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Ridwan S <ridwansala@gmail.com>

[IK.IJMS] [ID-43052] Revised Version Acknowledgement

Ambariyanto <ijms@live.undip.ac.id> Sun, May 8, 2022 at 11:01 AM
Reply-To: "Dr. Ridwan Sala" <ridwansala@gmail.com>
To: "Dr. Ridwan Sala" <ridwansala@gmail.com>

Dr. Ridwan Sala:

Thank you for submitting the revision of manuscript, "Walking Sharks (Hemiscyllium galei) in Doreri Bay Manokwari, Indonesia" to ILMU KELAUTAN: Indonesian Journal of Marine Sciences. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Manuscript URL: https://ejournal.undip.ac.id/index.php/ijms/author/submission/43052
Username: ridwansala
Editor: Indonesian Journal of Marine Science

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Ambariyanto
ILMU KELAUTAN: Indonesian Journal of Marine Sciences

INDONESIAN JOURNAL OF MARINE SCIENCE
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Ridwan S <ridwansala@gmail.com>

[IK.IJMS] Editor Decision - Reviewer C

Indonesian Journal of Marine Science <ijms.undip@gmail.com> Sat, Jan 22, 2022 at 11:55 AM
Reply-To: Indonesian Journal of Marine Science <ijms.undip@gmail.com>
To: "Dr. Ridwan Sala" <ridwansala@gmail.com>

Dr. Ridwan Sala:

We have reached a decision regarding your submission to ILMU KELAUTAN: Indonesian Journal of Marine Sciences, "Walking Sharks (Hemiscyllium galei) in Doreri Bay Manokwari, Indonesia".

Our decision is to:
Major Revision

However, if you feel that you can suitably address the reviewers' comments (included below), I invite you to revise and resubmit your manuscript on (or) before February 4, 2022 .

Indonesian Journal of Marine Science
ijms.undip@gmail.com

Reviewer C:

the references satisfactory?

Missing two important papers to strengthen discussion session of the paper:

- Wheeler, C.R., Rummer, J.L., Bailey, B., Lockwood, J., Vance, S. and Mandelman, J.W., 2021. Future thermal regimes for epaulette sharks (Hemiscyllium ocellatum): growth and metabolic performance cease to be optimal. Scientific reports, 11(1), pp.1-12.

- Tiga alasan kenapa pemerintah Indonesia harus melindungi hiu berjalan “kalabia” Papua RF Tapilatu: https://theconversation.com/tiga-alasan-kenapa-pemerintah-indonesia-harus-melindungi-hiu-berjalan-kalabia-papua-155051

incorrect grammars and typos would lead to misleading and misinterpretation.

Need to specify as the title focused on a few aspects of Bio-ecology

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Ridwan S <ridwansala@gmail.com>

[IK.IJMS] Proof Layout - 43052

Ilmu Kelautan <ijms.undip@gmail.com> Wed, Sep 7, 2022 at 4:10 PM
To: Ridwan Sala <ridwansala@gmail.com>

Dear
Ridwan Sala
Department of Marine Science, Faculty of Fishery and Marine Science, University of Papua

Please check the manuscript proof. Utilize the file contained in this email attachment to make necessary corrections to the manuscript.

Send the cost of publication (Rp. 2.500.000,-) to Widianingsih
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Manuscript revise and proof of payment are sent before September 10, 2022 to publish the manuscript in September 2022.

Thank you for your contribution to this journal.

Sincerely
IJMS Editor

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[IK.IJMS] [43052] Article Publication of IK.IJMS-2021-43052

1 message

Indonesian Journal of Marine Science <ijms.undip@gmail.com> Mon, Sep 19, 2022 at 1:52 PM
Reply-To: Indonesian Journal of Marine Science <ijms.undip@gmail.com>
To: "Dr. Ridwan Sala" <ridwansala@gmail.com>
Cc: Muhammad Fadil Insani <fadhilinzani21@gmail.com>, Duaitd Kolibongso <d.kolibongso@unipa.ac.id>

Dear Muhammad Fadil Insani, Ridwan Sala, Duaitd Kolibongso,

As co-author of the article entitled "Some Aspects of Bio-ecology of Walking Shark (Hemiscyllium galei) in Doreri Bay, Manokwari, Indonesia", we are pleased to let you know that the final open access version, containing full bibliographic details, is now available online.

The URL below is a quick and easy way to share your work with colleagues, other co-authors, and friends. Anyone clicking on the link will be taken directly to the final version of your article on the ILMU KELAUTAN: Indonesian Journal of Marine Sciences website (https://ejournal.undip.ac.id/index.php/ijms).

Your article link: https://ejournal.undip.ac.id/index.php/ijms/article/view/43052
DOI: 10.14710/ik.ijms.27.3.279-284

You can also use this link to download a copy of the article for your own archive. It also provides a quick and easy way to share your work with colleagues, co-authors, and friends. And you are welcome to add it to your homepage or social media profiles, such as Facebook, Google+, and Twitter.

Kind regards,

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Some Aspects of Bio-ecology of Walking Shark (*Hemiscyllium galei*) in Doreri Bay, Manokwari, Indonesia

~~Walking Sharks (*Hemiscyllium galei*) in Doreri Doreh Bay Manokwari, Indonesia~~

Complete author names
Afiifliaton
Addres
Email Corresponding author

Abstract

Walking sharks ~~is an~~are endemic ~~species~~ to the New Guinea-Australian region, inhabiting ~~found in~~ shallow reef ecosystems ~~and seagrass beds~~. In Papuan waters there are four species of walking sharks, ~~one of which is~~including *Hemiscyllium galei*. This research ~~was conducted to explore~~investigated ~~the~~ ecological and biological aspects of *H. galei* in ~~Dorery~~ Doreri~~h~~ Bay near Manokwari, West Papua Province. The samples used in this study were collected from two locations in the waters of ~~Doreri~~ Dore~~h~~ri Bay, namely the islands of Nusmapi and Arowi between September and November 2020. This research was conducted using underwater visual census (UVC) during night time. ~~The o~~Observations were ~~conducted~~ made at two locations covering a total area 9,000 m^2. A total of 10 individuals of *H. galei* were collected during the study and morphometric parameters were measured including total length, ~~(TL),~~ precaudal-fin length~~standard length, (SL),~~ head length ~~(HL)~~, and body weight ~~(BW)~~. ~~Once the necessary measurement were obtained~~After measurements were taken, all individual sharks were safely released back into their habitat ~~safely~~. ~~A L~~linear regression ~~equation was used for estimating the growth model of *H. galei*. The von Bertalanffy equation was used for estimating the growth model of *H. galei*.~~ Morphometric measurements showed the total length of individual walking sharks obtained was no more than 75 cm for male and female ~~species~~individuals. The abundance estimates of *H. galei* ~~in~~ at Arowi and Nusmapi were 13,33 ind.ha^{-1} and 8,88 ind.ha^{-1} respectively. Analysis of length-~~weigth~~ weight relationship showed a negative allometric growth pattern, where body length growth was faster than weight gain. ~~The growth model of van Bertalanffy for this species is $L_t = 68.60 [1 - e^{-0.51 (t-0.25)}]$ with value of K = 0,51, which explains~~indicating that the *H. galei* ~~in the waters of Doreri Bay had a medium to fast growth rate.~~

Keywords: *Hemiscyllium galei,* length-weigth relationship, growth, endemic species

Introduction

Indonesia ~~has been~~is known ~~to have a very high diversity of species~~for its exceedingly rich marine biodiversity, located in the heart of the Coral Triangle region of southeastern Asia. ~~due to the geographical location is in the center of marine biodiversity (i.e world of coral triangle).~~ It is the home of numerous endemic species (Allen & Erdmann, 2012), including several species of walking sharks belonging to the family Hemiscyllidae.~~One of Indonesia's potential endemic resources found in shallow water ecosystems is the walking shark.~~ There are nine species of walking sharks, ~~with~~ including six species ~~spread across several parts of Eastern~~in eastern Indonesia ~~waters~~, ~~with~~ of which four ~~of them were found~~occur in ~~the waters of~~ Papua and West Papua~~,~~: ~~namely~~ *Hemiscyllium henryi, Hemiscyllium strahani, Hemiscyllium galei, and Hemiscyllium freycinet~~t~~i* (Allen *et al*., 2016; Dudgeon *et al.*, 2020).

The Bird's Head Seascape (BHS) which encompasses the West Papuan region is inhabited by three species of walking sharks, including *H. freycineti* (mainly Raja Ampat Islands), *H. henryi* (Triton Bay region), and *H. galei* (Cenderawasih Bay). All three species are considered either vulnerable or endangered by ~~Based on the status from~~ the International Union for Conservation

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Nature (IUCN, 2021), ~~the walking shark type *H. freycinetti* has been on the Red List as near threatened, while the species *H. henryi* and *H. galei* have changed their status from Data Deficient in 2012 to Vulnerable in 2020. The walking sharks in West Papua are distributed in several locations in the Bird's Head Seascape (BHS), with 3 confirmed species (Allen *et al*, 2016; Dudgeon *et al*, 2020). One of them is *H. galei* which is found in the waters of Doreri Bay.~~

H. galei ~~in~~ inhabits coastal ecosystems, including coral reefs and seagrass of ~~Doreri~~ Dore~~h~~ri Bay~~ can be found in coastal ecosystems, coral reefs and seagrass~~. However, ~~ecologically, the~~ coastal ecosystems of Doreri Bay ~~has been~~are degraded due to the increasingly massive development in ~~the~~ coastal areas. This is indicated by the decreasing percentage of coral reef cover (Algutomo, *et al.*, 2022, Dasmasela *et al.*, 2019; Pattiasina *et al.*, 2018). There is ~~a~~ concern that degradation of coral reefs will ~~have an~~directly impact ~~on~~ the population of *H. galei*~~.~~ Nearly all *Hemiscyllium* species have highly localized distributions and are particularly vulnerable to habitat degradation, including pollution and illegal fishing practices (e.g. use of cyanide), and climate change (Jutan *et. al.*, 2018). Their vulnerability is especialy enhanced due to their egg-laying habits and low fecundity, poor swimming ability, and ease of detection by local fishers. ~~**As is known, species from the genus *Hemiscyllium* have limited swimming abilities, move on the bottom of the water using pectoral fins so they are very easy to find, and reproduce by laying eggs in living habitats, making them very vulnerable to various threats such as habitat deg**radation, pollution, fishing practices with using cyanide and climate change (Jutan *et al*, 2018).~~ Furthermore, ~~people sometimes catch~~ these sharks are utilized by humans for ~~consumption~~ food, medicine, and aquarium pets of for display in public aquaria Jutan *et al*., 2018)~~as medicine or sell them as ornamental fish in aquariums.~~

In an effort to conserve and protect the species, information on its ecological and biological aspects ~~is~~ are urgently needed. However, this information is still very limited. The only information regarding this species is reported by Allen *et al.* (2016). Therefore, it is important to conduct this research to support the information needs of this species in the waters of ~~Doreri~~ Dorer~~ih~~ Bay.

.

Materials and Methods

This research was conducted in September - November 2020 in ~~Doreri~~ Dore~~h~~ri Bay, Manokwari. Observations were made at 2 locations in ~~Doreri~~ Dore~~h~~ri Bay, namely Arowi and Nusmapi (Figure 1~~2~~). Observations of *H. galei* were carried out using Underwater Visual Census (UVC) with a total of 16 night dives (between 19:00 and 00:00 Eastern Indonesia Time), which were divided into 8 dives at each locations. The reason for choosing the night time wa~~s~~is because the walking shark is a nocturnal fish so the chances of finding it are greater. ~~T~~The observations in each site were conducted twice in September 2020 and three times in October and November 2020. Ten dives were taken place during high tide and six dives were taken place during low tide.

~~Each dives were carried out twice a week during .~~

The observations were taken along transects of 300 m length with a width of ~~2.5 m to the right and 2.5 to the left~~5 m~~,~~. O~~with o~~bservations were carried out 3 times at each station by two divers. ~~The t~~Transects ~~was~~ were ~~placed~~ located parallel to the shoreline at a depth range of 3 ~~m~~ to 7 m. ~~The *H galei* encountered was~~Specimens were captured by hand, ~~and then~~ placed in a container filled with seawater, and ~~. Then, the sharks were~~ brought ashore for morphological measurements. After the measurements were completed, the sharks were ~~then~~ released back into the water.

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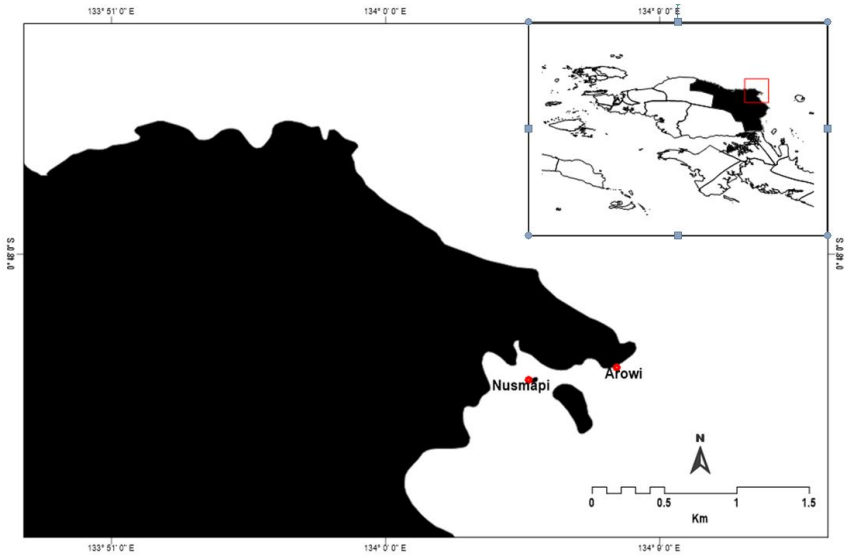

Figure 1. Sample collection sites of *Hemiscyllium galei* in Doreri Bay, Manokwari.

To ensure that the same walking shark was not measured more than once in different dives or time, we conduct identification of each individual based on the observing the shape and size of dark spots on the pectoral fins, which differ between individuals. The blackspot shape on the pectoral fin of walking sharks is a characteristic possessed by each Hemiscyllium individual (Allen et al, 2016). Examples of spot shapes on the pectorals of some walking shark are shown in Figure 2.

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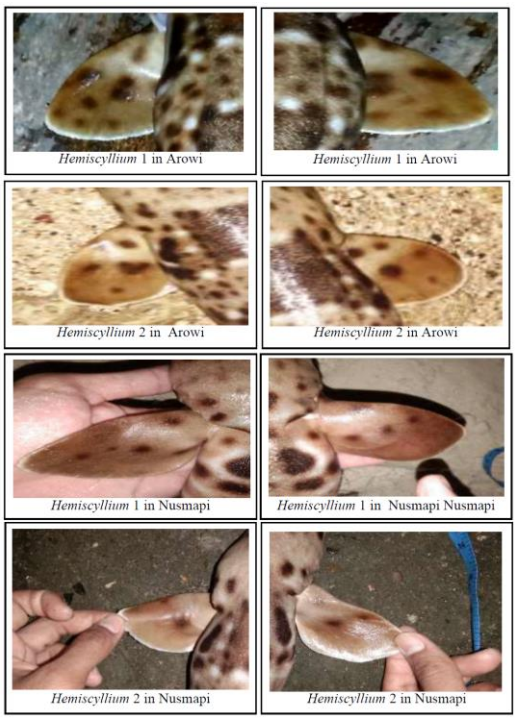
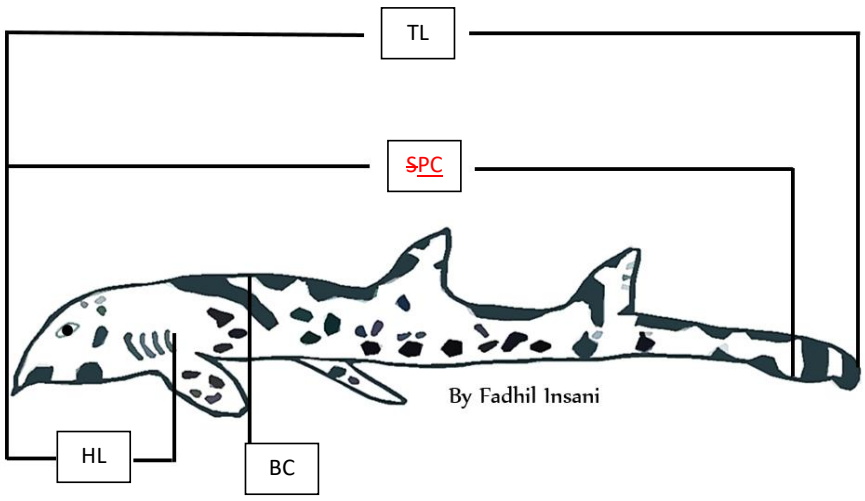


Figure 2. Examples of spot shapes on the pectorals of some walking shark. Photo: Muhammad Fadhil Insani

~~The *H. galei* found were measured their~~Measurements (Figure 3) included total length (TL), precaudal-fin length ~~standard length~~ (PC~~S~~L), head length (HL), body diameter (BC), and body weight (BW) (Omar, 2011). However, BC measurement was performed. ~~The measurement method of the fish is shown in Figure 2.~~ Linear ~~M~~measurements ~~of the shark samples using a measuring board~~ with an accuracy of 0.1 cm, were made on a measuring board and ~~. The fish~~ sharks were weighed using a scale with an accuracy of 0.01 gram.



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Comment [A1]: Standard length is never used for sharks. Instead you should use precaudal-fin length, which is measured from the tip of the snout to the base of the upper caudal-fin lobe.

Figure 3. Method of morphometric measurements of H. galei~~.~~ , showing~~It shows~~ total length (TL), precaudal-fin length~~standard length~~ (~~S~~PCL), head length (HL), and body diameter (BC).

Estimation of abundance of walking shark used formula $D = N_i/A_i$, D denotes density in ind.Ha^{-1}, N_i is number of individuals found in each site, and A is estimates area covered during the dives.

~~The relationship between the number of individuals encountered and environmental parameters was analyzed using the General Linear Model (GLM) with the following equation: **Y = a + b1 x1 +b2 x2 + b3 x3 + b4 x4 + b5 x5 + b6 x6,** where **Y**= number of individuals on each transect, **a** = constant, **b1**-**b6** = coefficient value of oceanographic factors; **x1** = temperature (°C); **x2** = current velocity (m.s^{-1}); **x3** = salinity (psu); **x4** = pH; **x5** = dissolved oxygen (mg.l^{-1}); **x6**= depth (meters). Criteria for significance of the variable follows Ghozali (2011), namely the variable has the effect on the number of walking sharks encountered by the divers when p value ≤ 0.05.~~

Length-weight relationship analysis was carried out to determine growth patterns (Le Cren, 1951 *in* Khouw, 2016). The relationship follows the formula $W = aL^b$, where W = individual weight; L = individual total length; a and b = constant. When the value of b equals 3, it ~~means~~ indicates an isometric growth pattern, and when b ≠ 3, it ~~means~~ shows an allometric growth pattern (negative allometric when b < 3 and positive allometric when b > 3).

~~The von Bertalanffy growth function (VBGF) in FISAT II software was used to estimate growth parameters, such as growth rate (K) and asymptotic length (Linf) following the Powell-Wetherall method (Wetherall *et al*, 1987). Growth parameters to waswere also estimated using empirical equations (Pauly, 1980): Log(-to) = -0.3922 - 0.2752 * log (Linf) - 1.038 log(K).~~

Comment [A2]: Precaudal-fin length (PCL) should be used for sharks rather than SL. In your present diagram the PCL line should intersect the shark's tail about about half-way between the present SL line and the rear edge of the second dorsal fin.

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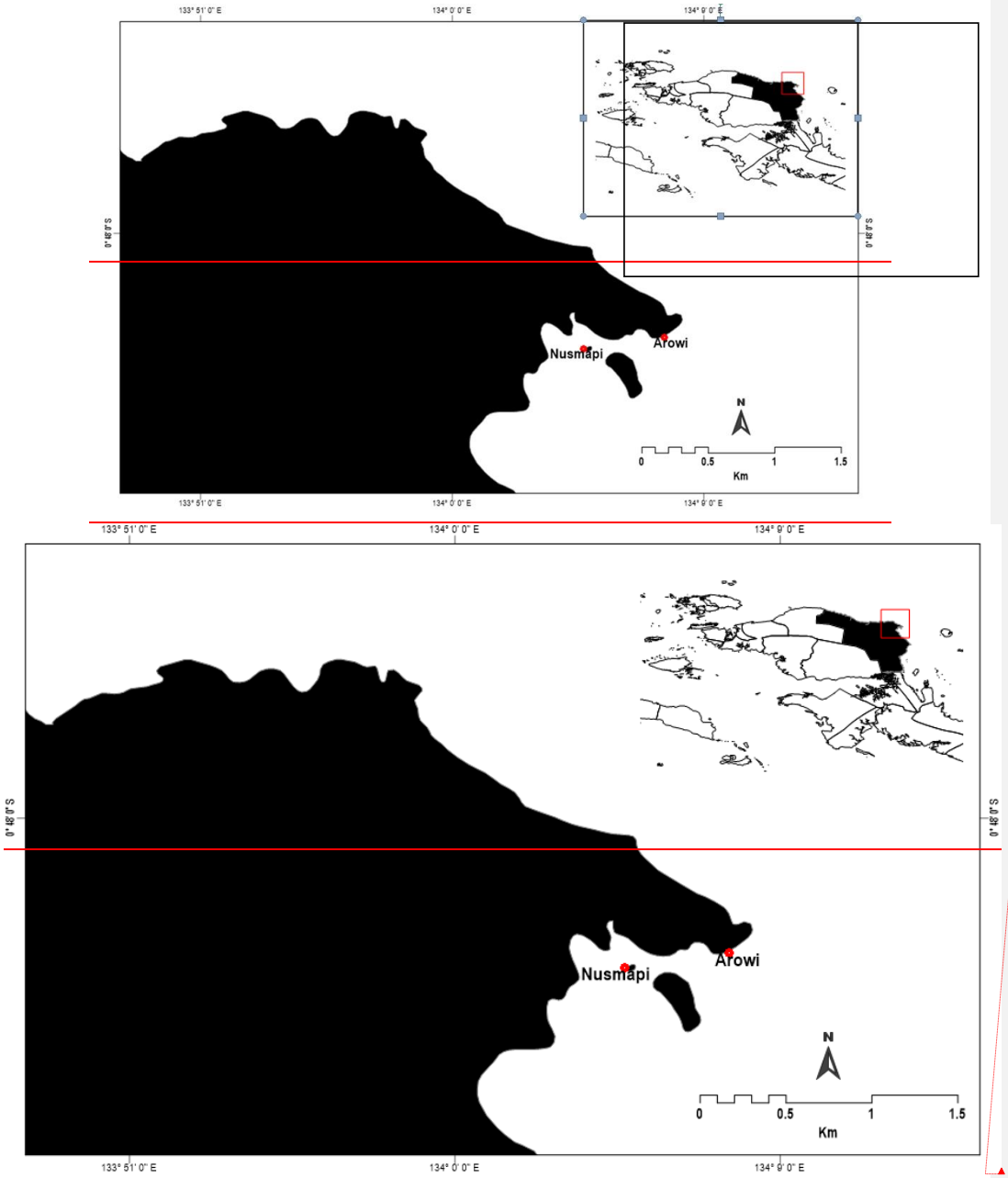

Figure 2. Sample collection sites of *Hemiscyllium galei* in Doreri Dorehri Bay, Manokwari.

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Result and Discussion

Morphological Characteristics

H. galei ~~had~~ has a relatively slender body morphology~~,~~ with two dorsal fins of ~~the same~~similar size. The shape of the mouth ~~was~~ is short and blunt. Other diagnostic features included two or more black spots or saddles on the anterior edge of the dorsal fins, and ~~Based on observations using identification keys, *H. galei* had two or more black spots on the fins. On the body there was~~ a combination of white lines and patches along the body (Figure 4). A detailed description of this species was provided by Allen *et al.* (2016).

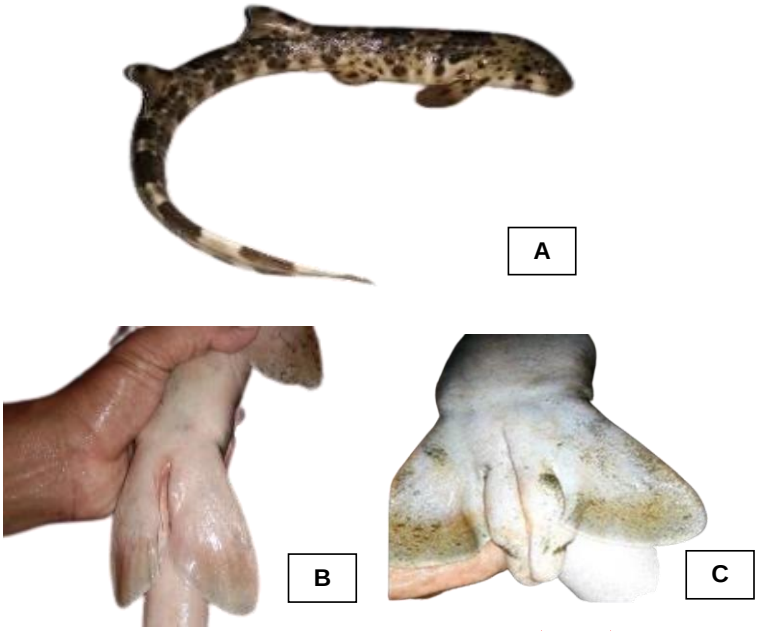

Figure 4. (A) Hemiscyllium galei; (B) Female specimen ~~with~~ showing ~~cloaca~~vent; (C) Male specimen ~~with~~ showing claspers. Photo: Muhammad Fadhil Insani

A total of 7 walking shark individuals were identified as male, while the other 3 individuals were female. Table 1 shows the morphometric measurements for each individual ~~of walking shark~~. The ~~measurement showed the~~ average total length was 67.2 ± 5.4 cm. ~~There was no *H. galei* encountered by the divers has total length more than 75 cm, for both male and female.~~ The largest male was 74 cm TL and the largest female was 72 cm TL.The average size of males tended to be larger than that of the females. Generally, ~~groups of sharks from the genus~~ *Hemiscyllium* sharks have a small body size of no more than 85 cm, with an average total length of about 70 cm ~~at adult size~~ (Heupell *et al.*, 1999; Allen & Erdmann, 2008; Allen, *et al.*, 2013; Widiarto *et al.*, 2020; Maduppa *et al.*, 2020; Mu'min *et al.*, 2021). ~~However,~~ Allen *et al.* (2016) reported that the largest size ~~so far of~~for the genus ~~*Hemiscyllium* belongs to~~is 81.5 cm TL, recorded for *Hemiscyllium henryi* ~~found in Triton Bay, Kaimana with a total length of 81.5 cm~~. In addition, Last and Steven (2009) reported ~~the largest~~a maximum size of 107 cm TL for *Hemiscyllium ocellatum* ~~i.e. 107.0 cm TL in~~ from Australia~~n waters~~, while Janson *et al.*, (2012) and Allen *et al.*, (2016) reported 84.0 cm TL and 65.7 cm TL respectively for the same species.

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Comment [A3]: The cloaca is an internal chamber and its opening is properly known as the vent.

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Table 1. Meristic comparison between *H. galei* male and female~~; TL (total length), SL PCL (precaudal fin lengthstandard length), HL (head length), and BW (body weight)~~

	Females (n = 3) (mean ± SD)	Males (n = 7) (mean ± SD)	All (n = 10) (mean ± SD)
	Females (n = 3) (mean+SD/)	Males (n = 7)	All (n = 10)
TL (cm)	66.3 ± 7.4	67.6 ± 5.1	67.2 ± 5.4
PCL (cm)	55.7 ± 7.1	57.9 ± 5.0	57.3 ± 5.4
HL (cm)	9.5 ± 0.9	9.9 ± 1.3	9.8 ± 1.1
BW (g)	820 ± 269.3	773 ± 121.1	787 ± 162.6

Note: TL (total length), SL (standard length), HL (head length), and BW (body weight).

	~~Females (n = 3) (mean ± SD)~~	~~Males (n = 7) (mean ± SD)~~	~~All (n = 10) (mean ± SD)~~
~~TL (cm)~~	~~66.3 ± 7.4~~	~~67.6 ± 5.1~~	~~67.2 ± 5.4~~
~~SL (cm)~~	~~55.7 ± 7.1~~	~~57.9 ± 5.0~~	~~57.3 ± 5.4~~
~~HL (cm)~~	~~9.5 ± 0.9~~	~~9.9 ± 1.3~~	~~9.8 ± 1.1~~
~~BW (g)~~	~~820 ± 269.3~~	~~773 ± 121.1~~	~~787 ± 162.6~~

Abundance and *habitats* of *H. galei* *and ~~condition of habitats~~*

Observations of *H. galei* were made at two locations in ~~Doreri~~ Dorehri Bay with the total coverage area of 9,000 m^2 (observation area of 4,500 m^2 per location per night). The highest abundance value was at the Arowi, which had a density of 13.33 $ind.ha^{-1}$, while at the Nusmapi Island, the estimated density was 8.88 $ind.ha^{-1}$. The difference in the number of *H. galei* encountered at the two locations ~~might be~~was probably influenced by tidal conditions. ~~Based on~~It was easier to detect individuals of H. galei during high tide; six individuals were found at high tide from a total of 16 dives.~~.~~ Tapilatu (2021) mentioned the low abundance of walking sharks. Likewise, that walking shark occupies only a limited area. Thus the population is very vulnerable to exploitation by humans.

The genus *Hemiscyllium* was commonly found foraging in shallow water of coral reefs and seagrass beds~~ areas for foraging~~. Their foraging activities were influenced by tides and light. Most of the sharks actively forage at night or after dusk (Compagno, ~~2002~~2001; Allen *et al.*, 2013; Bennett *et al*, 2015). ~~Based on the~~Our observations revealed that walking ~~during the UVC, generally~~ sharks were generally found on seabed substrates in the form of ~~living corals~~live coral reefs, ~~sandy corals~~coral patches in sandy areas, or coral ~~faults (rubble)~~rubble. ~~Most of them were found at the seabed substrates in the form of coral faults (rubble)~~ Rubble was the most common substrate type (Table 2).

Table 2. Data collection at two sites with sample ID including meristic of individual *Hemiscyllium galei* which was found at their substrates in each site

Site	Sample ID	TL	PCL	HL	BW	Sex	Substrate types
Arowi	Arowi-01	72	61	10,3	920	F	Sandy corals
Arowi	Arowi-02	70	60	10.2	800	M	Sandy corals
Arowi	Arowi-03	60	51.7	9	565	M	Coral reefs

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Comment [A4]: I suggest that SL be deleted from the table and elsewhere in the manuscript because this measurement is unknown for sharks – see my previous comment.
Comment [A5]: Define what variation was used
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Arowi	Arowi-04	58	47.6	8.6	515	F	Coral rubbles
Arowi	Arowi-05	62	52.4	9.3	670	M	Coral rubbles
Arowi	Arowi-06	71	62.5	10.8	820	M	Coral rubbles
Nusmapi	Nusmapi-01	74	63.2	12	940	M	Coral reefs
Nusmapi	Nusmapi-02	66	54.2	8	785	M	Coral rubbles
Nusmapi	Nusmapi-03	69	58.5	9.8	1085	F	Sandy corals
Nusmapi	Nusmapi-04	70	61.8	10	830	M	Coral rubbles

~~by measuring total length (TL), Standard Length (SL), Head Length (HL), body weight (BW). Length measurement are in centimeters (cm) and weigth in gram (g). Sex (Male = M, Female = F)~~

~~Site~~	~~Sample ID~~	~~TL~~	~~SL~~	~~HL~~	~~BW~~	~~Sex~~	~~Substrates~~
~~Arowi~~	~~Arowi-01~~	~~72~~	~~61~~	~~10,3~~	~~920~~	~~F~~	~~Sandy corals~~
~~Arowi~~	~~Arowi-02~~	~~70~~	~~60~~	~~10.2~~	~~800~~	~~M~~	~~Sandy corals~~
~~Arowi~~	~~Arowi-03~~	~~60~~	~~51.7~~	~~9~~	~~565~~	~~M~~	~~Coral reefs~~
~~Arowi~~	~~Arowi-04~~	~~58~~	~~47.6~~	~~8.6~~	~~515~~	~~F~~	~~Coral faultsrubble~~
~~Arowi~~	~~Arowi-05~~	~~62~~	~~52.4~~	~~9.3~~	~~670~~	~~M~~	~~Coral faultsrubble~~
~~Arowi~~	~~Arowi-06~~	~~71~~	~~62.5~~	~~10.8~~	~~820~~	~~M~~	~~Coral faultsrubble~~
~~Nusmapi~~	~~Nusmapi-01~~	~~74~~	~~63.2~~	~~12~~	~~940~~	~~M~~	~~Coral reefs~~
~~Nusmapi~~	~~Nusmapi-02~~	~~66~~	~~54.2~~	~~8~~	~~785~~	~~M~~	~~Coral faultsrubble~~
~~Nusmapi~~	~~Nusmapi-03~~	~~69~~	~~58.5~~	~~9.8~~	~~1085~~	~~F~~	~~Sandy corals~~
~~Nusmapi~~	~~Nusmapi-04~~	~~70~~	~~61.8~~	~~10~~	~~830~~	~~M~~	~~Coral faultsrubble~~

Note: Total length (TL), precaudal-fin length (PCL~~Standard Length (SL)~~), Head Length (HL), body weight (BW). Length measurements are in centimeters (cm) and weigth in gram (g). Sex (Male = M, Female = F)

Comment [A7]: Coral rubble or just rubble is the preferred term for this substrate.

Oceanographic conditions recorded in each sites shows values as follows. Water temperature of 28.03 -30.06^{o}C, water transparency of 12 – 14 m, current speed of 0.4 – 0.7 ms^{-1}, Salinity of 33 – 36‰, pH of 7.0 – 7.6 and dissolved oxygen of 6.3 – 7.0 mg.L^{-1}. Referring to the environmental quality standard reference issued by the Indonesian Ministry of Environment (Minister of Environment Decree No. 51 of 2004), the water quality at the research sites is classified as good. Thus, it can be said that walking sharks need a good quality aquatic environment to support their lives. There is very limited scientific information regarding environmental impact on walking shark lives. One useful information is a finding that optimum growth of *Hemiscyllium ocellatum* occurs at temperature higher that 27^{o}C and the growth decreases when reach temperature of 31^{o}C (Wheeler *et al*., 2021).

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~~Based on observations, most of the walking sharks wereas encountered at the time when the water starts to rise~~

~~GLM's analysis showed that the physical and chemical variables of the water environment measured, namely including water temperature, pH, dissolved oxygen (DO), salinity, water~~

~~transparenceturbidity, and sea current speed had no significant effect ($p < 0.05$) on the presence of walking sharks at both observation sites. This may be because the environmental variable measurement data was very lacking, and was not done continuously to get daily data that represented daily environmental dynamics in both locations.~~

Comment [A8]: I suggest that this paragraph should be deleted as it states you did not really measure these variables on a regular basis.

Length-weight relationship (LWR) and Growth pattern

LWR analysis of *H. galei* in the waters of ~~Doreri~~ Dorehri Bay is shown in Table 3. The values of the regression coefficients (b) were 2.341 dan 1,257 for the walking shark population in Arowi and Nusmapi respectively. The correlation coefficient (r) for LWR of population of *H. galei* found in Arowi was 0.98 and in Nusmapi was 0.49. Positive r values of LRWs show that the weight increase as the length increases (Walpole, 1995). Based on the b values, it ~~can~~ indicated that *H. galei* in ~~Doreri~~ Doreri h Bay had negative allometric growth, ~~in~~ which ~~explains that~~ indicates the length ~~growth~~ increase is faster than the weight gain. Allometric negative growth patterns found in this study ~~is in~~ agree~~ment~~ with the pattern of growth of *H. halmahera* found in Kao Bay, Halmahera (Jutan *et al.* 2017). In general, the growth pattern of fishes depend~~s~~ on physiological and environmental conditions such as temperature, pH, salinity, geographic location and also biological conditions such as gonadal development and food availability (Froese, 2006).

Table 3. The relationship between length and weight of *H. galei* including number of sampels (n), a and b coefficient, correlation coefficient (r) and growth pattern

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Location	n	a	b	The correlation coefficient (r)	Growth patterns
Arowi	6	0.040	2.341	0.98	Allometric negative
Nusmapi	4	4.295	1.257	0.49	Allometric negative

~~**Population Growth Model**~~

~~The estimation of the growth model of *H. galei* was analyzed based on the von Bertalanffy equation, in which was obtained asymptotic length (L_{inf}) of 68.60 cm and growth rate coefficient (K) of 0.51 year^{-1} were obtained. The theoretical value of t_o based on Pauly's (1983) formula was -0.25 year. Figure 4 shows the growth model of *H. galei* found in Dorery Dorehri Bay, where the growth followed the equation $Lt = 68.60 [1 - exp^{-0.51 (t-0.25)}]$.~~

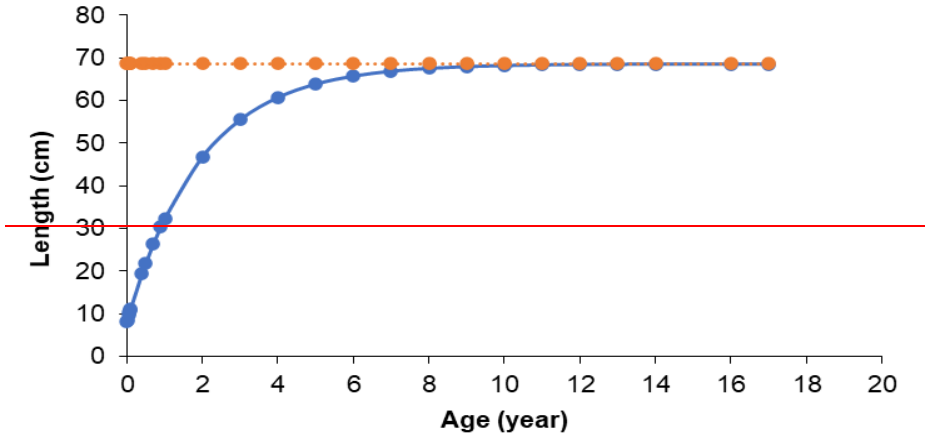

Figure 4. Growth model of *H. galei*

The growth of *H. galei* increased sharply at the ages between 2 to 4 years, after exceeding 60 cm length, it showed slower growth. Referring to Branstetter (1987), K value of 0.51 year^{-1} for *H. galei* found in Doreri Bay indicated fast growth of the sharks. According to Pauly and Morgan (1985), to get an estimate of the growth model, it is necessary to know the characteristics, behavior, and several life histories of the observed fish, so that the best growth model can be obtained that can actually represents the observed biota population. Although the number of individuals encountered during the UVC was relatively small, the number was considered representation representative of the walking shark population residing in Doreri Dorehri Bay during the observation periods. This is based on the consideration that the biological characteristics of the genus *Hemiscyllium*, are low fecundity, long life (up to 10 years) and spawning only once a year (Allen *et al*., 2016; Jutan *et al*., 2017; Jutan *et al*., 2018).

Conclusion

This study reveals several biological and ecological aspects related to the walking shark (*H. galei*). The abundance of these species in Doreri Bay was relatively low with individual sizes, both male and female, not exceeding 75 cm. In addition, the growth form of this species was found to tend to follow the negative allometric, where the length gain was faster than the weight gain or the fish tended to be thin. Some of this information has management implications, especially for protection the species from exploitation by the surrounding communities. Further, there is a need for habitat protection, especially coastal ecosystems (especially coral reefs) and prevention of pollution of the waters of Doreri Bay, especially due to increased development and settlements in the city of Manokwari which can increase domestic waste from the mainland.

Acknowledgement

I would like to thank you to the Oceanography Laboratory, Faculty of Fisheries and Marine Sciences, Papua University for providing diving equipment and oceanographic parameter measurement tools.

Acknowledgement

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