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Population structure and growth patterns of *Diadema setosum* (Echinodermata: Diadematidae) in the coastal ecosystems of Buru Island, Maluku, Indonesia

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Abstract. *Burhanuddin A, Omar SBA, Zainuddin EN, Syafiuddin. 2025. Population structure and growth patterns of* Diadema setosum *(Echinodermata: Diadematidae) in the coastal ecosystems of Buru Island, Maluku, Indonesia. Biodiversitas 26: 2936-2945.* Sea urchins (Echinoidea) are an important marine resource with economic and ecological value. Species such as *Diadema setosum* are consumed locally as a food source and are valuable in national and international markets. However, increasing demand has led to overexploitation, resulting in population declines. This research was carried out from February to July 2023 at two coastal locations, Jikumerasa Village in Buru District and Pasir Putih Village in South Buru District, Maluku Province, Indonesia. The aim was to analyze the growth patterns and condition indices of *D. setosum.* The method used is the line transect method, where sampling is carried out every month on a line transect that has five plots measuring 1x1 m. Data were compiled in tabular and graphical form using Microsoft Excel, regression equations were analyzed with data analysis software on regression software. Shell or test diameters of both male and female urchins ranged from 26.94-78.28, $\bar{x}$: 48.03±9.3mm SD, and body weights ranged from 11.39-249.37, $\bar{x}$: 72.18g±40.9 SD. The sea urchins from Pasir Putih station were greater than at Jikumerasa. The length-weight relationship (LWR) of *D. setosum* showed negative allometric growth in value equilibrium constant ($b<3$, $p>0.05$), with b-values ranging from 2.6763 to 2.7864. The Fulton’s condition factor (Kn) values ranged from 0.46 to 1.89 for males, 0.64 to 1.91 for females, and 0.43 to 1.91 for the combined population, indicating good overall health. Although more studies are needed to elucidate the effect of environmental conditions on echinoid sex determination, instances of skewed sex ratios may serve as indication for potential detrimental processes that may prevail in the environment. These findings contribute to a better understanding of the population structure and growth dynamics of *D. setosum*, which is crucial for guiding selective fishing methods, conservation strategies, and sustainable fisheries management.

Keywords: Coral triangle, growth, Indonesia, sea urchin, sex ratio

INTRODUCTION

Tropical marine ecosystems harbor extraordinary biodiversity, with coral reefs, seagrass beds, and mangroves among the most productive and ecologically significant habitats on Earth (Erniati et al. 2023; Wirabuana et al. 2025). The Indo-Pacific region, particularly the Coral Triangle—which includes Indonesia—is widely recognized as a global epicenter of marine biodiversity, supporting thousands of species of fish, corals, and invertebrates (Asaad et al. 2020; Hasan et al. 2022; Isroni et al. 2023; Putra et al. 2023). These ecosystems provide essential services, including nutrient cycling, habitat formation, and the maintenance of food web stability (Islamy and Hasan 2020). However, their ecological integrity is increasingly threatened by climate change, overfishing, habitat loss, and marine pollution (Dulvy et al. 2021; Capriati et al. 2025). Among the many marine invertebrate groups contributing to these systems, members of the phylum Echinodermata play critical ecological roles.

Echinoderms are a distinctive and evolutionarily significant group of marine invertebrates, comprising over 7,000 extant species and representing the only major group of deuterostomate invertebrates within the kingdom Animalia (Appeltans et al. 2012). They are globally distributed and are known for their ecological contributions, including bioerosion, sediment mixing, and grazing. In coral reef ecosystems, echinoderms—particularly sea urchins—are important in shaping benthic community structures and controlling algal overgrowth (Mahdy et al. 2019). In Indonesian waters, sea urchins such as *Diadema setosum* and *Echinothrix calamaris* are commonly observed in coral reefs and seagrass beds (Setyawan et al. 2014; Suryanti et al. 2017; Suryanti et al. 2018; Lutfiyani et al. 2021).

Sea urchins are vital herbivores and omnivores in coastal food webs. While they are primarily algal grazers, many species also consume sessile invertebrates such as sponges and corals, thereby playing complex roles in reef dynamics (Rodríguez-Barreras et al. 2015; Murie and Bourdeau 2021). *D. setosum* is one of the most widespread echinoids in the Indo-West Pacific, ranging from the Red

Sea and East Africa to Japan and northern Australia (Lessios et al. 2001; Uğurlu and Duysak 2022). It is easily identified by its long black spines, five white aboral spots, and an orange ring surrounding the anal cone (Muthiga and McClanahan 2020; Vafidis et al. 2021; Mak et al. 2025). Typically found in shallow waters (0-20 m) on rocky substrates, biogenic reefs, and seagrass beds, this species acts as both a detritivore and scavenger, contributing to nutrient cycling. However, dense populations can induce bioerosion and promote algal-dominated reef barrens, potentially leading to ecosystem degradation (Bronstein and Loya 2014).

Beyond its ecological roles, *D. setosum* holds economic importance, particularly in Indonesia, where interest in sea urchin fisheries is growing (Grisolía et al. 2012; Karmilah et al. 2021). The global harvest of sea urchins reached 71,186 tons in 2020, reflecting rising demand for their edible gonads (Zilia et al. 2023). In Indonesia, several species such as *Echinometra* spp., *Tripneustes gratilla*, and *D. setosum* are noted for their fast growth and economic potential (Setyawan et al. 2014; Lutfiyani et al. 2021). Despite its abundance in Maluku, especially around Buru Island, *D. setosum* remains underexploited, underscoring the need for biological and ecological studies to support sustainable utilization (Burhanuddin 2012).

While studies have addressed various aspects of *D. setosum* biology in other regions—including its physicochemical characteristics and population density (Tupan and Silaban 2017; Uneputty et al. 2017)—there is a lack of data concerning its length-weight relationship (LWR) and condition factors in the waters around Buru Island. These metrics are fundamental to understanding growth patterns, assessing population health, and estimating biomass, which are crucial for fisheries management (Demirci et al. 2016; Demirci et al. 2018; Yeşilbudak 2021). LWR studies also help evaluate environmental influences on population dynamics and provide a foundation for stock assessment and ecological monitoring (Demirci et al. 2020).

To date, no studies have examined the LWR or condition factors of *D. setosum* in Buru Island waters. This study addresses this gap by providing the first data on these biological parameters in the region. Understanding the species' bioecology is essential for its sustainable management and for informing fisheries development. The findings of this research will contribute to future efforts in population dynamics modeling, stock assessment, and ecosystem-based fisheries management.

MATERIALS AND METHODS

Sample collection and sampling locations

This study focused on *Diadema setosum*, collected between February and July 2023 from two distinct locations in South Buru District, Maluku, Indonesia: Jikumerasa Village (Station A) in Buru District and Pasir Putih Village (Station B) (Table 1, Figure 1). Station A featured a sandy substrate, soft coral, sparse seagrass, and was exposed to open water, while Station B had a sandy substrate dominated by rocky coral in a semi-enclosed bay. These locations were selected to investigate the influence of differing habitat conditions on *D. setosum* populations. For Jikumerasa station located at 3°10'26" S; 127°01'39"E and Pasir Putih station at 3°14'14" S; 126°00'19" E.

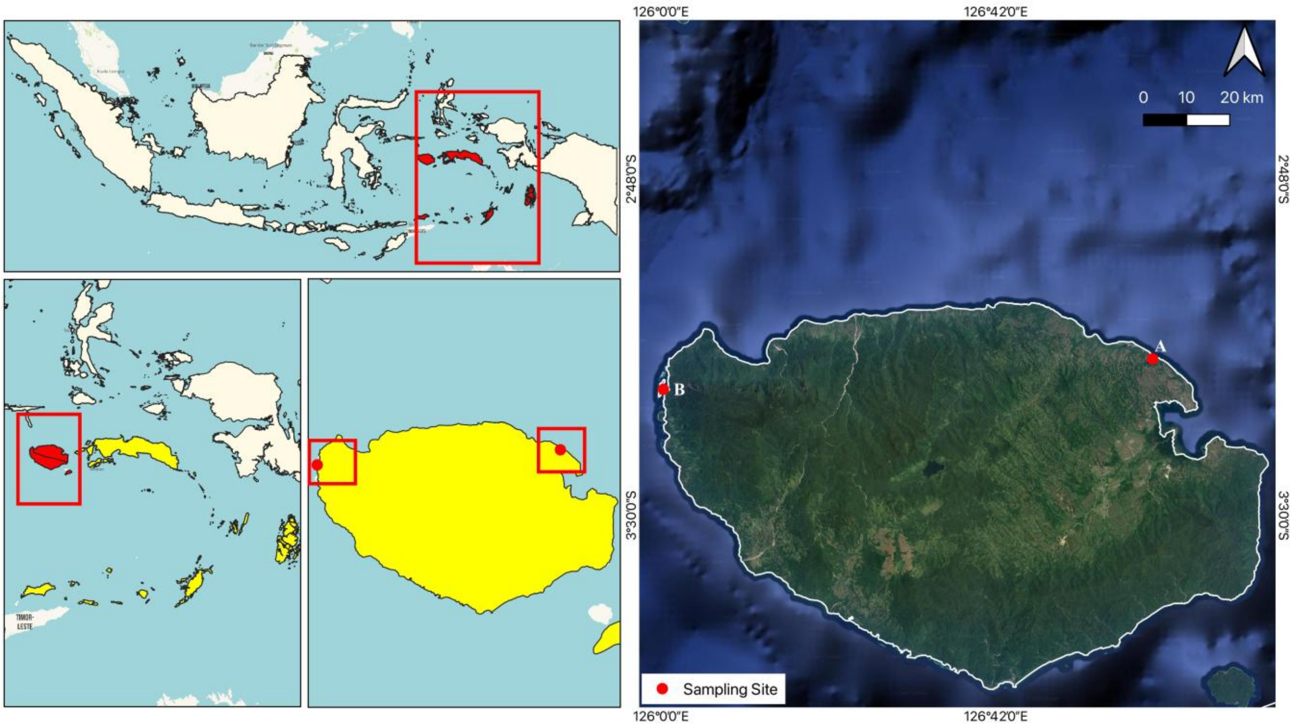

Figure 1. Map of sampling locations for sea urchin *Diadema setosum* on Buru Island, Maluku, Indonesia. A. Station A (Jikumerasa), B. Station B (Pasir Putih)

Table 1. Location of research sites (stations) on Buru Island, Maluku, Indonesia

Station	General description	Geographical location
Station A is Jikumerasa, Buru District	Open waters in contact with the sea	3°10'26" S 127°01'39" E
Station B is Pasir Putih, South Buru District	Semi-enclosed waters of the bay area	3°14'14" S 126°00'19" E

Sample analysis

A total of 60 individuals of *D. setosum* were collected monthly from each station during low tide, using random sampling from predetermined quadrants. The method used is the line transect method, where sampling is carried out every month on a line transect that has five plots measuring 1x1 m, assuming that the sample taken can represent the population of sea urchins. The test diameter (the exoskeleton) of each individual was measured with a digital caliper (0.01 mm accuracy), and wet weight was recorded using an electric scale (0.01 g accuracy). Each sample was labeled for identification, sexed, and dissected to examine gonad maturity using standard methods. This dissection was carried out using surgical scissors and a scalpel.

Morphological identification

Specimens of *D. setosum* were collected from all stations in Buru Island, Maluku, Indonesia. Adult tests averaged 49.30 mm horizontally (h.d.) ±12.50 mm and 26.19 mm vertically (v.d.) ±7.79 mm, reaching maximum dimensions of 83.88 mm (h.d.) by 51.56 mm (v.d.) based on 552 examined specimens. These tests appeared black, occasionally with a green tinge in large adults, and were horizontally circular with a depressed apical system. Distinctive markings included white spots on median areas and tests, with lines extending to genital plates, alongside blue iridophores forming spots along interambulacra mid-lines, sometimes in ambulacra, and on genital plates, notably above the madreporite.

The naked median areas had white spots seen both day and night. These white spots were also visible on the naked test in conjunction with white lines continuing from the spot marking along the mid-lines of the interambulacra to the genital plates. A bold pattern of blue iridophores occurred in this species. The pattern of iridophores occurred as a series of "spots" down the mid-lines of the interambulacra. These bisected the naked median areas continuing down just below the ambitus. Lines of blue "spots" also occurred as two series down the ambulacra in some specimens. A single blue "spot" was also present on each genital plate, including above the madreporite. More detailed descriptions can be found in the paper by Coppard and Campbell (2006).

Data analysis

Test diameter-wet weight relationship

The relationship between test diameter and wet weight for *D. setosum* was analyzed separately by sex for each station using the following equation (Froese 2006):

$$W = aL^b$$

Where, W is the wet weight (g), L is the test diameter (mm), a is the intercept (initial growth index), and b is the growth exponent/equilibrium constant. Growth was classified as isometric (b=3), negative allometric (b<3), or positive allometric (b>3). A t-test was used to test whether the b value significantly deviated from 3. Additionally, a t-test compared the growth exponents between males and females (Fowler and Cohen 1992).

Fulton's condition factor

The condition factors were calculated for each individual based on their sex. For populations exhibiting isometric growth (b=3), Fulton's condition factor (K) was determined using the formula:

$$K = \frac{105W}{L^3}$$

Where, W is the average wet weight (g) and L is the test diameter (mm) of sea urchins in the same size class (Barnham and Baxter 1998). For populations with allometric growth (b≠3), the relative condition factor (Kn) was calculated using the formula:

$$K_n = \frac{W}{aL^b}$$

Where, W is the observed wet weight (g), and aL^b is the predicted weight based on the population's test diameter-wet weight relationship (Le Cren 1951). These calculations were used to assess the health and well-being of *D. setosum* populations in different habitats.

Statistical analysis

All statistical analyses, including t-tests and linear regressions, were conducted using Microsoft Excel. A significance level of p<0.05 was used to determine statistical significance.

RESULTS AND DISCUSSION

Number of samples and sample size of *Diadema setosum*

A total of 360 individuals of *Diadema setosum* were collected from Station A (Jikumerasa Village, Buru District), where consistently high-water visibility indicated favorable environmental conditions for sea urchin growth. The samples comprised 165 males and 195 females, with test diameters ranging from 27.79 to 75.68 mm and wet weights between 11.39 and 226.03 g (Figure 2). At Station B (Pasir Putih Village, South Buru District), 362 individuals were collected under similarly stable conditions. This group included 165 males and 197 females, with test diameters ranging from 28.60 to 78.28 mm and wet weights between 17.74 and 249.37 g. Although sex ratios in echinoid populations are typically close to 1:1, slight deviations, such as the higher number of females observed at both sites, can occur due to several factors, including sampling season, reproductive cycle, and environmental conditions (Rocha et al. 2019; Vafidis et al. 2020). For broadcast spawners like *D. setosum*, local environmental cues such as temperature and food availability may influence gonadal development and sex differentiation, potentially resulting in skewed sex ratios (Bronstein et al. 2016). The similarity in sample sizes and environmental parameters between the two stations provides a reliable framework for comparing growth patterns and condition factors across *D. setosum* populations. These baseline data offer a foundation for further analyses of spatial variations in population dynamics and habitat-driven growth responses.

Water quality and habitat characteristics

The environmental parameters recorded at both research stations fall within the tolerance range suitable for the survival and growth of *D. setosum* (Table 2). This species thrives in tropical reef environments, typically favoring temperatures between 25-30°C, salinity levels of 27-35‰, and dissolved oxygen (DO) concentrations above 5 mg L^{-1} (Uğurlu and Duysak 2022; Efendi et al. 2024). Although pH values at Station A were slightly lower, they remained within the physiological tolerance range for echinoids, generally spanning from pH 6.5 to 8.5 (Uğurlu and Duysak 2023). DO levels at both stations exceeded 6 mg L^{-1}, indicating well-oxygenated conditions that support aerobic metabolism and active foraging (Lucey et al. 2022). These findings are consistent with prior studies in similar reef ecosystems, suggesting that both Station A and Station B provide ecologically viable habitats for sustaining *D. setosum* populations (Uğurlu and Duysak 2022, 2023).

Subtle differences in water quality between the two stations underscore the ecological nuances of their respective habitats. Slightly higher pH, salinity, and DO values at Station B may enhance metabolic efficiency and support more favorable conditions for growth. The rocky coral-dominated substrate at Station B likely offers greater structural complexity and food resource availability, promoting better physiological performance and reproductive potential. In contrast, the more sedimented environment of Station A, with soft corals and limited seagrass, may reduce feeding opportunities and slightly constrain growth conditions. Habitat structure plays a key role in shaping species distribution and health, as also observed by Suryanti et al. (2024), who reported that *E. calamaris*, another echinoid species, commonly inhabits shallow rocky and seagrass-dominated areas.

Relationship between test diameter-wet weight

The analysis of the length-weight relationship (LWR) of *D. setosum* at both Jikumerasa and Pasir Putih stations indicated negative allometric growth, where the increase in test diameter is proportionally greater than the increase in wet weight. Negative allometric growth is characterized by an allometric growth exponent (b) less than 3, implying that as the test diameter increases, wet weight increases at a slower rate. This can be observed in the LWR equations derived from the data (Figure 3).

At both stations, the b-values for males, females, and combined sexes are less than 3, indicating negative allometric growth. This suggests that *D. setosum* allocates more energy towards increasing its structural size (test diameter) rather than biomass (wet weight). This pattern could be an adaptive strategy, where a larger test diameter enhances protection from predators, particularly in environments with limited shelter or high predation pressure. (Demirci et al. 2020) state that LWRs of aquatic living organisms are useful in determining weight and biomass and allowing comparison of species life history, morphological features of populations living different areas, length, and age assemblies.

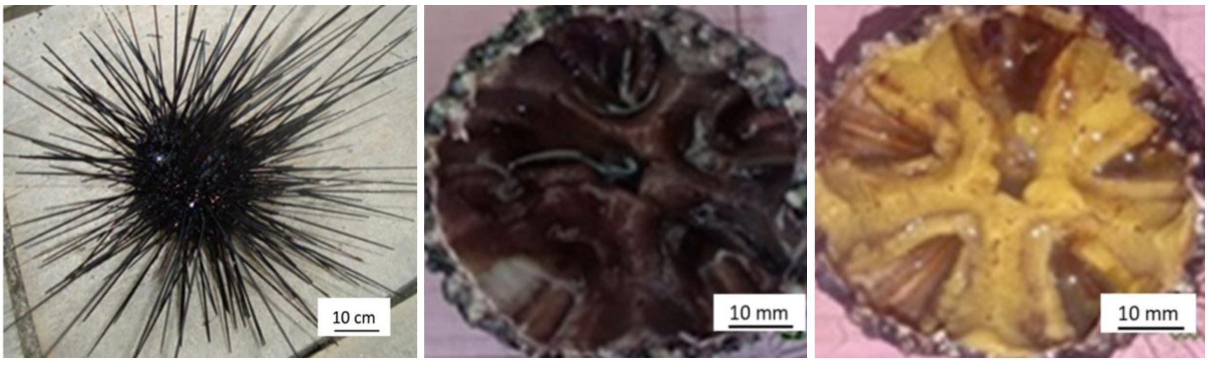

Figure 2. A. Specimen *Diadema setosum* collected from Buru Island, Maluku, Indonesia, B. Testis, C. Ovary

Table 2. Results of water quality measurements at the research station in Buru Island, Maluku, Indonesia

Station	Habitat characteristics	pH	Salinity ‰	Temperature (°C)	DO (mg L^{-1})
A	Sandy substrate, soft coral, little seagrass	6.96-7.31±7.16 SD: 0.14	27-29±27.8 SD: 0.75	27.7-29.8±28.7 SD: 0.86	6.31-7.01±6.72 SD: 0.28
B	Sandy substrate dominated by rocky coral and is semi-enclosed water/ bay	7.21-7.91±7.59 SD: 0.23	30-32±31.2 SD: 0.75	28.9-30.5±29.6 SD: 0.63	7.21-7.97±7.60 SD: 0.24

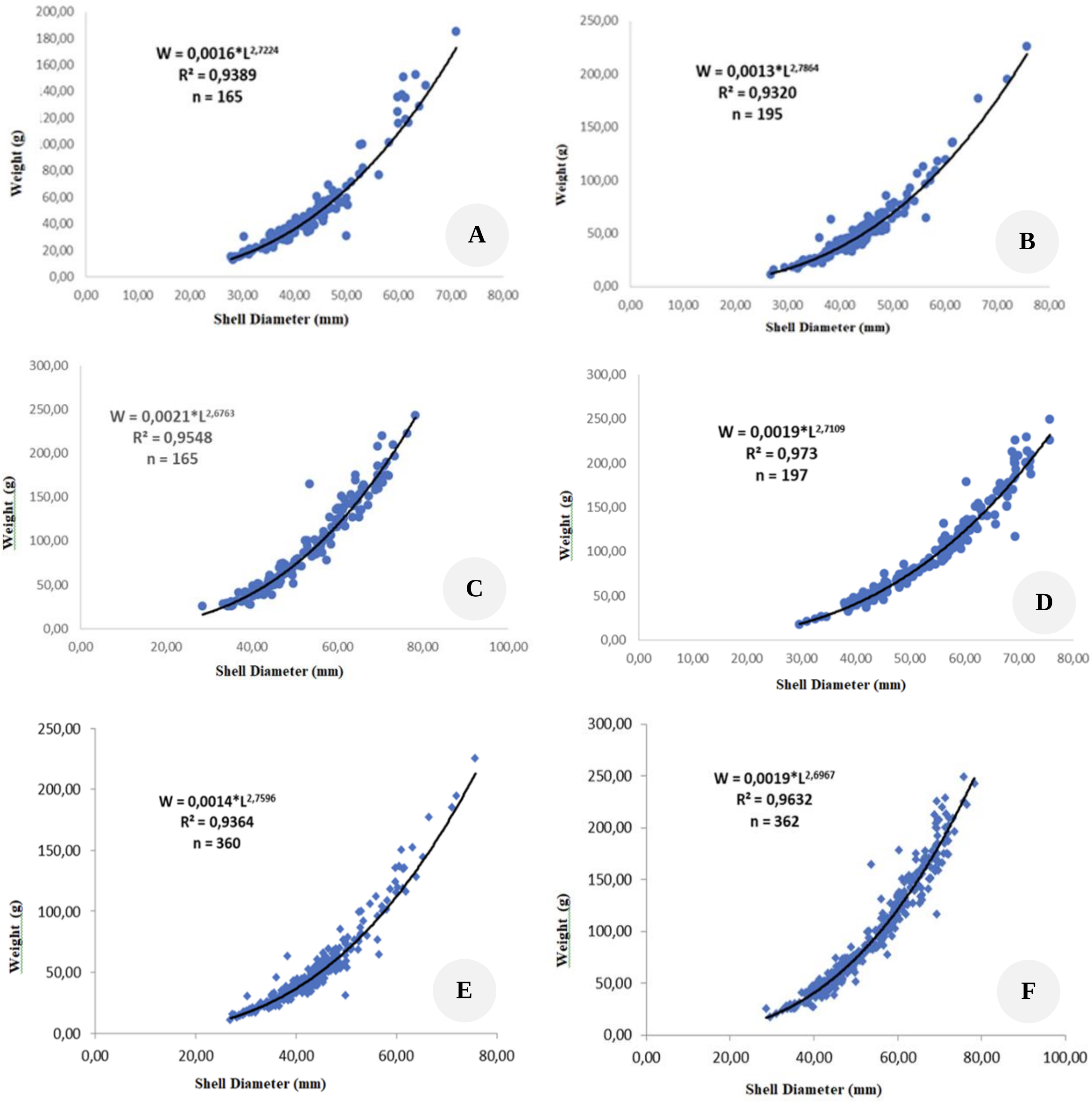

Figure 3. Correlation curve of shell of test diameter-body weight of sea urchin *Diadema setosum* during the research. A. Male for Jikumerasa station, B. Female for Jikumerasa station, C. Male for Pasir Putih station, D. Female for Pasir Putih station, E. All species (male + female) for Jikumerasa station, F. All Species (male + female) for Pasir Putih station

When compared with previous studies, similar patterns of negative allometric growth have been observed in other echinoderms. For example, Siddique and Ayub (2016) reported negative allometric growth in *D. setosum* populations in Malaysia, suggesting that this growth pattern may be common for the species across different geographical regions. Environmental factors such as feeding behavior, water temperature, and habitat conditions are believed to influence this trend. De Zoysa et al. (2017) also documented negative allometric growth in *Stomopneustes variolaris* from Sri Lanka, reinforcing the idea that similar environmental pressures may shape growth patterns across various echinoid species. In their study, *S. variolaris* collected from Beruwala, Tangalle, and Mt. Lavinia had mean test diameters of 6.70±1.26 cm, 6.54±2.71 cm, and 5.55±1.04 cm, respectively. Despite these insights, data on the length-weight relationships (LWRs) of the invasive sea urchin *D. setosum* remain limited in certain regions. One exception is the study by Şimşek et al. (2018), which reported a mean test diameter of 55.85 mm and a mean weight of 86.71 g for this species in Iskenderun Bay.

No significant differences in b-values between sexes or locations were found in this study ($p>0.05$), indicating that the growth patterns of *D. setosum* are consistent across the two study stations and between males and females. The high R^2 values (ranging from 0.9320 to 0.9732) for the regression equations further confirm a strong influence between test diameter and wet weight, while the r value ranging from 0.9699 to 0.9773.

The negative allometric growth observed in this study aligns with the findings of other researchers, such as De Zoysa et al. (2017), who reported similar LWR trends in echinoderm species. Table 2 provides a comparison of the LWR parameters from this study and other regions, highlighting that the b-values for *D. setosum* in Maluku fall within the range reported in other studies. The consistent negative allometric growth pattern of *D. setosum* observed in both Jikumerasa and Pasir Putih stations suggests that the species may have adapt to prioritize test diameter expansion, potentially as a defense mechanism. Further research exploring the impact of environmental parameters, feeding habits, and predator-prey interactions on growth dynamics in *D. setosum* could provide valuable insights into the ecological and physiological factors driving these patterns (Suryanti et al. 2024).

The present study revealed the b value (1.1773) was less than 3, which concludes that *D. setosum* from Iskenderun Bay were close to isometric growth in weight, because "b" exponent value usually lay between 2.5 to 4.0 and that depends on the age, sex or maturity of species (Uğurlu and Duysak 2022). Tomšić et al. (2010), Rahman et al. (2012, 2013), and De Zoysa et al. (2017) also reported the LWRs values of the current study were higher than the others (Table 3). This influence of negative allometric growth of *D. setosum* in sea urchins may be the environmental parameters and feeding habits (Rahman et al. 2012). De Zoysa (2017), *S. variolaris* sea urchin species from Beruwala, Tangalle and Mt. Lavinia in Sri Lanka has a test diameter of 6.70±1.26 cm, 6.54±2.71 cm and 5.55±1.04 cm, respectively. To till, there is limited data accessible on LWRs of the invasive sea urchin *D. setosum* in the Iskenderun Bay, except Şimşek et al. (2018), who recorded the mean length and weight of same species were 55.85 mm and 86.71 g, respectively.

Size distribution

The size distribution analysis revealed variation in test diameters and wet weights between the two study stations, highlighting subtle differences in growth patterns of *D. setosum*. At Station A, males exhibited test diameters from 27.79 to 71.09 mm and wet weights from 13.19 to 185.25 g, while females had test diameters ranging from 26.94 to 75.68 mm and wet weights between 11.39 and 226.03 g. In contrast, at Station B, males showed test diameters ranging from 28.60 to 78.28 mm and wet weights between 25.28 to 242.86 g, with females having diameters from 29.56 to 75.71 mm and wet weights from 17.74 to 249.37 g (Figure 4). These results show slightly larger test diameters and wet weights at Station B, suggesting more favorable environmental conditions, possibly due to better feeding grounds. The size frequency distribution of *D. setosum* reveals that the length ranges from 24.32 to 81.1 mm and weight from 27.14 to 185.11 g (Uğurlu and Duysak 2022). According to Rahman et al. (2012), respectively sea urchin *D. setosum* species from Pulau Pangkor, Peninsular Malaysia has an average test length and total weight of 59.66 mm and 101.68 g.

The frequency distributions of test diameter (TD), test height (TH) and wet weight (WW) were analyzed. The test diameter in *Echinometra mathaei* ranged between 19.0 and 77.2 mm with mean test diameter (Siddique and Ayub 2016). LWR and Condition factor of *E. mathaei* 165.46±6.3 mm he modal size-class in the population was 41-50 mm. The test height ranged between 9.5 and 40.1 mm with mean test height of 23.4±3.3 mm. The WW frequency distribution had a mean of 50.1±18.3 g and showed the modal size class to be 31-40 g. The maximum coefficient of variance (36.6%) was observed in the WW frequency distribution. The mean test diameter and weight of the population of *D. setosum* was 51.8±1.18 mm and 84.65±2.77 g, respectively. According to the Uğurlu and Duysak (2022), the most common test diameter in the sample from Iskenderun Bay was 65 mm with an average of 51.84±1.18 mm. The most frequent total body weight in the sample from Iskenderun Bay was 70 g and the average weight of the sample was 85.64±2.77 g. This difference may be due to the more favorable conditions in Station B, such as a higher availability of macroalgal food sources, allowing for larger body sizes. This is in accordance with the research of Elmasry et al. (2023) reported that when growing sea urchins have increased body weight, this indicates better physical condition. Most of the Mediterranean coast of Egypt shows poor physical status of different *P. lividus* populations which may be influenced by poor environmental conditions, low food availability, increased fishing pressure, high predation, or pollution.

Table 3. Relationship between test diameter and body weight for several sea urchin species between this study and other regions

Location	Species	N	a	b	R^2	Source
Eastern Adriatic, Kroasia	*Paracentrotus lividus*	1133	1.894	1.849	0.679	Tomšić et al. 2010
Pulau Pangkor, Malaysia	*Diadema setosum*	101	0.04	1.9049	0.6339	Rahman et al. 2012
Peninsular, Malaysia	*Stomopneustes variolaris*	355	0.004	2.4396	0.77	Rahman et al. 2013
Aegen Sea, Turki	*Paracentrotus lividus*	60	0.9953	-0.366	0.95	Kucukdermenei and Lok 2014
Mount-Lavinia, Beruwala,	*Stomopneustes variolaris*	43	0.9953	2.6472	0.9360	De Zoysa et al. 2017
Tangalle, Srilanka		99	0.9651	2.6536	0.8600	
		55	1.4665	2.4637	0.9402	
Iskenderun Bay, Turki	*Diadema setosum*	117	0.7917	1.1773	0.7079	Uğurlu and Duysak 2022
Panjang Island, Jepara District,	*Echinothrix calamaris*	41	0.012	2.575	0.9436	Suryanti et al. 2023
Central Java, Indonesia	*Diadema setosum*	41	0.004	2.202	0,9732	
Jikumerasa, Maluku	*Diadema setosum*	360	0.0014	2.7596	0.9364	This study
Pasir Putih, Maluku	*Diadema setosum*	362	0.0019	2.6967	0.9632	This study

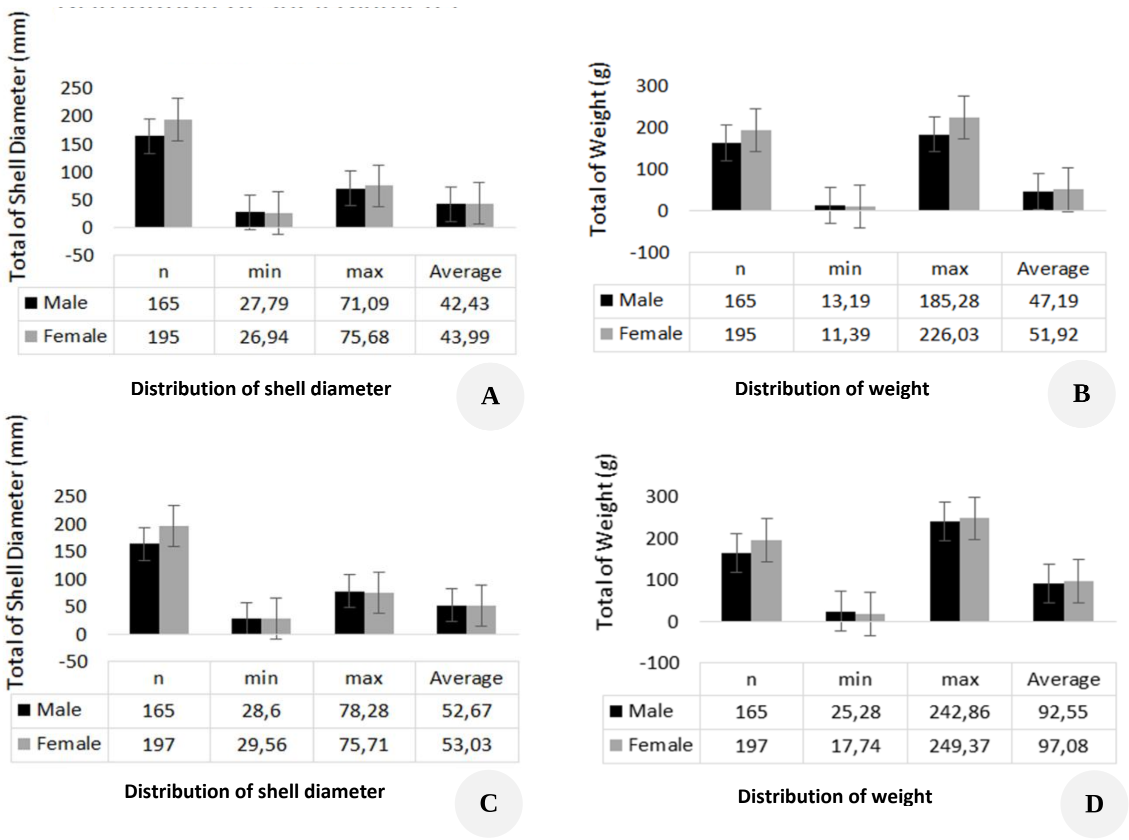

Figure 4. Distribution of shell or test diameter and weight *Diadema setosum* at Buru Island, Maluku, Indonesia. A-B. Station Jikumerasa, C-D. Station Pasir Putih. Error bar represents standard deviation. T-test at confidence level (0.05) significantly different

Differences in population size variation of *D. setosum* in this study as well as sea urchins in *E. mathaei*, reported by Siddique and Ayub (2016), displayed test diameters from 19.0 to 77.2 mm and wet weights between 13.31 and 121.60 g, suggesting that growth patterns can vary considerably across different sea urchin species, even within comparable habitats. *Paracentrotus lividus* from Çanakkale, as described by Köktürk (2014), had an average test diameter of 38.19 mm and wet weight of 36.12 g, much smaller than the values observed at both stations in this study. Furthermore, Sellem and Bouhaouala-Zahar (2021) reported that *P. lividus* on the Tunisian coast had a maximum test diameter of 67.9 mm, which also falls short of the larger sizes seen at Station B. Şimşek et al. (2018) documented average test diameters and wet weights of *D. setosum* in Iskenderun Bay at 55.85 mm and 86.71 g, respectively, showing a closer resemblance to the results from Station A, further emphasizing that environmental conditions, particularly food resources, likely play a critical role in determining the growth potential of these sea urchins.

Despite these size variations, statistical analyses showed no significant differences between the two stations, indicating that both populations of *D. setosum* grew under similar conditions. The two study stations have different physical characteristics of the habitat, even the environmental parameters are also likely to be different, causing differences in regarding size distribution. This study confirms that the population of *D. setosum* in the two different habitats with different physical characteristics of the environment will support its growth.

Fulton's condition factors

Fulton's condition factor (Kn) is a widely used metric in marine biology to assess the health and overall growth condition of organisms. It is calculated to evaluate whether an organism is well-nourished and growing optimally under prevailing environmental conditions. In this study, Kn values were determined for both male and female.

Table 4 presents the range of values and the mean condition factors for each gender and station. Condition factor of sea urchin *D. setosum* at station A ranged from 0.4308-1.9121±0.9667; SD: 0.1320 and at station B the condition factor ranged from 0.6408-1.8859±1.0059; SD: 0.1132, The Kn values across both stations were consistently close to 1.0, indicating that the *D. setosum* populations were in good health. Condition factors near or slightly above 1.0 suggest that the organisms are well-nourished, experiencing optimal growth conditions, and have adequate access to resources for both structural growth and reproductive development (Ujjania et al. 2012). The slightly higher Kn values observed in females could indicate reproductive investment, as females often allocate more energy towards gonadal development, contributing to higher overall body condition (Siddique and Ayub 2016).

Table 4. Range of values and average condition factors for *Diadema setosum* during the study based on gender and research location

Station	Sex	n (ind)	Min	Max	Mean	SD
Jikumerasa	Male	165	0.4625	1.7548	0.9942	0.1284
Jikumerasa	Female	195	0.6650	1.9121	1.0076	0.1290
Jikumerasa	Male + Female	360	0.4308	1.9121	0.9667	0.1320
Pasir Putih	Male	165	0.6816	1.8859	1.0081	0.1348
Pasir Putih	Female	197	0.6408	1.4287	1.0041	0.0915
Pasir Putih	Male + Female	362	0.6408	1.8859	1.0059	0.1132

The higher Kn values at Station B might reflect better habitat conditions, such as improved food availability and shelter, leading to a healthier population. Such findings are consistent with research showing that *D. setosum* populations exhibit higher condition factors in favorable environments, particularly coral reef ecosystems, where food resources and habitat complexity are abundant (Suryanti et al. 2023). Other studies on condition factors of sea urchins, such as *Echinometra mathaei*, have shown similar Kn values, ranging from 0.95 to 1.06 for males and 0.99 to 1.04 for females, without significant seasonal variation (Siddique and Ayub 2016). Additionally, *D. setosum* populations in other regions have exhibited condition factor peaks during the northeast monsoon, when food availability and reproductive activity are highest (Siddique and Ayub 2016).

Moreover, internal and external factors, such as age, sex, climate, and food availability, significantly influence condition factors (Das et al. 2021). In coral reef ecosystems, sea urchins play an important role in controlling microalgal populations and maintaining ecological balance (Suryono et al. 2017; Pérez-Portela et al. 2020). Understanding the condition factors of *D. setosum* can help in managing and conserving sea urchin populations, as it provides insights into population dynamics, resilience to environmental stress, and overall fish health (Brosset et al. 2015; Albo-Puigserver et al. 2021). Future research should further investigate seasonal influences, reproductive cycles, and environmental variables such as water temperature and nutrient availability to assess how these factors affect the condition of *D. setosum* populations. Comparing condition factors across different habitats will also help in understanding the impacts of environmental variability on sea urchin health and growth, especially in the context of climate change.

The findings from this study indicate that *D. setosum* populations at both Station A and Station B exhibit negative allometric growth, where test diameter increases at a faster rate than wet weight. The high Fulton's condition factors observed in both populations suggest that the sea urchins are thriving in their respective environments, although minor differences in size distribution and condition factors point to potential variations in habitat quality.

The results also highlight the importance of localized environmental factors, such as food availability and substrate composition, in shaping the growth dynamics of *D. setosum*. Further research is needed to explore the influence of these factors on the reproductive cycles, feeding behavior, and long-term population health of *D. setosum* in different habitats across the Buru District. Research on the population dynamics and stock estimation of *D. setosum* needs to be conducted as a follow-up study, including its management strategy in the regulation of fishing and aquaculture efforts.

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