

MORPHOMETRIC CHARACTERISTICS OF THE STONE OCTOPUS (*Octopus cyanea*) LANDED ON BARRANG CADDI ISLAND, MAKASSAR CITY

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ABSTRACT

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The stones octopus (*Octopus cyanea*) fishery is a prime export commodity for Indonesia; however, high exploitation pressure in the absence of stringent regulations on Barrang Caddi Island threatens the sustainability of its wild stocks. This study aims to analyze the morphometric characteristics of *O. cyanea* landed on Barrang Caddi Island. Specimens were collected from the catches of traditional fishers from December 2025 to January 2026 across eight sampling sessions. Body length dimensions were measured using a measuring tape with an accuracy of 0.1 cm across four primary parameters: total length, mantle length, mantle width, and arm length. Data were evaluated through a comparative statistical approach using an Independent Samples t-test ($\alpha = 0.05$) to analyze morphometric variations between sexes. The results indicated that the morphometric characteristics of the stone octopus are generally monomorphic ($p > 0.05$), with a total length range of 59.6–62.6 cm and a mantle length range of 10.4–10.5 cm. Significant variations between sexes were exclusively identified in arm length ($p < 0.05$), where females exhibited longer arms (53.0 ± 9.3 cm) as a functional adaptation for egg protection (brooding behavior). The catch was dominated by the 10 cm mantle size class, which is heavily influenced by gear selectivity (pocong-pocong and bole-bole), the West Monsoon season, and high fishing pressure driven by the island's geographical proximity to the mainland. This truncated size structure indicates an early warning of growth overfishing. Therefore, these morphometric data are highly critical as a scientific baseline to design site-specific fisheries management frameworks, such as establishing minimum legal size limits, in the Spermonde Archipelago.



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INTRODUCTION

In the global market, octopus fisheries currently hold a position as an economically vital marine commodity, driven by a continuously increasing demand trend (Li et al., 2025; Rafiq et al., 2025). This aquatic organism from the class Cephalopoda offers diverse utilities for both food and non-food applications (Freiría-martínez et al., 2025). The global supply chain identifies China, Spain, Morocco, Indonesia, and Vietnam as the top five largest exporters of cephalopods worldwide (FAO, 2026). Consequently, Indonesia has strategically positioned octopuses as a prime export commodity within the non-fish fisheries sector to bolster state foreign exchange reserves and reinforce the economy of small-scale coastal and island fishers (Kasim et al., 2025).

The Spermonde Archipelago in South Sulawesi, particularly Barrang Caddi Island in Makassar City, represents one of the highly active landing centers for the stone octopus (*Octopus cyanea*). Traditional fishers on this island rely on *O. cyanea* as their primary livelihood,

harvesting them from the surrounding waters (Rafiq et al., 2024). However, massive fishing activities conducted without stringent catch-size regulations threaten the sustainability of the *O. cyanea* stock in these waters. This situation contrasts with neighboring islands in the cluster, such as Langkai, Lanjukang, and Bonetambung Islands, which have implemented seasonal closure systems to preserve stock sustainability (Dessibali & Chandra; Raazy et al., 2022).

The absence of a similar management system on Barrang Caddi Island, compounded by high economic dependency, creates a substantial socio-economic vulnerability for the island community if the wild octopus population continues to decline under exploitation pressure. (Rafiq et al., 2024). Furthermore, the biological traits of *O. cyanea*, characterized by rapid growth and a short life cycle (Tarigan et al., 2026), combined with high market prices (Pradilia & Gani, 2025), make them a highly attractive target yet highly susceptible to overexploitation (Rafiq et al., 2025). Therefore, implementing sustainable octopus fisheries management strategies grounded in biological data is critically urgent in this region.

Several prior studies have examined various biological aspects of *O. cyanea* across several octopus fishing and landing islands in Makassar City. Reported findings Rafiq et al. (2025) evaluated the stock status of octopuses around Langkai and Lanjukang Islands, focusing on body weight trends of the landed catch. Meanwhile, more profound bioecological assessments on Bonetambung Island covered parameters such as sex ratio, gonadal maturity stage (GMS), size at first maturity, gonadosomatic index (GSI), and growth dynamics (Omar et al., 2020a; 2020b). Previous research from Junedi et al. (2020) has also identified the morphometric characteristics of *O. cyanea* landed on Bonetambung Island.

Morphometric characteristics serve as vital instruments in fisheries biology (Ramadhaniaty et al., 2023). Although previous studies have provided essential insights for the Spermonde region, the morphometric characteristics of the stone octopus landed on Barrang Caddi Island have remained unexplored. Geographically, Barrang Caddi Island is situated relatively close to mainland Makassar City, rendering it a high-intensity landing site that feeds into marketing channels and subsequent distribution to processing industries. This study aims to analyze the morphometric characteristics of *O. cyanea* landed on Barrang Caddi Island. The baseline data generated from this research can providing essential baseline data to support sustainable local fisheries management.

METHOD

Specimens of *O. cyanea* were gathered from the catches of traditional fishers landing their harvests on Barrang Caddi Island. Sampling was carried out from December 2025 to January 2026. According to the local fishing calendar, this sampling timeframe coincided with the moderate-intensity octopus fishing season (Rafiq et al., 2024). Based on information from local fishers, the observed octopus fishing activities spanned the waters around Barrang Caddi, Kodingareng Keke, and Samalona Islands (Figure 1). To harvest the biota, fishers operated traditional handlines equipped with locally crafted artificial lures known as *pocong-pocong* (mimicking an octopus) and *bole-bole* (mimicking octopus prey).

A total of eight sampling sessions were conducted, with sex identification performed directly at the landing site. During each collection session, morphological features were examined on every individual to separate males from females. Male specimens were identified by the presence of a secondary sexual characteristic, namely the hectocotylus on the third right arm, whereas specimens lacking this feature were categorized as females.

Morphometric measurements were performed on all selected male and female octopus specimens. Body length dimensions were measured using a measuring tape with an accuracy of 0.1 cm. The primary morphometric parameters measured are outlined in Table 1. All morphometric data for male and female octopuses were subsequently analyzed using a comparative statistical approach. The significance of morphometric variations between sexes was evaluated using an Independent Samples t-test at a 5% significance level ($\alpha=0.05$).

RESULT AND DISCUSSION

Morphometric characteristics are essential for identifying fish species, habitat specificities, and ecological criteria. Based on measurements of the *O. cyanea* specimens landed on Barrang Caddi Island, variations in body dimensions, including total length, mantle size, and arm proportions, were observed across both sexes. To provide a comprehensive quantitative description, the mean values, standard deviations, size ranges, and independent t-test results for each morphometric parameter are presented in detail in Table 2.

Figure 1.
Octopus landing and fishing locations

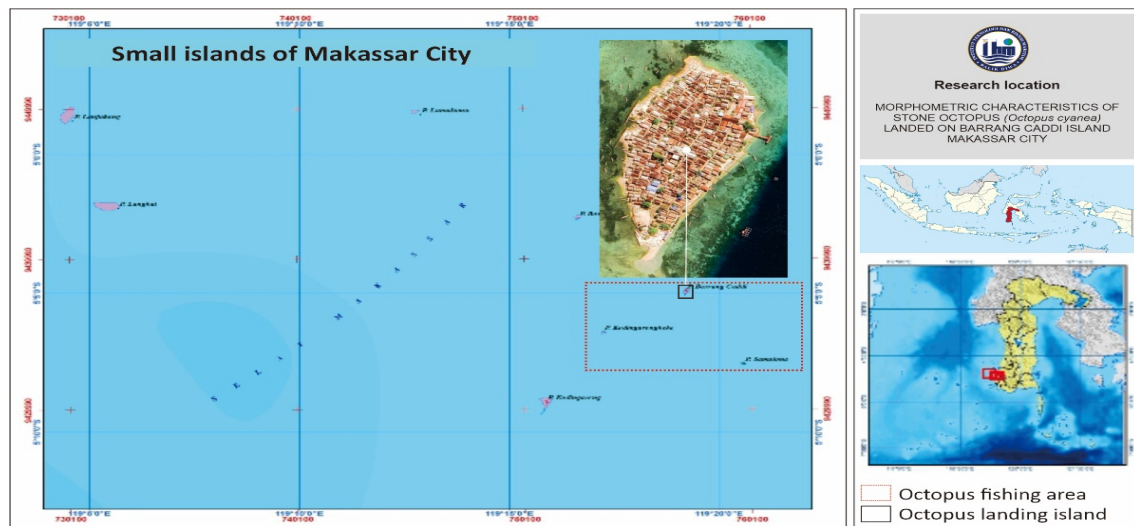


Table 1.
Morphometric characteristics of the stones octopus (*O. cyanea*) measured (Pariansyah et al., 2025)

No	Characteristics	Definition	Measurement documentation
1.	Total length	Length from the tip of the longest arm to the posterior end of the mantle	
2.	Mantle length	Length from the midpoint between the eyes to the posterior end of the mantle	

3. Mantle width Greatest straight-line (dorsal) width of the mantle
4. Arm length Length from the beak to the tip of the arm

**Table 2.**Morphometric values of the stones octopus (*O. cyanea*) landed on Barrang Caddi Island

No.	Characteristics	Male (n = 8)	Female (n = 25)
1.	Total length (cm)	59,6 ± 17,4 ^a	62,6 ± 10,9 ^a
2.	Mantle length (cm)	10,4 ± 2,4 ^a	10,5 ± 3,1 ^a
3.	Mantle width (cm)	9,9 ± 3,7 ^a	7,8 ± 2,3 ^a
4.	Arm length (cm)	50,5 ± 14,8 ^a	53,0 ± 9,3 ^b

Note: Different superscript letters within the same row denote statistically significant differences based on the t-test ($p < 0.05$).

Morphometric measurements of *O. cyanea* specimens revealed diverse size variations between male and female groups (Table 2). The independent samples t-test ($p < 0.05$) indicated that most major structural components of the octopus body showed no statistically significant differences between sexes. This pattern confirms that *O. cyanea* landed on Barrang Caddi Island exhibits relatively similar external morphological features (monomorphism) across its primary body structure, irrespective of internal reproductive differences. This uniform body shape suggests that natural selection in the coral reef waters of Spermonde prioritizes standardized hydrodynamics and camouflage capabilities for both sexes to survive predators.

When compared to other regions, this monomorphic nature across most external body structures aligns with findings Lamalelang et al. (2024) in Sikka waters, NTT, which reported that statistical tests between male and female *O. cyanea* in both northern and southern zones mostly yielded no significant differences. Nonetheless, the general trend where female body dimensions are slightly superior to males in Spermonde reinforces the typical biological pattern of the species. A similar phenomenon was documented Junedi et al. (2020) in the Makassar Strait and Bone Gulf, as well as Pariansyah et al. (2025) in Kaur waters, Bengkulu, consistently asserting that female octopuses tend to exhibit relatively larger body proportions or size ratios than their male counterparts.

The research data indicate that the average total length of female octopuses tends to be higher than that of males. However, the wide size variation within the male group resulted in a large standard deviation, which masked any statistically detectable difference ($p > 0.05$). These total length values demonstrate that both males and females caught by traditional handlines are at an equivalent adult somatic growth phase. The selectivity factor of the artificial *pocong-pocong* and *bole-bole* lures contributes significantly to narrowing the cumulative total length variability landed on the island; these gears tend to trigger aggressive responses primarily from individuals of an adequate size. Extremely small or large individuals tend to escape the reach of these traditional handlines, thereby concentrating total length data within a specific range.

Mantle length is considered the most stable linear growth indicator in cephalopod biology because it is unaffected by arm elasticity, which is prone to stretching or tearing. The average mantle length of male and female octopuses showed almost identical values. The t-test

confirmed the absence of significant differences in this linear dimension ($p > 0.05$). This proves that the linear growth rate of the mantle cavity in both sexes progresses concurrently with age, where the mantle space expands proportionally to accommodate visceral organs and the digestive system at an identical scale. The consistency in mantle length also indicates that the natural food supply in the coral reef ecosystems of Barrang Caddi, Kodingareng Keke, and Samalona supports balanced somatic growth for both male and female groups without causing energy imbalances.

On a broader geographical scale, the similarity in mantle length between males and females on Barrang Caddi Island presents an interesting localized variation when compared to other populations Pariansyah et al. (2025).. In the Kaur population, the ratio of mantle length to mantle width showed significant differences, serving as a prominent distinguishing structural component between sexes. This indicates that while linear mantle length dimensions of *O. cyanea* across several Indonesian waters progress in parallel, horizontal geometric shape dynamics can still be influenced by the localized habitat characteristics of each water body.

In contrast to the length parameters, the average mantle width of male octopuses demonstrated a tendency toward higher values compared to females. Although this difference did not achieve statistical significance due to the fluctuating data distribution among males ($p > 0.05$), the phenomenon indicates a geometric divergence where male mantles tend to widen horizontally. This horizontal widening in males is suspected to be related to the anatomical space required to accommodate the complex male reproductive system, particularly the terminal spermatophoric complex that elongates before being channeled to the hectocotylized arm. Conversely, the more slender mantle of females provides a hydrodynamic advantage during rapid swimming maneuvers while foraging before entering the fully mature gonadal phase.

The tendency of the male mantle to widen horizontally on Barrang Caddi Island is consistent with the morphometric structure of octopuses in Sikka waters (Lamalelang et al., 2024), where the anterior body region of males (including head width) was found to dominate. However, this condition contrasts sharply with the dynamics of *O. cyanea* populations in other parts of eastern Indonesia. Balansada et al., (2019) in Salibabu waters, Talaud Islands, it was reported that females possessed significantly larger and wider anterior body

The only morphometric parameter displaying a statistically significant difference was arm length ($p < 0.05$). Female octopuses possessed a significantly longer average arm length than the male group. This divergence in arm length performance underscores different functional specializations and biological energy allocations between sexes. Females require longer and stronger arms to support prolonged egg-protecting activities (brooding behavior) within dens (coral substrates or rock crevices) until hatching. During the brooding phase, female octopuses actively utilize their arms to clean eggs of sediment, facilitate the flow of fresh oxygenated water, and deter small predators. This ecological adaptation to the Spermonde waters prompts the female group to prioritize somatic growth in the arms relative to males, whereas males allocate energy more efficiently toward mobility to find mates.

The superiority of arm length in female octopuses exhibits a high level of consistency with earlier reports from various regions. Prior research Junedi et al. (2020) in the Makassar Strait and Bone Gulf also documented that mature female octopuses had significantly longer arms. This phenomenon was further confirmed Lamalelang et al. (2024) in the northern waters of Sikka. Passive and sedentary brooding inside coral crevices appears to be a universal evolutionary factor for female *O. cyanea* to maintain arm integrity from predation threats, unlike males that move actively to seek mates, rendering their arms more vulnerable to damage or amputation from predator attacks.

The geographical positioning of Barrang Caddi Island, located relatively close to the mainland of Makassar City, carries distinct logistical implications for the size patterns of the landed octopuses. Easy market access triggers a high intensity of traditional *pocong-pocong* and

bole-bole handline operations by local fishers across the reef flats surrounding the island. This intense exploitation pressure (fishing pressure) causes the majority of the captured specimens to center around a mantle length of 10 cm. Compared to findings Omar et al. (2020a, 202b) on Bonetambung Island, which is located further out (outer island), the average size of octopuses on Barrang Caddi Island tends to be smaller. The proximity to mainland consumer ports accelerates fishing turnover, meaning *O. cyanea* in Barrang Caddi waters are harvested before reaching their maximum biological growth potential. While high transportation accessibility from the island to mainland Makassar accelerates the supply chain, it simultaneously increases the ecological burden on the surrounding reef waters.

On a broader comparative scale, size variations stemming from geographical gradients and anthropogenic pressures are common among global cephalopods. Octopus populations under differing environmental characteristics and pressures demonstrate contrasting plasticity in size at maturity (Courage, 2013). Octopuses in the Mediterranean Sea are known to reach reproductive maturity at much smaller mantle sizes (3.7–5.3 inches) compared to Atlantic Ocean populations, which can achieve maximum weight before spawning. This reinforces the indication that the interaction between local fishing pressure and environmental supply in Barrang Caddi directly truncates the wild population's size structure.

The sampling period from December 2025 to January 2026 also influenced the metric size structure of the gathered octopuses. The local fishing calendar marks this period as a moderate catch season (Rafiq et al., 2024), characterized by the migration and emergence of medium-sized individuals across the coral reef flats. The modifications of traditional handlines, namely *pocong-pocong* and *bole-bole*, selectively attract medium-to-adult octopuses that display highly aggressive and territorial behaviors. This explains why the mantle length distribution of traditional catches on Barrang Caddi Island is concentrated around a mean of 10.4–10.5 cm. Environmental conditions during the West Monsoon, which tend to bring rough seas, also restrict traditional fishing operations to nearby islands like Samalona and Kodingareng Keke, thereby concentrating fishing efforts within that specific zone.

The link between sampling timing and a size structure dominated by a specific size class highlights a distinctive seasonal variation compared to other regions. For instance, *O. cyanea* sampling in Sikka during July–August was dominated by the "large" size category (above 10 cm). Conversely, a study on another octopus species (*O. vulgaris*) in Popisi waters, Central Sulawesi, found that the largest mantle sizes peaked in March rather than July (Hutagaol et al., 2019). These differing trends support the growth theory emphasizing that water temperature fluctuations during differing hatching seasons across regions significantly control the daily somatic growth acceleration of octopuses, thus generating variable size structures across seasons and regions (Courage, 2013).

The findings regarding morphometric sizes offer important contributions to the formulation of local fisheries regulations in the study area. The biological characteristics of cephalopods, fast growth combined with a short life cycle, demand precise minimum legal size limits based on real field data. The fact that the average mantle length of octopuses in Barrang Caddi hovers around 10 cm warrants vigilance among policymakers against the threat of growth overfishing, where marine biota are harvested before reaching their optimal growth potential. The lack of size-limit regulations on this island, when compared to the successful implementation of seasonal closures on Langkai and Lanjukang Islands since 2021 (Raazy et al., 2022), could trigger a drastic long-term decline in wild stock availability due to disruptions in natural recruitment cycles.

Consequently, fisheries managers can utilize the morphometric database from this study as a scientific baseline to design zoning or minimum weight regulations for octopuses landed on Barrang Caddi Island. Implementing site-specific fisheries management based on biological data will protect juvenile cohorts, allowing them to spawn at least once before harvest. Aligning catch size limits, educating fishers on the importance of returning undersized octopuses (catch-and-release), and adopting sustainable fisheries governance will

secure the long-term economic resilience of traditional fishers. This tactical step simultaneously maintains food web balances within the coral reef ecosystems of the Spermonde Archipelago, Makassar City.

CONCLUSION

The morphometric characteristics of *Octopus cyanea* on Barrang Caddi Island are generally monomorphic ($p > 0,05$), with a total length range of 59.6–62.6 cm and a mantle length range of 10.4–10.5 cm. Significant variations between sexes are restricted to arm length ($p < 0,05$), where females exhibit longer arms (53.0 ± 9.3 cm). The dominance of the 10 cm mantle size class in the catch during December–January reflects seasonal influences, the selectivity of traditional gear (*pocong-pocong* and *bole-bole*), and high fishing pressure driven by the island's geographical proximity to mainland Makassar City. The outcomes of this study can serve as an essential scientific baseline for developing site-specific fisheries management frameworks, such as establishing minimum legal size limits, to ensure the sustainability of the stones octopus stock in the Spermonde Archipelago.

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