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Review

A Review of the Conservation Status and Ecology of the Giant Freshwater Whipray (*Urogymnus polylepis*) across Its Known Distribution

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Abstract: The giant freshwater whipray is a large-bodied stingray species that is listed as endangered across its known range from India through Southeast Asia. However, little is known about the species' ecology, biology, and conservation status. We reviewed all available literature, articles, and reports on the species found through database and internet searches in order to consolidate and update information on the giant freshwater whipray. We found that remarkably little research has been done, and most existing information on the species is derived from fisher catch reports. Whiprays of 300 kg or more have been reported in most countries where it occurs. The available evidence suggests that this species is endangered across its range by numerous threats, including fishing, bycatch, bottom trawls, pollution, and habitat destruction and fragmentation. Various reports indicate declines in population size, genetic diversity, and body size. Relatively stable populations may persist in the Maeklong River, Thailand, the Mekong River in Cambodia, and insular Southeast Asia. More work is needed to understand the species' spatio-temporal distribution, reproductive behavior, migration patterns, and general ecological and biological characteristics in order to inform effective management and conservation plans. Due to difficulties in sampling this rare species and monitoring fisher catches, partnership and collaboration with all stakeholders, including local fishers, government officials, and researchers, is essential to produce conservation gains for the giant freshwater whipray.

Keywords: giant freshwater stingray; *Himantura chaophraya*; *Himantura polylepis*; megafauna; megafish; endangered species; conservation; tropical freshwater diversity; biodiversity

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1. Introduction

The giant freshwater whipray *Urogymnus polylepis*, known from tropical rivers of Southeast Asia, has long been recognized as one of the largest freshwater fishes in the world [1], and, as of June 2022, a specimen from Cambodia became the largest freshwater fish ever caught and officially recorded (Figure 1a) [2]. First described as *Trygon polylepis* by Bleeker in 1852 from a specimen collected in Java, Indonesia [3], it was later described by Monkolprasit and Roberts in 1990 as a new species *Himantura chaophraya* [1]. In 2008, Last and Manjaji-Matsumoto found the Bleeker specimen and *H. chaophraya* to be conspecific and recognized *H. polylepis* as the senior synonym [3]. A subsequent review of morphological and molecular data led Last et al. in 2016 to reclassify the species as *Urogymnus polylepis* [4]. In both scientific and popular literature, *U. polylepis* is variously referred to as "giant freshwater whipray" or "giant freshwater stingray".

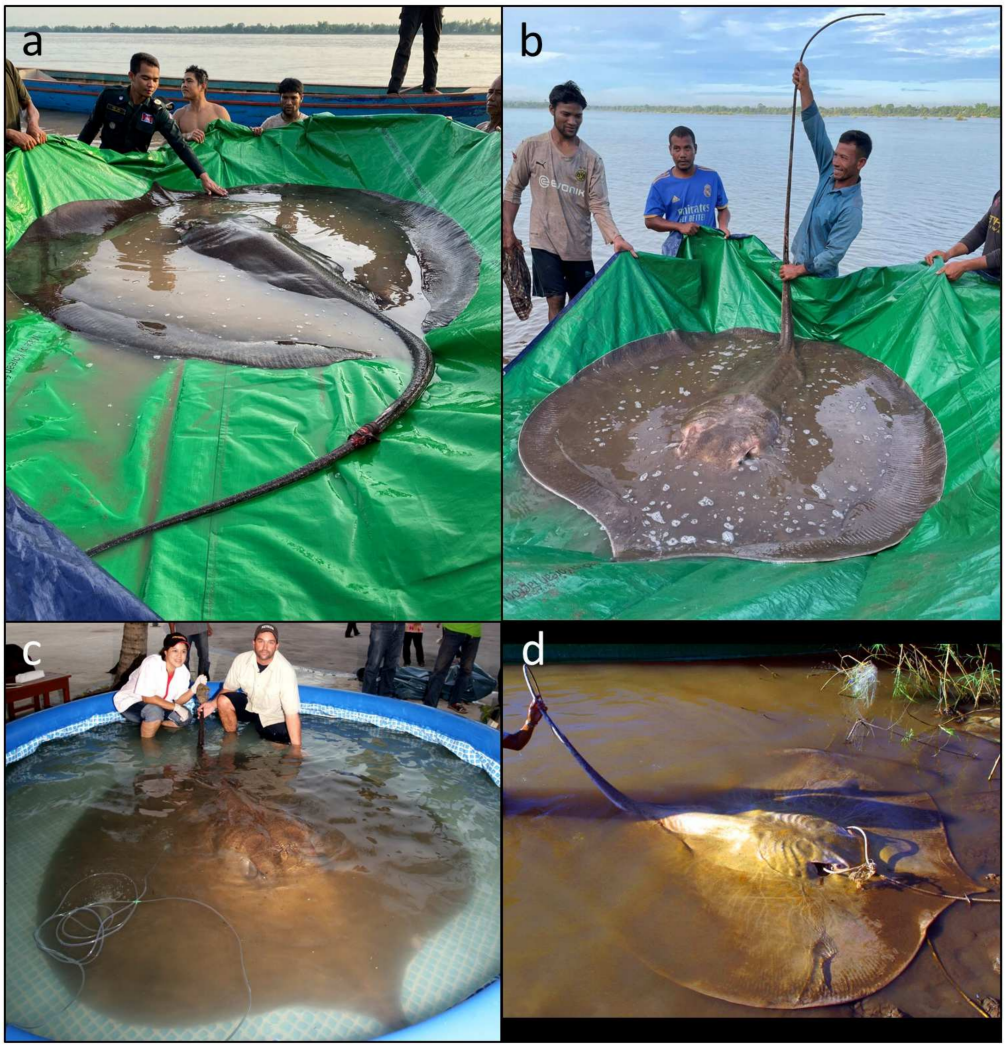

Figure 1. Photographs of giant freshwater whiprays. (**a**) Current record holder. Female caught in the Mekong River in Stung Treng, Cambodia, on 14 June 2022. Measurements: 220 cm disc width (DW), 220 cm disc length (DL), 398 cm total length (TL), 300 kg. Photo credit: Seila Chea. (**b**) Female caught in the Mekong River in Stung Treng, Cambodia, on 5 May 2022. Measurements: 185 cm DW, 200 cm DL, 393 cm TL, 180 kg. Photo credit: Elizabeth Everest. (**c**) Individual caught in the Meaklong River, Samut Songkhram Province, Thailand, on 28 January 2009. Photo credit: Zeb Hogan. (**d**) Individual caught in the Mekong River in Prey Veng, Cambodia on 14 December 2002. Measurements: 202 cm DW, 413 cm TL Photo credit: Zeb Hogan.

This species is most notable for its extremely large size. The largest individual to be reliably measured, weighed, and documented has a disc width of 220 cm, a total length of 398 cm, and a weight of 300 kg (Figure 1a) [2]. Fishers from the Chao Phraya and Mekong basins reported individuals reaching even greater sizes, as large as 500–600 kg [1]. This whipray is brown or grey in color and has a broad, nearly circular body shape with a long, thin, whiplike tail [5]. Near the base of the tail is a long, barbed spine [1] that can inflict painful wounds. A detailed description of its morphology may be found in [1]. The giant freshwater whipray feeds on bony fishes as well as benthic invertebrates, and occurs on sandy bottoms of freshwater river systems and brackish estuaries [5–7]. Grant et al. [8] characterized the giant freshwater whipray as a euryhaline generalist, indicating that individuals are found in a range of salinities (freshwater to marine) with certain environments preferred during specific life-history stages. They noted that adults of euryhaline generalists are often found in a range of salinities, whereas juveniles are usually only found in freshwater or very low-saline environments [8]. The species has

been documented from inland rivers, estuaries, and coastal marine habitats [9]. Although more research is needed on its biology and reproductive ecology, the giant freshwater whipray is thought to reach a maximum age of 12 or more years, have a generation length of 8–22 years, and mature at approximately three years and 110 cm disc width [9]. A viviparous species, females give birth to live pups, with litter sizes of 1–3 pups considered typical. Pups are approximately 30 cm in disc width at birth [9].

The giant freshwater whipray is patchily distributed across eastern India and Southeast Asia [5]. Until the early 2000s, its range was thought to include northern Australia and New Guinea, but molecular and morphometric work by Last and Manjaji-Matsumoto [3] showed that individuals in this region were a separate species, the freshwater whipray *Urogymnus dalyensis*. The giant freshwater whipray is known in ten countries and several major river basins, including the Mekong, Chao Phraya, and Ganges [9].

The International Union for Conservation of Nature (IUCN) has assessed the giant freshwater whipray as endangered due to population declines as high as 79% over the last century [9]. There are a variety of threats to this species' persistence, including subsistence and commercial fishing, habitat degradation, pollution, and dams [9]. Although this species is listed as endangered, there is very little existing information on its distribution, ecology, or conservation status. However, recent literature describes updated distributions, new observations, and expanded records of giant freshwater whipray throughout its range, e.g., [10–13]. This review summarizes the current scientific understanding of giant freshwater whipray for each country within its known range. Media reports, social media posts, and field observations were also reviewed in order to supplement research-derived knowledge about its current distribution. This review was conducted by searching Google and Google Scholar for combinations of country names along with "*Urogymnus polylepis*", "*Himantura polylepis*", "*Himantura chaophraya*", "giant freshwater whipray", and "giant freshwater stingray". When those searches yielded few or no results, additional, more general searches for lists of sharks and rays for that country were also performed. A summary of these resources by country, with any available information on the number, size, life stage, and habitat of reported individuals, is available in Table 1.

Table 1. Summary of whiprays reported in the resources reviewed in this paper. Report date corresponds to the year the whiprays were captured. Size range: DW = disc width, DL = disc length, TL = total length, WT = wet weight of live fish. Life stage: I = immature, M = mature. Ref. no. corresponds to the reference number in the References section.

Report Date	Number of Individuals	Size Range	Life Stage	Habitat	Reference	Reference Type	Ref. No.
INDIA							
2018–2021	13	120–223 cm DW 95–300 kg WT	M	Coastal Riverine	Sen et al., 2022	Research paper	[7]
1996–1997	1	-	-	Riverine	Sezaki et al., 1999	Research paper	[14]
2018–2019	5	141–223 cm DW 117–300 kg WT	-	Riverine	Sen et al., 2020	Research paper	[15]
BANGLADESH							
2016–2019	52	-	-	-	Haque et al., 2021	Research paper	[16]
2021	1	373 kg WT	-	-	Kamruzzaman, 2021	News article	[17]
2011	1	224 kg WT	-	-	Daily Star, 2011	News article	[18]
2017–2019	-	-	-	-	Haque et al., 2022	Research paper	[19]
MYANMAR							
2016–2021	7	122–194 cm DW 129–194 cm DL 130 kg WT	M	Riverine	Grant et al., 2022	Research paper	[11]
-	-	-	-	Coastal Riverine	Psomadakis et al., 2019	Book	[20]

Table 1. *Cont.*

Report Date	Number of Individuals	Size Range	Life Stage	Habitat	Reference	Reference Type	Ref. No.
THAILAND							
1987–1989	3	78–192 cm DW	I, M	Riverine	Monkolprasit and Roberts, 1990	Research paper	[1]
1996–1997	2	-	-	Riverine	Sezaki et al., 1999	Research paper	[14]
2009–2011	40	-	-	Riverine	Khudamrongsawat et al., 2017	Research paper	[21]
-	-	-	-	Riverine	Bhummakasikara et al., 2013	Research paper	[22]
2012–2017	71	30–250 cm DL	I, M	Riverine	Phomikong et al., 2019	Research paper	[23]
2015	1	240 cm DW 340 kg WT	-	Riverine	Howard, 2015	News article	[24]
2016	70	-	-	Riverine	Howard, 2016	News article	[25]
2017	1	202 cm DW 240 kg WT	-	Riverine	Grisendi, 2017	YouTube video	[26]
1992–1993	3–25	-	-	Riverine	Cook and Compagno, 1994	Research paper	[27]
2018	22	72–206 cm DW 110–414 cm TL 13–105 kg WT	-	Riverine	Zeb Hogan	Unpublished data	-
LAO PDR							
1993–1995	-	-	-	Riverine	Roberts and Baird, 1995	Report	[28]
-	-	400 kg WT (max)	-	Riverine	Grey et al., 2017	Research paper	[29]
2011	1	190 cm 310 kg WT	-	Riverine	Thammavongsa, 2011	News article	[30]
2020	1	-	-	Riverine	Radio Free Asia, 2020	Social media post	[31]
2016–2020	3	60–240 kg WT	-	Riverine	Sinsamout Onboundisane	Unpublished data	-
CAMBODIA							
2022	1	220 cm DW 398 cm TL 300 kg WT	-	Riverine	Millward, 2022	News article	[2]
-	-	-	-	Riverine	Rainboth, 1996	Book	[6]
-	-	20–300 kg WT	-	Riverine	Campbell et al., 2020	Research paper	[13]
2022	1	396 cm TL 181 kg WT	-	Riverine	Bittel, 2022	News article	[32]
1999–2002	2	420 cm TL 210 cm DW 18–180 kg WT	-	Riverine	Try et al., 2004	Report	[33]
2022	5	39–220 cm DW 45–220 cm DL 147–398 cm TL 3–300 kg WT	-	Riverine	Zeb Hogan	Unpublished data	-
VIETNAM							
None available							
MALAYSIA							
2011–2021	61	37–192 cm DW 16–500 kg WT	I, M	Coastal Riverine	Then, Lim, and Loh, 2022	Research paper	[10]
2011–2017	16	82–500 kg WT	-	Coastal Riverine	Windusari et al., 2020	Research paper	[12]
2012–2019	7	41–300 kg WT	-	Coastal Riverine	Iqbal et al., 2020	Research paper	[34]
1997	1	53 cm DW	-	Riverine	Yano et al., 2005	Book	[35]
-	1	-	-	Riverine	Chong et al., 2010		[36]
2003–2004	4	-	I, M	Riverine	Fyler and Caira, 2006	Research paper	[37]
2015–2016	9	-	-	Riverine	Manjaji-Matsumoto et al., 2016	Report	[38]
2017–2019	2	-	-	-	Booth et al., 2021	Research paper	[39]
2003–2004	6	-	-	Riverine	Healy, 2006	Research paper	[40]
2002–2004	6	46–127 cm DW	-	Riverine	Jensen and Guyer, 2021	Research paper	[41]

Table 1. *Cont.*

Report Date	Number of Individuals	Size Range	Life Stage	Habitat	Reference	Reference Type	Ref. No.
BRUNEI DARUSSALAM							
2011	1	200 kg WT	-	Coastal	Windusari et al., 2020	Research paper	[12]
INDONESIA							
1984	1	57 cm DW	I	Riverine	Monkolprasit and Roberts, 1990	Research paper	[1]
1852	1	30 mm DW	I	-	Last and Manjaji-Matsumoto, 2008	Research paper	[3]
2014–2018	12	100–300 kg WT	-	Coastal Riverine	Windusari et al., 2020	Research paper	[12]
2008	2	99–127 cm DW	-	-	Jensen and Guyer, 2021	Research paper	[41]
2008–2016	12	150–200 cm DW 200–450 cm TL 35–350 kg WT	-	Coastal Riverine	Iqbal and Yustian, 2016	Research paper	[42]
2016–2019	42	150–200 cm DW 200–500 cm TL 35–300 kg WT	-	Coastal Riverine	Iqbal et al., 2020	Conference proceedings	[43]
2018	9	-	-	Coastal Riverine	Iqbal, Zulkifli, and Yustian, 2018	Research paper	[44]
2016	1	363 kg	-	Riverine	Lovgren, 2019	News article	[45]
-	-	-	-	-	Fahmi, 2013	Conference proceedings	[46]

2. Summaries by Country

2.1. India

Minimal information is available for the giant freshwater whipray in India. It is currently known from the eastern states of Odisha and West Bengal, where it has been reported along the coast of the Bay of Bengal and from rivers flowing into the Bay of Bengal [7]. These rivers include the Ganges [14], Hooghly (lower Ganges) [15], Mahanadi [7], and Kandala [9]. It is currently caught infrequently as bycatch, often in trawls or gill nets, and then sold in local markets or exported [7].

As part of a larger study to map phylogenetic relationships among stingrays of India and Southeast Asia, Sezaki et al. [14] performed molecular analyses on one specimen from the Ganges River, India and two from the Chao Phraya River, Thailand. Their results showed significant molecular differences in the specimen from the Ganges versus the ones from the Chao Phraya. Although the specimens were closely related, the molecular differences were great enough to indicate separate lineages within the species, perhaps resulting from local adaptation to geographically isolated river systems [14].

Sen et al. [7] investigated 13 giant freshwater whiprays landed in Odisha and West Bengal between 2018 and 2021, providing important insights into the species' ecological and reproductive traits. Of these specimens, there were four males and nine females, with disc widths ranging from 120–223 cm and weights ranging from 95–300 kg. All were mature, and three of the females were pregnant with pups. Pregnant females had a range of four to 15 developed embryos, which is considerably higher than what was previously thought to be the typical litter size for this species (1–2 pups) [9]. Mature individuals were observed in this area from December to March, suggesting a seasonal migration from freshwater to coastal waters for breeding. Gut content analysis of ten individuals showed a preference for bony fishes, shrimps, and crabs [7].

Although more work is needed to confirm the population status of the giant freshwater whipray in India, fishers from northeast India interviewed by Sen et al. [7] indicated a marked decline over the last ten years in the number caught, from 10–15 per month to three to five per year. India has one of the largest shark and ray fisheries in the world and is in great need of conservation measures to protect threatened elasmobranch species [47].

2.2. Bangladesh

There is almost no published literature available on the giant freshwater whipray in Bangladesh. A paper by Haque et al. [16] provides a checklist of sharks and rays documented from the Bay of Bengal in Bangladesh, in which the giant freshwater whipray is included. The checklist was constructed from a literature review, other confirmed records, and the authors' own surveys of landing sites (Cox's Bazar, Chattogram, and St. Martin's Island) in southeast Bangladesh between 2016 and 2019. In their surveys, 52 giant freshwater whipray specimens were documented [16]. According to the 2021 IUCN Red List assessment, there are unpublished reports of this species from the Sundarbans region (an extensive mangrove forest in southwest Bangladesh extending into India) and central coastal waters, as well as farther upstream in rivers that flow into the Bay of Bengal [9]. Two news reports documented large stingrays (224 and 373 kg) captured in central Bangladesh in the Modhumoti and Padma rivers [17,18], although the species' identities were not confirmed. Haque et al. [16] also described high fishing intensity and a strong market for elasmobranchs in Bangladesh with no effective monitoring for protected species at landing sites. As such, the giant freshwater whipray is threatened by unregulated fishing in this region. In a related publication, Haque et al. [19] reported results of fishermen interviews conducted in southeast Bangladesh that indicated declines in diversity, individual size, and catch size of elasmobranchs over their lifetimes. It was also found that fishers had a hard time correctly identifying the giant freshwater whipray [19], showing that education is needed in order to facilitate accurate descriptions of its distribution and population status.

2.3. Myanmar

Until recently, the presence of giant freshwater whipray in Myanmar was uncertain [9]. There are almost no published scientific or media accounts of this species in Myanmar, and historically it has not been represented in shark and ray species lists for the country (e.g., [48]). A 2019 FAO marine species guide appears to be the first to list the species as present in Myanmar [20], and a brief communication in the Journal of Fish Biology by Grant et al. in 2022 [11] provides the only published scientific account. The authors conducted landing site surveys in Rakhine State (southwest Myanmar on the coast of the Bay of Bengal) between 2017 and 2018, and also solicited information on captures of large stingrays from social media in order to obtain photographic evidence of the giant freshwater whipray in Myanmar. Photographic evidence was obtained for seven individuals in five locations in Rakhine and Chin states. Six individuals were documented from four locations in the Kaladan and Mayu rivers near the Bay of Bengal in Rakhine. The seventh individual was documented farther upstream in the Kaladan River in China, and is notable because it was a pregnant female who birthed two pups upon capture [11]. This finding provides further support for the observation that the young of euryhaline generalists are typically only found in freshwater environments [8], and may suggest that parturition and rearing for giant freshwater whipray occur in upstream riverine environments. This observation also provides new morphological information about giant freshwater whipray neonates [11].

Howard et al. [48] documented extremely high fishing pressure on rays in Myanmar, with over 4000 tons caught in the Tanintharyi Region (southern Myanmar in the upper Malay Peninsula) alone in 2013–2014. As such, the giant freshwater whipray in Myanmar likely faces high fishing pressure, putting the population at risk.

2.4. Thailand

More is known about the giant freshwater whipray from Thailand than from other countries. Monkolprasit and Roberts [1] used specimens from the Chao Phraya River to describe *H. chaophraya* in 1990. Genetic [14,21,22] and life-history [23] studies have also been conducted for this species in Thailand. Furthermore, individuals may be more commonly encountered in Thailand than in other countries, as Thai fishing guides still offer services for catching giant freshwater whipray. (A Google search for "giant freshwater stingray Thailand" on 15 February 2023 yielded several results for giant stingray fishing guides).

Monkolprasit and Roberts [1] documented catch reports that revealed a widespread distribution of this species across Thailand. They reported captures of the species throughout the 1980s from Thai rivers, including the Chao Phraya at Ang Thong and Sing Buri (central Thailand) approximately 130–200 km upstream from the Gulf of Thailand; the Mekong in Nakhon Phanom (northeast Thailand); the Bang Pakong, a river that feeds into the northeast corner of the Bight of Bangkok; the Tha Chin, a distributary of the Chao Phraya, near Hankha (central Thailand); and the Ta Pi River Basin in peninsular Thailand (western Gulf of Thailand) [1]. Additionally, Khudamrongsawat et al. [21] sampled giant freshwater whiprays from 2009 to 2011 from the lower Maeklong in Samut Songkhram, the upper Chao Phraya in Nakhon Sawan, and the lower Bang Pakong in Chachoengsao. The IUCN Red List Assessment reports additional occurrences in the Nan River, and possibly as far north on the Mekong as Chiang Khong [9]. The Maeklong may support the largest population of giant freshwater whipray in Thailand as studies report larger sample sizes from this river versus other Thai rivers [21,23], and multiple news reports and social media posts document captures of this species in the Maeklong [24–26]. Additionally, an unpublished telemetry study in the Maeklong in 2018 documented 22 individuals, with disc widths ranging from 72–206 cm, weights ranging from 13–105 kg, and relatively even ratios of sex and life stage (Zeb Hogan, unpublished data). A large individual captured in the Maeklong in 2009 may be seen in Figure 1c.

As previously described, Sezaki et al. [14] determined that Thai specimens from the Chao Phraya were genetically distinct from a Ganges River, India specimen, suggesting different lineages within the species. Khudamrongsawat et al. [21] evaluated the genetic diversity of specimens from the Maeklong, Chao Phraya, and Bang Pakong rivers, which represent hydrologically distinct river basins. They found low diversity among rivers and in general, suggesting recent or ongoing dispersal events, possibly via seasonal connections among river basins, as well as broader effects of population decline.

Phomikong et al. [23] calculated growth rates from specimens from the Maeklong and Chao Phraya rivers, and found an estimated size at birth of 28 cm disc width with slower individual growth rates in the Maeklong compared to individuals in the Chao Phraya.

Although in need of updating, the IUCN Red List Assessment for the population in Thailand (last updated in 2000) listed the giant freshwater whipray as critically endangered [49]. Fisher reports of catches of this species suggested an 88% population decline between 1992 and 1993 [27]. Threats to this species in Thailand include artisanal fisheries, environmental degradation, habitat fragmentation, and altered flow regimes resulting from dam construction and operation [50].

2.5. Lao PDR

Very little is written about the giant freshwater whipray in Lao PDR, and all reports are from the southern part of the country, particularly in the Khone Falls area near the Lao PDR-Cambodia border. Roberts and Baird [28] described observations made during 1993–1995 of fishers using large hooks baited with medium-sized fishes to catch giant freshwater whipray in deep pools above Khone Falls. In 2014, Gray et al. [29] interviewed fishers from the Siphandone wetlands—a mosaic of islands and channels around the Khone Falls on or alongside the Mekong in Khong and Mounlapamok districts of Champasak Province. Their interview results suggested that, although giant freshwater whiprays were still caught semi-regularly (approximately once per month), they were relatively rare (mean date of last capture was 25 months before the survey) and their population was in steep decline, having changed in perception from uncommon to possibly extirpated over the previous twenty years [29].

One news article documented a fisher report of a 310 kg giant freshwater stingray (species identity not confirmed) from a remote village in Champasak Province, southern Lao PDR in 2011 [30], suggesting that large individuals were present in Lao PDR until recently. The most recent report found from Lao PDR was a social media post in 2020

documenting the capture of a giant freshwater stingray (species identify not confirmed) in Champasak Province [31].

Additional unpublished information suggests that giant freshwater whiprays are considered uncommon in Lao PDR, and are caught mostly in central to southern parts of the country (Sinsamout Onboundisane, pers. comm.). The species' preferred habitat appears to be wide river areas with sandbars, vegetation, and deep pools in close proximity to each other. The species is usually captured as bycatch in large mesh gill nets or on hook and line targeting other large species. However, a survey of fishers in Khong District in 2021 revealed that some fishers target the species when they notice the whipray's tracks in the sand on sandbars or individuals coming to shore to eat earthworms in the early rainy season. When individuals are captured, they usually become mortalities due to fighting as they are pulled to shore. Fishers can get 200–350 Thai baht (5.83–10.20 USD) per kilogram when selling the meat to restaurants or middlemen. Captures in the last decade include a 240 kg individual in Khammouane Province in 2016 and two individuals, one weighing 60 kg and the other with an unknown weight, in Champasak Province in 2020 (Sinsamout Onboundisane, pers. comm.).

2.6. Cambodia

Cambodia is another country where very little has been published on the giant freshwater whipray, but recent captures in May and June 2022 (Figure 1a,b) [2,32], including the record-breaking 300 kg specimen [2], suggest that Cambodia may contain good habitat for this species. In total, five females, including three large individuals, were captured during this time period in Stung Treng Province, northeastern Cambodia. Their body sizes ranged from 39 to 220 cm disc width and 3 to 300 kg (Zeb Hogan, unpublished data). A fisher reported that one of the large females had four pups that appeared to emerge from the spiracle (Zeb Hogan, pers. comm.). Despite these recent captures, fishers perceive the population to be in decline [9,13]. The IUCN Red List assessment reports a population decline of 62% from 1980 to 2006, with a 50–95% decline in the lower Cambodian Mekong and a 30–50% decline in the upper Cambodian Mekong [9]. Campbell et al. [13] documented fisher perceptions of the species' status in the northern Cambodian Mekong through interviews conducted in 2018. Fishers reported population declines over the previous 20 years, but the species was considered uncommon rather than rare or extirpated, indicating it was still being captured with some regularity. Fishers also reported declines in the body size of individuals captured. It was best known from deep pool areas of the mainstem Mekong in Stung Treng and Kratie provinces (northeastern Cambodia). The fishers associated these declines primarily with illegal and destructive fishing practices, such as electrofishing [13]. This area may be ecologically significant for this species as all recent captures were from there and another large individual was captured in the area in 2008 [24].

Less is known about the species from the southern Cambodian Mekong. In a report published in 2004 by the Southeast Asian Fisheries Development Center, Try et al. [33] documented stories of shark and ray captures in Cambodia. They reported giant freshwater whiprays captured in 1999 and 2000 weighing 18 and 180 kg, respectively, from Prey Veng Province, which is downstream of Phnom Penh in southern Cambodia [33]. Another large individual with a disc width of 202 cm was captured in Prey Veng Province in 2002 (Figure 1d; Zeb Hogan, pers. comm.).

A workshop hosted by the Wonders of the Mekong Project, a Cambodia-based research, conservation, and development program, was held in August 2022 to compile and share information about the giant freshwater whipray in Cambodia. Participants included officials and biologists from the Cambodian Fisheries Administration as well as commune chiefs, community fisheries representatives, fishers, and local and international organizations. Fishers from certain locales reported declines in catches of this species, sometimes reporting that they no longer caught it, whereas fishers from other areas reported still regularly capturing it (as often as once per month). Some reported capturing large individuals, whereas others reported only ever catching small ones. However, small individuals are

often confused with similar-looking species, so their identity may be uncertain. When whiprays were caught, they were normally eaten or sold. One fisher told of a 350-kg individual that was recently sold for approximately 2.50 USD per kg. Participants identified the whipray's primary habitat as deep pools with soft, sandy, or muddy bottoms, and some specific deep pools were identified as being more likely to produce this species. These pools were all in the northern Cambodian Mekong, probably because the survey respondents lived and fished in this region. Fishers noted that this species is primarily caught using baited hooks and gill nets between January and June, which corresponds with the lowest river levels during the dry season (January through May). Workshop participants identified various threats to the species, including land use changes, chemical pollution, fishing pressure, and altered flow caused by upstream dams, which agrees with the findings of Campbell et al. [13]. Noted data needs included identifying and understanding critical habitats, reproductive biology, breeding season, feeding behavior, and migration patterns.

Additional unpublished information provided by Heng Kong (pers. comm.) indicates that the giant freshwater whipray is often found in shallow, flat sandbars, which agrees with the observation that fishers in Thailand sometimes target the species in these habitats (see Section 2.5). Research is needed to understand the seasonal and daily uses of deep pools versus shallow sandbar habitats by this species. For example, giant freshwater whipray may utilize deep pools more during the day or the dry season for cover or thermal refugia and utilize shallow sandbars more during the evenings or during the rainy season when it is cooler and there is more of this habitat available (Heng Kong, pers. comm.).

2.7. Vietnam

Although the IUCN Red List assessment names Vietnam as a country in which the giant freshwater whipray occurs [9], we were unable to find any specific reports of this species from Vietnam. A list of Vietnam fishes from 1974 excluded this species [51], and general descriptions of the species' range in more recent publications do not include occurrences from Vietnam (e.g., [5,50,52]). However, its presence in Vietnam is likely considering it has been documented from the Mekong River in southern Cambodia [33]. Furthermore, if saline environments are an important component of the giant freshwater whipray's lifecycle, then Vietnam is the only country in the Mekong River Basin where this habitat type occurs.

2.8. Malaysia

Recent research has expanded the known range and ecology of giant freshwater whipray in Malaysia [10,12,34]. Occurrences of giant freshwater whipray have been documented in Malaysian Borneo since at least the late 1990s [35], but only recently from Peninsular Malaysia [34]; although, Chong et al. [36] described a fisher account of its occurrence in the Endau River basin (eastern Peninsular Malaysia) and the IUCN Red List assessment describes a personal communication identifying the species in the Sembrong River (western Peninsular Malaysia) [9]. Iqbal et al. [34], using internet and social media searches, found seven catch reports with sufficient evidence to support its identity as the giant freshwater whipray in Peninsular Malaysia. The reports were made between 2012 and 2019 in five distinct coastal areas along both coastlines. Body weights ranged from 41 kg to approximately 300 kg [34].

In Malaysian Borneo, the IUCN Red List assessment describes the giant freshwater whipray as occurring in most of the rivers in Sabah and Sarawat [9]. Individuals have been documented from the Buket River [35] and the Kinabatangan River and its tributaries in northeast Sabah [36–38]. Using the same internet and social media search process as Iqbal et al. [34] (described above), Windusari et al. [12] updated the Malaysian Borneo distribution to include numerous coastal and inland locations within Sarawak and Sabah. They also documented occurrences throughout the rest of Borneo (Indonesia and Brunei Darussalam) [12]. The observations throughout Borneo included records between 2011 and 2018, with body weights ranging from 82 to 500 kg. The largest individual was a female

captured in 2015 in Sabah; its weight of 500 kg may make it the largest known specimen of this species, but as it was reported only through a social media post, the weight cannot be verified. The authors noted seasonality to where species were documented: in estuaries in almost all months, tidal reaches from February to November, and freshwater non-tidal areas from May to October [12].

The most recent published occurrences for Malaysia by Then et al. in 2022 [10] included two direct encounters through field surveys that confirmed the species' presence in Sarawak and Sabah, as well as four public wildlife sightings that expanded the known distribution in Peninsular Malaysia, Sarawak, and Sabah. The authors' search of online news and social media reports yielded 29 confirmed captures from 2014 to 2022 across Malaysia. Adding these to the reports published by [12,34,38,39] brought the total reported captures of giant freshwater whipray in Malaysia to 61 between 2011 and 2022 [10]. Then et al. [10] noted that most individuals were captured with bottom trawls and hook and line.

Then et al. [10] also described biological, ecological, and genetic information of giant freshwater whipray in Malaysia. The rivers in which specimens were caught were characterized by clean or only slightly polluted water and sandy or sandy-silty substrates. Body weights ranged from 16 to 500 kg, with females generally larger than males in weight and disc width. One of Then et al.'s [10] direct survey encounters was a female from Sarawak with four pups, the size of which ranged from 37 to 43 cm disc width. The other was a male from Sabah. As these individuals were found for sale at markets already dead, the authors took genetic samples, the analysis of which suggested two clades within the species: one from the Gulf of Thailand and Malaysian Borneo, and the other from Bangladesh, India, and Indonesia [10].

The only other published work on the species in Malaysia was a number of parasitology studies conducted on specimens from the Kinabatangan River that found the giant freshwater whipray hosted a diversity of parasites [37,40,41].

The giant freshwater whipray is likely highly threatened in Malaysia [9]. Chong et al. [36] identified habitat loss, overharvest, by-catch, dams, pollution, and endemicity as significant threats. Pollution and bottom trawls may be particularly significant to this species in Malaysia given its association with clean water and the high number of individuals captured by trawls [10]. Booth et al. [39] documented a large market for elasmobranchs in Sarawak, with over 26,500 individuals worth 125,000 USD traded annually.

2.9. Brunei Darussalam

Almost nothing is known about the giant freshwater whipray from Brunei Darussalam. The only documentation found for the species in this country was the recent update on its distribution in Borneo by Windusari et al. in 2020 [12]. As described above, the authors confirmed reports of the species from the internet and social media, and found one valid report in Brunei Darussalam. The occurrence was in Danau, Kampung Penapar, Telisai coastal village, Tutong district on 20 September 2011. The individual weighed 200 kg and was reported on Facebook. Windusari et al. [12] note that this is the first confirmed record for Brunai Darussalam, and based on the results of our search it may be the only confirmed record in that country to date. In their 2005 book *Sharks and Rays of Malaysia and Brunei Darussalam*, Yano et al. [35] did not mention its presence in the country. In 2018, Sulaiman et al. [53] built a checklist of freshwater species from Brunai Darussalam, but only included bony fishes, which excludes the giant freshwater whipray.

Although information on the freshwater whipray in Brunei Darussalam is scarce, information on its biology and ecology from Malaysian and Indonesian Borneo likely applies to the population in Brunei Darussalam due to its geographic proximity. See descriptions in Sections 2.8 and 2.10 for known information on the species from these countries.

2.10. Indonesia

The holotype of the giant freshwater whipray described by Bleeker in 1852 was a juvenile collected in Java, Indonesia [3]. According to the IUCN Red List assessment,

unpublished data document two more occurrences from Java—one in the Citarum River and one from coastal Palabuhanratu [9]. Occurrences are also documented from Sumatra and Kalimantan [12,42–44]. A nearly 400 kg individual was captured by a fisher in 2016 at the mouth of the Bungin River in south Sumatra [45]. Other occurrences in Sumatra were documented by multiple authors [42–44], who compiled reports supported with photographs and other evidence from local newspapers, the internet, social media, and interviews with local people. This produced 27 confirmed reports of the giant freshwater whipray in numerous estuaries and rivers throughout southern Sumatra between 2008 and 2019. These occurrences ranged from the coast to 200 km inland and had body weights ranging from 35 to 350 kg [42,43]. For Kalimantan, similar news and social media reports were compiled, yielding occurrences in numerous rivers and estuaries up to 200 km inland with body weights ranging from 100 to 200 kg [12,43]. Additionally, a museum specimen at the California Academy of Sciences was collected from the Mahakam basin in Kalimantan in 1984 [1], and two females were purchased by Jensen and Guyer [41] in 2008 from the Pasar Beringin fish market in North Kalamantan for parasitology research. Notes on the ecology of the giant freshwater whipray in Borneo were compiled by Windusari et al. [12], and a summary can be found in Section 2.8.

The giant freshwater whipray in Indonesia is thought to be highly threatened due to habitat degradation, pollution, and high fishing pressure [46]. Indonesia has one of the largest shark and ray fisheries in the world [47]. This species is caught by gill nets, traps, and demersal longline fisheries [46].

3. *Urogymnus dalyensis*

The range of the giant freshwater whipray was thought to include Australia and New Guinea [50] until 2008 when Last and Manjaji-Matsumoto [3] described individuals from this region as a new species, the freshwater whipray *Urogymnus dalyensis*. Several unique studies have been conducted on the freshwater whipray and, as it is closely related to the giant freshwater whipray [4], we felt that it was worth looking at some of its biological attributes, which may be similar across species.

Similar to the giant freshwater whipray, the freshwater whipray has been shown to be a top predator, grow to large sizes [54], and utilize both estuarine and freshwater habitats [55]. Examination of the freshwater whipray's mechanoreceptive lateral line and electroreceptive ampullary systems revealed more similarities to those of marine species than obligate freshwater species, lending further support to it being euryhaline [56]. Twelve months of monitoring movement patterns in 64 km of the Wenlock River, Australia, showed that movements were influenced by the diel cycle during the wet season and by the tidal and lunar cycles during the dry season [57]. The whiprays tended to stay within a river section less than 8 km in length, but males traveled approximately 60 km downstream to brackish water during the wet season [57].

4. Data Gaps, Emerging Threats, and Steps towards Conservation

Data on the giant freshwater whipray is scarce across its range, and information from research-derived studies is even scarcer. Most of this species' distributional records come from social media and news reports, especially when considering that many academic papers used such records to update known distributions (e.g., [10,12,34]). Relatively more has been published on the species in Thailand, Malaysia, and Indonesia. More work is needed to update the species' distribution throughout the rest of its range, with Vietnam being particularly noteworthy as no records were found from this country. Most of the existing work has been done in the last decade, suggesting that interest in the species is increasing and may lead to more studies and improved understanding of the species' distribution and other knowledge gaps.

More information is needed on the biology, ecology, and spatio-temporal distribution of the giant freshwater whipray in order to generate a clear understanding of its conservation status and conservation and management needs across its range. Specific data

gaps were identified by a number of authors, and included the need for better taxonomic descriptions [16], improved understanding of movement between river systems [34], and identification of breeding grounds, breeding ecology, and reproductive behavior [7]. Information is also needed on the seasonality of movements and residency among inland and coastal habitats, similar to [57], as well as fine-scale habitat use, in particular the use of deep pools versus shallow habitats. A need for training fishers in species identification was also identified, especially in areas where closely-related species (e.g., *Urogymnus granulatus*) may be present [9,58]. Filling these gaps would increase the ability to confirm geographic ranges, identify country-specific conservation statuses, and create effective conservation and management programs that may include seasonal fishing closures or protected habitats (e.g., deep pools).

Key threats to giant freshwater whipray across its range were identified as high fishing pressure, unmanaged artisanal fisheries, lack of legal protection, habitat degradation, pollution, dams, and bottom trawls, among others, e.g., [10,16,36,39,47]. Adams et al. [59] noted that, because of capture-induced parturition, the population-level impact from fishing is likely higher than would be expected from the number of catches alone. This phenomenon has been documented multiple times for giant freshwater whipray [1,59]. The aquarium trade has also been identified as a threat to this species, especially because it does not survive well in aquaria and thus requires continual harvest from the wild [9].

Suggestions for moving towards species conservation include using environmental DNA (eDNA) for rapid detection and monitoring [10] as well as social media and citizen scientist data collection efforts to improve understanding of its range [11]. Haque et al. [16] recommended incorporating all stakeholders into the conservation and management process, reducing fishing pressure and habitat degradation by bottom trawls, improving law enforcement, and increasing capacity in local communities to move towards sustainable fishing practices. In Cambodia, building partnerships that include government, scientists, and communities has yielded many benefits, including increased catch reporting, collection of local ecological knowledge, and even voluntary release of specimens that historically would have been consumed or sold [60]. This has also provided the opportunity to acoustically tag and study the movement patterns of these individuals. We echo the position of Haque et al. [16] that it will take a concerted effort on the part of all stakeholders to significantly improve the understanding and conservation of the giant freshwater whipray across its range.

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References

1. Monkolprasit, S.; Roberts, T.R. *Himantura chaophraya*, a new giant freshwater stingray from Thailand. *Jpn. J. Ichthyol.* **1990**, *37*, 203–208.
2. Millward, A. *Record-Breaking Ray Confirmed as World's Largest Freshwater Fish*; Guinness World Records Limited: London, UK, 2023; p. 2022.
3. Last, P.R.; Manjaji-Matsumoto, B.M. *Himantura dalyensis* sp. nov., a new estuarine whipray (Myliobatoidei: Dasyatidae) from northern Australia. In *Descriptions of New Australian Chondrichthyans: CSIRO Marine and Atmospheric Research Paper*; CSIRO Marine and Atmospheric Research: Hobart, Australia, 2008; Volume 22, pp. 283–291.

4. Last, P.R.; Naylor, G.J.P.; Manjaji-Matsumoto, B.M. A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. *Zootaxa* **2016**, *4139*, 345–368. [CrossRef] [PubMed]
5. Last, P.; Naylor, G.; Séret, B.; White, W.; de Carvalho, M.; Stehmann, M. *Rays of the World*; CSIRO Publishing: Clayton, Australia, 2016.
6. Rainboth, W.J. *Fishes of the Cambodian Mekong*; Food & Agriculture Org.: Rome, Italy, 1996.
7. Sen, S.; Thomas, S.; Joe Kizhakudan, S.; Dash, G.; Pradhan, R.K.; Ghosh, S.; Das, M.; Dash, B.; Zacharia, P.U. New observations of the endangered giant freshwater whipray, *Urogymnus polylepis*, provide further evidence for its distribution and breeding in the north—East coast of India. *J. Fish Biol.* **2022**, *101*, 1611–1616. [CrossRef] [PubMed]
8. Grant, M.I.; Kyne, P.M.; Simpfendorfer, C.A.; White, W.T.; Chin, A. Categorising use patterns of non-marine environments by elasmobranchs and a review of their extinction risk. *Rev. Fish Biol. Fish.* **2019**, *29*, 689–710. [CrossRef]
9. Grant, I.; Rigby, C.L.; Bin Ali, A.; Fahmi; Haque, A.B.; Hasan, V.; Sayer, C. *Urogymnus polylepis*. In *The IUCN Red List of Threatened Species*, 25 January 2021 ed.; International Union for Conservation of Nature and Natural Resources: Gland, Switzerland, 2021; Volume 2021, p. e.T195320A104294071.
10. Then, A.Y.-H.; Lim, K.C.; Loh, K.-H. Updated distribution of the endangered freshwater stingray *Urogymnus polylepis* in Malaysia, with notes on biology and genetics. *Raffles Bull. Zool.* **2022**, *70*, 534–549.
11. Grant, M.I.; Bicknell, A.W.J.; Htut, T.; Maung, A.; Maung, T.; Myo Myo, K.; Rein, T.; San, M.K.; White, W.T.; Ya, K.Z. Market surveys and social media provide confirmation of the endangered giant freshwater whipray *Urogymnus polylepis* in Myanmar. *J. Fish Biol.* **2022**, *101*, 302–307. [CrossRef]
12. Windusari, Y.; Hanum, L.; Zulkifli, H.; Yustian, I. Contemporary distribution records of the giant freshwater stingray *Urogymnus polylepis* in Borneo (Chondrichthyes: Dasyatidae). *Ichthyol. Explor. Freshw.* **2019**, *29*, 337–342.
13. Campbell, T.; Pin, K.; Ngor, P.B.; Hogan, Z. Conserving Mekong megafishes: Current status and critical threats in Cambodia. *Water* **2020**, *12*, 1820. [CrossRef]
14. Sezaki, K.; Begum, R.A.; Wongrat, P.; Srivastava, M.P.; SriKantha, S.; Kikuchi, K.; Ishihara, H.; Tanaka, S.; Taniuchi, T.; Watabe, S. Molecular phylogeny of Asian freshwater and marine stingrays based on the DNA nucleotide and deduced amino acid sequences of the cytochrome b gene. *Fish. Sci.* **1999**, *65*, 563–570. [CrossRef]
15. Sen, S.; Dash, G.; Kizhakudan, S.J.; Chakraborty, R.D.; Mukherjee, I. New Record of the Giant Freshwater Whipray, *Urogymnus polylepis* from West Bengal Waters, East Coast of India. *Ichthyol. Explor. Freshw.* **2020**, *30*, 91–99.
16. Haque, A.B.; Cavanagh, R.D.; Seddon, N. Evaluating artisanal fishing of globally threatened sharks and rays in the Bay of Bengal, Bangladesh. *PLoS ONE* **2021**, *16*, e0256146. [CrossRef]
17. Kamruzzaman, M. *Stingray Weighing Hundreds of Kilos Caught in Bangladesh*; Anadolu Agency: Ankara, Turkey, 2021.
18. Daily Star. Shapla Pata Maachh. 2011. Available online: https://www.thedailystar.net/news-detail-196743 (accessed on 22 May 2023).
19. Haque, A.B.; Cavanagh, R.D.; Spaet, J.L.Y. Fishers' tales—Impact of artisanal fisheries on threatened sharks and rays in the Bay of Bengal, Bangladesh. *Conserv. Sci. Pract.* **2022**, *4*, e12704. [CrossRef]
20. Psomadakis, P.N.; Thein, H.; Russell, B.C.; Tun, M.T. *Field Identification Guide to the Living Marine Resources of Myanmar*; Food and Agriculture Organization of the United Nations (FAO) and Department of Fisheries, Ministry of Agriculture, Livestock and Irrigation Republic of the Union of Myanmar (MOALI): Rome, Italy, 2019.
21. Khudamrongsawat, J.; Bhummakasikara, T.; Chansue, N. Preliminary study of genetic diversity in the giant freshwater stingray, *Himantura chaophraya* (Batoidea: Dasyatidae) from the remnant populations in Thailand. *Trop. Nat. Hist.* **2017**, *17*, 53–58.
22. Bhummakasikara, T.; Kongrit, C.; Siripunkaw, C.; Chansue, N.; Khudamrongsawat, J. Development of microsatellite DNA primers for the giant freshwater stingray, *Himantura chaophraya* (Batoidea: Dasyatidae) in Thailand, and cross-species amplification in other stingrays. *Conserv. Genet. Resour.* **2013**, *5*, 453–455. [CrossRef]
23. Phomikong, P.; Seehirunwong, S.; Jutagate, T. A preliminary estimate of age and growth of two populations of dasyatid stingray *Urogymnus polylepis* in Thailand. *J. Fish. Environ.* **2019**, *43*, 43–54.
24. Howard, B.C. *Car-Size Stingray May Be World's Largest Freshwater Fish*; National Geographic: Washington, DC, USA, 2015.
25. Howard, B.C. *70 Car-Size Stingrays Die Mysteriously*; National Geographic: Washington, DC, USA, 2016.
26. Catfish World by Yuri Grisendi. Monster Giant Freshwater Stingray Record 530 lbs. YouTube. 2017. Available online: https://www.youtube.com/watch?v=zezxJ9xJiuA (accessed on 22 May 2023).
27. Cook, S.F.; Compagno, L.J.V. Preliminary Thailand field trip notes: November–December 1993. *Chondros* **1994**, *5*, 8–13.
28. Roberts, T.R.; Baird, I.G. Traditional fisheries and fish ecology on the Mekong River at Khone Waterfalls in southern Laos. *Nat. Hist. Bull. Siam Soc.* **1995**, *43*, 219–262.
29. Gray, T.N.E.; Phommachak, A.; Vannachomchan, K.; Guegan, F. Using local ecological knowledge to monitor threatened Mekong megafauna in Lao PDR. *PLoS ONE* **2017**, *12*, e0183247. [CrossRef]
30. Thammavongsa, P. 310 kg Freshwater Stingray caught in Mekong River. In *Vientiane Times*; Shark Year Magazine: Yarmouth, NS, Canada, 2011.
31. Radio Free Asia. Lao Fishermen Catch Giant Stingray. Facebook. 2020. Available online: https://www.facebook.com/RFAEnglish/videos/lao-fishermen-catch-giant-stingray/365433141481087/ (accessed on 22 May 2023).
32. Bittel, J. Watch a Giant Stingray's Safe Return to Its River Home. In *The New York Times*; The New York Times Company: New York, NY, USA, 2022.

33. Try, I.; Jensen, K.R.; Sereywath, P.; Longdy, V. Shark and ray fisheries in Cambodia: A review of national management activities. *Fish People* **2004**, *2*, 24–31.
34. Iqbal, M.; Yustian, I.; Setiawan, A.; Nurnawati, E.; Zulkifli, H. Filling a gap on the blank distribution of the giant freshwater stingray *Urogymnus polylepis*: First records in Malay Peninsula (Chondrichthyes: Dasyatidae). *Ichthyol. Explor. Freshw.* **2020**, *1112*, 1–4.
35. Yano, K.; Ahmad, A.; Gambang, A.C.; Idris, A.H.; Solahuddin, A.R.; Aznan, Z. *Sharks and rays of Malaysia and Brunei Darussalam*; SEAFDEC/MFRDMD: Kuala Terengganu, Malaysia, 2005.
36. Chong, V.C.; Lee, P.K.Y.; Lau, C.M. Diversity, extinction risk and conservation of Malaysian fishes. *J. Fish Biol.* **2010**, *76*, 2009–2066. [CrossRef] [PubMed]
37. Fyler, C.A.; Caira, J.N. Five new species of Acanthobothrium (Tetraphyllidea: Onchobothriidae) from the freshwater stingray *Himantura chaophraya* (Batoidea: Dasyatidae) in Malaysian Borneo. *J. Parasitol.* **2006**, *92*, 105–125. [CrossRef] [PubMed]
38. Manjaji-Matsumoto, B.M.; Kyne, P.M.; Yee, J.C.; Dickson, A.F. Tagging and monitoring of coastal marine and freshwater elasmobranch population in Sabah. In *WWF Malaysia Project Report (Shark Protection—Marine Programme; Project Number MA010311-000-GENF/ UMS Project Code GL00138)*; WWF-Malaysia Marine Programme: Petaling Jaya, Selangor, 2017; p. 50. Available online: https://researchers.cdu.edu.au/en/publications/tagging-and-monitoring-of-coastal-marine-and-freshwater-elasmobra (accessed on 22 May 2023).
39. Booth, H.; Chaya, F.; Ng, S.; Tan, V.; Rao, M.; Teepol, B.; Matthews, E.; Lim, A.; Gumal, M. Elasmobranch fishing and trade in Sarawak, Malaysia, with implications for management. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2021**, *31*, 3056–3071. [CrossRef]
40. Healy, C.J. Three new species of Rhinebothrium (Cestoda: Tetraphyllidea) from the freshwater whipray, *Himantura chaophraya*, in Malaysian Borneo. *J. Parasitol.* **2006**, *92*, 364–374. [CrossRef] [PubMed]
41. Jensen, K.; Guyer, R. First Report of Lecanicephalidean Tapeworms (Eucestoda) from Freshwater, Including Description of Three New Species of Tetragonocephalum. *J. Parasitol.* **2021**, *107*, 1–15. [CrossRef]
42. Iqbal, M.; Yustian, I. Occurrence of the giant freshwater stingray *Urogymnus polylepis* in Sumatra, Indonesia (Chondrichthyes: Dasyatidae). *Ichthyol. Explor. Freshw.* **2016**, *27*, 333–336.
43. Iqbal, M.; Setiawan, A.; Windusari, Y.; Yustian, I.; Zulkifli, H. Updating Status of the Distributional Records of Giant Freshwater Stingray *Urogymnus Polylepis* (Bleeker, 1852) in Indonesia. 2020, p. 020004. Available online: https://www.researchgate.net/publication/344292386_Updating_Status_of_The_Distributional_Records_of_Giant_Freshwater_Stingray_Urogymnus_polylepis_Bleeker_1852_in_Indonesia (accessed on 22 May 2023).
44. Iqbal, M.; Zulkifli, H.; Yustian, I. The valid species and distribution of stingrays (Myliobatiformes: Dasyatidae) in south Sumatra waters, Indonesia. *BIOVALENTIA Biol. Res. J.* **2018**, *4*, 12–20. [CrossRef]
45. Lovgren, S. *This Giant Stingray Could Be World's Biggest Freshwater Fish*; National Geographic: Washington, DC, USA, 2019.
46. Fahmi, D. Some Rare and Endemic Elasmobranchs of Indonesia and Their Conservation Status. 2013, pp. 87–97. Available online: https://repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/176184/1/12thseastar_087.pdf (accessed on 22 May 2023).
47. Dulvy, N.K.; Simpfendorfer, C.A.; Davidson, L.N.K.; Fordham, S.V.; Bräutigam, A.; Sant, G.; Welch, D.J. Challenges and priorities in shark and ray conservation. *Curr. Biol.* **2017**, *27*, R565–R572. [CrossRef]
48. Howard, R.; Ahmad, A.; Shein, U. *Shark and Ray Fisheries of Myanmar–Status and Socio-Economic Importance*. Report. 2015. Available online: https://lighthouse-foundation.org/Binaries/Binary1080/TCP-Report-12-SHARK-AND-RAY-FISHERIES-OF-MYANMAR-FINAL.pdf (accessed on 22 May 2023).
49. Compagno, L.J.V.; Cook, S.F. *Urogymnus polylepis* (Thailand subpopulation). In *The IUCN Red List of Threatened Species*; International Union for Conservation of Nature and Natural Resources: Gland, Switzerland, 2000; Volume e.T39408A10228071.
50. Compagno, L.J.V.; Cook, S.F. Giant freshwater stingray or whipray *Himantura chaophraya* Monkolprasit & Roberts, 1990. In *Sharks, Rays and Chimaeras: The Status of Chondrichthyan Fishes*; Fowler, S.L., Cavanagh, R.D., Camhi, M., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A., Musick, J.A., Eds.; IUCN: Gland, Switzerland; Cambridge, UK, 2005; pp. 348–349.
51. Orsi, J.J. A check list of the marine and freshwater fishes of Vietnam. *Publ. Seto Mar. Biol. Lab.* **1974**, *21*, 153–177. [CrossRef]
52. Fowler, S.L.; Reed, T.M.; Dipper, F. Elasmobranch Biodiversity, Conservation and Management. In *Proceedings of the International Seminar and Workshop, Sabah, Malaysia, July 1997*; IUCN: Gland, Switzerland; Cambridge, UK, 2002.
53. Sulaiman, Z.; Hui, T.H.; Lim, K.K.P. Annotated checklist of freshwater fishes from Brunei Darussalam, Borneo. *Zootaxa* **2018**, *4379*, 24–46. [CrossRef]
54. Ebner, B.C.; Morgan, D.L.; Kerezsy, A.; Hardie, S.; Beatty, S.J.; Seymour, J.E.; Donaldson, J.A.; Linke, S.; Peverell, S.; Roberts, D. Enhancing conservation of Australian freshwater ecosystems: Identification of freshwater flagship fishes and relevant target audiences. *Fish Fish.* **2016**, *17*, 1134–1151. [CrossRef]
55. Every, S.; Pethybridge, H.; Fulton, C.; Kyne, P.; Crook, D. Niche metrics suggest euryhaline and coastal elasmobranchs provide trophic connections among marine and freshwater biomes in northern Australia. *Mar. Ecol. Prog. Ser.* **2017**, *565196*, 181–196. [CrossRef]
56. Marzullo, T.A.; Wueringer, B.E.; Jnr, L.S.; Collin, S.P. Description of the mechanoreceptive lateral line and electroreceptive ampullary systems in the freshwater whipray, *Himantura dalyensis*. *Mar. Freshw. Res.* **2011**, *62*, 771–779. [CrossRef]
57. Campbell, H.A.; Hewitt, M.; Watts, M.E.; Peverell, S.; Franklin, C.E. Short-and long-term movement patterns in the freshwater whipray (*Himantura dalyensis*) determined by the signal processing of passive acoustic telemetry data. *Mar. Freshw. Res.* **2012**, *63*, 341–350. [CrossRef]

58. Fishbase. *Urogymnus granulatus (Macleay, 1883), Mangrove Whipray*; Fishbase: Los Baños, Laguna, Philippines, 2023.
59. Adams, K.R.; Fetterplace, L.C.; Davis, A.R.; Taylor, M.D.; Knott, N.A. Sharks, rays and abortion: The prevalence of capture-induced parturition in elasmobranchs. *Biol. Conserv.* **2018**, *217*, 11–27. [CrossRef]
60. Eschenroeder, J. *Building Partnerships with Local Communities in Study of Mekong Fish Movement*; Canadian Science Publishing: Ottawa, ON, Canada, 2022; Volume 2023.