Comparative Analysis of the Distribution and Composition of Grouper Fish (Family Serranidae) in the Coral Reef Ecosystems of Batanta and Salawati Islands, Raja Ampat

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Abstract. The Coral Reef Ecosystems of Batanta and Salawati Islands, Raja Ampat is a critical habitat for grouper species (Family Serranidae), which play essential roles in coral reef ecosystems. This study assessed the species composition, abundance, and biomass of groupers across 12 sampling sites in the region. Using the Underwater Visual Census (UVC) method, we identified 14 grouper species, with *Plectropomus areolatus* classified as vulnerable by the IUCN. Our results revealed an average grouper abundance 17.33 ind/350m^2 for Batanta and 18.33 ind/350m^2 for Salawati. An average biomass the mean biomass 4288.16 gr/350m^2 for Batanta and 1881.10 gr/350m^2 for Salawati, indicating substantial biomass within the area. Statistical analyses, including the Kruskal-Wallis test and t-tests reveal no significant difference in abundance between the two locations, as indicated by the non-significant p-value ($p = 0.87$). Correlation analysis demonstrated a very strong positive relationship between grouper abundance and biomass, suggesting that the Anthropogenic activities have not yet significantly impacted the grouper populations in Salawati and Batanta. The study emphasizes the importance of habitat protection and sustainable fisheries management to support grouper populations. Additionally, ongoing monitoring and adaptive management strategies are necessary to ensure the long-term health of grouper populations and the coral reef ecosystems they inhabit.

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1 Introduction

Coral reef ecosystems, known for their high biodiversity and complex habitat structures [1,2], are critical for the survival of various marine species, particularly reef-associated fishes like groupers (Family Serranidae). Groupers (Family Serranidae) are critically important both ecologically and economically [3,4]. Groupers play a significant ecological role as top predators, helping to regulate fish populations and maintain the health and balance of reef ecosystems [5]. As apex predators in coral reef ecosystems, Grouper help regulate the balance of species by controlling prey populations [6], which maintains ecosystem stability and biodiversity [7]. Their predation helps prevent the overgrowth of certain species, supporting the health and resilience of coral reefs [8]. Economically, groupers are highly valued in commercial and subsistence fisheries worldwide, contributing significantly to the livelihoods of coastal communities [9]. Groupers are also sought after in the live reef food fish trade [10], and previous studies have highlighted groupers are among the most highly valued reef fishes and increasingly important in international trade [11].

Recent research has emphasized the vulnerability of groupers, as many species have long lifespans, late sexual maturity, and site fidelity, making them particularly vulnerable to overfishing and habitat degradation [12–14]. The protection and sustainable management of groupers are thus essential not only for maintaining ecosystem functions but also for ensuring long-term economic benefits for fisheries and local communities dependent on marine resources, prompting a need for detailed studies on their distribution and population dynamics, particularly within protected areas [15]. In addition, understanding the ecological function patterns and habitat preferences of different grouper species can help inform targeted conservation strategies. These efforts are critical in mitigating the impacts of overexploitation and habitat loss, ensuring the resilience of grouper populations and the ecosystems they support. Enhanced monitoring and the implementation of science-based management measures, such as marine protected areas (MPAs) and regulated fishing practices, are crucial for the long-term sustainability of grouper species [16] .

The Salawati and Batanta are part of Raja Ampat Archipelago area is located to the west of Papua Island in the West Papua Province, specifically in the Bird's Head region of Papua. Based on Law No. 26 of 2002, Raja Ampat was declared a new regency with Waisai as its capital. The Raja Ampat Regency consists of four major islands: Waigeo, Batanta, Salawati, and Misool. Geographically, the Raja Ampat Archipelago lies between 01°15' N - 2°15' S and 129°10' - 121°10' E, covering a total area of approximately 1,026,540 hectares. About 85% of the archipelago is marine, consisting of 610 uninhabited islands and 35 islands that are home to indigenous communities, comprising 10 ethnic groups. This marine region has been designated as a Marine Conservation Area (Marine Tourism Park/TWP) under Decree No. KEP.36/MEN/2014 by the Ministry of Marine Affairs and Fisheries. Raja Ampat Archipelago area also, located within the Coral Triangle, is a region of high marine biodiversity and is designated as a conservation zone aimed at preserving coral reef habitats and their associated species. The Coral Triangle location is of immense ecological significance due to their high biodiversity and the critical role they play in supporting reef-associated species, such as groupers (Family Serranidae). Groupers serve as apex predators in these ecosystems, helping to regulate fish populations, maintain biodiversity, and sustain the health of coral reefs. Despite their importance, groupers in The Coral Triangle location, especially in Salawati and Batanta are also face threats from overfishing, habitat degradation, and climate change, which jeopardize both their populations and the resilience of coral reef ecosystems. This study aims to fill a significant knowledge gap by assessing the distribution, abundance, and biomass of grouper species across 12 sampling sites in the Salawati and Batanta area. By analyzing the spatial variability in grouper populations between different clusters and examining key ecological metrics such as abundance and biomass, this research

provides critical baseline data for the development of targeted conservation strategies. The study also evaluates the conservation status of the observed species and explores potential environmental and anthropogenic factors influencing grouper populations in the Salawati and Batanta area. Through comprehensive field surveys and statistical analyses, this research will contribute to a better understanding of the ecological dynamics of grouper populations in coral reef habitats. The findings will be essential for designing effective conservation strategies, particularly for species that are vulnerable or experiencing population declines. By integrating ecological data with conservation needs, this study underscores the importance of preserving grouper populations to maintain the overall health and resilience

2 Methods

2.1 Research Site Location

A total of 12 sampling sites were selected across the Salawati and Batanta Area. Table 1 provides a comprehensive overview of the sampling sites within the Salawati and Batanta regions of Raja Ampat, categorized into two distinct clusters based on geographic location. The Salawati cluster includes six sampling stations, primarily situated around the northern and eastern shores of Salawati Island, including key locations such as Warir Island and Jefman Island. The Batanta cluster encompasses six stations along the eastern and northeastern shores of Batanta Island, covering areas such as Peev Island, Tanjung Alauket, and Insaway Island. The table details the exact geographic coordinates (longitude and latitude) of each station in degrees, minutes, and seconds (DMS) format, ensuring precise location tracking for ecological and statistical analyses. These clusters serve as the basis for comparing the distribution and composition of grouper fish (Serranidae) between the two regions, allowing for an in-depth examination of how local environmental factors and habitat characteristics may influence species diversity and abundance in these coral reef ecosystems.

Table 1. The sampling sites within the Salawati and Batanta Area were divided into two categories based on clusters

Site Code	Location	Longitude	Latitude	Cluster
SWBC.01	North of Warir Island, Salawati	131° 07' 59.23" E	0° 59' 41.14" S	Salawati
SWBC.02	Jefman Island, Salawati	131° 07' 29.24" E	0° 55' 33.92" S	Salawati
SWBC.03	Mataan Island, Salawati	131° 08' 40.78" E	0° 57' 30.92" S	Salawati
SWBC.04	Kapatlap Island, Salawati	131° 03' 28.73" E	0° 55' 35.90" S	Salawati
SWBC.05	Senapan Island, Salawati	131° 01' 36.80" E	0° 53' 41.46" S	Salawati
SWBC.06	Waipelet Village, Salawati	130° 59' 30.48" E	0° 55' 15.46" S	Salawati
SWBC.07	East of Batanta Island	130° 52' 50.23" E	0° 50' 45.92" S	Batanta
SWBC.08	Northeast of Batanta Island	130° 54' 37.12" E	0° 47' 59.28" S	Batanta
SWBC.09	Tanjung Alauket, Batanta	130° 51' 08.28" E	0° 45' 42.23" S	Batanta
SWBC.10	Peev Island, Batanta	130° 46' 15.53" E	0° 45' 18.83" S	Batanta
SWBC.11	Run Island, Batanta	130° 40' 09.44" E	0° 46' 28.16" S	Batanta
SWBC.12	Insaway Island, Batanta	130° 38' 41.39" E	0° 48' 07.20" S	Batanta

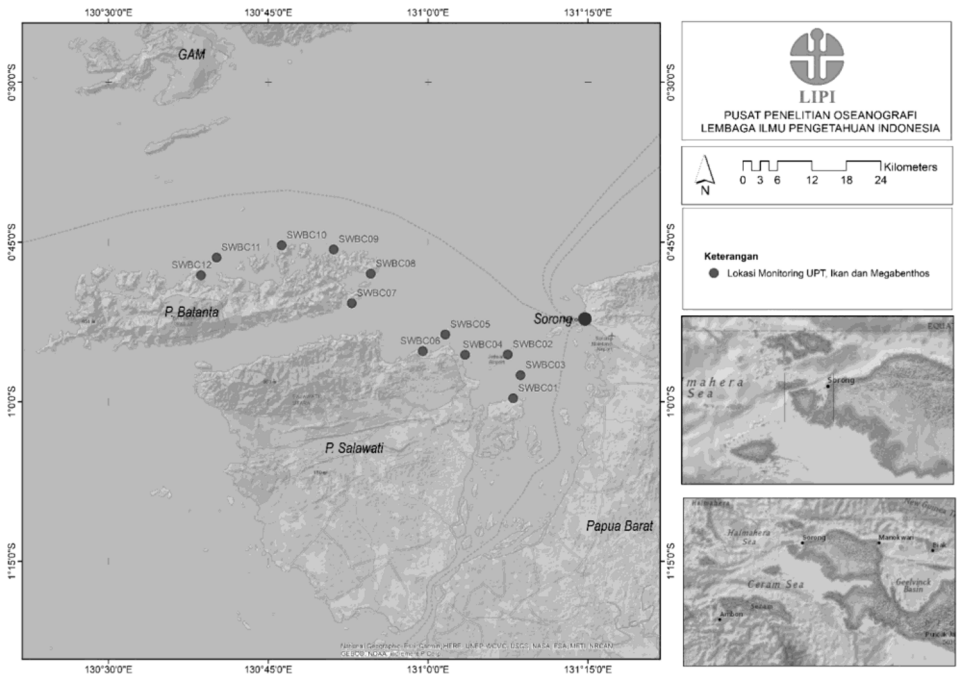

Fig. 1. The sampling sites within the Salawati and Batanta Area were divided into two categories based on clusters

2.2 Reef Fish Collecting Data

Coral reef fish biodiversity monitoring was conducted using the Underwater Visual Census (UVC) method, as developed by English (1994). UVC is a widely used global technique for monitoring coral reef fish, but it is also highly effective for surveying other marine organisms. This method is particularly valuable for reef health monitoring programs and can significantly aid in management and conservation decision-making [17,18]. The Underwater Visual Census (UVC) method, widely used for monitoring reef fish populations, was employed in this study to assess the species composition, abundance, and biomass of groupers (Family Serranidae) in the Salawati and Batanta area. The UVC technique is particularly effective for assessing reef-associated fish populations, providing reliable data on species distribution and density. The UVC method applied with a belt transect follows the standard procedures of the Reef Health Monitoring Program [19–21]. At each site, a belt transect was deployed to standardize the area surveyed. Each transect was 70 meters long and 5 meters wide, with an observation width of 2.5 meters on either side of the transect line. This resulted in a total surveyed area of 350 square meters per transect. The transect length and width followed the standardized protocols set by the Reef Health Monitoring Program (RHM) (English, 1994).

A trained and certified divers swam along the transect line and visually identified and counted all grouper species within the 5-meter-wide transect area. Divers maintained a slow, steady pace to minimize disturbance to the fish and ensure accurate count and recorded the number of individuals of each grouper species observed, along with estimates of their sizes. To estimate biomass, the divers also recorded the size (total length) of each fish observed during the transect survey. Fish sizes were categorized into predefined size classes (e.g., 0-5 cm, 5-10 cm, etc.) to facilitate the estimation of biomass based on length-weight

relationships. Biomass estimates were calculated using established length-weight relationships for each grouper species. These relationships were based on species-specific coefficients available in the literature (fishbase.org). The total biomass for each species was computed for each transect, and the results were extrapolated to estimate biomass per hectare. While this study provides valuable insights into the distribution, abundance, and biomass of grouper species in the Salawati and Batanta area. The abundance refers to the total number of individual groupers per hectare, while biomass refers to the total weight of groupers per hectare several limitations should be considered when interpreting the findings. The data collection was conducted during April - Mei 2021 and collecting in diurnal time. Environmental variables such as water quality, reef health, and human activities (e.g., fishing pressures, tourism) were not directly measured during the survey. Additionally, climate change-related factors, such as ocean warming and acidification, which are known to affect coral reef ecosystems, were not assessed in this study.

2.3 Analysis

The analysis of grouper species in this study is based on species ranking determined by the number of individuals recorded throughout the research period, providing insight into the most abundant species within the study area. To compare grouper abundance across two distinct location categories, Salawati and Batanta coral reef ecosystem area, a Kruskal-Wallis test was employed. This non-parametric test was also applied to assess differences in grouper biomass between the two clusters. This test is appropriate when comparing groups that have different sample sizes or when the data are not normally distributed. In our study, the Kruskal-Wallis test was used to compare grouper abundance and biomass between Salawati and Batanta coral reef ecosystem area. These statistical methods are fundamental in ecological research for drawing meaningful conclusions from data, enabling effective conservation strategies and management decisions based on the findings. Additionally, a correlation analysis between grouper abundance and biomass was conducted to determine whether there are signs of impact on tourism a destructive fishing practices in the Salawati and Batanta coral reef ecosystem area. A significant correlation between low biomass and high abundance could indicate overfishing, suggesting that groupers may be subject to unsustainable harvesting pressures. This multi-layered analysis helps provide a clearer understanding of species distribution, ecosystem health, and the potential impacts of fishing activities on grouper populations in the conservation area.

3 Result and Discussion

3.1 Species of Groupers (Family Serranidae) in the The Salawati and Batanta area

Table 2 provides a detailed summary of various grouper species, listing their common names, conservation status according to the IUCN Red List, and their listing on CITES. The IUCN statuses range from LC (Least Concern) to VU (Vulnerable), with most species classified as Least Concern, indicating that they are not currently facing a significant risk of extinction. However, one species, *Plectropomus areolatus* (Squaretail coralgrouper), is listed as Vulnerable (VU), suggesting it faces a higher risk of extinction in the wild. None of the species are listed on the CITES (Convention on International Trade in Endangered Species) appendices, indicated by the NE (Not Evaluated) designation. This means that, while some species may be of concern locally, they are not subject to international trade regulations aimed at protecting endangered species. The species listed, including *Plectropomus* and

Cephalopholis, are significant components of coral reef ecosystems in Salawati and Batanta area and are commonly known by various names such as the Spotted coralgrouper, Leopard coralgrouper, Highfin coralgrouper, Peacock hind, Bluespotted hind, Darkfin hind and Freckled hind, highlighting their ecological and economic importance in tropical marine environments. The data emphasizes the need for continued monitoring, especially for species like *Plectropomus areolatus*, which may require more targeted conservation efforts.

Table 2. presents the species of groupers (Family Serranidae) found in the Salawati and Batanta area, highlighting those whose current Red List status differs from their original classification. The abbreviations used are as follows: DD = Data Deficient; LC = Least Concern; NE = Not Evaluated; VU = Vulnerable based on fishbase.org (access; Oktober 2024)

Species	Common names	IUCN	CITES
Aethaloperca rogaa	Redmouth grouper	LC	NE
Anyperodon leucogrammicus	Slender grouper	LC	NE
Cephalopholis argus	Peacock hind	LC	NE
Cephalopholis cyanostigma	Bluespotted hind	LC	NE
Cephalopholis microprion	Freckled hind	LC	NE
Cephalopholis urodeta	Darkfin hind	LC	NE
Cromileptes altivelis	Chromileptes altivelis	DD	NE
Diploprion bifasciatum	Barred soapfish	LC	NE
Epinephelus merra	Honeycomb grouper	LC	NE
Plectropomus areolatus	Squaretail coralgrouper	VU	NE
Plectropomus maculatus	Spotted coralgrouper	LC	NE
Plectropomus leopardus	Leopard coralgrouper	LC	NE
Plectropomus oligacanthus	Highfin coralgrouper	LC	NE
Variola louti	Yellow-edged lyretail	LC	NE

3.2 Abundance-Based Ranking of Grouper Species

This Figure 2. (left) presents the abundance-based ranking of grouper species (Family Serranidae) recorded in the coral reef ecosystem of Salawati, Raja Ampat. The horizontal axis (Frequency) represents the number of individuals observed for each species, while the vertical axis lists the species in order of percentile rank based on their abundance. The dashed blue line marks the mean abundance of 7.86 individuals across species. Species such as *Cephalopholis microprion* and *Cephalopholis cyanostigma* have the highest frequencies, indicating they are the most abundant in the sample. In contrast, species like *Aethaloperca rogaa* and *Cromileptes altivelis* are among the least abundant. Statistical analysis reveals a t-value of 1.95 (df = 13, p = 0.07), suggesting a trend towards significance but not enough to reject the null hypothesis at the conventional 5% significance level. The Hedges' g effect size of 0.49 indicates a moderate difference in abundance among the species. The log Bayes Factor (log BF_{01} = -0.16) provides weak evidence against the null hypothesis, suggesting inconclusive support for the observed differences. The 59.5% credible interval (CI_{595}) around the Bayes Factor (-1.38, 1.82) and the standard error of 0.71 reflect some degree of uncertainty in the results. Overall, the figure highlights the distribution and abundance

patterns of different grouper species, providing insight into species dominance and rarity within the ecosystem. In comparison the presents the abundance-based ranking of grouper species (Family Serranidae) recorded in the coral reef ecosystem of Batanta, Raja Ampat (Figure 2 – right) show the species *Cephalopholis microprion* the highest abundance, whereas *Cephalopholis urodeta* exhibits the lowest. The statistical test results t-value of 3.21 (df = 13, p = 6.89e-03) demonstrate a significant variation in abundance across species. The Hedges' effect size of 0.81, with a 95% confidence interval of [0.21, 1.38], suggests a moderate to strong difference in species abundance. This ranking provides valuable insight for conservation efforts by identifying dominant species and potentially highlighting those that may require enhanced protection or monitoring due to their lower abundance.

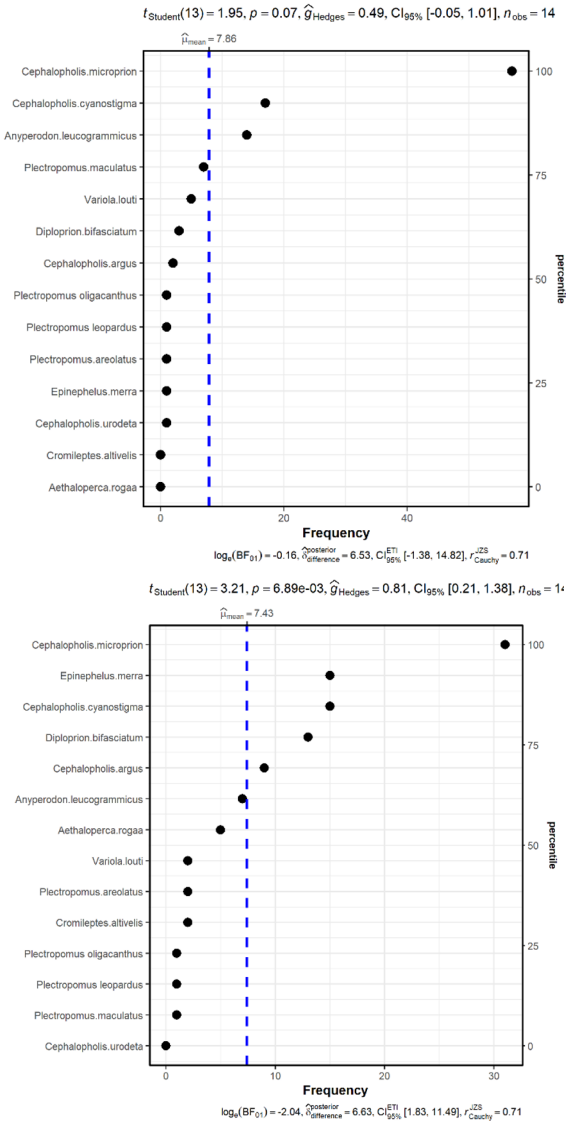

Fig. 2. Abundance-Based Ranking of Grouper Species in the Salawati (right) and Batanta (left) area

3.3 Grouper Abundance and Biomass in the Two Cluster Region of the Salawati and Batanta area

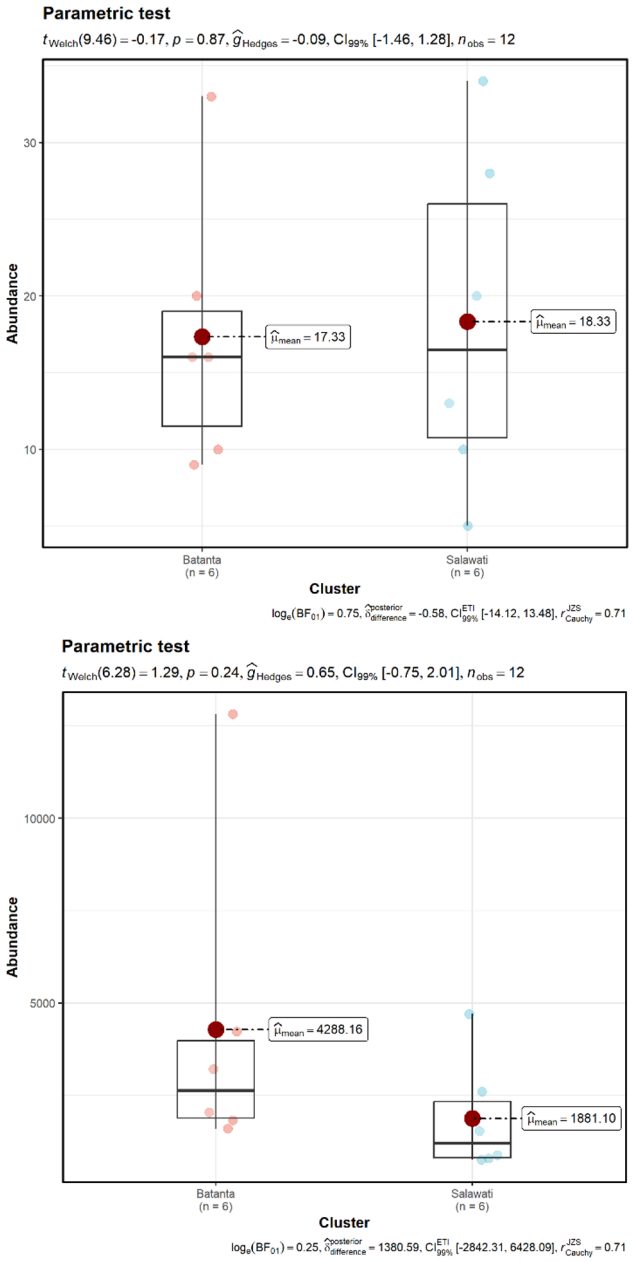

Fig. 3. Kruskall-Wallis analysis comparing grouper abundance (left) and biomass (right) between two cluster locations: Batanta and Salawati

The Figure 3 shows a comparison of grouper species abundance between two locations, Batanta and Salawati, using Welch's t-test. The y-axis represents the abundance, while the x-axis distinguishes the two locations. Each boxplot illustrates the spread of abundance data

within each location, with individual data points shown as dots. The red circles indicate the mean abundance, which is 17.33 ind/350m^2 for Batanta and 18.33 ind/350m^2 for Salawati. The boxes and whiskers represent the range of values, with Batanta displaying more variability than Salawati. The statistical analysis reveals no significant difference in abundance between the two locations, as indicated by the non-significant p-value ($p = 0.87$) and a small effect size (Hedges' = -0.09). The 95% confidence interval [-1.46, 1.28] further supports the lack of meaningful difference. Additionally, the Bayesian analysis ($\log_e (BF_{01}) = 0.75$) indicates weak evidence for a difference. Overall, the abundance of grouper species is similar between Batanta and Salawati, with no significant variation observed between the two areas. The condition biomass form Salawati and Batanta was shown different result. The figure presents a parametric test comparing the biomass of grouper species between two clusters Batanta and Salawati (Figure 3 – left) indicating the mean biomass 4288.16 gr/350m^2 for Batanta and 1881.10 gr/350m^2 for Salawati. The boxes and whiskers depict the interquartile range and the variability of biomass, with Batanta showing a much wider spread than Salawati. the biomass between Batanta and Salawati shows no statistically significant difference, although Batanta has a higher mean biomass and a wider range. The results suggest that the biomass of grouper species in the two regions is relatively similar, with no clear evidence that one region supports a higher biomass than the other. This could reflect similar environmental conditions or resource availability in both areas.

3.4 Correlation Between Grouper Biomass and Abundance

Figure 5 illustrates the correlation between biomass and density (abundance) for each site location in Salawati (Figure 5 - left) and Batanta (Figure 5 – right) coral reef ecosystem area. This figure illustrates a positive and significant relationship between grouper abundance (x-axis) and biomass (y-axis) in the Salawati region, based on six data points (SWBC01–SWBC06). The blue line represents the trend, showing that as the number of groupers increases, their total biomass also rises. The shaded area around the line indicates the confidence interval, suggesting some uncertainty but reinforcing the general trend. A Pearson correlation coefficient of 0.85 demonstrates a strong positive correlation, and the relationship is statistically significant ($p=0.03$). This indicates that the increase in grouper numbers is strongly associated with an increase in their biomass. The Bayesian analysis ($\log_e 10(BF_{01}) = -1.09$) suggests weak evidence against the null hypothesis, but the overall statistical evidence strongly supports the observed correlation. These results highlight the ecological link between grouper abundance and biomass in the Salawati region. In comparison figure 5 (right) presents the correlation between grouper biomass (y-axis) and abundance (x-axis) for six samples (SWBC07 to SWBC12) in the Batanta region. The blue line represents the linear regression model indicating a positive relationship between the two variables. The Pearson correlation coefficient ($r_{Pearson}=0.9$) suggests a very strong positive correlation, supported by a statistically significant p-value of 0.01. The confidence interval (95% CI [0.36, 0.99]) around the correlation indicates a high level of certainty in the observed trend. The shaded region around the regression line represents the confidence band, illustrating the degree of variability. The Bayesian factor analysis ($\log_e 10(BF_{01}) = -1.57$) implies weak evidence against the null hypothesis, although the posterior Pearson correlation ($r_{posterior}=0.70$) further supports the existence of a meaningful relationship. This analysis indicates that as the abundance of groupers increases in Batanta, their total biomass also rises in a strongly correlated manner, highlighting the tight coupling between population size and biomass in this region

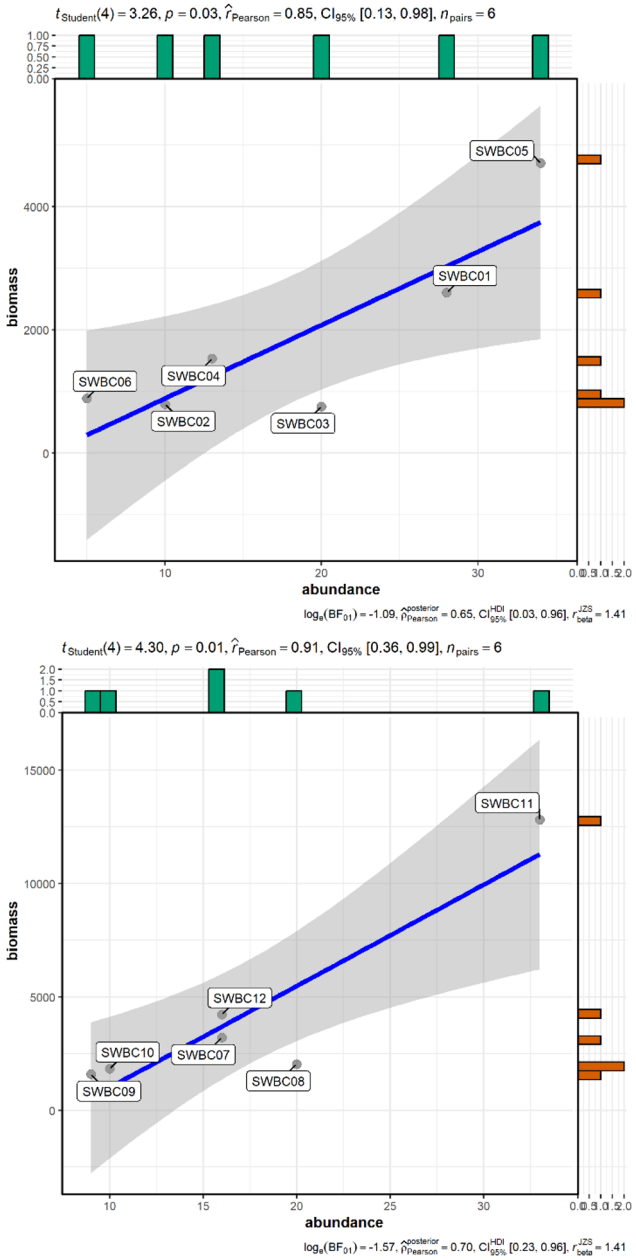

Fig. 5. Correlation analysis between grouper biomass and abundance (density).

3.5 Discussion

The study of grouper species (Family Serranidae) in Salawati and Batanta area provides crucial insights into species diversity and conservation needs. The majority of the species listed in Table 2 are classified as Least Concern (LC) on the IUCN Red List, indicating that they are not currently facing significant global threats. However, the presence of *Plectropomus areolatus*, which is classified as Vulnerable (VU), highlights the importance

of localized conservation measures. The fact that none of the species are listed under CITES (Convention on International Trade in Endangered Species) suggests that international trade may not yet pose a significant threat to these species, though regional conservation efforts may still be required to prevent overexploitation [22]. Continued monitoring is essential to ensure that population levels remain stable, particularly for species like *Plectropomus areolatus*, which may be more sensitive to environmental changes or fishing pressures [23,24].

The distribution of grouper species in the Batanta and Salawati coral reef ecosystem area, where 14 species were identified, is heavily influenced by the part of the coral triangle region in Indonesia, renowned for their extraordinary marine biodiversity. The area hosts pristine coral reefs and marine life, attracting divers and eco-tourists worldwide. Raja Ampat has become one of the world's premier diving destinations due to its remarkable marine diversity and beauty. With increased tourism infrastructure development, such as dive resorts, liveaboard boats, and tourism services, there has been a significant rise in human activity in these seawaters. This growth in tourism can have both positive and negative impacts on local marine ecosystems, particularly on key fish species like grouper. In contrast, Saleh Bay in West Nusa Tenggara, with 21 species of grouper reported [25], and the Simeulue and Banyak Islands, which host 20 species belonging to six genera, benefit from more complex marine environments [26]. These areas typically feature deeper waters, diverse reef structures, and greater habitat heterogeneity, which provide a wider array of ecological niches for grouper species to occupy.

The observed decline in diversity among grouper species (Family Serranidae) in Salawati and Batanta is likely associated with the rising levels of marine tourism in the region. Although the number of grouper species observed was relatively moderate, the analysis indicates that anthropogenic activities have not yet significantly affected the grouper populations in Salawati and Batanta. However, we believe that if marine tourism activities are not properly regulated and controlled, they could negatively impact grouper populations in the future, affecting both their abundance and biomass. Several previous research was shown the increase in tourism frequently results in significant ecological disruptions, particularly through habitat degradation and overfishing [17,21,27–31]. As tourist activity intensifies, the pressure on local marine ecosystems especially coral reefs, which serve as critical habitats for grouper fish also escalates [32–34]. Activities such as boat anchoring, snorkeling, and diving can cause physical damage to coral formations, leading to habitat loss that adversely affects grouper populations [35,36]. Furthermore, heightened fishing pressure, particularly on commercially valuable species, may contribute to overfishing, resulting in declines in both the abundance and diversity of grouper species [37]. The expansion of tourism is often accompanied by the adoption of unsustainable fishing practices, such as spearfishing, which disproportionately impact larger, mature individuals essential for maintaining population stability. Collectively, these factors indicate that increased marine tourism in Salawati and Batanta may significantly contribute to the observed reductions in grouper diversity, highlighting the urgent need for targeted conservation measures to mitigate these adverse effects on vital marine populations. Ongoing monitoring and the implementation of sustainable tourism practices are crucial for preserving grouper diversity in these essential ecosystems.

In contrast, the waters of Salawati and Batanta display relatively favorable conditions regarding abundance and biomass, largely due to the local cultural practice of Sasi in Raja Ampat area [38]. This traditional resource management strategy is crucial for protecting grouper populations and ensuring the sustainability of their biomass. Sasi involves implementing temporary closures or restrictions on fishing activities for specific species or during designated periods, allowing fish populations to recover and reproduce, thus promoting sustainability in local fisheries [38–43]. The enforcement of Sasi has proven

particularly effective in maintaining grouper abundance, as these species are often subjected to substantial fishing pressure due to their economic significance. By limiting fishing during critical spawning times or in designated areas, Sasi ensures that a sufficient number of individuals remain for reproduction, which helps sustain or even increase biomass over time. This approach not only facilitates the recovery of grouper populations but also enhances the overall health of the marine ecosystem [39,41,43]. Furthermore, Sasi embodies a comprehensive understanding of the interdependence between ecological health and community welfare . Local fishers acknowledge that their livelihoods depend on the marine environment's health, making cultural practices like Sasi integral to sustainable resource management and the preservation of marine biodiversity for future generations. Additionally, the Sasi system promotes community engagement and collaboration in marine conservation efforts, with local stakeholders actively involved in monitoring and enforcing regulations, thereby fostering increased awareness and stewardship of marine resources. While these positive outcomes are noteworthy, challenges persist, as rising tourism and external fishing pressures may compromise the effectiveness of traditional practices like Sasi if not adequately managed. Consequently, integrating contemporary conservation strategies with traditional practices is vital to ensuring the continued protection of grouper populations.

4 Conclusion

This study presents a thorough evaluation of grouper species and their populations within Coral Reef Ecosystems of Batanta and Salawati Islands, Raja Ampat. Among the species observed, *Plectropomus areolatus* (Squaretail coralgrouper) was classified as Vulnerable (VU), while *Cephalopholis microprion* had the highest recorded abundance in both Salawati and Batanta. The statistical analysis reveals no significant difference in abundance between the two locations and also the biomass between Batanta and Salawati shows no statistically significant difference, although Batanta has a higher mean biomass and a wider range. Correlation analysis demonstrated a very strong positive relationship between grouper abundance and biomass, suggesting that the Anthropogenic activities have not yet significantly impacted the grouper populations in Salawati and Batanta.

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