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RESEARCH ARTICLE

Annotated Checklist of Cartilaginous Fishes in Palawan Waters

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ABSTRACT

An annotated checklist of 67 species of sharks, rays, and chimaeras (Chondrichthyes) confirmed to be present in Palawan waters was described based on (1) market visits in Puerto Princesa, Aborlan, Brookes Point, and Roxas between October 2021 and March 2022; (2) contributory citizen science soliciting photographs and video footage validated by the authors; and (3) review of various ichthyologic types of research in Palawan that include museum collection records, taxonomic papers, results of DNA analysis, institutional project reports, and related literature, particularly on the occurrence and distributional range of the species.

An additional 24 species were placed on the unconfirmed list due to insufficient evidence collected and thus required further investigation. The Province of Palawan exercises environmental jurisdiction over its surrounding marine areas under Republic Act No. 7611, known as the Strategic Environmental Plan for Palawan, with the Palawan Council for Sustainable Development (PCSD), as its regulatory, enforcement, and policy-making authority. In response to the Wildlife Act (Republic Act 9147), the PCSD drafted Resolution 15-521(s. 2015), which updated the list of terrestrial and marine wildlife species in Palawan for protection and management and included only 15 shark and ray species. This paper provides an updated list of Palawan Chondrichthyes (with notes on the conservation status based on the IUCN Global Red List Assessment), suggests a prescriptive approach to enhancing conservation policies in the province, and addresses some critical issues of conservation and management of the Philippine sharks and related species, in particular, and the Philippine fisheries in general.

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1. INTRODUCTION

The Philippines, situated in the Coral Triangle, is known for harboring high species diversity across different marine taxa (Sanciangco et al. 2013), including shore fishes (Carpenter and Springer 2005) (Figure 1). However, despite numerous published studies on marine fishes in this region, cartilaginous fishes (Superclass Chondrichthyes) still need to be studied more as compared to bony fishes (Class Osteichthyes). Chondrichthyans are generally grouped into two: chimaeras (Class Holocephali) which are deep-sea species, and sharks and rays (Class Elasmobranchii), which can occupy different depths and marine habitat types and, in some species, even freshwater ecosystems. Most species are long-lived but face numerous anthropogenic threats, such as overfishing, which has placed more than one-third of all elasmobranchs at high extinction risk (Dulvy et al. 2021a) and are classified by the International Union for the Conservation of Nature (IUCN) as threatened species. While chondrichthyans – particularly sharks and rays – are often found at various scales of fishing activities in the Philippines, research on the fishery and trade of these resources is scarce, with the few published studies focused on targeted fisheries for specific taxa such as dogfishes for their shark liver oil (Encina 1975; Gaudiano and Alava 2003), mobulids (Acebes and Tull 2016; Rayos et al. 2012) and whale sharks (Alava et al. 1997) in the Bohol Sea, and thresher sharks in Tawi-tawi, Sulu (Muallil and Hapid 2020).

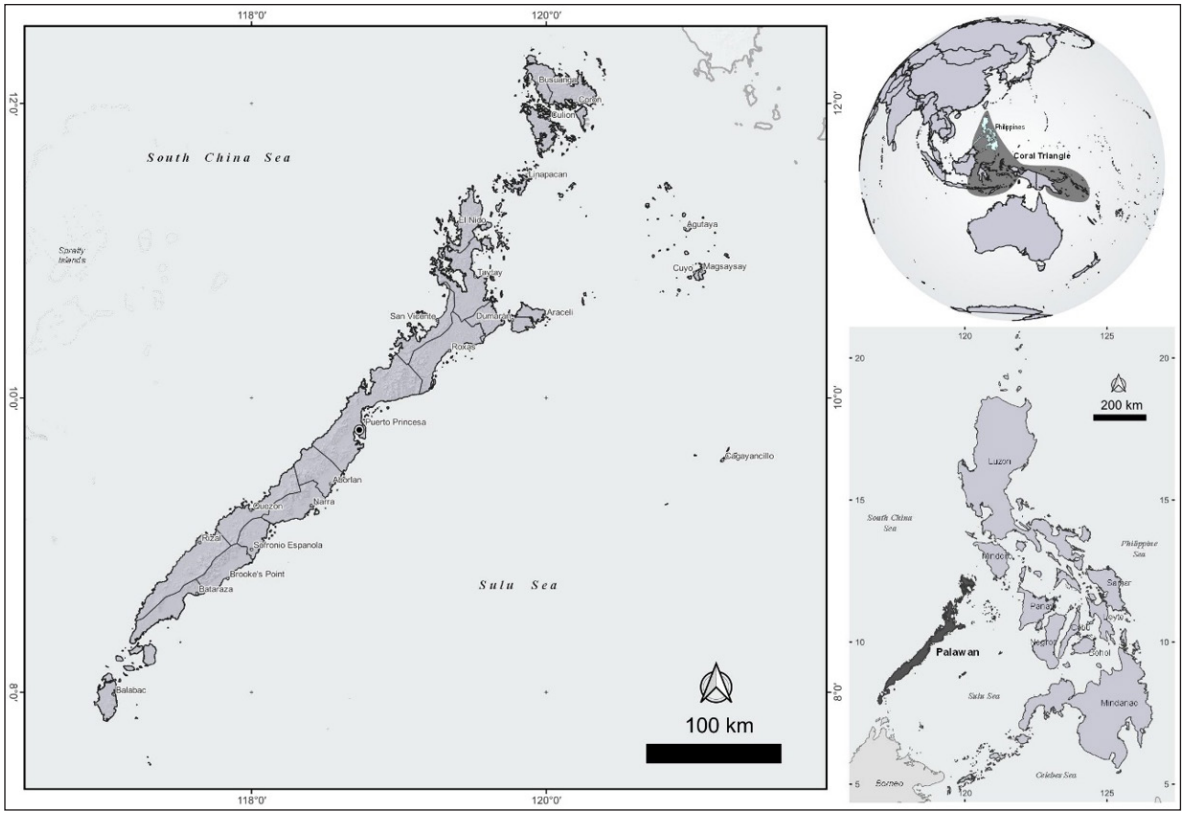

Figure 1. Location map of the project site – Palawan, Philippines.

In the Philippines, 205 chondrichthyans were reported in its territorial waters, of which only 116 were confirmed (BFAR-NFRDI 2017). Species confirmation is particularly challenging since species were known from nominal listings taken in market and landing site surveys, often without voucher specimens or photo documentation. As such, reviewing and re-establishing a comprehensive list of chondrichthyan species in Philippine waters has become one of the priority actions for shark fisheries management in the country as identified in the Philippine Shark Plan 2017-2022 (BFAR-NFRDI 2017). This follows the amendment of the Philippine Fisheries Code in 2016 (Republic Act No. 10654), which penalizes the catch and trade of species listed in any of the three Appendices of the Convention on International Trade in Endangered Species (CITES) even at the domestic level. The Bureau of Fisheries and Aquatic Resources (BFAR) is mandated to enforce this law for the entire Philippine waters within the exclusive economic zone (EEZ). In the Province of Palawan, however, it is the Palawan Council for Sustainable Development (PCSD) that is the regulatory, enforcement, and policymaking authority of the province, mandated to manage its own waters under the Republic Act No. 7611, known as the Strategic Environmental Plan for Palawan. In 2019, under BFAR Fisheries Administrative Order (FAO) 263 series of 2019, which delineated 12 Fisheries Management Areas (FMAs) (Figure 2), all of Palawan waters, extending to the EEZ in the West Philippines Sea and part of Sulu Sea in the east, became a major component of FMA 5. FAO 263 seeks to address illegal fishing, mainstream science-based fisheries management, and acknowledge the crucial role of local government units (LGUs) in the sustainable management of shared fisheries resources.

The unique administrative setup in Palawan is both a recognition and a response to the exceptional marine and terrestrial biodiversity of Palawan and the conservation challenges this poses. Palawan, comprising of one long and narrow island and about 1,700 smaller islands in the southwestern Philippines in between the South China Sea Large Marine Ecosystem (LME) in the west and Sulu Celebes Seas LME in the east (Figure 2), is touted as the country's "last ecological frontier." The United Nations Educational, Scientific, and Cultural Organization (UNESCO) designated the whole province as a Biosphere Reserve in 1990 for its tropical humid forests and coastal marine ecosystems. Terrestrial and aquatic habitats

are home to several endemic species and some of the world's most threatened flora and fauna.

Palawan's rich biodiversity, as well as its remote and isolated nature, makes it a prime location for poaching activities. In 2018, for instance, local fishers were caught on Coron Island with semi-processed meat of silky sharks *Carcharhinus falciformis* (Bibron 1839) (Formoso 2018a) while the Philippine Navy arrested 20 Vietnamese fishers for illegal entry into Philippine waters and poaching of 175 assorted sharks and rays (Formoso 2018b), including CITES-listed wedgefishes shown in the photograph accompanying the article.

Chondrichthyans in Palawan were reported to have been identified since 1907 (Smith and Williams 1999). Although Compagno et al. (2005) remarked that naturalists from first-world countries had published references on Philippine marine fishes as early as 1706, whether these accounts included cartilaginous fishes from Palawan waters was unclear. A search through the National Museum of Natural History (NMNH) database of the Smithsonian Institution yielded voucher specimens from the province dating as far back as 1909. Philippine chondrichthyan diversity was not largely known until the publication of the *Checklist of Philippine Chondrichthyes* (Compagno et al. 2005), which noted 39 species in Palawan based on specimens collected from the province. In recent years, an increase in the chondrichthyan research effort in the province has led to several publications that support the importance of Palawan waters to cartilaginous fishes. Last and Gaudiano (2011) described a new species of gollumshark *Gollum suluensis* (Last and Gaudiano 2011), from a specimen collected from a fish market in Puerto Princesa City. In Tubbataha Reefs Natural Park (TRNP), a 97,030-hectare protected area in the middle of the Sulu Sea, 23 species of sharks and rays were documented from underwater visual census, baited remote underwater video surveys, and citizen science reports suggesting it may be a global hotspot for reef sharks (Murray et al. 2015). Citizen science reports from TRNP also led to the first Philippine record of the reef manta ray *Mobula alfredi* (Krefft 1868) (Aquino et al. 2015). Two other rare species were also reported from Cagayancillo: the cryptic ornate eagle ray *Aetomylaeus verspertilio* (Bleeker 1852) identified from underwater video footage (Araujo et al. 2018) and the first country record of the smalltooth sandtiger shark *Odontaspis ferox* (Risso 1810) identified from photos of landed catch (Ponzo 2017) and from DNA sequencing (Pereda et al. 2017).

Despite PCSD's efforts to expand its biodiversity inventory and curb illegal wildlife trade,

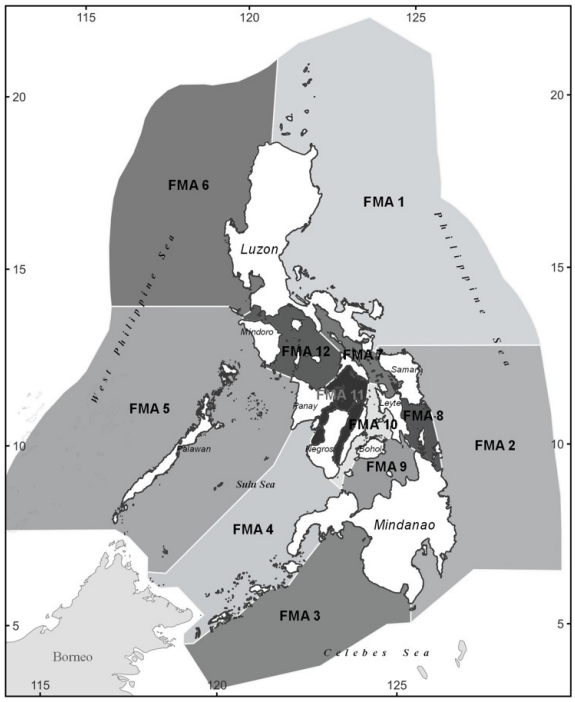

Figure 2. Map showing the Fisheries Management Areas (FMAs) designated by Fisheries Administrative Order (FAO) No. 263. FMA 5 is of special note to the study as it encompasses waters immediately surrounding the Province of Palawan.

information gaps remain, especially concerning chondrichthyans, which has limited its management efficacy. In 2015, the PCSD came out with an updated list of threatened terrestrial and marine wildlife species (PCSD Resolution 15-521) wherein at least 15 shark and ray species were listed and regulated in Palawan based on the IUCN Red List Threatened Categories as well as on CITES Appendices (see Table 1). Prior to this resolution, at least 24 chondrichthyan species also found in the Philippines were already listed in the CITES Appendices and, as such, qualify as regulated species under RA 10654 (with more species expected to be added to the list after the recent CITES Conference of Parties held in November 2022). However, the PCSD's threatened species list only has 15 elasmobranch species, which suggests an under-representation of threatened chondrichthyan species in the province. This is likely due in part to low capacity in species identification in the field and the challenges faced when elasmobranchs are cut or processed into unidentifiable pieces, as is usually observed in major and smaller informal markets. The problem of species misidentification in the field by law enforcement and fisheries monitoring teams is also exacerbated by recent and ongoing taxonomic changes, such as stingrays in Family Dasyatidae (Last et al. 2016a)

Table 1. List of regulated sharks and rays of Palawan as listed in PCSD Resolution 15-521.

Ref No.	FAMILY	SCIENTIFIC NAME
I. Critically Endangered Species (incl. those species listed under CITES Appendix I)		
1	Pristidae	*Pristis* spp.
II. Endangered Species (including those species listed under CITES Appendix II)		
2	Sphyrnidae	*Sphyrna mokarran* (Rüppell, 1837)
III. Vulnerable (including those species listed under CITES Appendix III)		
3	Alopiidae	*Alopias pelagicus* (Nakamura, 1935)
4	Carcharhinidae	*Carcharhinus longimanus* (Poey, 1861)
5	Dasyatidae	*Himantura uarnak* (Gmelin, 1789)
6	Dasyatidae	*Urogymnus asperrimus* (Bloch & Schneider, 1801)
7	Ginglymostomatidae	*Nebrius ferrugineus* (Lesson, 1831)
8	Heterodontidae	*Heterodontus zebra* (Gray, 1831)
9	Myliobatidae	*Manta birostris* (Walbaum, 1792)
10	Myliobatidae	*Manta alfredi* (Krefft, 1868)
11	Rhincodontidae	*Rhincodon typus* (Smith, 1828)
12	Rhinobatidae	*Rhina ancylostoma* (Bloch & Schneider, 1801)
13	Rhinobatidae	*Rhynchobatus australiae* (Whitley, 1939)
14	Sphyrnidae	*Sphyrna zygaena* (Linnaeus, 1758)
15	Stegostomastidae	*Stegostoma fasciatum* (Hermann, 1783)

and manta rays in Family Mobulidae (White et al. 2018), among others. These gaps highlight the need to review and verify various information sources on chondrichthyan species diversity in Palawan to strengthen PCSD's efficacy for managing cartilaginous fish resources.

2. METHODS

Information used in this provincial chondrichthyan species checklist was gathered and verified by 1) market surveys in three municipalities and one city and 2) review of species listings from various ichthyologic types of research in Palawan that include museum collection records, taxonomic papers, results of DNA analyses, institutional project reports, and related literature, particularly on the occurrence and distributional range of species. Supplementary to this, photographs and video footage of chondrichthyans taken in Palawan, whenever made available to the authors, were validated, reviewed collectively, and used in enhancing the checklist.

2.1 Market survey

Market visits were conducted to provide information on chondrichthyans in waters surrounding the Palawan islands. Small informal markets known as "*talipapa*" in the capital city of Puerto Princesa were mainly targeted and visited between October 2021 and March 2022. The large formal markets in nearby Aborlan, Brooke's Point, and Roxas municipalities were visited only once during the study (Figure 3).

Tissue samples for DNA analysis were collected whenever allowed by the vendor or fisher as covered by Gratuitous Permit (GP) Number 2021-010 granted by the PCSD. Vendors and, when available, fishers were asked about the catch location and fishing gear used in the catch. In cases where the catch location could not be determined, the default location used was the market where it was being sold. Pictures were taken to identify the specimens, compiled in a photo catalog, and tagged using an alphanumeric code, e.g., DLA 001, based on the initials of the photographer/data collector and following a chronological order for the numeric part. The same alphanumeric code was used to keep track of all information related to the specimen.

2.2 Literature review

The initial set of information reviewed for the study was sourced from PCSD and included local apprehension reports, research reports, and

Figure 3. Map showing the location of markets visited during the conduct of this study.

the threatened species checklist included in PCSD Resolution 15-521. The next set of references was records of specimens reported in museums or specimen holdings in Palawan (i.e., Western Philippine University, as reported by Gonzales 2013) and outside of the province (i.e., the Silliman University (SU) in Dumaguete and the Smithsonian Institution in Washington, DC). Specimens in SU, as examined and identified by Compagno et al. (2005), were added to the checklist if the indicated source or catch location was Palawan or in close proximity thereof. The Smithsonian collection, on the other hand, was searched online (https://collections.si.edu/search/) using the keyword "Palawan" and filtered using the category "Chondrichthyes" to yield species that could be added to the checklist. Only species clearly coming from Palawan or its surrounding waters were added to the list. Geographic coordinates, when provided, were checked to determine whether the catch location was within the FMA 5 or close to Palawan.

Species names in the preliminary checklist were counter-checked for nominal changes using Eschmeyer's Catalog of Fishes. Species identification and additional validation of species presence in Palawan were made by further reviewing taxonomic papers, cited references, and other relevant literature accessed from various websites such as shark-references.com, researchgate.net, and academia.edu. The Google Scholar search engine was also used to yield links to additional published literature regarding Chondrichthyes present in Palawan. Special attention was given to newly published literature and taxonomy papers to note any taxonomic changes that may have affected the species in the checklist. Genetic samples, specimens, and field codes indicated in published literature were matched with inventory lists, e.g., the SU inventory list, to ensure that the specimen referred to by any literature was from Palawan. In several instances, further literature review yielded species not yet included in the preliminary checklist and thus were added.

2.3 Citizen science

Social media platforms, including Facebook and YouTube, were also scanned for possible reports of Chondrichthyes encountered in the province using keywords that included "shark," "ray/s," "fish," "Tubbataha," and "Palawan" as well as keywords in local parlance such as "pating," "iho," and "pagi." Owners of the posts were then contacted to verify whether the footage was indeed taken in Palawan as well as to gather more information on the encounter. Only verified footages were included in this study. Additional information from the Marine Wildlife Watch of the Philippines (MWWP) database was also included in this review. The MWWP database contained posts on Chondrichthyes encountered all over the country from 2012 up to 2022. The information in the database had already been validated by the website managers, which simplified the integration of information into the checklist. Lastly, photographs

and video footage personally shared by individuals which were taken in Palawan were also reviewed, with species validated by the authors through distinguishing features and characters as published in taxonomic papers (various species authorities, see reference list), as presented in Sharks of the World (Ebert et al. 2021) and Rays of the World (Last et al. 2016b), or through email consultations with global shark or ray specialists regarding questionable or unknown species (e.g., *Rhynchobatus* sp. by Dr. Rima Jabado, Elasmo Project).

2.4 Confirming species presence

The presence of a species was considered confirmed in Palawan if one or more of the following types of evidence were obtained: (1) published literature and validated reports recording its presence in Palawan; (2) a voucher specimen from Palawan that had been examined and identified by one or more of the authors to be of that species; (3) DNA analysis of a tissue sample taken from Palawan confirmed it to be of that species; and/or (4) a photograph or video footage of the species taken in Palawan that was identified unanimously by the authors to be of that species (in cases where no consensus was arrived at, the opinions of global experts were sought to settle the issue).

On the other hand, species were considered unconfirmed when: (1) the catch location, although indicated to be elsewhere in the country, was in close proximity to Palawan islands as in the case of specimens collected by Motomura et al. (2017) from Panay; (2) an unresolved issue arose regarding the evidence available for the species in the checklist, e.g., a published paper presenting a checklist which could not be validated or doubt was cast upon the species identification; or (3) historical data were available on the species presence in the province, but no record of any specimen was found. Distribution maps alone were not used as a basis for inclusion in both the confirmed and unconfirmed lists.

All confirmed species listed herewith are presented in a checklist generally following the format of Compagno et al. (2005). Taxonomic nomenclature used in this paper followed that of Eschmeyer's Catalog of Fishes (https://researcharchive.calacademy.org/research/ichthyology/ catalog/fishcatmain.asp) supplemented by information taken from the Global Biodiversity Information Facility (GBIF) (https://www.gbif.org/species/search) regarding scientific authorities for taxonomic classes and orders. Common names and conservation status were derived from the IUCN Red List (www.iucnredlist.org). Possible distributional range of the species was adopted from the IUCN Red List, Last et al. (2016b), and Ebert et al. (2021). This paper also included a separate list of unconfirmed species to highlight the need for further investigation into their possible presence.

3. RESULTS

3.1 Species observed in markets

A total of 123 individuals were documented as being sold in the markets visited. Only 108 individuals were identified to the species level based on diagnostic characters for each species and were found to represent three shark species (i.e., bignose shark *Carcharhinus altimus* (Springer, 1950); blackspot shark *Carcharhinus sealei* (Pietschmann, 1913); grey carpetshark *Chiloscyllium punctatum* (Müller & Henle, 1838) and five ray species (i.e., spotted eagle ray *Aetobatus ocellatus* (Kuhl, 1823); coach whipray *Himantura uarnak* (Gmelin, 1789); oriental bluespotted maskray *Neotrygon orientalis* (Last, White & Serét, 2016); Jenkins' whipray *Pateobatis jenkinsii* (Annandale, 1909); bluespotted lagoon ray *Taeniura lymma* (Fabricius, 1775). Another 15 individual specimens could not be identified even to the genus level as these had been chopped up into unidentifiable pieces. Only its meat and other features identified it as either batoid or shark. Each specimen was treated as an individual species and labeled as "Ray" spp. (n = 10) or "Sharks" spp. (n =5).

The highest number of individuals and species documented was recorded in Brgy. Tagburos (n = 43, 6 species), followed by Brgy Inagawan Subcolony - Sitio Tacduan (n = 31, 3 species), Brgy Sicsican (n = 14, 2 species), Brgy. Sta. Lourdes (n = 8, 3 species), and Brgy Mangingisda (n = 7, 2 species). The rest of the markets were observed to have singular species (see Table 2).

Rays were found to be more abundant and prevalent than sharks in these markets. The oriental bluespotted maskray *Neotrygon orientalis* was observed in 12 of the 13 markets visited (92%), with a collective total (n) of 60 individuals documented in this study. This was followed by the bluespotted lagoon ray *Taeniura lymma* in 7 of 13 markets (54%; n = 31), coach whipray *Himantura uarnak* in 4 of 13 markets (31%; n = 10), Jenkins' whipray *Pateobatis jenkinsii* in 2 of 13 markets (15%; n = 3), and spotted eagle ray *Aetobatus ocellatus* in 1of 13 markets (8%; n = 1).

The three shark species (i.e., *Carcharinus altimus*, *C. sealei*, and *Chiloscyllium punctatum*), and

Table 2. List of shark and ray species documented in 13 markets in Aborlan, Brooke's Point, and Puerto Princesa City, Palawan, from October 2021 to January 2022.

SPECIES	Fish Market/Locality*													Total (No. & %) Ind. / Species	Species Occurrence (No. & %) /Market
	Aborlan			BP	Puerto Princesa City										
	Public Market	Brgy Plaridel	Brgy Isaub	Public Market	Brgy Bacungan	Brgy Inagawan	Brgy Inagawan Sub-colony (Sitio Tacduan)	Brgy Iwahig (Sitio Bucana)	Brgy Mangingisda	Brgy San Pedro (Sitio Abanico)	Brgy Sican	Brgy Sta. Lourdes	Brgy Tagburos		
SHARKS															
1. *Carcharhinus altimus* (Spring-er, 1950). Bignose Shark.													1	1 (1%)	1 (8%)
2. *Carcharhinus sealei* (Pietsch-mann, 1913). Blackspot Shark.													1	1 (1%)	1 (8%)
3. *Chiloscyllium punctatum* (Müller & Henle, 1838). Grey Carpetshark.							1							1 (1%)	1 (8%)
4 - 8. Unknown shark sp.1,2,3,4,5							2						3	5 (5%)	5 (40%)
BATOIDS															
1. Aetobatus ocellatus (Kuhl, 1823). Spotted Eagle Ray.													1	1 (1%)	1 (8%)
2. Himantura uarnak (Gmelin, 1789). Coach Whipray.					1		2					1	6	10 (8%)	4 (31%)
3. Neotrygon orientalis (Last, White & Serét, 2016). Oriental Bluespotted Maskray.		1	3	4	2		12	2	2	3	9	4	18	60 (49%)	12 (92%)
4. Pateobatis jenkinsii (Annan-dale, 1909). Jenkins' whipray.												1	2	3 (2%)	2 (15%)
5. Taeniura lymma (Forsskål, 1775). Bluespotted Lagoon Ray	1					2	13		5		5		4	31 (25%)	7 (54%)
6 - 15. Unknown ray sp.1 - 10							1					2	7	10 (10%)	10 (80%)
Total No. & % Individu-als/market	1 (1%)	1 (1%)	3 (2%)	5 (4%)	3 (2%)	2 (2%)	31 (25%)	2 (2%)	7 (6%)	3 (2%)	14 (11%)	8 (11%)	43 (35%)	123	
Species Diversity (No. & %)/market	1 (4%)	1 (4%)	1 (4%)	2 (9%)	2 (9%)	2 (9%)	7 (30%)	1 (4%)	2 (9%)	1 (4%)	2 (9%)	5 (22%)	17 (74%)		

all of the unidentified sharks (n = 5) and rays (n = 10) were encountered as single specimens. One species that was included in this study but did not come from the markets was the pink whipray *Pateobatis fai* (Jordan & Seale, 1906) (n = 2) which was documented in Baywalk Puerto Princesa City from the confiscated catch of illegal fishers apprehended in the TRNP on 10 October 2021 (Tubbataha Park Rangers, pers comm).

3.2 Catch location and fishing gear

The species sold in the markets were reported to have been sourced from within municipal or city waters facing either the Sulu Sea (n = 99 individuals; 80%) or the West Philippines Sea (n=24; 20%) (Figure 4). The visits to the local "talipapa" in Puerto Princesa City showed that the catch location was not limited to the city and included Roxas and El Nido in the north and Aborlan in the south. Those caught from the north were often sold in the Tagburos "talipapa" while those from Aborlan were sold in Tacduan, Barangay Inagawan. Fishing gears reportedly used were: simple hook and line (n = 60), a fish net locally called "pante" (n = 42), and an improvised speargun (SG) locally called "pana" (n = 22). Sharks and rays caught in hook and line and pante fisheries suggested these were incidental or bycatch fisheries, while those caught using pana implied targeted fisheries by the mere nature of the fishing gear and how it was normally employed. Although hook and line fishery has been employed in shark fisheries, the fishers interviewed during the study revealed that they were targeting

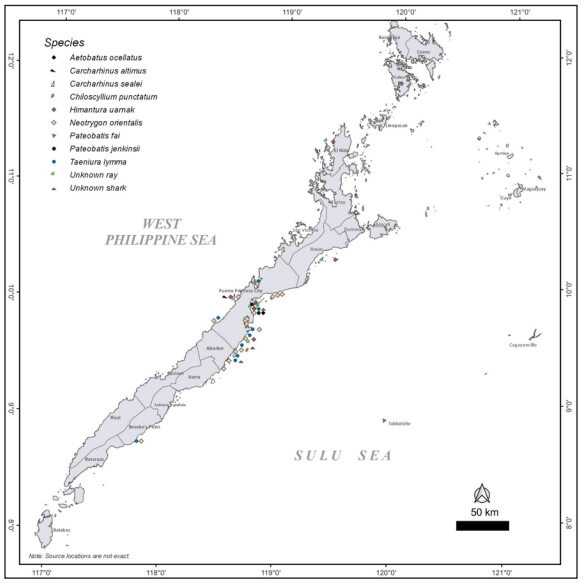

Figure 4. Map showing the catch location of specimens encountered during the study as reported by the vendors and fishers.

commercial species rather than sharks or rays and were fishing in waters closer to shore. Their fishing practice was also quite different from known shark fisheries such as that which occurred in Cagayancillo (LAMAVE 2017).

Most specimens were rays, with only a few sharks in the catch. Apparently, it was much easier to transport rays, being smaller and easier to hide. One fisher explained that sharks were mostly caught in the waters between mainland Palawan and the northern island municipalities. These would be chopped up before docking to avoid detection since most fishers were highly wary of the misperceived Palawan shark ban (i.e., PCSD drafted Resolution 15-521 s. 2015). The regulation applied only to 15 species listed under the CITES Appendices or the Threatened Status (i.e., Critically Endangered, Endangered, and Vulnerable) of the IUCN Global Red List Categories but during law enforcement, "similar-looking" species may also be confiscated.

Another opportunistic visit to the public market in Poblacion, Roxas, revealed that nine out of 24 stalls selling seafood products included rays in their display. Larger rays were chopped up into pieces while juveniles were presented whole. The authors were not able to count the total number of individuals in each stall, but at least three species were identifiable: *N. orientalis*, *T. lymma*, and *H. uarnak*. Most vendors said that these were caught by net, while others did not know how they were caught. They all presumed the catch location to be Green Island Bay. Anecdotal information from a local fisherman in Roxas revealed that these species were commonly caught in the said bay. Along with what he described as hammerhead sharks, he also perceived a decline in his encounters with these fishes over the years.

3.3 Confirmed cartilaginous fish species in Palawan

Based on market visits and reviewed literature, supplemented by collection records of PCSD, SU, and the Smithsonian Institution and photographs and video footage acquired from various individuals, 67 Chondrichthyes species were confirmed to be present in the province, with an additional 24 more whose presence needed further validation. The lists are by no means complete, as the likelihood of undocumented species in the province is still high, given the limited research dedicated to chondrichthyans. Some listed species were not included in previously published Philippine Chondrichthyes lists (Alava et al. 2014;

Compagno et al. 2005) as these were only recognized after these publications came out. The confirmed species recorded in Palawan represented 10 taxonomic orders and 30 families, as presented in Table 3.

Table 3. List of confirmed species recorded in Palawan represented 10 orders and 30 families.

Species		Authority	Common Name	Conservation Status	
Class Holocephali Bonaparte, 1832. (Chimaeroids and their relatives)					
Order Chimaeriformes Obruchev, 1953. Chimaeras.					
Family Chimaeridae Rafinesque, 1815 (shortnose chimaeras or ratfishes)					
1	*Chimaera phantasma*	Jordan & Snyder, 1900	silver chimaera	VU	A2d
Class Elasmobranchii Bonaparte, 1838. (sharks and batoids)					
SHARKS					
Order Carcharhiniformes Compagno, 1973. (ground sharks)					
Family Atelomycteridae White, 1936 (coloured catsharks)					
2	*Atelomycterus marmoratus*	Anonymous [Bennett], 1830	coral catshark	NT	A2cd
Family Carcharhinidae Jordan and Evermann 1896 (requiem sharks)					
3	*Carcharhinus albimarginatus*	Rüppell, 1837	silvertip shark	VU	A2bd
4	*Carcharhinus altimus*	Springer, 1950	bignose shark	NT	A2d
5	*Carcharhinus amblyrhynchoides*	Whitley, 1934	graceful shark	VU	A2d
6	*Carcharhinus amblyrhynchos*	Bleeker, 1856	grey reef shark	EN	A2bcd
7	*Carcharhinus brevipinna*	Valenciennes, 1839	spinner shark	VU	A2bd
8	*Carcharhinus falciformis*	Bibron, 1839	silky shark	VU	A2bd
9	*Carcharhinus limbatus*	Valenciennes, 1839	blacktip shark	VU	A2bd
10	*Carcharhinus longimanus*	Poey, 1861	oceanic whitetip shark	CR	A2bd
11	*Carcharhinus melanopterus*	Quoy & Gaimard, 1824	blacktip reef shark	VU	A2bcd
12	*Carcharhinus sealei*	Pietschmann, 1913	blackspot shark	VU	A2d
13	*Carcharhinus sorrah*	Valenciennes, 1839	spottail shark	NT	A2d
14	*Loxodon macrorhinus*	Müller & Henle, 1839	sliteye shark	NT	A2d
15	*Negaprion acutidens*	Rüppell, 1837	sharptooth lemon shark	EN	A2abcd+3bcd+4abcd
16	*Prionace glauca*	Linnaeus, 1758	blue shark	NT	A2bd
17	*Rhizoprionodon acutus*	Rüppell, 1837	milk shark	VU	A2bd
18	*Triaenodon obesus*	Rüppell, 1837	whitetip reef shark	VU	A2bcd
Family Galeocerdonidae Poey, 1875 (tiger sharks)					
19	*Galeocerdo cuvier*	Péron & Lesueur, 1822	tiger shark	NT	A2bd+3d
Family Hemigaleidae Hasse, 1878 (weasel sharks)					
20	*Hemigaleus microstoma*	Bleeker, 1852	sickelfin weasel shark	VU	A2d
21	*Paragaleus longicaudatus*	Bessednov, 1966	slender weasel shark	VU	A2d
Family Pentanchidae Smith, 1912 (deepwater catsharks)					
22	*Apristurus herklotsi*	Fowler, 1934	longfin catshark	LC	
23	*Apristurus macrostomus*	Zhu, Meng & Li, 1985	broadmouth catshark	LC	
24	*Apristurus platyrhynchus*	Tanaka, 1909	flatnose catshark	LC	
Family Pseudotriakidae Gill, 1893 (false catsharks)					
25	*Gollum suluensis*	Last & Gaudiano, 2011	Sulu gollum shark	LC	
Family Scyliorhinidae Gill, 1862 (catsharks)					
26	*Cephaloscyllium fasciatum*	Chan, 1966	reticulated swellshark	CR	A2d

Continuation of Table 3. List of confirmed species recorded in Palawan represented 10 orders and 30 families.

Species		Authority	Common Name	Conservation Status	
Family Sphyrnidae Bonaparte, 1840 (hammerhead sharks)					
27	*Sphyrna lewini*	Griffith & Smith, 1834	scalloped hammer-head	CR	A2bd
28	*Sphyrna mokarran*	Rüppell, 1837	great hammerhead	CR	A2bd
Order Heterodontiformes Berg, 1940 (bullhead sharks)					
Family Heterodontidae Gray, 1851 (bullhead sharks or horn sharks)					
29	*Heterodontus zebra*	Gray, 1831	barred bullhead shark	LC	
Order Lamniformes Berg, 1958 (mackerel sharks)					
Family Alopiidae Bonaparte, 1835 (thresher sharks)					
30	*Alopias pelagicus*	Nakamura, 1935	pelagic thresher	EN	A2bd
Family Lamnidae Bonaparte, 1835 (mackerel sharks)					
31	*Isurus oxyrinchus*	Rafinesque, 1810	shortfin mako	EN	A2bd
Family Megachasmidae Taylor, Compagno & Struhsaker, 1983 (megamouth sharks)					
32	*Megachasma pelagios*	Taylor, Compagno & Struh-saker, 1983	megamouth shark	LC	
Family Odontaspididae Müller & Henle, 1839 (sand tiger sharks)					
33	*Odontaspis ferox*	Risso 1810	smalltooth sand tiger	VU	A2bd
Order Orectolobiformes Applegate, 1972 (carpet sharks)					
Family Ginglymostomatidae Gill, 1862 (nurse sharks)					
34	*Nebrius ferrugineus*	Lesson 1831	tawny nurse shark	VU	A2bcd
Family Hemiscylliidae Gill, 1862 (bamboo sharks)					
35	*Chiloscyllium plagiosum*	Anonymous [Bennett], 1830	whitespotted bambooshark	NT	A2d
36	*Chiloscyllium punctatum*	Müller and Henle 1838	grey carpetshark	NT	
Family Rhincodontidae Müller and Henle, 1841 (whale sharks)					
37	*Rhincodon typus*	Smith 1828	whale shark	EN	A2bd+4bd
Family Stegostomatidae Gill, 1862 (zebra sharks)					
38	*Stegostoma tigrinum*	Forster 1781	zebra shark	EN	A2bd+3bd
Order Pristiophoriformes Berg, 1958 (sawsharks)					
Family Pristiophoridae Bleeker, 1859 (sawsharks)					
39	*Pristiophorus lanae*	Ebert and Wilms 2013	Lana's sawshark	NT	A2d
Order Squaliformes Compagno, 1973 (dogfish sharks)					
Family Centrophoridae Bleeker, 1859 (gulper sharks)					
40	*Centrophorus isodon*	Chu, Meng & Liu, 1981	blackfin gulper shark	EN	A2d
41	*Centrophorus longipinnis*	White, Ebert & Naylor, 2017	longfin gulper shark	EN	A2d
42	*Centrophorus sp.*		leafscale gulper shark.		
43	*Deania cf. calcea*	Lowe, 1839	birdbeak dogfish		
44	*Deania sp.*		birdbeak dogfish		
Family Etmopteridae Fowler, 1934 (lanternsharks)					
45	*Etmopterus sp.*		lanternshark.		
BATOIDS					
Order Myliobatiformes Compagno, 1973 (stingrays)					
Family Aetobatidae Agassiz, 1858 (pelagic eagle rays)					
46	*Aetobatus ocellatus*	Kuhl, 1823	spotted eagle ray	VU	A2bd
Family Dasyatidae Jordan & Gilbert, 1879 (whiptail stingrays)					
47	*Himantura uarnak*	Gmelin, 1789	coach whipray	EN	A2d

Continuation of Table 3. List of confirmed species recorded in Palawan represented 10 orders and 30 families.

Species		Authority	Common Name	Conservation Status	
48	*Neotrygon orientalis*	Last, White & Serét, 2016	oriental bluespotted maskray	LC	
49	*Pastinachus sp.*		cowtail ray		
50	*Pateobatis fai*	Jordan & Seale, 1906	pink whipray	VU	A2bd
51	*Pateobatis jenkinsii*	Annandale, 1909	Jenkins' whipray	VU	A2bd
52	*Taeniura lymma*	Fabricius, 1775	bluespotted lagoon ray	LC	
53	*Taeniurops meyeni*	Müller & Henle, 1841	blotched fantail ray	VU	A2d
54	*Urogymnus asperrimus*	Bloch & Schneider, 1801	porcupine ray	VU	A2bd
55	*Urogymnus granulatus*	Macleay, 1883	mangrove whipray	VU	A2bd
Family Gymnuridae Fowler, 1934 (butterfly rays)					
56	*Gymnura poecilura*	Shaw, 1804	longtail butterfly ray	VU	A2d
57	*Gymnura zonura*	Bleeker, 1852	zonetail butterfly ray	EN	A2d
Family Mobulidae Gill, 1893 (mantas or devil rays)					
58	*Mobula alfredi*	Krefft, 1868	reef manta ray	VU	A2bcd+3d
59	*Mobula birostris*	Walbaum, 1792	oceanic manta ray	EN	A2bcd+3d
60	*Mobula kuhlii*	Valenciennes, 1841	shorthorned pygmy devil ray	EN	A2bd+3d
61	*Mobula thurstoni*	Lloyd, 1908	bentfin devil ray	EN	A2bd+3d
Family Myliobatidae Bonaparte, 1835 (eagle rays)					
62	*Aetomylaeus vespertilio*	Bleeker, 1852	ornate eagle ray	EN	A2d
Family Rhinopteridae Jordan & Evermann, 1896 (cownose rays)					
63	*Rhinoptera javanica*	Müller & Henle, 1841	Javanese cownose ray	EN	A2cd
Order Rajiformes Berg, 1940 (skates)					
Family Anacanthobatidae von Bonde & Swart, 1923 (legskates or smooth skates)					
64	*Sinobatis borneensis*	Chan, 1965	Borneo legskate	LC	
Order Rhinopristiformes Last, Séret & Naylor, 2016 (guitarfishes)					
Family Rhinidae Müller & Henle, 1841 (bowmouth guitarfishes or wedgefishes)					
65	*Rhina ancylostoma*	Bloch & Schneider, 1801	bowmouth guitarfish	CR	A2bd
66	*Rhynchobatus australiae*	Whitley, 1939	bottlenose wedgefish	CR	A2bd
Family Rhinobatidae Bonaparte, 1835 (guitarfishes)					
67	*Rhinobatos sp.*		guitarfish		

The confirmed species count could be further broken down to one chimaera, 44 sharks, and 22 batoid species. Carcharinidae (requiem sharks) was the most speciose family with 16 species, followed by Dasyatidae (stingrays), composed of nine species. Table 3 presents the checklist of Chondrichthyes in Palawan as compiled in this paper. It should be noted that more than half of the list is globally threatened, with 22 species categorized as Vulnerable (VU), 15 as Endangered (EN), and six as Critically Endangered (CR).

Annex 1 provides a table of the evidence gathered to confirm species presence in Palawan. Some species had more than one type of evidence to confirm its presence. Published literature or validated reports provided evidence on the greatest number of species (61 out of 67) in the list, with 32 species recorded to have voucher specimens in various museums in the country and abroad. Validated photographs and video footage also added proof of presence in 51 of the 67 species in the confirmed list.

3.4 Checklist of confirmed Palawan Chondrichthyes Huxley, 1880 (Cartilaginous fishes)

The checklist presented herewith is by no means complete despite the exhaustive effort to compile

all information available. There is a strong likelihood that a few species may have been missed, and future research and documentation should be conducted to update and revise these lists. Furthermore, the catch location was not always determined as most specimens were collected from different markets, which may or may not be near where it was caught. Thus, the occurrence of the species defaults to the market where they were bought unless the vendor or fisher provided a catch location.

Class Holocephali Bonaparte, 1832 (Chimaeroids and their relatives)

Order Chimaeriformes Obruchev, 1953 (chimaeras)

Family Chimaeridae Rafinesque, 1815 (shortnose chimaeras or ratfishes)

1. *Chimaera phantasma* (Jordan & Snyder, 1900). Silver chimaera.

Reference: Its presence in the country was previously confirmed (Alava et al. 2014; Compagno et al. 2005). A specimen (USNM 437754) was also collected on 17 July 2015 from an Iloilo market. The vendor stated that it was caught near Palawan (Smithsonian Institution Archives 2022), likely in the vicinity of Cagayancillo. A review of the morphologic features of the specimen and DNA barcoding done by NFRDI (M. Santos, pers. comm. 2022) identified it to be of this species. Finucci et al. (2020) showed the distribution of extant populations in continental shelves and upper slopes generally at less than 500 m depth throughout the province.

Class Elasmobranchii Bonaparte, 1838 (sharks and batoids)

SHARKS

Order Carcharhiniformes Compagno, 1973 (ground sharks)

Family Atelomycteridae White, 1936 (coloured catsharks)

2. *Atelomycterus marmoratus* (Anonymous [Bennett] 1830). Coral catshark.

Reference: The first two species records of the province came from Busuanga and Linapacan (Herre 1953), while Compagno et al. (2005) noted a newer specimen from Linapacan (SU–13562) in their Philippine material. The species was also included in the list of coastal fishes in Palawan (Gonzales 2013) and in Alava et al. (2014). VanderWright et al. (2021a) illustrated the distribution of extant populations to span the waters of the northern island municipalities and Cagayancillo.

Family Carcharhinidae Jordan & Evermann, 1896 (requiem sharks)

3. *Carcharhinus albimarginatus* (Rüppell, 1837). Silvertip shark.

Reference: The species is listed in Alava et al. (2014). It has been documented in TRNP (Murray et al. 2019; Murray et al. 2015; Compagno et al. 2005). Distribution maps (Espinoza et al. 2021; Ebert et al. 2021) indicated its presence in the northern island municipalities, including parts of northern mainland Palawan and Cagayancillo.

4. *Carcharhinus altimus* (Springer, 1950). Bignose shark.

Reference: A specimen (JPAG 197) was collected from San Jose, Taytay, during the WWF Elasmobranch Biodiversity Conservation Project (EBCP) in 1999 (Compagno et al. 2005). Another specimen (DLA 101) caught from Nagtabon (West Philippine Sea) was seen in the Tagburos market in 2021 during the conduct of this study. Rigby et al. (2020a) suggested the presence of extant populations in continental shelves and slopes (Last and Stevens 2009) found between the municipalities of Cuyo and Cagayancillo all the way to the TRNP.

5. *Carcharhinus amblyrhynchoides* (Whitley, 1934). Graceful shark.

Reference: A photograph of an individual taken in TRNP by Tommy Schultz in 2019 showed the distinct white band extending from the caudal to the dorsal fin. A video posted on YouTube (Bruynoghe 2021), also taken in TRNP, showed the same distinct marking but was mistaken for a pregnant blacktip reef shark. The species is described as tubby with large eyes, gill slits, and a fairly large pectoral fin (Ebert et al. 2021). The species is reported to occur in continental and insular shelves down to depths of 75 m (Weigmann 2016). Patchy distribution has been suggested by Simpfendorfer et al. (2021a) throughout the province.

6. *Carcharhinus amblyrhynchos* (Bleeker, 1856). Grey reef shark.

Reference: The presence of the species has been well documented in TRNP (Murray et al. 2015; Compagno et al. 2005). It has also been recorded in the Arena-Cavili area in Cagayancillo (LAMAVE 2019). The distribution map in Simpfendorfer et al. (2020a) indicated the presence of extant populations throughout the province, including the Spratly Islands.

7. *Carcharhinus brevipinna* (Valenciennes, 1839). Spinner shark.

Reference: A specimen was collected from Malampaya Sound, Taytay, in 1947 and another (BRU110), under the auspices of the WWF EBCP, from Barangay Matahimik market in Puerto Princesa in 2000

(Compagno et al. 2005). The distribution map (Rigby et al. 2020b) showed the presence of resident populations in the northern mainland Palawan and adjacent island municipalities, including Cagayancillo and TRNP.

8. *Carcharhinus falciformis* (Bibron, 1839). Silky shark.

Reference: A specimen was collected from San Jose, Taytay, in 1999 (Compagno et al. 2005). Several photos of the species have been taken in TRNP by guests and dive masters of liveaboard dive boats (Murray et al. 2015). The species is said to be widely distributed throughout tropical waters (Last and Stevens 2009). Occurrence maps in Rigby et al. (2021a) and Ebert et al. (2021) showed a wide distribution throughout the province.

9. *Carcharhinus limbatus* (Valenciennes, 1839). Blacktip shark.

Reference: A dried jaw (JPAG 198) collected in 2000 from Taytay fit the description of the species (Compagno et al. 2005). The species has also been caught in waters off Narra, Brookes Point, and Sofroñio Española municipalities in Southern Palawan (Santos et al. 2017). Distribution maps (Ebert et al. 2021; Rigby et al. 2021b) indicated the presence of extant populations all over Palawan, including the Spratly Islands.

10. *Carcharhinus longimanus* (Poey, 1861). Oceanic whitetip shark.

Reference: The species was included in the species inventory list of TRNP (TMO Records). The authors of this paper reviewed a photograph taken by a diving tourist in TRNP, and its features fit the description of the species. Occurrence maps for the species indicated a provincewide distribution (Ebert 2021; Rigby et al. 2018).

11. *Carcharhinus melanopterus* (Quoy & Gaimard, 1824). Blacktip reef shark.

Reference: The species has been frequently documented in TRNP (Murray et al. 2019; Murray et al. 2015). The regular presence of juveniles of this species around Puerco Island in Green Island Bay, Roxas has also been reported (Bonares, pers. comm. 2022), suggesting that the area was a vital nursery site for the species (Utzurrum 2022). Distribution maps showed extant populations all over the province except the Spratly Islands (Ebert et al. 2021; Simpfendorfer et al. 2020b).

12. *Carcharhinus sealei* (Pietschmann, 1913). Blackspot shark.

Reference: Six specimens (BRU122, JPAG214, JPAG215, JPAG220, JPAG221, and JPAG223) were collected from a market in Puerto Princesa in 2000 (Compagno et al. 2005). The Smithsonian Institution Archives (2022) included a specimen (USNM 431606) collected from Ulugan Bay on the west coast of Puerto Princesa on 8 April 2014. NFRDI barcoding identified the specimen as *C. sealei* (M. Santos pers. comm. 2022). Market visits in 2021 also recorded one individual (DLA 106) being sold in an informal market in Tagburos. The vendor claimed it was caught off Nagtabon (West Philippine Sea). Distribution maps (Dulvy et al. 2021b; Ebert et al. 2021) illustrated extant populations all over the province, including the Spratlys.

13. *Carcharhinus sorrah* (Valenciennes, 1839). Spottail shark.

Reference: Gonzales (2013) included the species in the list of coastal fishes in the province, although details on its catch location were unavailable. Distribution maps in Simpfendorfer et al. (2021b) and Ebert et al. (2021) showed extant populations were limited to the waters north to northeast of the northern island municipalities and Cagayancillo.

14. *Loxodon macrorhinus* (Müller & Henle, 1839). Sliteye shark.

Reference: The first record in the province was of a specimen collected from Malampaya Sound in 1947 (Compagno et al. 2005; Herre 1953). The species was also included in the list of coastal fishes of Palawan (Gonzales 2013), attesting to its presence in the province. Although the distribution map in Ebert et al. (2021) only suspected the presence of an extant population in the province, Rigby et al. (2021c) illustrated a widespread distribution throughout.

15. *Negaprion acutidens* (Rüppell, 1837). Sharptooth lemon shark.

Reference: The first record of the species in the country was of a specimen taken from Malampaya Sound in 1947 (Herre 1953), whose disposition, to date, remains unknown. Compagno et al. (2005) suspected its presence in coral reefs in the Philippines, given its wide habitat range in the Indo-Pacific. In 2015, a video taken in TRNP displayed two individuals fitting the description of this species (Inge Onderwater 2015). The distribution map by Simpfendorfer et al. (2021c) pointed to its presence in the waters surrounding the Spratly Islands and the municipalities of Narra and Quezon, extending north to the northern island municipalities and Cagayancillo.

16. *Prionace glauca* (Linnaeus, 1758). Blue shark.

Reference: Seven specimens (JPAG 210, JPAG 211, JPAG 212, BRU 117, BRU 118, BRU 119, and BRU 120) were collected during the WWF EBCP on 13 March

2000 from Puerto Princesa public markets. BRU 117 appeared to be a newborn female (Compagno et al. 2005). Distribution maps of the species (Ebert et al. 2021; Rigby et al. 2019a) indicated a widespread global occurrence, suggesting that it was the most wide-ranging species of sharks.

17. *Rhizoprionodon acutus* (Rüppell, 1837). Milk shark.

Reference: The first specimen collected from Malampaya Sound, Taytay, in 1947 was identified as *Aprionodon acutidens* (Herre 1953). The second record in the province (JPAG 217) was collected about half a century later from a Puerto Princesa public market on 14 March 2000 (Compagno et al. 2005). Distribution is said to extend from the West Philippine Sea to the Sulu Sea in the northern half of the province (Ebert et al. 2021), although Rigby et al. (2020c) suggested a more provincewide distribution.

18. *Triaenodon obesus* (Rüppell, 1837). Whitetip reef shark.

Reference: The first specimen (USNM 151227) collected in the province was from Caxisigan Island, Northern Balabac Strait, on 4 January 1909 during the Albatross Philippine Expedition (Smithsonian Institution Archives 2022). TRNP reportedly has the highest population density, about three times that of the Great Barrier Reef (Walker and Palomar-Abesamis 2006). Widespread occurrence in the province has been indicated by distribution maps (Ebert et al. 2021; Simpfendorfer et al. 2020c).

Family Galeocerdonidae Poey, 1875 (tiger sharks)

19. *Galeocerdo cuvier* (Peron & Lesueur, 1822). Tiger shark.

Reference: The oldest record in Palawan was of a 227-kg specimen caught by Alvin Seale (Compagno et al. 2005; Herre 1953). The species has been frequently sighted in TRNP (Murray et al. 2019; Murray et al. 2015). Widespread occurrence in the province has been indicated by distribution maps (Ebert et al. 2021; Ferreira and Simpfendorfer 2019).

Family Hemigaleidae Hasse, 1878 (weasel sharks)

20. *Hemigaleus microstoma* (Bleeker, 1852). Sicklefin weasel shark.

Reference: Six specimens (BRU 123, BRU 124, BRU 125, JPAG 216, JPAG 219, and JPAG 222) collected from Puerto Princesa public markets in 2000 turned out to be the first confirmation of the presence of the species in the country (Compagno et al. 2005). Distribution maps by Sherman et al. (2021a) and Ebert et al. (2021) suggested a province wide occurrence.

21. *Paragaleus longicaudatus* (Bessednov, 1966). Slender weasel shark.

Reference: White and Harris (2013) used a specimen from Palawan (PMH 237–07) as part of their comparative materials, which they identified as *Paragaleus randalli*. Prokofiev (2019) reviewed their paper and noted that there was no difference between that which they identified as *P. randalli* and the previous description of *P. longicaudatus* given by Bessednov in 1966. Thus, he concluded that the species name should be restored to *P. longicaudatus* (Bessednov 1966) and *P. randalli* be considered as a synonym. The distribution map in VanderWright et al. (2021b), assessing the species as *P. randalli*, suggested the presence of extant populations all over the province.

Family Pentanchidae Smith, 1912 (deepwater catsharks)

22. *Apristurus herklotsi* (Fowler, 1934). Longfin catshark.

Reference: The holotype of the species (USNM 93134) was sourced about 5.4 km west of Cagayancillo mainland and identified as *Pentanchus herklotsi* (Fowler 1941) on 31 March 1909 during the Albatross Philippine expedition (Smithsonian Institution Archives 2022; Compagno et al. 2005). Nakaya and Kawauchi (2013) revisited the specimen to provide a more accurate taxonomic description. The distribution map in Ebert et al. (2021) limited its presence to Cagayancillo, but Rigby et al. (2020d) suggested that extant populations could be present in the northern half of the Cagayan Ridge and northwestern borders of Sulu Sea closer to mainland Palawan.

23. *Apristurus macrostomus* (Zhu, Meng & Li, 1985). Broadmouth catshark.

Reference: The species was not listed in Compagno et al. (2005) nor Alava et al. (2014). Nakaya and Kawauchi (2013) mentioned two non-type specimens used in the study coming from the Philippines. They stated that one specimen (BSKU 15546) came from the Sulu Sea east of the southern municipalities of mainland Palawan. The distribution maps in Rigby et al. (2020e) and Ebert et al. (2021) indicated the presence of the species in the southern part of the Sulu Sea east of Narra going south to Bataraza.

24. *Apristurus platyrhynchus* (Tanaka, 1909). Flatnose catshark.

Reference: The species was not listed in Compagno et al. (2005), and its presence in the country was deemed uncertain by Alava et al. (2014). The distribution map in a study by Nakaya and Kawauchi (2013) showed its

presence in the central Sulu Sea near Cagayancillo, although there was no mention of any specimen collected from the area. However, an earlier taxonomic review of the species (Nakaya and Sato 2000) indicated that a specimen (USNM 93135) was collected from the south central Sulu Sea. The distribution map in Duffy and Huveneers (2015) indicated the presence of the species extending westward from Sibuko Bay across the Sulu Sea all the way through the southern portion of Balabac Strait.

Family Pseudotriakidae Gill, 1893 (false catsharks)

25. *Gollum suluensis* (Last & Gaudiano, 2011). Sulu gollum shark.

Reference: Seven whole specimens (JPAG 229, JPAG 230, JPAG 233, JPAG 234, JPAG 235, JPAG 237, and JPAG 237a) collected from a market in Puerto Princesa were identified in Compagno et al. (2005) as *Gollum* sp.1 Sulu gollum. Last and Gaudiano (2011) first described the species designating specimen JPAG 235 (PNM 15175) as the holotype for the species and ascribed its limited distribution to the western part of the Sulu Sea off Palawan mainland on insular slopes at about 730 m depth. Dulvy et al. (2020a) concurred with the limited distribution.

Family Scyliorhinidae Gill, 1862 (catsharks)

26. *Cephaloscyllium fasciatum* (Chan, 1966). Reticulated swellshark.

Reference: Four specimens (JPAG 231, JPAG 232, JPAG 238, and JPAG 239) were collected from a market in Liberty, Puerto Princesa, on 16 March 2000 during the WWF EBCP and were categorized as undescribed species (Compagno et al. 2005). However, Nakaya et al. (2013) indicated in their review of the genus *Cephaloscyllium* that this species is the only one that can be found in the Philippines. Nakaya K, Inoue S, Ho, H-C. 2013. A review of the genus *Cephaloscyllium* (Chondrichthyes: Carcharhiniformes: Scyliorhinidae) from Taiwanese waters. Zootaxa 3752 (1): 101–129.

Family Sphyrnidae Bonaparte, 1840 (hammerhead sharks)

27. *Sphyrna lewini* (Griffith & Smith, 1834). Scalloped hammerhead.

Reference: The species has been recorded in TRNP (Murray et al. 2019) by several dive tourists visiting the park. Rigby et al. (2019b) suggested the presence of extant populations throughout the province and the country. Although considered the most common hammerhead shark in tropical seas and was seen in other parts of the country (Compagno et al. 2005), no other record of its presence elsewhere in the province could be found.

28. *Sphyrna mokarran* (Rüppell, 1837). Great hammerhead.

Reference: The species has been recorded at TRNP (Murray et al. 2019). Extant populations have been indicated in Palawan's northern waters, including Cagayancillo (Rigby et al. 2019c; Ebert et al. 2021).

Order Heterodontiformes Berg, 1940 (bullhead sharks)

Family Heterodontidae Gray, 1851 (bullhead sharks or horn sharks)

29. *Heterodontus zebra* (Gray, 1831). Barred bullhead shark.

Reference: Although the species is present in the country (Alava et al. 2014; Compagno et al. 2005), the only reference to its presence in the province was provided by Gonzales (2013). However, the specific source or location of the species was not given, but the distribution map in Rigby et al. (2020e) reflected extant populations in the Spratly Islands.

Order Lamniformes Berg, 1958 (mackerel sharks)

Family Alopiidae Bonaparte, 1835 (thresher sharks)

30. *Alopias pelagicus* (Nakamura, 1935). Pelagic thresher.

Reference: The species is listed in Compagno et al. (2005) and Alava et al. (2014), but no specimens were obtained from the province then. In 2006, it was encountered in Cagayancillo (A. Songco pers. comm. 2021) but not fully documented. The species was eventually documented during the 2015 LAMAVE survey and included in the TRNP species list (Murray et al. 2015). Rigby et al. (2019d) and Ebert et al. (2021) suggested that this wide-ranging, often offshore species may be found all over the province.

Family Lamnidae Bonaparte, 1835 (mackerel sharks)

31. *Isurus oxyrinchus* (Rafinesque, 1810). Shortfin mako.

Reference: A pair of dried jaws (SUML 002) was collected off Eastern Palawan on 16 May 2000 during the WWF EBCP. This was identified by Compagno et al. (2005) to be of this species. Distribution maps by Rigby et al. (2019e) and Ebert et al. (2021) presented a wide area of occurrence covering the whole province.

Family Megachasmidae Taylor, Compagno & Struhsaker, 1983 (megamouth sharks)

32. *Megachasma pelagios* (Taylor, Compagno &

Struhsaker, 1983). Megamouth shark.
Reference: Kyne et al. (2019a) and Ebert et al. (2021) distribution maps indicated a wide global distribution that included the province. However, no other reports of its occurrence in the province were available until a stranding incident was posted on social media, reportedly from Sitio Iget, Bgy. San Jose de Oro, Araceli, Palawan on 20 April 2019 (Matillano 2019). The individual reportedly measured 4.8768 m long. A picture taken by Divine Ventilacion was included in the Facebook post, which the authors used to validate the species identification.

Family Odontaspididae Müller & Henle, 1839 (sand tiger sharks)
33. *Odontaspis ferox* (Risso, 1810). Smalltooth sand tiger.
Reference: The species was not included in Compagno et al. (2005) nor Alava et al. (2014), although its presence in the country was suspected (Compagno et al. 2005). The only record thus far for the country came from a landed specimen in Cagayancillo on 18 June 2017. The 3.296 m-long female was caught south of Cawili in more than 1,300 m deep waters (Ponzo 2017). DNA barcoding analysis definitively identified the specimen as this species (Pereda et al. 2017). This is the first record of the species in the province and the country. Graham et al. (2016) and Ebert et al. (2021) have not yet reflected this in their distribution maps for the species.

Order Orectolobiformes Applegate, 1972 (carpet sharks)
Family Ginglymostomatidae Gil, 1862 (nurse sharks)
34. *Nebrius ferrugineus* (Lesson, 1831). Tawny nurse shark.
Reference: Despite being included in the list of Compagno et al. (2005) and Alava et al. (2014), these references did not mention its presence in the province. The first record of its presence in Palawan was in TRNP (Murray et al. 2015), although Simpfendorfer et al. (2021d) suggested a broader distribution throughout the province. On 4 June 2022, a photograph (M. Corvera and M. Sarmiento pers. comm.) was taken of a specimen sold in a market in the municipality of Quezon, Palawan, and forwarded to the authors for identification. The features of the specimen matched those of this species.

Family Hemiscylliidae Gill, 1862 (bamboo sharks)
35. *Chiloscyllium plagiosum* (Anonymous [Bennett] 1830). Whitespotted bambooshark.
Reference: Its presence in the country was confirmed (Compagno et al. 2005; Alava et al. 2014), but its presence in the province was only reported in Gonzales (2013). Distribution maps by Kyne et al. (2021a) and Ebert et al. (2021) noted its occurrence throughout the province, including the Spratly Islands.
36. *Chiloscyllium punctatum* (Müller & Henle, 1838). Grey carpetshark.
Reference: Compagno et al. (2005) noted a specimen (FMNH–50966) collected from Puerto Princesa in the early years. Decades later, in 2021, another individual (DLA 054) was seen being sold in Sitio Tacduan, Barangay Inagawan, Puerto Princesa, during the conduct of this study. The fisher claimed to have caught it in Sitio Tagumpay of the same barangay facing the Sulu Sea. Gonzales (2013) also included this species in his inventory of fishes in Palawan, although the specific catch location was not declared. Distribution maps by Dudgeon et al. (2016) and Ebert et al. (2021) indicated its presence all over the province.

Family Rhincodontidae Müller & Henle, 1841 (whale sharks)
37. *Rhincodon typus* (Smith, 1828). Whale shark.
Reference: The species was included in Compagno et al. (2005) and Alava et al. (2014) and has been seen in TRNP (Murray et al. 2015) consistently up to the present times. Araujo et al. (2019) recorded 117 individuals in one season in Honda Bay, Puerto Princesa City, describing the area as a globally important whale shark hotspot. One of their tagged individuals (P1125) also showed up in Cuyo and TRNP. The species distribution map (Pierce and Norman 2016) suggested a provincewide occurrence in the last Red List Assessment.

Family Stegostomatidae Gill, 1862 (zebra sharks)
38. *Stegostoma tigrinum* (Forster, 1781). Zebra shark.
Reference: Formerly listed as present in the country by Compagno et al. (2005) and Alava et al. (2014) as *Stegostoma fasciatum*, the revision in nomenclature was later proposed by Dahl et al. (2019) when they redescribed the species. The revised nomenclature was inevitably carried out due to the convincing arguments presented by the authors. The earliest specimen in the province was supposedly taken from Puerto Princesa in the 1800s. In 1999, another specimen (JPAG 199)

was collected from Tagburos, Puerto Princesa, during the WWF EBCP (Compagno et al. 2005). Murray et al. (2015) also included this species in the TRNP list using its old name. Dudgeon et al. (2019) suggested a province-wide distribution.

Order Pristiophoriformes Berg, 1958 (sawsharks)
Family Pristiophoridae Bleeker, 1859 (sawsharks)
39. *Pristiophorus lanae* (Ebert & Wilms, 2013). Lana's sawshark.
Reference: Alava et al. (2014) noted the presence of this new species but further remarked that taxonomy was unresolved for another yet undescribed *Pristiophorus* sp., which was also present in the country.
According to the Smithsonian Institution Archives (2022), on 17 July 2015, a specimen (USNM 437753) was bought off an Iloilo market where the vendor indicated it was caught in Palawan. Features of the specimen matched those of this species, and DNA barcoding analysis done by NFRDI further confirmed the identity of this species (M. Santos pers. comm. 2022). Distribution maps in Dulvy et al. (2020b) and Ebert et al. (2021) have not yet reflected its presence in the province; its occurrence is currently limited to other parts of the Philippines. It should also be noted that several sawshark rostrums were observed by one of the authors of this paper, being kept at the PCSD compound in Irawan a few years prior to this study. Unfortunately, the specimens had been disposed of before the authors could examine them further for this paper.

Order Squaliformes Compagno, 1973 (dogfish sharks)
Family Centrophoridae Bleeker, 1859 (gulper sharks)
40. *Centrophorus isodon* (Chu, Meng & Liu, 1981). Blackfin gulper shark.
Reference: Three specimens (JPAG 224, JPAG 225, and JPAG 227) collected from Liberty, Bagong Sikat, Puerto Princesa on 16 March 2000 were identified to be of this species which was previously unrecorded in the country (Compagno et al. 2005). Although the species was also recognized by Alava et al. (2014), this occurrence has not yet been reflected in the latest Red List Assessment in its extant population distribution map (Rigby et al. 2020f) nor in Ebert et al. (2021).
41. *Centrophorus longipinnis* (White, Ebert & Naylor, 2017). Longfin gulper shark.
Reference: Compagno et al. (2005) noted that a specimen (JPAG 226), identified as *Centrophorus lusitanicus*, exhibited an unusually elongated first dorsal fin. The specimen was collected from Liberty, Bagong Sikat market in Puerto Princesa. DNA sample (GN 4348) from the same specimen (JPAG 226) was used in the study describing the new species *C. longipinnis* (White et al. 2017). The authors noted that, within the *C. longipinnis* group, the specimen from Palawan showed some molecular and morphological differences from the others but was still similar enough to the Indonesian specimen. Rigby et al. (2020g) considered its presence in the country uncertain in the Red List Assessment of the species. The distribution map in Ebert et al. (2021), on the other hand, acknowledged its presence in Puerto Princesa.
42. *Centrophorus* sp.
Reference: The LAMAVE Report (LAMAVE 2017) noted several specimens while documenting shark oil fisheries in Cawili, Cagayancillo. The individuals were identified down to the genus level only as *Centrophorus* sp. Some of the specimens in the photos provided to the authors are possibly that of *C. granulosus* or *C. squamosus* as well as *C. longipinnis*. However, the specimens have yet to be morphologically verified; thus, the species is listed here as is.
43. *Deania* cf. *calcea* (Lowe, 1839). Birdbeak dogfish.
Reference: Compagno et al. (2005) noted a specimen (JPAG 228) collected from Liberty, Bagong Sikat, Puerto Princesa on 16 March 2000 which appeared similar to *Deania calcea* but differed in interdorsal space length and relative sizes of the dorsal fins. They further recommended that more materials be collected and more comparisons made to resolve this taxonomic issue.
44. *Deania* sp. Birdbeak dogfish.
Reference: The LAMAVE Report (LAMAVE 2017) noted several dogfish sharks while documenting shark oil fisheries in Cawili, Cagayancillo. These species were identified down to the genus level only as *Deania* sp. At least one specimen was suspected to be that of *D. profundorum*. However, the specimens have not been morphologically verified, and thus, the species is listed here as is.

Family Etmopteridae Fowler, 1934 (lanternsharks)
45. *Etmopterus* sp. Lanternsharks.
Reference: The LAMAVE Report (LAMAVE 2017) noted several lanternsharks while documenting shark oil fisheries in Cawili, Cagayancillo. These

species were identified down to the genus level only as *Etmopterus* sp.

BATOIDS

Order Myliobatiformes Compagno, 1973 (stingrays)

Family Aetobatidae Agassiz, 1858 (pelagic eagle rays)

46. *Aetobatus ocellatus* (Kuhl, 1823). Spotted eagle ray.

Reference: Previously identified as *Aetobatus* cf. *narinari* (Compagno et al. 2005), the oldest specimen in the province originated from Taytay Bay, Palawan (Herre 1953). The next recorded specimen (BRU 121) was collected on 12 April 2000 during the WWF EBCP from a market in Puerto Princesa (Compagno et al. 2005). This specimen was included in the materials used by White et al. (2010) to compare *A. ocellatus* and *A. narinari*. Apart from concluding that the two species differed a little morphologically, the authors noted that the DNA sequences from specimens originating from the Philippines (including Palawan) were similar to that from Taiwan, Singapore, Indonesia, Malaysia, and Northern Australia. They further stated that *A. ocellatus* should replace *A. narinari* as the valid name for the species in the Indo-West Pacific area.

In the recent past, the species had been documented several times in TRNP by researchers and tourists (Murray et al. 2015) as *A. narinari*. It was also encountered in Tagburos, Puerto Princesa (DLA 092) during this study's market visits in 2021. A video forwarded by PCSD to this paper's authors showed another specimen of this species caught off Port Barton, San Vicente, on 15 February 2022. Distribution maps in Kyne et al. (2016) and Last et al. (2016b) suggested a provincewide occurrence of the species.

Family Dasyatidae Jordan & Gilbert, 1879 (whiptail stingrays)

47. *Himantura uarnak* (Gmelin, 1789). Coach whipray.

Reference: The earliest specimen from the province came from Malampaya Sound, Taytay (Compagno et al. 2005; Fowler 1941). Its presence in the country had been noted by Alava et al. (2014), and distribution maps by Last et al. (2016b) and Sherman et al. (2021b) denoted a province-wide occurrence. In the 2021 market visits of this study, eight specimens were observed coming from several barangays in Puerto Princesa (DLA 010, DLA 015, DLA 030, DLA 038, DLA 067, DLA 120, and DLA 122) and from Roxas (DLA 068) all facing Sulu Sea while two other samples came from the west coast of Puerto Princesa (DLA 036) and El Nido (DLA 031) facing the West Philippine Sea.

48. *Neotrygon orientalis* (Last, White & Serét, 2016). Oriental bluespotted maskray.

Reference: The species was listed in Compagno et al. (2005) as *Dasyatis kuhlii*. After the resurrection of the genus *Neotrygon* (Last and White 2008), Alava et al. (2014) confirmed its presence in the country as *Neotrygon kuhlii*, while Murray et al. (2015) reported its presence in TRNP under the same nomenclature. Last and White (2008) reviewed the species complex and described three new species within the complex, which included *N. orientalis*, said to be the valid species in the Philippines.

During the 2021 market visits, this species was reported to have been caught from the east and west coasts of Puerto Princesa, from Aborlan and Brookes Point facing the Sulu Sea and in El Nido facing the West Philippine Sea. The species was also seen in the Roxas public market, said to have been caught in Green Island Bay, Roxas. It was likewise encountered during the swim transects conducted in the waters surrounding Puerco Island (Utzurrum 2022). Both distribution maps of Last et al. (2016b) and Sherman et al. (2021c) illustrated a provincewide occurrence.

49. *Pastinachus* sp. Cowtail stingray.

Reference: Murray et al. (2015) reported the presence of a *Pastinachus* sp. in TRNP. Herre (1953) recorded a specimen from Puerto Princesa identified by Compagno et al. (2005) as *P.* cf. *sephen*, while Alava et al. (2014) considered its presence in the country uncertain.

50. *Pateobatis fai* (Jordan & Seale, 1906). Pink whipray.

Reference: In 2006, a photo of a specimen was taken in TRNP by Lene and Claus Topp. The presence of the species in the country was confirmed by Alava et al. (2014) as *Himantura fai*. The species was again encountered in TRNP a year after that (Murray et al. 2015). The genus was later changed to *Pateobatis* based on new morphological and molecular insights gained (Last et al. 2016a). On 10 October 2021, two specimens (DLA 041 and DLA 042) fitting the description of the species were confiscated from illegal fishers caught in TRNP (Figure 5). The presence of the species in TRNP has not yet been reflected in the distribution maps of either Last et al. (2016b) or Manjaji-Matsumoto et al. (2016).

Figure 5. DLA 042 Pateobatis fai, one of the two specimens confiscated from illegal fishers caught in Tubbataha Reefs Natural Park in 2021.

51. *Pateobatis jenkinsii* (Annandale, 1909). Jenkin's whipray.
Reference: Previously listed as *Himantura jenkinsii* in Compagno et al. (2005) and Alava et al. (2014), it underwent the same nomenclature change as *Pateobatis fai* (Last, Naylor, and Manjaji-Matsumoto 2016). Specimens (BRU 109, BRU 116, and JPAG 213b) were collected from Puerto Princesa public markets in March 2000 (Compagno et al. 2005). Another three specimens (DLA 006, DLA 077, and DLA 088) were encountered in informal markets in Puerto Princesa during the 2021 market visits. All three were caught from Honda Bay. A video forwarded to the authors by PCSD also featured at least one individual exhibiting the midline row of thorny denticles distinctive of this species. The rays were reportedly caught in the West Philippine Sea fronting San Vicente. Distribution maps by Last et al. (2016b) and Manjaji-Matsumoto et al. (2020a) denoted a provincewide occurrence.
52. *Taeniura lymma* (Fabricius, 1775). Bluespotted lagoon ray.
Reference: The first specimens from the province were collected from Ulugan Bay (USNM 170359) (Fowler 1941) and Balabac (Herre 1953). Other specimens were later collected from Cuyo (USNM 261704) on 25 May 1978 by the team of Victor Springer and from Busuanga (USNM 411553) on 14 March 2003 by the team of Jeffrey Williams (Smithsonian Institution Archives 2022). Compagno et al. (2005) remarked that this stingray was commonly sold in the markets.

This species was the second most commonly encountered (n = 31) during the 2021 market visits of this study. These were reportedly caught in Aborlan, Brookes Point, and from the east and west coasts of Puerto Princesa (Figure 6). It has also been photographed several times by divers in TRNP (Murray et al. 2015). The species was seen being sold in the Roxas public market and encountered four times during the swim transect done around Puerco Island (Utzurrum 2022). Distribution maps by Last et al. (2016b) and Sherman et al. (2021d) showed a provincewide occurrence.
53. *Taeniurops meyeni* (Müller & Henle, 1841). Blotched fantail ray.
Reference: The species has been photographed in TRNP numerous times (Murray et al. 2015). Distribution maps by Kyne and White (2015) and Last et al. (2016b) showed a provincewide distribution.
54. *Urogymnus asperrimus* (Bloch & Schneider, 1801). Porcupine ray.
Reference: Herre (1953) reported the species in

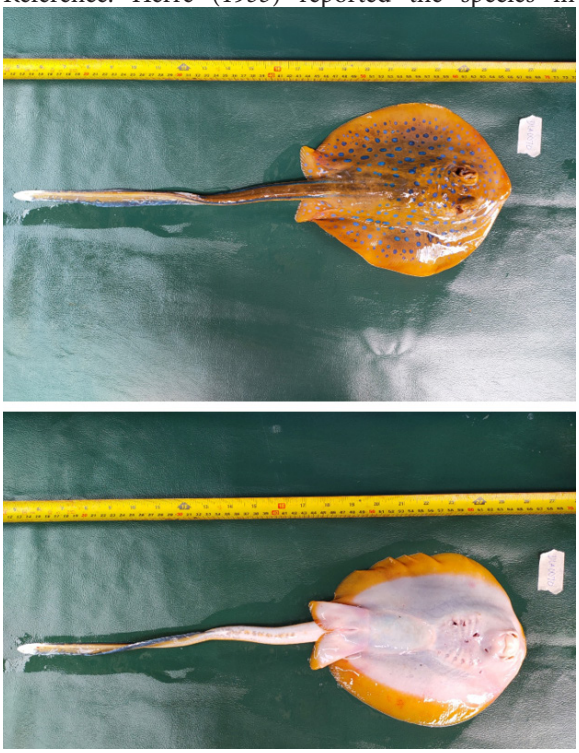

Figure 6. DLA 070 Taeniura lymma seen in Tacduan, Puerto Princesa market, said to have been caught in the municipality of Aborlan (Sulu Sea).

Malampaya Sound, Brookes Point, and Balabac (Compagno et al. 2005). The species has also been reported in TRNP (Murray et al. 2015) as *Urogymnus* sp. Photographs shared by tourists and dive masters who visited the park fit the description of the species. The species distribution map in Last et al. (2016b) showed a broad occurrence throughout the province, although that in Chin and Compagno

(2016) did not reflect its presence in Palawan.

55. *Urogymnus granulatus* (Macleay, 1883). Mangrove whipray.

Reference: The species also changed nomenclature from *Himantura granulata* due to recent molecular insights (Last et al. 2016a). Compagno et al. (2005) reported its presence in Puerto Princesa (JPAG 207). On 12 January 2022, Bernard Bonares forwarded photographs to this paper's authors, prompting a cursory survey of the waters immediately surrounding Puerco Island, Roxas. A closer look at the said ray revealed it to be a juvenile of this species (Utzurrum 2022). Last et al. (2016b) and Manjaji-Matsumoto et al. (2020b) denoted a provincewide occurrence in their distribution maps.

Family Gymnuridae Fowler, 1934 (butterfly rays)

56. *Gymnura poecilura* (Shaw, 1804). Longtail butterfly ray.

Reference: A photograph of a butterfly ray in Gonzales (2013) had been identified as *Gymnura japonica* whose distribution was limited to Japan and Southern China. The features of the specimen appeared to fit better the description of *G. poecilura* whose presence in the country has already been confirmed by Alava et al. (2014). The species is known to occur in the waters surrounding the province, including the Spratlys (Sherman et al. 2021e).

57. *Gymnura zonura* (Bleeker, 1852). Zonetail butterfly ray.

Reference: A photograph of a butterfly ray in Gonzales (2013) was identified as *Gymnura natalensis*, only known in South-East Atlantic and South-West Indian Ocean (Last et al. 2016b). Rather, the features of the specimen fit the description of *G. zonura*. Alava et al. (2014) confirmed the presence of the species in the country. *G. zonura* is said to be present in northern island municipalities and Cagayancillo (Last et al. 2016b) and the Spratlys (Sherman et al. 2021f).

Family Mobulidae Gill, 1893 (mantas or devil rays)

58. *Mobula alfredi* (Krefft, 1868). Reef manta ray.

Reference: The species was first recognized in the province in 2011 when photographs taken by dive tourists in TRNP were reviewed to investigate its presence in the country (Aquino et al. 2015). Prior to the resurrection of the species (Marshall et al. 2009), all manta rays had been identified as *Manta birostris*. The phylogeny of the manta and devil rays was later reviewed and updated, wherein the genus *Manta* became a synonym of *Mobula* based on molecular evidence (White et al. 2018), thus resulting in the change in nomenclature. Distribution maps by Last et al. (2016b) and Marshall et al. (2019a) pointed to a provincewide occurrence of extant populations.

59. *Mobula birostris* (Walbaum, 1792). Oceanic manta ray.

Reference: A live specimen was photographed in the waters off Dumaran (JPAG 206) on 1 July 1999 (Compagno et al. 2005). In TRNP, only one out of the 33 photographs reviewed in 2011 turned out to be of this species (Aquino et al. 2015), although it was again photographed in 2015 (Murray et al. 2015). Last et al. (2016b) and Marshall et al. (2020) noted the presence of extant populations all over the province and most of the Sulu Sea.

60. *Mobula kuhlii* (Valenciennes, 1841). Shorthorned pygmy devil ray.

Reference: During her 2023 visit to TRNP, Dr. Andrea Marshall and her guests photographed a ray she identified as of this species. Although distribution maps in Last et al. (2016b) and Rigby et al. (2022) suggested a provincewide distribution of the species, the encounter in TRNP is the only record for the species in Palawan as of writing.

61. *Mobula thurstoni* (Lloyd, 1908). Bentfin devil ray.

Reference: The species has been reported in TRNP (Murray et al. 2015). The distribution map in Last et al. (2016b) pointed to a population in the Spratlys, while Marshall et al. (2019b) indicated a more provincewide occurrence.

Family Myliobatidae Bonaparte, 1835 (eagle rays)

62. *Aetomylaeus vespertilio* (Bleeker, 1852). Ornate eagle ray.

Reference: Last et al. (2016b) and White and Kyne (2016) did not include Palawan in the species' area of occurrence in the country. Araujo et al. (2018) later reported on its presence in Cagayancillo.

Family Rhinopteridae Jordan & Evermann, 1896 (cownose rays)

63. *Rhinoptera javanica* (Müller & Henle, 1841). Javanese cownose ray.

Reference: Two specimens (JPAG 208 and JPAG 209) were collected from a Puerto Princesa market on 12 March 2000 (Compagno et al. 2005). Gonzales (2013) also included this species in his list for the province. The distribution map in Last et al. (2016b) showed a broad coverage throughout the waters surrounding the province, although that of Sherman et al. (2021g) was more limited to the nearshore waters of mainland Palawan and the northern municipalities and excluded Cagayancillo and the Spratlys.

Order Rajiformes Berg, 1940 (skates)
Family Anacanthobatidae von Bonde & Swart, 1923 (legskates or smooth skates)
64. *Sinobatis borneensis* (Chan, 1965). Borneo legskate.
Reference: In describing three new species of this genus, Last and Séret (2008) used a specimen (MNHN 1997–3321) identified to be of this species for comparison. The specimen was collected from the waters north of the municipality of Cagayancillo. Distribution maps in Last et al. (2016b) and Rigby et al. (2020h) indicated the presence of the species on the west coast of southern Palawan from Rizal to Balabac, including the Spratlys.

Order Rhinopristiformes Last, Séret & Naylor, 2016 (guitarfishes)
Family Rhinidae Müller & Henle, 1841 (bowmouth guitarfishes or wedgefishes)
65. *Rhina ancylostoma* (Bloch & Schneider, 1801). Bowmouth guitarfish.
Reference: A pair of dried jaws (JPAG 171) collected from San Jose, Taytay on 19 April 1999 was identified to be of this species (Compagno et al. 2005). The species has also been photographed and caught on video several times in TRNP (Murray et al. 2015). Distribution maps by Last et al. (2016b) and Kyne et al. (2019b) reflected a province-wide occurrence of the species.
66. *Rhynchobatus australiae* (Whitley, 1939). Bottlenose wedgefish.
Reference: Gonzales (2013) included a *Rhynchobatus djiddensis* in his list for Palawan. It lacked the mask-like interorbital bars distinctive of that species. Instead, the features of the specimen fit more the description of *R. australiae*. The species has been photographed in TRNP several times and reported by Murray et al. (2015) as *Rhynchobatus* sp. whitespotted guitarfish. A review of the photographs taken in TRNP showed that the animal fit the description of *R. australiae*. A video taken by a dive master in TRNP in 2019 and shared with the Tubbataha Management Office (TMO) also showed an individual of this species, although it was identified as a guitarfish in the video. On 27 September 2019, the Philippine Coast Guard apprehended a Vietnamese vessel in Balabac, carrying dried elasmobranch specimens among its catch. These included 11 pieces of wedgefish skin (Araujo 2019), some of which appeared to be of this species. Distribution maps by Last et al. (2016b) and Kyne et al. (2019c) showed widespread species occurrence throughout the province.

Family Rhinobatidae Bonaparte, 1835 (guitarfishes)
67. *Rhinobatos* sp.
Reference: A pair of dried jaws (JPAG 195) was encountered in the municipality of Taytay on 29 June 1999. Its identity could not be fully ascertained (Compagno et al. 2005).

3.5 Unconfirmed cartilaginous fish species in Palawan

An additional 24 shark, ray, and chimaera species listed below (see Table 4) are categorized as unconfirmed in Palawan. Although the evidence of their presence in the province had been deemed insufficient, these species have been listed here to underscore the need for further investigation. The Global Red List Status of these species has not been included.

CHIMAERAS
1. *Hydrolagus purpurescens* (Gilbert, 1905). Purple chimaera.
Reference: A market survey on the southern coast of Panay Island from 2012 to 2016 yielded a specimen (UPVMI 769) of this species (Motomura et al. 2017). Due to the proximity of the fishing grounds of southern Panay fishers and the waters surrounding Cuyo and Cagayancillo, the presence of the species in Palawan waters would be highly probable but would require further investigation.

SHARKS
2. *Carcharhinus hemiodon* (Valenciennes, 1839). Pondicherry shark.
Reference: Herre (1953) reported the species in Malampaya Sound, but no specimen was mentioned. Compagno et al. (2005) and Alava et al. (2014) confirmed its presence in the country but did not specify its occurrence in the province. Neither distribution maps in Ebert et al. (2021) nor Kyne et al. (2021b) reflected its presence in the province. Thus, the presence in the province needs further validation.
3. *Carcharhinus macloti* (Müller and Henle 1839). Hardnose shark.
Reference: A specimen (UPVMI 1689) was collected during the market surveys conducted on the southern coast of Panay Island (Motomura et al. 2017). Given the proximity of their fishing grounds to the northern island municipalities of Palawan, it may also likely be present in the province. Rigby et al. (2021d) illustrated the presence of extant populations all over the province in their species distribution map.

Table 4. List of unconfirmed species in Palawan in need of further validation.

Species		Scientific Authority	Common name
Chimaera			
1	*Hydrolagus purpurescens*	Gilbert, 1905	purple chimaera
Sharks			
2	*Carcharhinus hemiodon*	Valenciennes, 1839	pondicherry shark
3	*Carcharhinus macloti*	Müller & Henle, 1839	hardnose shark
4	*Carcharodon carcharias*	Linnaeus, 1758	white shark
5	*Chiloscyllium griseum*	Müller & Henle, 1838	grey bamboo shark
6	*Halaelurus buergeri*	Müller & Henle, 1838	blackspotted catshark
7	*Mustelus griseus*	Pietschmann, 1908	spotless smooth-hound
8	*Mustelus manazo*	Bleeker, 1854	starspotted smooth-hound
9	*Sphyrna zygaena*	Linnaeus, 1758	smooth hammerhead
10	*Squalus altipinnis*	Last, White & Stevens, 2007	western highfin spurdog
11	*Squalus brevirostris*	Tanaka, 1917	Japanese shortnose spurdog
Batoids			
12	*Bathytoshia brevicaudata*	Hutton, 1875	smooth stingray
13	*Bathytoshia lata*	Garman, 1880	brown stingray
14	*Glaucostegus granulatus*	Cuvier, 1829	sharpnose guitarfish
15	*Hemitrygon akajei*	Bürger, 1841	red stingray
16	*Himantura leoparda*	Manjaji-Matsumoto & Last, 2008	leopard whipray
17	*Narke dipterygia*	Bloch & Schneider, 1801	spottail sleeper ray
18	*Okamejei boesemani*	Ishihara, 1987	Boeseman's skate
19	*Okamejei panayensis*	Misawa, Babaran & Motomura, 2022	Philippine skate
20	*Rhinobatos schlegelii*	Müller and Henle 1841	brown guitarfish
21	*Rhinobatos whitei*	Last, Corrigan & Naylor, 2014	Philippine guitarfish
22	*Rhynchobatus springeri*	Compagno & Last, 2010	broadnose wedgefish
23	*Telatrygon zugei*	Bürger, 1841	pale-edge sharpnose ray
24	*Urolophus aurantiacus*	Müller & Henle, 1841	oriental stingaree

4. *Carcharodon carcharias* (Linnaeus, 1758). White shark.

Reference: The only species record in Palawan was from Malampaya Sound (Herre 1953), but Compagno et al. (2005) believed that the species may be more widely albeit sporadically distributed. Rigby et al. (2019f) and Ebert et al. (2021) noted that extant populations may still be present in more than half of the province, from Narra and Quezon extending up to the northern island municipalities. However, other experts believe that the available evidence is insufficient to prove the presence of the species in the province. Thus, the species has been placed under the unconfirmed category for further validation.

5. *Chiloscyllium griseum* (Müller & Henle, 1838). Grey bamboo shark.

Reference: Gonzales (2013) included this species in his checklist for coastal fishes in Palawan, although the catch location was not specified. The features of his specimen appeared to fit that of the species. Balisco et al. (2023) also included this species in their checklist, indicating the Western Sulu Sea as its catch location, although no photograph nor voucher specimen was reported. Other literature (Ebert et al. 2021; Compagno et al. 2005), however, maintained that the presence of the species in the country was uncertain, and it was likely confused with *C. punctatum*. Thus, this species has been placed on the unconfirmed list until more evidence can be provided on its presence in the province.

6. *Halaelurus buergeri* (Müller & Henle, 1838). Blackspotted catshark.

Reference: The 2012 to 2016 market survey along the southern coastal towns of Panay Island yielded a specimen (UPVMI 445) of this species (Motomura et al. 2017). The proximity of the fishing grounds of Panay

fishers to those of the northern island municipalities of Palawan suggested that the species may also be present in the province. Rigby et al. (2020i) appeared to support this premise, indicating the presence of extant populations in the waters northeast of Cuyo.

7. *Mustelus griseus* (Pietschmann, 1908). Spotless smooth-hound.

Reference: Compagno et al. (2005) did not include this in the list, while Alava et al. (2014) stated that the species had taxonomic issues that needed to be resolved. On 17 July 2015, a whole specimen (USNM 437772) was bought off an Iloilo market, where the vendor informed the collectors that the specimen was caught in Palawan (Smithsonian Institution Archives 2022). An initial DNA analysis done by the NFRDI laboratory identified the specimens through barcoding to be of this species (M. Santos, pers. comm. 2022). Pending the final report, however, the species has been listed here as unconfirmed.

8. *Mustelus manazo* (Bleeker, 1854). Starspotted smooth-hound.

Reference: The 2012 to 2016 market survey along the southern coastal towns of Panay Island yielded a specimen (UPVMI 469) of this species (Motomura et al. 2017). The proximity of the fishing grounds of Panay fishers to those of the northern island municipalities of Palawan suggested that the species may also be present in the province. Rigby et al. (2020j) appeared to support this premise, indicating the presence of extant populations in the waters northeast of Cuyo.

9. *Sphyrna zygaena* (Linnaeus, 1758). Smooth hammerhead.

Reference: Early records in the province came from Taytay and Balabac Strait (Herre 1953). Compagno et al. (2005) remarked that there were lesser validated reports of the species due, likely, to its similarity with *S. lewini* and *S. mokarran*, resulting in confusion in identification. The hammerhead shark depicted in Gonzales (2013) and identified as *S. lewini* exhibited a wide, curved head lacking a central indentation that suggested it was *S. zygaena* instead. Although the presence in the country was confirmed (Alava et al. 2014), neither the species distribution map in Rigby et al. (2019g) nor Ebert et al. (2021) showed any presence of extant populations in the province. Furthermore, some experts consulted on the matter were not fully convinced that the specimen presented by Gonzales (2013) was sufficient evidence of the presence of the nominally temperate species in Palawan.

10. *Squalus altipinnis* (Last, White & Stevens, 2007). Western highfin spurdog.

Reference: The 2012 to 2016 market survey along the southern coastal towns of Panay Island yielded a specimen (UPVMI 1000) of this species (Motomura et al. 2017). The proximity of the fishing grounds of Panay fishers to those of the northern island municipalities of Palawan suggested that the species may also be present in the province. Finucci et al. (2019) appeared to support this premise, further indicating that extant populations of this species may be found all over the province.

11. *Squalus brevirostris* (Tanaka, 1917). Japanese shortnose spurdog.

Reference: A specimen (USNM 437829/PHIL-219) collected from an Iloilo market was reportedly caught off Palawan waters, likely near Cagayancillo (Smithsonian Institution Archives 2022). DNA barcoding in BOLDSYSTEMS initially identified the specimen to be of this species. However, the species has been relegated to the unconfirmed list pending the finalization of the DNA analysis.

BATOIDS

12. *Bathytoshia brevicaudata* (Hutton, 1875). Smooth stingray.

Reference: Balisco et al. (2023) listed this species as being present in Puerto Princesa, Bataraza, and TRNP, although no photograph accompanied the report, nor was there mention of a voucher specimen in the paper. Thus, without the possibility of validation, the species had to be placed on the unconfirmed list until additional evidence could be acquired.

13. *Bathytoshia lata* (Garman, 1880). Brown stingray.

Reference: Balisco et al. (2023) noted the presence of this species in TRNP and the Western Sulu Sea. However, the sighting could not be validated with no accompanying photograph or voucher specimen. Thus, the species was placed on the unconfirmed list until more evidence could be acquired.

14. *Glaucostegus granulatus* (Cuvier, 1829). Sharpnose guitarfish.

Reference: Compagno et al. (2005) noted specimens obtained from Malampaya Sound (Fowler 1941; Herre 1953). However, they were not able to examine any Philippine material and further remarked that the record for the region needed validation. Alava et al. (2014) also reiterated the need to validate the presence of this species in the country. Neither Last et al. (2016b) nor Kyne and Jabado (2019) noted any extant population in Palawan.

15. *Hemitrygon akajei* (Bürger, 1841). Red stingray.

Reference: Balisco et al. (2023) included this species

in their checklist for Palawan. Compagno et al. (2005) examined several specimens from elsewhere in the Philippines and stated that, although these looked almost similar to *H. akajei*, there was a difference in denticle morphology. This may likely be the case in the record of Balisco et al. (2023). Furthermore, the Philippines is not known to be part of its habitat range (Rigby et al. 2021e; Last et al. 2016b). Without any possibility of validating the records of Balisco et al. (2023) , the species has been assigned to the unconfirmed list until additional evidence can be acquired.

16. *Himantura leoparda* (Manjaji-Matsumoto & Las, 2008). Leopard whipray.

Reference: Last et al. (2016b) indicated in their distribution map that the species is found all over the country, including Palawan. However, no record of any specimen taken from Palawan could be found. During the 2021 market visits, a specimen (DLA 015) was seen in the Tagburos market, which appeared to exhibit the distinctive ocellate pattern of this species. Species identity was difficult to validate since the specimen had been chopped up into small portions. A tissue sample was taken to verify species identity, and pending the results of DNA barcoding by NFRDI, the specimen has been tentatively identified as *H. uarnak*.

17. *Narke dipterygia* (Bloch & Schneider, 1801). Spottail sleeper ray.

Reference: Compagno et al. (2005) noted that there was no Philippine material for this species but that its presence in the country was possible. Alava et al. (2014) acknowledged that the nominal records of species in the country needed further validation. A review of the Smithsonian Institution Archives (2022) revealed a specimen (USNM 231599) collected by R.E. Schroeder, which was identified to be of this species. The specimen had been collected from a Puerto Princesa market in September 1978 but was not mentioned by Compagno et al. (2005). The species has been classified as unconfirmed pending further investigation.

18. *Okamejei boesemani* (Ishihara, 1987). Boeseman's skate.

Reference: Compagno et al. (2005) noted that the specimen taken from the Philippine EZZ off Luzon needed further assessment. Alava et al. (2014) stated that the nominal record for the species required further investigation. On 17 July 2015, Jeffrey Williams and his team bought a specimen (USNM 437756) from an Iloilo market where the vendor indicated it was fished near Palawan (Smithsonian Institution Archives 2022). NFRDI barcoding has initially identified the specimen as of this species (M. Santos, pers. comm. 2022). However, the species has been categorized as unconfirmed pending the final report on the DNA analysis.

19. *Okamejei panayensis* (Misawa, Babaran & Motomura, 2022). Philippine skate.

Reference:A whole specimen (UPVMI 577) was purchased during the 2012 to 2016 market survey in southern Panay (Motomura et al. 2017), which turned out to be this new species of skates (Misawa et al. 2022). Due to the proximity of the fishing grounds of Panay fishers to Cuyo and Cagayancillo, the presence of the species in Palawan waters is possible but would require further investigation.

20. *Rhinobatos schlegelii* (Müller & Henle, 1841). Brown guitarfish.

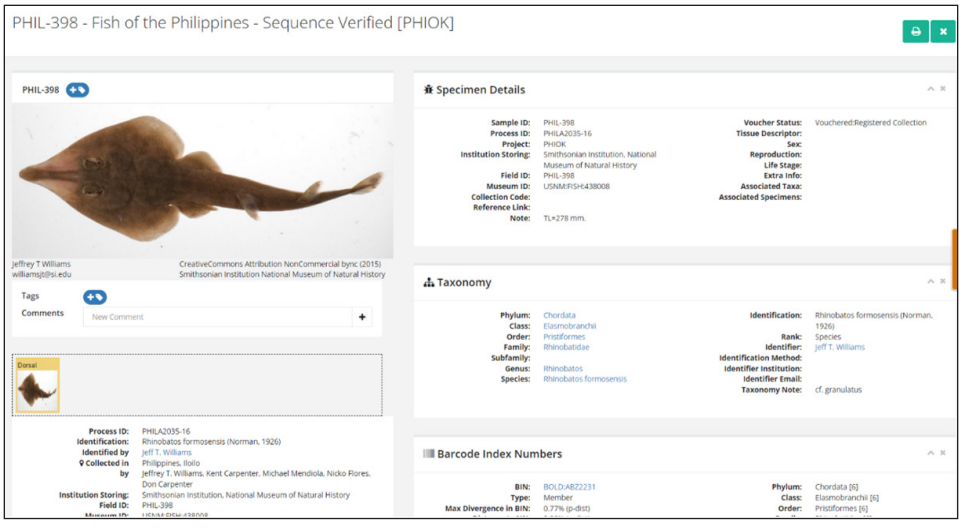

Figure 7. Specimen USNM 438008/PHIL398 was identified to be *Rhinobatos formosensis,* which has been considered a synonym of *R. schlegelii*.

Reference: On 23 July 2015, Jeffrey Williams and his team collected two specimens (USNM 438006 and USNM 438008) from an Iloilo market where the vendor informed them that these were caught in Palawan (Smithsonian Institution Archives 2022). NFRDI barcoding through BOLDSYSTEMS (Figure 7) identified the specimens to be *R. formosensis*, a synonym of this species (Eschmeyer and Van der Laan 2022; Last et al. 2016c). Neither distribution maps in Last et al. (2016b) nor Rigby et al. (2021f) reflected the presence of the species in the country. Thus, the species has been added to the unconfirmed list pending the finalization of the DNA results.

21. *Rhinobatos whitei* (Last, Corrigan & Naylor, 2014). Philippine guitarfish.

Reference: No specimens from Palawan have been collected of this species, although Motomura et al. (2017) were able to collect one from a market in Southern Panay (UPVMI 576). Considering the proximity of the Panay fishers' fishing grounds to Cuyo and Cagayancillo, the species may also be present in Palawan. The species distribution map in Dulvy et al. (2021c) appeared to support this theory.

22. *Rhynchobatus springeri* (Compagno & Last, 2010). Broadnose wedgefish.

Reference: In the apprehension case of a Vietnamese vessel in Balabac on 27 September 2019, Araujo (2019) noted that some of the specimens were of this species. One of the photographs taken of the specimens included in the report displayed rows of white spots extending to the tail, a distinctive characteristic of this species. However, the authors of this paper did not wholly agree on the species identification. Thus, the species has been listed as unconfirmed.

23. *Telatrygon zugei* (Bürger, 1841). Pale-edge sharpnose ray.

Reference: Herre (1957) mentioned the species in Malampaya Sound (Compagno et al. 2005). No other literature has mentioned the species' presence in the province since then.

24. *Urolophus aurantiacus* (Müller & Henle, 1841). Oriental stingaree.

Reference: Jeffrey Williams and his team collected a specimen (USNM 438029) on 24 July 2015 from an Iloilo market. Vendor indicated that the specimen was caught off Palawan (Smithsonian Institution Archives 2022), likely in the Cagayancillo area. NFRDI barcoding analysis initially identified it to be of this species (M. Santos, pers. comm. 2022). The species was not listed in Compagno et al. (2005) nor in Alava et al. (2014) and has been placed on the unconfirmed list until the final DNA report has been completed.

4. DISCUSSION

The checklist provided additional evidence for the rich biodiversity that Palawan possessed. However, it was difficult to determine how this diversity has changed over the years, given the patchy information collected over time and the constant evidence of targeted fisheries and by-catch in the province. This situation is likely true for other provinces around the country, most of which still need an independent checklist for their locality. Nevertheless, this study should significantly contribute to the national checklist that is due for updating. This study assembled a more robust checklist for Palawan to provide accurate information to facilitate decision-making and streamline processes to achieve the SEP Law (RA 7611) objectives, which were established to provide environmental protection for Palawan and its resources.

This paper highlighted information sources on the cartilaginous fishes of Palawan, most of which were from fisheries operations supplemented by sightings and records from wild populations (e.g., in TRNP). The authors relied heavily on published literature and reports to compile the checklist of confirmed chondrichthyans for the province. Citizen science provided the study with significant supplemental information, especially on the species' presence in different parts of the province, e.g., the Facebook post of a stranded megamouth shark *Megachasma pelagios*, in Araceli. This highlighted the fact that, although there may have been some research efforts focused on chondrichthyans in the past up to current times, these may have been insufficient to represent the chondrichthyan diversity for Palawan accurately. The information gained from citizen science exposed the possibility that the current checklist was incomplete and thus should be reviewed and updated as new information became available. The hope is that this study would stimulate efforts by decision-makers and stakeholders to support targeted research on cartilaginous fishes, to gain more knowledge on their population status in the wild, and quantify the threats facing them so mitigation measures could be identified to sustain extant populations.

4.1 Local conservation awareness

Local fishers' strong awareness of the law has become a double-edged sword for conservation research and management. When asked why there were not that many cartilaginous fishes sold openly, most fishers and vendors alike answered that there

was a ban in Palawan on these fishes. They were likely referring to the PCSD Resolution 15-521 and, not fully understanding its content and scope, perceived it to mean that all shark catches – not just the 15 species listed in the Resolution – are illegal. A few claimed to have no idea about these fishes and did not want to respond to further questions. In an anonymous video forwarded by PCSD to the authors on 17 February 2022, one fisher referred to his catch, which was obviously a ray species (i.e., Jenkin's whipray) as "*pusit*" (i.e., a squid in local parlance). Since squids are morphologically distinct from rays, even from a layman's perspective, the response was suspect, possibly to deflect further questions. There were also instances during the market survey when reports of landed sharks did not pan out, as the fishers who initially reported the landings eventually recanted their statement.

While some have been deterred from catching and selling cartilaginous fishes, the community's heightened wariness of the perceived shark ban has caused difficulty in obtaining information and monitoring. Those who persist have become more creative in the disposal of their catch, adding to the difficulty in monitoring. With the increasing emergence of informal markets or "talipapa" in every barangay all over the city, the difficulty level in monitoring the trade of Chondrichthyes grows exponentially. Furthermore, while only certain species are protected, enforcement personnel often cannot distinguish between protected species and those not.

Major drivers for shark exploitation included local consumption of shark meat and the high demand for shark fins in Asian markets (Martins et al. 2018; BFAR-NFRDI 2017). Chondrichthyes have also been exploited for medicinal purposes, including shark liver oil (BFAR-NFRDI 2017; LAMAVE 2017; Thangaraj et al. 2013). In a developing country such as the Philippines, differentiating between catch and by-catch is difficult as fishers often try to maximize their catch by consuming or selling everything. Thus, these factors have created a multi-layered challenge for conserving Chondrichthyes in the country and Palawan per se.

4.2 Elasmobranch research

Several local and national agencies, NGOs, and academe have contributed to the province's knowledge and conservation of Chondrichthyes over the years. PCSD, being the lead agency in all things pertaining to conservation in the province, has led several enforcement efforts, resulting in apprehensions and seizures and shark identification training for their staff and Wildlife Enforcement Officers (WEOs). The collaboration between BFAR, NMNH Smithsonian Institution, and Old Dominion University in 2013 provided a number of species new to the province and thus contributed to the knowledge of Chondrichthyes in Palawan. In addition, BFAR, through its National Stock Assessment Program (NSAP), has been monitoring fish landing sites for the presence of Chondrichthyes in the province for about two decades as of writing. According to the NSAP Capture Fisheries Atlas (Santos et al. 2017), a total of 63 landing sites all over the province have been monitored since. The local academe and NGOs have likewise contributed to Chondrichthyes' information through their respective research efforts.

The province has two recognized repositories for Chondrichthyes specimens – the Western Philippine University (WPU) and the PCSD. Their current list of specimens, however, is very limited. WPU's current collection holds two specimens of one species (i.e., *Pateobatis fai*), while PCSD possesses four stingray tails (unidentified species) and three shark jaws (also unidentified species). WPU's earlier collections from the WWF EBCP in 1998-2001 as well as PCSD's collection from previous years, had been destroyed or disposed of over time.

4.3 Conservation and management

In the Philippine National Plan of Action (NPOA)-Sharks 2017-2022 (BFAR-NFRDI 2017), sharks and rays (elasmobranchs) have been reportedly caught from 13 major fishing grounds (Cagayancillo not included) around Palawan waters and landed in 63 monitored sites of 11 coastal municipalities and the lone city in the province. In this study, although the informal markets visited were all on the eastern side of mainland Palawan facing the Sulu Sea, vendors and fishers still indicated the West Philippine Sea as their catch location in several instances. This implied that fishers might have tried to evade detection at monitored landing sites by selling their catch in informal markets on the opposite side of mainland Palawan. It further suggested that elasmobranch fisheries could be more prevalent than what has been observed in this study and less documented than other commercially important fisheries (e.g., small pelagics) in which they may also be caught.

The PCSD Resolution 15-521 listed at least 15 sharks and rays under three categories,

namely, Category I – Critically Endangered (inc. CITES Appendix I species), for members of the Family Pristidae, including *Pristis* spp.); Category II – Endangered (CITES Appendix II species), one species, *Sphyrna mokarran*); and Category III – Vulnerable (CITES Appendix III species), 13 species (see Table 1). In the latest Notification to Parties issued on 10 February 2023, CITES expanded its list of protected Chondrichthyes to include the requiem sharks (https://cites.org/eng/node/134778). There are 15 requiem sharks confirmed to be present in the province through this paper that has yet to be added to the PCSD list. Furthermore, based on recent assessments (2020-2021) by the IUCN SSC Shark Specialist Group (see https://www.iucnredlist.org), at least 43 species of sharks, batoids, and chimaeras that were confirmed to be present in Palawan waters in this study have globally threatened status, i.e., six species are Critically Endangered, 15 species are Endangered, and 22 species are Vulnerable (see Table 3). These threatened species, along with the requiem sharks, need to be considered when updating the PCSD list. Once updated, the next step could be a tiered, risk-based, species-specific assessment to identify species of highest conservation priority.

5. CONCLUSION

More ray species than sharks were observed in the market survey. *Neotrygon orientalis* and *Taeniura lymma* were the most common species in these markets. The limited number of shark species in the market may have been the consequence of seller avoidance of the perceived shark ban in the province. This did not necessarily mean that shark fisheries had ceased to exist. Rather, the perceived ban made fisheries operations more covert, making monitoring more complex and challenging.

Based on the literature review and reports received, the presence of 67 chondrichthyan species was confirmed for the province, with Cagayancillo and Puerto Princesa showing high diversity. TRNP, which is geopolitically situated under the municipality of Cagayancillo, recorded 28 species. Dedicated chondrichthyan research, as well as citizen science (especially in TRNP), contributed to this knowledge base. Other places in the province have little, if any, chondrichthyan research taking place, resulting in widespread knowledge gaps about species distribution or threats.

The checklist presented here is likely not fully reflective of the chondrichthyan biodiversity in the province, nor is it complete, and future research efforts should enhance it. An additional 24 species still require further validation. Although some literature referred to most of these species as present in the province, the basis for these statements was difficult to validate.

The perceived "total ban" on sharks in the province versus the actual species listed in the PCSD Resolution 15-521 has created a conundrum for research and conservation. While it deters some from targeting sharks which benefits species with declining populations, it does not ensure that shark fisheries have ceased to exist in the province. Instead, shark fisheries have become more covert, with fishers and vendors becoming more creative in selling their catches (e.g., chopping large individuals into pieces making identification difficult, naming rays as squids, or selling the catch outside of their localities to avoid detection), making identification and monitoring of the catch more difficult. Numerous markets and landing sites are all over Palawan – some quite remote and difficult to access, much less monitor.

There are valid concerns in ensuring that the naming and identification of species under regulation is correct. Only a few species are listed, and regulation is based on their threat status under the IUCN Categories or listing in the CITES appendices. These listings, in turn, are supported by population, threats, and risk data as applied to each species of concern, albeit globally. Monitoring of these species at the local level needs to be conducted to apply appropriate information for local management.

5. RECOMMENDATIONS

In the conduct of this study, the authors noted a need for more information, especially in various remote locations outside Puerto Princesa City. Local researchers must be encouraged to conduct chondrichthyan research, especially in areas with huge information gaps. A priority conservation action could be basic research on species diversity, supported by DNA barcoding to verify species identifications. Species-specific population assessment coupled with fisheries interaction studies could provide significant information to conservation managers and help formulate appropriate policies. The information generated by these studies could be fed into the knowledge platform of the PCSD for easy access and input to policies. A DNA fingerprinting laboratory is recommended for PCSD to set up in the province to facilitate such research and possibly enhance monitoring and enforcement work.

Training for species identification and stock

assessment is needed to conduct the previously mentioned activities properly. Enhancing repositories such as those found in PCSD and WPU is advisable. Specimens requiring further examination need such facilities for proper long-term storage and safekeeping, similar to the Philippine National Museum. Museum repositories are good sources of information and function as knowledge hubs for students, faculty, and researchers alike and may even be a source of revenue if correctly managed and made available to paying visitors.

It would benefit conservation managers to review the policies on shark fisheries in the province and study sustainable shark fisheries models. In order to strengthen shark and ray conservation in Palawan, a risk assessment should be completed that also integrates information from chondrichthyan age and growth models. This assessment could be used to inform a review of shark fisheries management and conservation policies. A review of the human dimensions of Palawan's fisheries and the drivers behind fisher behavior would also help define policies that would avoid penalizing fishers outright for possession of wildlife and encourage their support for conservation and management efforts. It is also recommended that the current list of regulated species in the province under PCSD 15-521 be reviewed and amended using the list of confirmed species in Palawan (this study) to aid enforcement.

At the national level, the Philippine government, through its Philippine Aquatic Red List Committee (PARLC), aims to establish the Philippine National Red List of threatened aquatic species, which will serve as a guide for the country's conservation management efforts. This paper contributes to the checklist of aquatic species for the Philippines, particularly in the revision of the "Pating Ka Ba? Identification Guide for Sharks, Batoids and Chimaeras of the Philippines" (Alava et al. 2014) and the third iteration of the Philippine NPOA-Sharks (BFAR-NFRDI 2017).

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AUTHOR CONTRIBUTIONS

Aquino MTR: Conceptualization, Methodology, Validation, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision, Project administration. **Alava MNR**: Conceptualization, Methodology, Validation, Investigation, Data Curation, Writing - Review & Editing, Supervision, Project administration, Funding acquisition. **Utzurrum J:** Validation, Investigation, Data Curation, Writing - Review & Editing. **Abalo DL**: Validation, Investigation, Resources, Data Curation, Visualization. **Gaudiano JPA**: Validation, Investigation, Data Curation. **Santos MD**: Investigation, Data Curation, Review & Editing; Writing - Review & Editing.

CONFLICTS OF INTEREST

To the best of our knowledge, no conflict of interest exists.

ETHICS STATEMENT

This study did not deal with live animals nor humans as subjects.

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