



Morphometric variation of five dominant parrotfish (Scaridae) harvested from the Northern Waters of Aceh

Nanda Ulfa Khaira¹, Muchlisin Z.A², Nur Fadli^{2,*}

¹Integrated Coastal Resource Management, Graduate School of Universitas Syiah Kuala, Banda Aceh, Aceh, Indonesia.

²Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Aceh, Indonesia.

ARTICLE INFO

Keywords:

Aceh waters
morphometrics
Parrotfish
Measurement characters
DFA

ABSTRACT

The waters of Aceh are surrounded by three major water bodies: the Andaman Sea, the Indian Ocean, and the Malacca Strait. Differences in current patterns extend the distribution range and contribute to the species diversity. Fish from the Scaridae family are among the species that thrive in these environments. The family Scaridae (Rafinesque 1810), commonly known as parrotfish, inhabits tropical seas, including the Pacific, Indian, and Atlantic Oceans, and is often found in coral reef areas. Parrotfish play a crucial role in maintaining coral reef health as one of the herbivorous fish species. This study aims to analyze the morphometric variation of five parrotfish species harvested from the Northern waters of Aceh. Traditional morphometrics using 12 measurement characters were applied to 60 fish samples from five species of the Scaridae family (*Chlorurus capistratooides*, *Chlorurus sordidus*, *Scarus ghobban*, *Scarus niger*, and *Scarus rubroviolaceus*). The results showed that *Scarus rubroviolaceus* shares four similar characters with *Scarus ghobban*: ED, HL, CPL, and PFL; it also shares four characters with *Scarus niger*: ED, HL, CPL, and SNL. *Chlorurus capistratooides* shares three similar characteristics with *Scarus niger*: CPL, ED, and PFL. In addition, the results of the DFA analysis revealed that *Scarus ghobban* and *Scarus niger* exhibit the highest degree of similarity in morphometric traits, particularly in HL, SNL, DFBL, ED, and PFL. Furthermore, *Scarus rubroviolaceus* demonstrates a slight overlap with *Chlorurus capistratooides*, while *Scarus niger* shows a minor overlap with *Scarus rubroviolaceus*. This study provides morphological diversity of parrotfish species in the northern Aceh waters.

DOI: 10.13170/depik.14.2.41572

Introduction

Northern Aceh waters, geographically situated between 5.13° – 5.97° N and 94.97° – 95.77° E, are strategically located between three significant marine areas: the Andaman Sea, the Indian Ocean, and the Malacca Strait (Kurnia *et al.*, 2016). The unique positioning of these waters subjects them to diverse oceanographic influences (Ramadhaniaty *et al.*, 2018). This complex interaction of water bodies contributes to the rich marine biodiversity found in the region, including the thriving coral reef ecosystems that are considered one of Aceh's most valuable natural resources (Baird *et al.*, 2012; Rudi *et al.*, 2012).

Coral reef ecosystems are vital to marine biodiversity, providing essential habitats that support various marine life. These ecosystems serve as

spawning grounds, nursery areas, and feeding zones for numerous marine organisms (Hughes *et al.*, 2002; Fadli *et al.*, 2014; Darling dan D'Agata, 2017). Among the species benefiting from these ecosystems are fish from the family Scaridae, commonly known as parrotfish (Bezerra *et al.*, 2018; Habib *et al.*, 2020; Fekri *et al.*, 2023). Parrotfish play a crucial role in maintaining the health and sustainability of coral reefs, primarily through their feeding habits, which involve consuming algae that grow on dead coral. This process prevents algae from overgrowing and suffocating live corals, thereby maintaining the balance within the reef ecosystem (Ghiffar *et al.*, 2017; Edrus dan Hadi, 2020; Habib *et al.*, 2020; Latuconsina *et al.*, 2024).

* Corresponding author.

Email address: nurfadli@usk.ac.id

The condition of the northern Aceh waters based on BOD₅ concentrations of 0.8-2.3 mg/L and DO values of 7.9-8.2 mg/L, as well as TSS still below the specified threshold with a value range of 4-14 mg/L, indicates that the waters are still in a status of not being polluted by BOD₅ and TSS (Khairunna et al., 2022). The concentrations of TSS, BOD₅, and DO on the north coast of Aceh shows value that these three parameters are still classified as good waters (Khairunna et al., 2022). TSS is one of the physical indicators in studying environmental conditions, particularly pollution status (Siswanto, 2015). BOD₅ concentration is conducted to see the amount of oxygen required by microorganisms to decompose materials during the aerobic decomposition process. The higher the BOD₅ concentration in a body of water, the higher the concentration of organic matter in the water as well (Yudo, 2010; Irham et al., 2017).

Family Scaridae Rafinesque, 1810 inhabit tropical and subtropical waters, including the Pacific, Indian, and Atlantic Oceans, and are frequently observed in coral reef areas (Allen dan Erdmann, 2012; Habib et al., 2020; Froese dan Pauly, 2024). The family consists of 10 genera and approximately 90 species (Allen dan Erdmann, 2012; Froese dan Pauly, 2024), with 23 species reported in Indonesia (Allen dan Adrim, 2003). Parrotfish are true bony fish (Teleostei) with flattened, elongated bodies (Adrim, 2008). They often form schools and live near rocky coral reefs (Utomo dan Ain, 2013). Parrotfish are well-known for their brightly colored scales and are classified as herbivorous fish that feed on algae growing on dead coral, which helps maintain coral reef health (Ghiffar et al., 2017; Rahaningmas dan Mansyur, 2018; Edrus dan Hadi, 2020; Loupatty et al., 2021; Latuconsina et al., 2024). Additionally, they possess unique morphological features that facilitate their feeding habits, including hard and sharp teeth adapted for scraping algae from the surfaces of dead corals (Froese dan Pauly, 2024). Several studies have shown that parrotfish significantly influence the benthic structures of coral reefs through their feeding activities. By scraping or excavating calcareous materials and redistributing sediment, parrotfish contribute to the physical restructuring of coral reef habitats, which can impact the composition and diversity of benthic organisms (Burkepile et al., 2020; Bakhtiar et al., 2021; Abu-Taweel et al., 2023).

Morphometric studies are crucial for understanding the physical characteristics, size distribution, and sex determination of fish species (Muchlisin et al., 2014; Batubara et al., 2018; Rahayu et al., 2023). Such studies are also instrumental in species classification and can provide insights into

the evolutionary relationships between different fish species (Jaferian et al., 2010; Batubara et al., 2018; Gupta et al., 2018; Fadli et al., 2023). Several studies have focused on the Scaridae in different regions of Indonesia. However, the research conducted are generally related to the ecology of the fish, and some of it is related to the use of molecular techniques. For example, DNA barcoding and phylogenetic studies of the green humphead parrotfish (*Bolbometopon muricatum*) in the North Maluku waters (Achmad et al., 2020). Additionally, DNA barcoding of parrotfish in the waters around Ambon Island has been reported by Loupatty et al. (2021).

Research on morphometrics related to Scaridae fish is still very limited. Hence, this study aims to conduct a detailed morphometric analysis of five parrotfish species collected from the Northern waters of Aceh. Morphometric studies of parrotfish provide valuable insights into their biology. Furthermore, the results will contribute to developing conservation strategies and sustainable managing these critical marine ecosystems.



Figure 1. Map of the parrotfish sampling locations in the northern Aceh waters.

Materials and Methods

Location and time of research

Parrotfish samples were collected at the Pelabuhan Perikanan Samudera (PPS) Kutaraja, Lampulo, Banda Aceh from December 2022-May 2023 (Figure 1). The samples were obtained from fishermen who caught the fish in the northern Aceh waters, around Aceh Island and Weh Island and landed at PPS Kutaraja, Banda Aceh. Five species of parrotfish: *Chlorurus capistratoides*, *C. sordidus*, *Scarus ghobban*, *S. niger*, and *S. rubroviolaceus* were collected in this study (Figure 2). Sixty fish samples for each species were randomly selected for morphometric analysis and then taken to the Laboratory of Genetics

and Aquatic Biodiversity, Faculty of Marine and Fisheries, Universitas Syiah Kuala, for further analysis.

Data analysis

A total of 60 fish samples for each species were collected and then separated based on species. The samples were labeled and photographed. The ZEN 2012 (Blue edition) software measured twelve morphometric measurement characters. The measurement characters are presented in Figure 3, while the measurement descriptions are provided in Table 1.

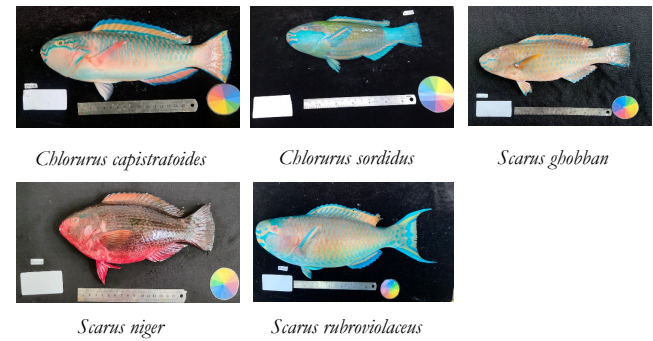


Figure 2. Parrotfish species in the northern Aceh waters.

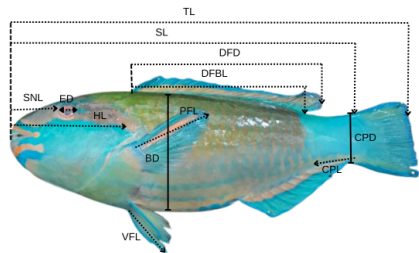


Figure 3. Measurement of traditional morphometric characters.

The morphometric data were analyzed using the following equation (Schindler dan Schmidt, 2006):

$$M_{trans} = \frac{(M \times 100)}{TL}$$

Mtrans represents the transformed data, M is the actual measurement data, and TL is the total length. The morphometric data were analyzed using univariate analysis (one-way ANOVA), Duncan's post-hoc test, and multivariate analysis (Discriminant Function Analysis, DFA) using SPSS 22 software.

Table 1. Descriptions of traditional morphometric measurement characters.

Character	Code	Description
Total Length	TL	Distance from the tip of the head to the tip of the tail

Standard Length	SL	Distance from the tip of the head to the caudal peduncle
Head Length	HL	Distance from the head to the operculum
Caudal Peduncle Length	CPL	Distance from the end of the anal fin to the beginning of the tail fin
Snout Length	SNL	Distance from the head to the beginning of the eye
Dorsal Fin Width	DFD	Distance from the beginning to the end of the dorsal fin
Dorsal Fin Length	DFBL	Distance from the base of the dorsal fin to its end
Eye Diameter	ED	Distance from the start to the end of the eye
Caudal Peduncle Width	CPD	Distance from the bottom to the top of the caudal peduncle
Body Width	BD	Distance from the bottom to the top of the body
Pectoral Fin Length	PFL	Distance from the start to the end of the pectoral fin
Ventral Fin Length	VFL	Distance from the start to the end of the ventral fin

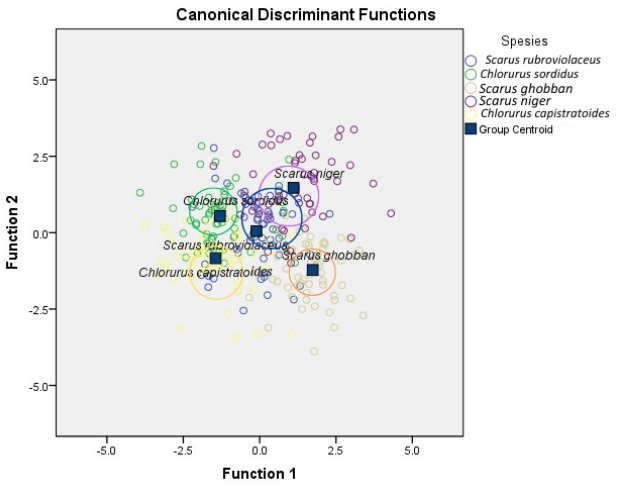


Figure 4. Discriminant function analysis (DFA) plot with 12 morphometric variables for parrotfish from the northern Aceh waters, Indonesia.

Results

ANOVA tests show that species differences largely affect morphological variation ($p < 0.05$) (Table 2). There are no significantly different characters in the five species and the same character among the five species is only ED. The DFA analysis on Function 1 yielded an eigenvalue of 1.633, accounting for 48.8% of the total variance, with SNL and CPL being the significant contributing characters. Function 2 had an eigenvalue of 0.945, explaining 28.2% of the total variance, but had no significant contributing characters. Function 3 had an eigenvalue of 0.464, accounting for 13.9% of the total variance, with significant contributions from SL, DFD, CPD, DFBL, BD, PFL, HL, and ED. Function 4, with an eigenvalue of 0.306 and 9.1% of the total variance, had VFL as the contributing

character (Table 3). The DFA results also showed the highest similarity in morphometric characters is observed between *Scarus ghobban* and *Scarus niger*, particularly in characters such as HL, SNL, DFBL,

ED, and PFL. While *Scarus rubroviolaceus* slightly overlaps with *Chlorurus capistratoides*, and *Scarus niger* slightly overlaps with *Scarus rubroviolaceus* (Figure 4).

Table 2. Mean values $\pm$ SD of morphometric character transformation for each fish species. Values followed by different superscripts indicate differences ($p < 0.05$).

No.	Character (code)	Species				
		<i>Chlorurus capistratoides</i>	<i>Chlorurus sordidus</i>	<i>Scarus ghobban</i>	<i>Scarus niger</i>	<i>Scarus rubroviolaceus</i>
1	Total Length (TL)	10.80 $\pm$ 1.79 ^b	8.70 $\pm$ 1.47 ^a	15.69 $\pm$ 7.65 ^d	10.03 $\pm$ 1.34 ^b	11.82 $\pm$ 1.69 ^c
2	Standard length (SL)	85.82 $\pm$ 4.78 ^c	82.26 $\pm$ 6.40 ^b	84.13 $\pm$ 2.01 ^{b,c}	83.02 $\pm$ 8.37 ^b	76.51 $\pm$ 9.13 ^a
3	Head Length (HL)	27.41 $\pm$ 4.30 ^b	27.18 $\pm$ 3.12 ^b	23.54 $\pm$ 5.63 ^a	24.92 $\pm$ 5.82 ^a	23.88 $\pm$ 4.92 ^a
4	Caudal Peduncle Length (CPL)	9.31 $\pm$ 5.36 ^a	9.38 $\pm$ 4.005 ^a	11.87 $\pm$ 6.95 ^b	10.67 $\pm$ 6.84 ^{a,b}	10.16 $\pm$ 6.06 ^{a,b}
5	Snout Length (SNL)	12.11 $\pm$ 3.03 ^b	12.52 $\pm$ 2.46 ^b	9.77 $\pm$ 3.88 ^a	10.33 $\pm$ 4.32 ^a	10.35 $\pm$ 3.51 ^a
6	Dorsal Fin Width (DFD)	52.33 $\pm$ 4.12 ^c	48.08 $\pm$ 8.21 ^b	50.36 $\pm$ 5.13 ^{b,c}	50.70 $\pm$ 7.24 ^c	44.45 $\pm$ 6.56 ^a
7	Dorsal Fin Base Length (DFBL)	48.14 $\pm$ 4.42 ^c	44.49 $\pm$ 6.80 ^b	45.62 $\pm$ 5.55 ^b	45.60 $\pm$ 6.71 ^b	41.07 $\pm$ 6.53 ^a
8	Eye Diameter (ED)	4.30 $\pm$ 1.42 ^a	4.40 $\pm$ 3.71 ^a	4.46 $\pm$ 1.82 ^a	4.80 $\pm$ 2.03 ^a	4.00 $\pm$ 1.75 ^a
9	Caudal Peduncle Width (CPD)	12.69 $\pm$ 1.09 ^b	13.44 $\pm$ 1.94 ^c	13.04 $\pm$ 0.92 ^{b,c}	14.58 $\pm$ 1.99 ^d	11.94 $\pm$ 1.42 ^a
10	Body Width (BD)	30.48 $\pm$ 2.82 ^b	29.14 $\pm$ 3.90 ^{a,b}	29.07 $\pm$ 3.46 ^{a,b}	32.08 $\pm$ 5.61 ^c	27.63 $\pm$ 4.60 ^a
11	Pectoral Fin Length (PFL)	20.81 $\pm$ 2.36 ^b	21.36 $\pm$ 8.01 ^a	18.48 $\pm$ 2.26 ^b	20.15 $\pm$ 3.83 ^b	18.26 $\pm$ 3.13 ^a
12	Ventral Fin Length (VFL)	12.38 $\pm$ 1.97 ^{a,b}	14.82 $\pm$ 8.02 ^c	12.88 $\pm$ 12.88 ^{a,b}	13.86 $\pm$ 2.62 ^{b,c}	11.50 $\pm$ 2.10 ^a

Table 3. Eigenvalue, % of the variance, and structure matrix of traditional morphometric characters. Asterisks indicate characters contributing to the discriminant function of parrotfish from the northern Aceh waters, Indonesia.

Fungsi	DF1	DF2	DF3	DF4
<i>Eigenvalue</i>	1.633 ^a	.945 ^a	.464 ^a	.306 ^a
<i>% of Variance</i>	48.8	28.2	13.9	9.1
<i>Canonical Correlation</i>	.787	.697	.563	.484
SNL	-.227*	.023	.142	-.116
CPL	.121*	-.039	-.002	-.031
SL	-.008	-.143	.670*	.039
DFD	.022	-.090	.593*	.195
CPD	.147	.380	.573*	-.120
DFBL ^b	-.020	-.039	.526*	.145
BD	.041	.164	.422*	.250
PFL	-.146	.100	.265*	-.078
HL	-.226	.034	.250*	-.027
ED	.040	.055	.127*	-.011
VFL	-.017	.149	.241	-.327*

Discussion

This study confirms that traditional morphometric remains a tool for species differentiation, particularly in regions where parrotfish species coexist and may exhibit overlapping morphological features. The analysis revealed significant variation in key morphological traits, including standard length (SL), head length (HL), and dorsal fin width (DFD). *Chlorurus capistratoides* exhibited significantly larger body size than the other species. This variation in SL is likely linked to differences in ecological niches, with larger body sizes possibly providing advantages in specific habitats, such as deeper or more structurally complex environments. These differences in body size can

also influence species interactions, such as competition for resources or predator-prey dynamics (Kulbicki et al., 2018). In addition, head length (HL) showed significant variation, with *Scarus ghobban* having a notably shorter head than other species. This could reflect differences in feeding strategies, where a smaller head might be an adaptation for specialized feeding on specific types of prey or in particular habitats (Hoey, 2018).

Despite the significant differences observed, some traits were remarkably similar across species, indicating shared evolutionary or ecological pressures. For example, the diameter of the eyes (ED) showed minimal variation among the species, suggesting that visual acuity may be a uniformly

important trait across these parrotfish, possibly due to similar light environments or visual predation pressures in their habitats. This uniformity aligns with findings in other fish species, where eye morphology is conserved due to its critical role in survival and reproduction (Rice dan Westneat, 2005). Another similarity was observed in the pectoral fin length (PFL) among *Chlorurus capistratooides*, *Scarus ghobban*, and *Scarus niger*. This suggests that these species may have similar swimming behaviors or occupy similar ecological niches where efficient locomotion using pectoral fins is advantageous. Fish respond differently to environmental conditions, affecting their morphology and character traits (Lante et al., 2012). Environmental factors such as water conditions, food availability, and water depth can affect the morphological variation of fish (Kulbicki et al., 2018; Zulfahmi et al., 2021).

The Discriminant Function Analysis (DFA) results further highlighted both the similarities and differences among the species. The DFA results, which show slight overlaps between *Scarus rubroviolaceus* and *Chlorurus capistratooides* as well as between *Scarus niger* and *Scarus rubroviolaceus*, suggest a complex interplay of morphological traits that may reflect both genetic and environmental influences. While certain traits like SL and HL were key discriminators, the analysis also showed that some species shared similar values for other traits, such as pectoral fin length (PFL) and body depth (BD). This indicates that while these species are morphologically distinct, there are also areas of overlap where they may exhibit similar ecological functions or behaviors. Such overlapping traits can complicate species identification and provide insights into shared ecological roles within the reef ecosystem. Fish with high morphometric similarity typically exhibit high genetic relatedness and inhabit the same habitat, whereas fish with low genetic relatedness and different habitats display low morphometric similarity (Saleky et al., 2021; Sianturi et al., 2021). Furthermore, morphological variation within a species may result from hybridization (genetic mixing) due to interbreeding between species in the wild (Arifin dan Kurniasih, 2016; Saleky et al., 2021).

Understanding the morphological diversity within and between parrotfish species is crucial for effectively managing and preserving biodiversity in coral reef ecosystems. Parrotfish play a vital role in maintaining reef health through their grazing activities, which prevent algae overgrowth and promote coral growth. The distinct morphologies observed in this study might be linked to specific ecological roles within the reef ecosystem, suggesting

that conservation strategies should consider the functional diversity represented by these morphological differences (Brandl dan Bellwood, 2013). The morphological diversity observed in this study underscores the need to protect various habitats within the reef ecosystem to maintain the ecological functions these species perform. Certain parrotfish species demonstrate highly specialized feeding behaviors. *Scarus spinus*, for instance, predominantly scrapes crustose coralline algae (CCA), despite their low nutritional value. This suggests that the species may selectively target protein-rich microphotoautotrophs associated with CCA, particularly filamentous cyanobacteria, as a key component of its diet (Nicholson dan Clements, 2022). Conservation strategies should aim to preserve the morphological diversity within this group to ensure the resilience of coral reef ecosystems in the face of environmental changes (Mallela dan Fox, 2018).

Conclusion

This study showed morphological diversity of parrotfish species in the northern Aceh waters. The significant morphometric differences identified not only enhance our understanding of the taxonomy and systematics of the Scaridae family but also provide insights into the ecological and evolutionary processes driving species diversification. Future research should focus on integrating morphometric data with genetic analyses to explore the genetic basis of the observed morphological variation and to clarify the evolutionary relationships among these species. Finally, long-term ecological studies could assess how environmental changes, such as climate change or habitat degradation, might impact parrotfish's morphological and functional diversity in this region.

Acknowledgments

This study was funded by Universitas Syiah Kuala (Thesis Magister Research Scheme, contract number: 435/UN11.2.1/PT.01.03/PNBP/2023).

References

- Abu-Taweel, G. M., Z. Al-Fifi, E. Abada, H. Khemira, G. Almalki, Y. Modafar, K. Mohamed Khedher dan Z. Mundher Yaseen. 2023. Parrotfish: An overview of ecology, nutrition, and reproduction behaviour. *Journal of King Saud University-Science*, 35(7): 102778. doi:<https://doi.org/10.1016/j.jksus.2023.102778>
- Achmad, M. J., R. Subur, Supyan dan N. Akbar. 2020. DNA barcode and phylogenetics of green humphead parrotfish (*Bolbometopon muricatum*) in North Maluku waters. *Aquaculture, Aquarium, Conservation & Legislation*, 13(5): 2779-2787.
- Adrim, M. 2008. Aspek biologi ikan kakatua (Suku Scaridae). *Jurnal oseaana*, 33(1): 41-50.

- Allen, G. dan M. Erdmann. 2012. Reef fishes of the East Indies. Volumes I-III. Tropical Reef Research, Perth, Australia.
- Allen, G. R. dan M. Adrim. 2003. Coral reef fishes of Indonesia. Zoological Studies, 42(1): 1-72.
- Allen, G. R. dan M. Erdmann. 2012. Reef fishes of the East Indies. Tropical Reef Research, Perth.
- Arifin, O. Z. dan T. Kurniasih. 2016. Variasi genetik tiga populasi ikan nila (*Oreochromis niloticus*) berdasarkan polimorfisme mt-DNA. Jurnal Riset Akuakultur, 2(1): 67-75.
- Baird, A. H., S. J. Campbell, N. Fadli, A. S. Hoey dan E. Rudi. 2012. The shallow water hard corals of Pulau Weh, Aceh Province, Indonesia. Aquaculture, Aquarium, Conservation & Legislation, 5(1): 23-28.
- Bakhtiar, D., I. Jaya, H. M. Manik dan H. H. Madduppa. 2021. KARAKTERISTIK HAMBUR BALIK AKUSTIK PADA IKAN KAKAKTUA (*Chlorurus sordidus*) MELALUI PENGUKURAN SECARA EX-SITU DENGAN METODE AKUSTIK. Saintek Perikanan: Indonesian Journal of Fisheries Science and Technology, 17(4): 271-278.
- Batubara, A. S., Z. A. Muchlisin, D. Efizon, R. Elvyra, N. Fadli dan M. Irham. 2018. Morphometric variations of the Genus *Barbonymus* (Pisces, Cyprinidae) harvested from Aceh Waters, Indonesia. 26(4): 231. doi:<https://doi.org/10.2478/aopf-2018-0026>
- Bezerra, I. M., K. P. Gramacho, M. A. Barreto, C. W. Hackrad, J. L. L. Feitosa, R. A. Torres, B. P. Ferreira, M. González-Wanguemert dan F. C. Félix-Hackrad. 2018. Genetic diversity and gene flow of the threatened Brazilian endemic parrotfish *Scarus trispinosus* (Valenciennes, 1840). Marine Environmental Research, 142: 155-162.
- Brandl, S. J. dan D. R. Bellwood. 2013. Morphology, sociality, and ecology: can morphology predict pairing behavior in coral reef fishes? Coral Reefs, 32(3): 835-846. doi:10.1007/s00338-013-1042-0
- Burkepile, D. E., M. H. Schmitt, K. Stears, M. K. Donovan dan D. I. Thompson. 2020. Shared insights across the ecology of coral reefs and African savannas: are parrotfish wet wildebeest? BioScience, 70(8): 647-658.
- Darling, E. S. dan S. D'Agata. 2017. Coral reefs: fishing for sustainability. Current Biology, 27(2): R65-R68. doi:<https://doi.org/10.1016/j.cub.2016.12.005>
- Edrus, I. N. dan T. A. Hadi. 2020. Struktur komunitas ikan karang di perairan pesisir Kendari Sulawesi Tenggara. Jurnal Penelitian Perikanan Indonesia, 26(2): 59-73.
- Fadli, N., A. Damora, Z. A. Muchlisin, M. Ramadhaniaty, N. M. Razi, S. R. Rahayu, E. D. Macusi, A. Habib dan M. N. Siti-Azizah. 2023. Morphometric and genetic variations of three grouper species (genus *Epinephelus*) from the northern region of Aceh province, Indonesia. Zoologischer Anzeiger, 307: 89-95. doi:<https://doi.org/10.1016/j.jcz.2023.10.002>
- Fadli, N., Z. A. Muchlisin, M. Affan dan S. Rahimi. 2014. The status of coral reefs in Aceh Besar district, Aceh Province, Indonesia. Aquaculture, Aquarium, Conservation & Legislation, 7(5): 365-371.
- Fekri, L., A. Asriyana, S. Subhan, D. Disnawati dan M. I. Hatma. 2023. Diversity of parrotfish at fishing port, Kendari City, Southeast Sulawesi. PELAGICUS, 4(1): 17-28.
- Froese, R. dan D. Pauly. (2024). FishBase. from <https://www.fishbase.us/>, accessed on July 20, 2024.
- Ghiffar, M. A., A. Irham, S. A. Harahap, N. Kurniawaty dan S. Astuty. 2017. Hubungan kondisi terumbu karang dengan kelimpahan ikan karang target di perairan Pulau Tinabo Besar, Taman Nasional Taka Bonerate, Sulawesi Selatan. Jurnal Ilmu Kelautan SPERMONDE, 2(3): 17-24.
- Gupta, D., A. K. Dwivedi dan M. Tripathi. 2018. Taxonomic validation of five fish species of subfamily Barbinae from the Ganga river system of northern India using traditional and truss analyses. PLOS ONE, 13(10): e0206031. doi:10.1371/journal.pone.0206031
- Habib, K. A., M. J. Islam, A. K. Neogi, N. Nahar dan S. S. Mishra. 2020. New records of two parrotfish (Perciformes: Scaridae) from Saint Martin's Island of the Bay of Bengal, Bangladesh. FishTaxa, 17: 32-38.
- Hoey, A. S. 2018. Feeding in parrotfishes: the influence of species, body size, and temperature. In Biology of parrotfishes, CRC Press. (pp. 119-133).
- Hughes, T. P., D. R. Bellwood dan S. R. Connolly. 2002. Biodiversity hotspots, centres of endemism, and the conservation of coral reefs. Ecology Letters, 5(6): 775-784. doi:10.1046/j.1461-0248.2002.00383.x
- Irham, M., F. Abrar dan V. Kurnianda. 2017. Analisis BOD dan COD di perairan estuaria Krueng Cut, Banda Aceh. Depik, 6(3): 199-204.
- Jaferian, A., H. Zolgharnian, M. Mohammadi, D. M. A. Salari-Aliabadi dan S.-J. Hossini. 2010. Morphometric study of *Eleutheronema tetradactylum* in Persian Gulf based on the truss network. World Journal of Fish and Marine Sciences, 2(6): 499-504.
- Khairunna, N., S. Agustina, I. Setiawan, I. Irwan, M. Ramadhaniaty, R. Sakinah, S. Keumala dan K. Ondara. 2022. Status Kualitas Perairan Utara Aceh Ditinjau Dari Konsentrasi TSS, BOD5, Dan DO. Jurnal Kelautan dan Perikanan Indonesia, 1(3): 135-144.
- Kulbicki, M., A. M. Friedlander, D. Mouillot dan V. Parravicini. 2018. Geographic variation in the composition and function of parrotfishes. In A. S. Hoey & R. M. Bonaldo (Eds.), Biology of parrotfishes, CRC Press, Boca Raton. (pp. 215-244).
- Kurnia, K., P. Syahrul dan R. Thaib. 2016. Pemetaan daerah penangkapan ikan pelagis kecil di perairan Utara Aceh. Jurnal Ilmiah Mahasiswa Kelautan Perikanan Unsyiah, 1(2): 185-194.
- Lante, S., A. Tenriulo dan N. N. Palinggi. 2012. Variasi genetik ikan beronang (*Siganus guttatus*) asal Perairan Barru, Lampung, dan Sorong menggunakan penanda RAPD (Random Amplified Polymorphism DNA). Jurnal Riset Akuakultur, 7(2): 195-204.
- Latuconsina, H., R. Ambo-Rappe dan A. I. Burhanuddin. 2024. Iktiofauna padang lamun perairan tropis: Biodiversitas, Ancaman, dan Pengelolaannya. UGM Press.
- Loupatty, S., G. Limmon, F. Rijoly, J. Tetelepta dan J. Pattikawa. 2021. Diversity of parrotfish in Ambon Island waters, Eastern Indonesia. In: IOP Conference Series: Earth and Environmental Science, IOP Publishing, 805(1): 012003.
- Mallela, J. dan R. J. Fox. 2018. The role of parrotfishes in the destruction and construction of coral reefs. In Biology of parrotfishes, CRC Press. (pp. 161-196).
- Muchlisin, Z. A., B. Zulkarnaini, S. Purnawan, A. Muhadjier, N. Fadli dan S. H. Cheng. 2014. Morphometric variations of three species of harvested cephalopods found in northern sea of Aceh Province, Indonesia. Biodiversitas, 15(2): 142-146.
- Nicholson, G. M. dan K. D. Clements. 2022. *Scarus spinus*, crustose coralline algae and cyanobacteria: an example of dietary specialization in the parrotfishes. Coral Reefs, 41(5): 1465-1479. doi:10.1007/s00338-022-02295-y
- Rahaningmas, J. M. dan A. Mansyur. 2018. Pengaruh perbedaan jenis umpan terhadap hasil tangkapan Ikan Kakatua (famili: Scaridae) menggunakan pancing ulur. Jurnal Sumberdaya Akuatik Indopasifik, 2(1): 25-34.
- Rahayu, S. R., Z. A. Muchlisin, N. Fadli, N. M. Razi, M. Ramadhaniaty, L. S. Handayani, S. Maulida, F. M. Nur, N. Nurlaili dan M. N. Siti-Azizah. 2023. Morphometric and genetic variations of four dominant species of snappers (Lutjanidae) harvested from the Northern Coast of Aceh waters, Indonesia. Zoologischer Anzeiger, 303: 26-32. doi:10.1016/j.jcz.2023.01.008
- Ramadhaniaty, M., I. Setyobudiandi dan H. Madduppa. 2018. Morphogenetic and population structure of two species marine bivalve (Ostreidae: *Saccostrea cucullata* and *Crassostrea iredalei*) in Aceh, Indonesia. Biodiversitas, 19(3): 978-988. doi:10.13057/biodiv/d190329
- Rice, A. N. dan M. W. Westneat. 2005. Coordination of feeding, locomotor and visual systems in parrotfishes (Teleostei: Labridae). Journal of Experimental Biology, 208(18): 3503-3518. doi:10.1242/jeb.01779
- Rudi, E., S. J. Campbell, A. S. Hoey, N. Fadli, M. Linkie dan A. H. Baird. 2012. The Coral Triangle Initiative: what are we missing? A case study from Aceh. Oryx, 46(04): 482-485. doi:10.1017/S0030605312000178
- Saleky, D., R. Sianturi, M. Dailami dan A. B. Kusuma. 2021. Kajian Molekuler Ikan *Oreochromis* spp. dari Perairan Daratan Merauke-Papua, Berdasarkan DNA Mitokondria Fragmen Gen Sitokrom

- Oksidase Subunit I. Jurnal Perikanan Universitas Gadjah Mada, 23(1): 37-43.
- Schindler, I. dan J. Schmidt. 2006. Review of the mouthbrooding Betta (Teleostei, Osphronemidae) from Thailand, with descriptions of two new species. *Zeitschrift für Fischkunde*, 8(1/2): 47-69.
- Sianturi, R., M. Dailami dan D. Saleky. 2021. Identifikasi dan Analisis Filogenetik Ikan Ekonomis Penting *Oreochromis* sp. dengan Pendekatan DNA Barcoding. *Bioscientist: Jurnal Ilmiah Biologi*, 9(2): 465-476.
- Siswanto, A. D. 2015. Sebaran Total Suspended Solid (TSS) Pada Profil Vertikal Di Perairan Selat Madura Kabupaten Bangkalan. *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, 8(1): 26-32.
- Utomo, S. P. R. dan C. Ain. 2013. Keanekaragaman jenis ikan karang di daerah rata-rata dan tubir pada ekosistem terumbu karang di Legon Boyo, Taman Nasional Karimunjawa, Jepara. *Management of Aquatic Resources Journal (MAQUARES)*, 2(4): 81-90.
- Yudo, S. 2010. Kondisi kualitas air Sungai Ciliwung di wilayah DKI Jakarta ditinjau dari parameter organik, amoniak, fosfat, deterjen dan bakteri coli. *Jurnal Akuakultur Indonesia*, 6(1): 34-42.
- Zulfahmi, I., D. Yuliandhani, A. Sardi, N. Kautsari dan Y. Akmal. 2021. Variasi morfometrik, hubungan panjang bobot dan faktor kondisi ikan famili Holocentridae yang didaratkan di Pelabuhan Perikanan Samudra (PPS) Lampulo, Banda Aceh. *Jurnal Kelautan Tropis*, 24(1): 81-92.

How to cite this paper:

Khaira, N. U., Z. A. Muchlisin, N. Fadli. 2025. Morphometric variation of five dominant parrotfish (Scaridae) harvested from the northern waters of Aceh. *Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan*, 14(2): 169–175.