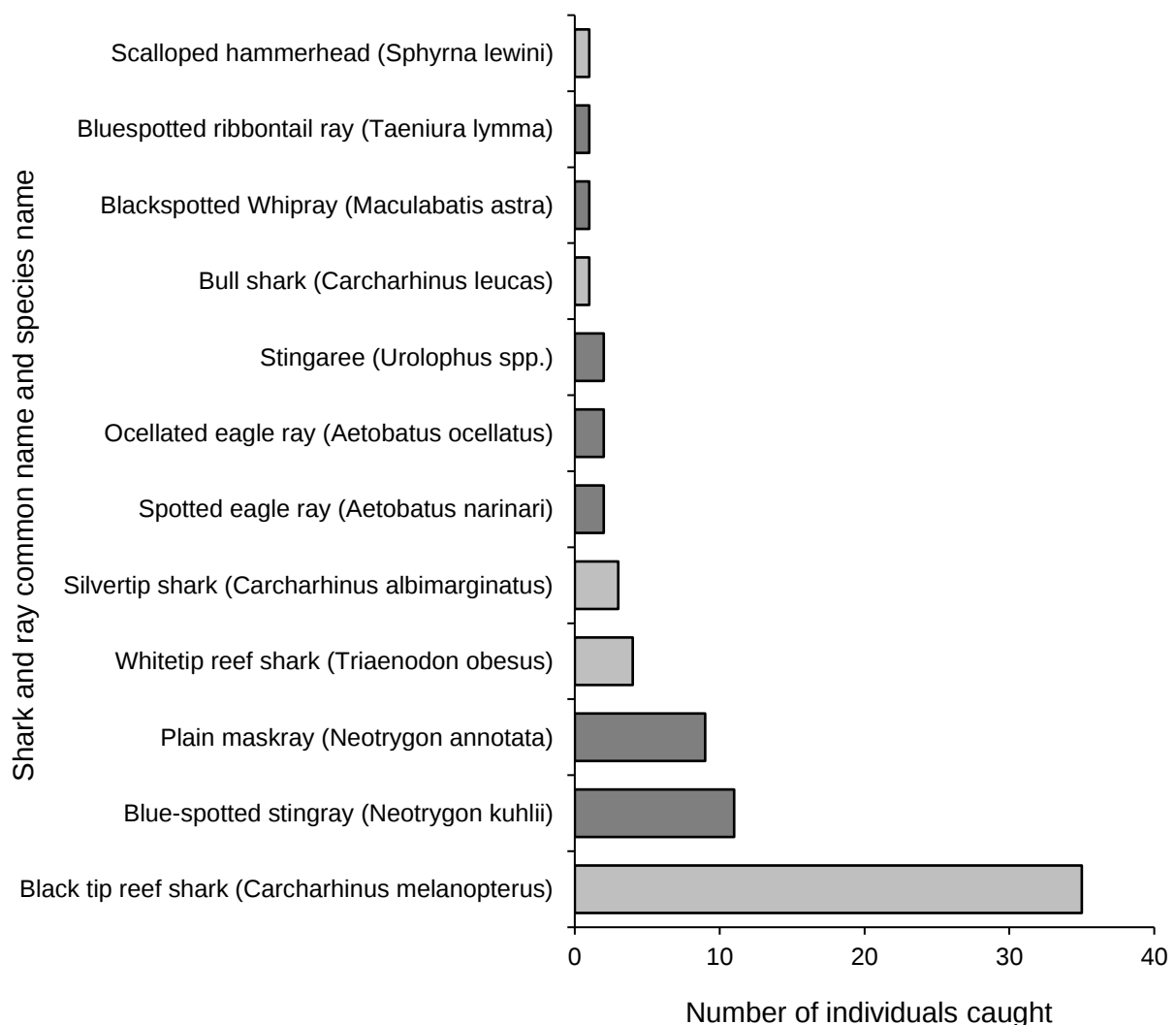


Figure 10: The species of sharks and rays that were surveyed during the fisheries catch-and-effort surveys that were conducted annually in 13 communities in Kavieng District, New Ireland Province, and the number of individuals that were sampled. The fisheries catch-and-effort surveys occurred annually from late-2015 to early 2017. The data are arranged in order of number of species caught, not in taxonomic order. Shark species are represented by bars shaded in light grey; ray species are represented by bars shaded in darker grey.

Summary

Although no living examples of sawfish or rhino rays were encountered during this study, the outcomes of the key informant questionnaire surveys indicate that sawfish, wedgefish and guitarfish have been observed in the region during recent years. Wedgefish appear to be more abundant than sawfish, guitarfish and giant guitarfish across Kavieng District, and no sawfish were documented in Murat LLG, especially among younger male generations of fishers. The most widespread fishing gears used in the region are spearguns, which can be used to targeted rhino rays, and particularly juvenile animals, which inhabit areas of sandy substratum, areas that appear to be frequently targeted by local fishers. Despite this, most sawfish and rhino rays appear to caught accidentally and are witnessed alive, which for wedgefish, such observations appear to be quite regular during recent years. Moreover, although no sawfish were sighted in Murat LLG, it is apparent the no wedgefish and guitarfish – which are sighted – are not target, consumed or sold at local markets. This could be due to the inhabitants of Murat LLG practicing the Seventh-Day Adventist faith, a branch of Christian Protestantism that forbids the consumption of certain food items, including animals that possess canines or sharp teeth, which would encompass many sharks, and also rays.

Although in the White *et al.* (2017) study there were no mention of sawfish in New Ireland Province, we anticipate that the evidence obtained in this study will help widen the spread – and especially historical spread – of sawfish distribution in PNG to include New Ireland Province. Moreover, due to the low target rate and utilisation of rhinopristsids in Kavieng District, there is an opportunity for sawfish and rhino ray management. WCS is currently in the process of facilitating community driven marine protected areas (MPAs) in Lovongai and Murat LLGs that will be enforced with LLG laws, which are recognised under the PNG Constitution as part of the Organic Law. The rules and penalties – as well as the boundaries – of the MPAs will be driven by communities that live in each respective region. Working with communities, WCS aims to incorporate the first sawfish and rhino ray management rules in the Lovongai LLG MPA, and because of the practicing of the SDA faith in Murat LLG, it is anticipated that the first shark and ray management and protection rules will be implemented with the establishment and declaration of the Murat LLG MPA. Additional management measures that can be incorporated into the MPAs and elsewhere in the region could include reduced capture and live release training protocols for when the animals are captured; such training can be provided to communities once the MPA rules and management measures are in place. Further data collection, including market and fisheries landing assessments, catch-per-unit-effort surveys, and environmental DNA (eDNA) analyses could provide a better understanding of rhinopristsids (and sharks and rays in general) in Kavieng District. If such plans arise, they will represent the first sawfish and rhino ray protection legislation in PNG, setting the benchmark for elsewhere in the country.

References

- Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D. and others (2014). Extinction risk and conservation of the world's sharks and rays. *eLife* 3: e00590
- Hau, C.Y., Abercrombie, D.L., Ho, K.Y.K., Shea, K.H.S. (2018). 'King shark fins' not quite sharks... so what's in my soup? a rapid survey on the availability of shark-like batoid fins in Hong Kong SAR and Guangzhou, China retail markets. Bloom and Hong Kong Shark Foundation. pp 30.
- Harrison L, Dulvy NK (eds) (2014). Sawfish: a global strategy for conservation. IUCN Species Survival Commission Shark Specialist Group, Vancouver
- Jabado, R.W. (2019). Wedgefishes and giant guitarfishes: A guide to species identification. Wildlife Conservation Society, New York, United States. 30pp
- Leeney, R.H, Mana, R.R., Dulvy, N.K. (2018). Fishers' ecological knowledge of sawfishes in the Sepik and Ramu rivers, northern Papua New Guinea. *Endangered Species Research*. **36**: 15–26
- Kyne, P.M., Jabado, R.W., Rigby, C.L., Dharmadi, M.A., Gore, Pollock, C.M., Herman, K.B., Cheok, J., Ebert, D.A., Simpfendorfer, C.A., Dulvy, N.K. 2020. The thin edge of the wedge: Extremely high extinction risk in wedgefishes and giant guitarfishes. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 1–25
- National Housing and Population Census on Papua New Guinea, 2011
- White, W.T., Appleyard, S.A., Kyne, P.M., Mana, R.R. (2017). Sawfishes in Papua New Guinea: a preliminary investigation into their status and level of exploitation. *Endangered Species Research*. **32**: 277–291
- White, W.T., Baje, L., Sabub, B., Appleyard, S.A., Pogonoski, J.J., Mana, R.R. (2017). Sharks and rays of Papua New Guinea. ACIAR Monograph No. 189. Australian Centre for International Agricultural Research: Canberra. 327 pp.

Appendix I: Questionnaire survey form for community key informants

Fishers' knowledge survey of shovelnose rays and their relatives (Order Rhinopristiformes) in Kavieng District, New Ireland Province, Papua New Guinea

Interviewer: _____ Date: _____ Data sheet code: _____

QUESTIONNAIRE

PART ONE: GENERAL INFORMATION

- 1) Community name:**
- 2) Name of person (only if consented):**
- 3) Age of interviewee:**
- 4) Gender:**
- 5) Job/Occupation:**
- 6) Were you born in New Ireland Province? If not, where were you born?**
 - a. Yes
 - b. No, I was born in _____.
- 7) What level of education have you received?**
 - a. No schooling
 - b. Elementary (Grade 1 – 5)
 - c. Secondary school (Grade 6 – 12)
 - d. College or technical institute
 - e. University
 - f. Other
- 8) How many people live in your household?**
 - a. Youth (aged 0 – 17)
 - b. Adults (aged 18+)
- 9) How many people in your house have a job?**
- 10) Do you have electricity in your house?**

PART TWO: FISHING INFORMATION

I 1) Is fishing your main source of livelihood?

☐ Yes ☐ No

If no, what is your main source of livelihood?

What other livelihood activities do you undertake?

I 2) For how many years have you been fishing?

I 3) How often do you go fishing?

I 4) Which fish or shellfish do you usually catch?

I 5) How do you normally go fishing?

- a. From a canoe
- b. From a boat
- c. From the shore
- d. Other (please specify)

I 6) Which fishing gear(s) do you normally use?

- a. Gill net
- b. Hand line
- c. Spear gun
- d. Troll line
- e. Gleaning
- f. Other (please specify)

I 7) Where do you normally fish? (show on map)

I 8) In which types of area(s) do you normally go fishing?

- a. Coral reefs
- b. Sea grass beds
- c. Sand flats
- d. Muddy areas
- e. Rocky bottoms
- f. Open water
- g. Mangroves
- h. Estuaries
- i. Rivers
- j. Other (please specify)

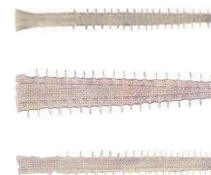
PART THREE: SIGHTINGS INFORMATION

19) Have you ever seen any animals – alive or body parts - that look like these?

- a. Yes
- b. No – finish survey

If yes, which ones?

- a. Sawfish



- b. Wedgefish



- c. Guitarfish



20) Where have you seen these animals?

	Sawfish		Wedgefish		Guitarfish	
	Tick	Explain	Tick	Explain	Tick	Explain
a) Alive in the water If so, where? Point to map.						
b) In a fishing net If so, where? What kind of net? Map?						
c) At a market If so, where? Map?						
d) Sawfish nose in a community house If so, where? Map?						
e) Other Map?						

21) How often do you see these animals?

	Sawfish	Wedgefish	Guitarfish
a) Very frequently – at least once per week			
b) Quite frequently – at least once per month			
c) Sometimes – around once per year			
d) Rarely – once every two or three years			
e) Very rarely – only once or twice in my life			
f) I don't know			

22) When do you usually see them? (particular months/seasons or year-round?)**23) When did you last see them?**

	Sawfish	Wedgefish	Guitarfish
a) This month			
b) This year			
c) Last year			
d) A few years ago			
e) More than five years ago			
f) More than ten years ago			

24) Have you seen a change in how often you see these animals during your lifetime?

	Sawfish	Wedgefish	Guitarfish
a) I see them more often			
b) No change			
c) I see them less often			

25) Have you seen a change in the number of these animals during your lifetime?

	Sawfish	Wedgefish	Guitarfish
d) There has been an increase in number			
e) No change			
f) There has been a decrease in number			

26) Have you seen a change in the size of these animals during your lifetime?

	Sawfish	Wedgefish	Guitarfish
g) There has been an increase in size			
h) No change			
i) There has been a decrease in size			

27) If any changes, why do you think this is?

PART FOUR: UTILISATION INFORMATION

28) Are these animals caught intentionally, as target species, or accidentally?

- a. Targeted
- b. Accidentally caught
- c. I don't know

29) What are the animals used for?

- d. Caught for food – local consumption
- e. Caught to sell
 - i. If to sell, please explain
- f. Traditional or customary use
 - i. If traditional use, please explain
- g. Other
 - i. Please explain

30) How much are these animals sold for?

K_____ per _____

31) How does this compare to the price of other large fish?

32) How important are these animals to people's lives and livelihoods?

- a. More important than other fish
- b. About the same as other fish
- c. Less important than other fish

Why?

33) Do you have any further comments or information? Feel free to write on the back of this sheet if there's not enough space

Thank you for your time

Questionnaire adapted from: Leeney, R.H., Mana, R., Dulvy, N.K. 2018. Fishers' ecological knowledge of sawfishes in the Sepik and Ramu rivers, northern Papua New Guinea. Endangered Species Research 36