



Marine
CONSERVATION
PHILIPPINES

Semiannual Report

SIATON



OCT 2025

marineconservationphilippines.org

EXECUTIVE SUMMARY

Marine Conservation Philippines Report Siaton - May - August 2025



Marine Conservation Philippines (MCP) conducted a total of **890 surveys** across four survey methodologies (Fish, Substrate, Invertebrates, and Predation) across the three municipalities we monitor (Zamboanguita, Siaton and Santa Catalina) between June and August 2025. With **871 surveys** conducted in the previous season (March-May 2025), this **brings the total for this reporting period to 1,761 surveys. This represents a 23% increase in the number of surveys** from the previous report.

	Fish	Substrate	Invertebrates	Predation
Number of Surveys	425	455	455	426

The chart below presents the average fish biomass for the latest survey season at the four sites monitored in Siaton Municipality, specifically highlighting the density and average size of fish in each of the reefs (Figure 1). Given our focus on food security, we have specifically selected fish families of commercial interest for analysis. **The average commercial biomass for Siaton was ~14kg per 150m².**

The highest average commercial biomass was recorded at Kookoos, at 24.31 kg per 150 m². The highest-performing MPA was Salag, increasing from the previous reporting period to 11.6 kg/150 m². The lowest values were at Andulay, which was recorded as having 5.6 kg/150 m². This is still an increase from the last season.

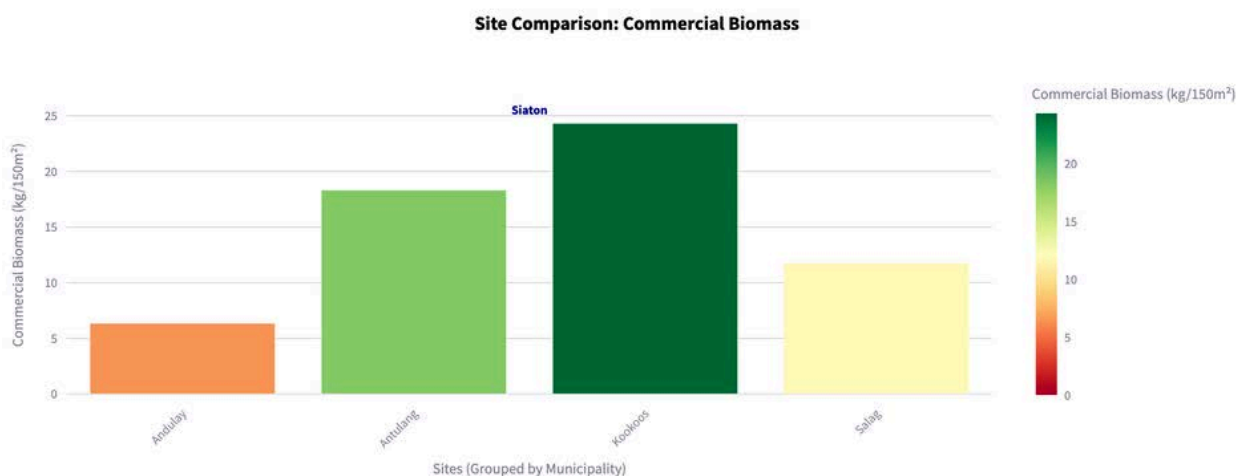


Figure 1. Commercial fish biomass (kg per 150m²) across all survey sites in the Siaton Municipality, June–August 2025. . Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness.

Hard coral cover is an excellent indicator of the overall health of a coral reef, as it is this type of coral that builds the long-term physical structure of the reef. The average hard coral cover in Siaton was 30.5%, compared to 41% in 2017, when monitoring began. This is **classified as moderate hard coral cover**, according to the Australian Institute of Marine Science. Interestingly the highest coral cover was recorded at Kookoos a non-MPA at ~36% (Figure 2).

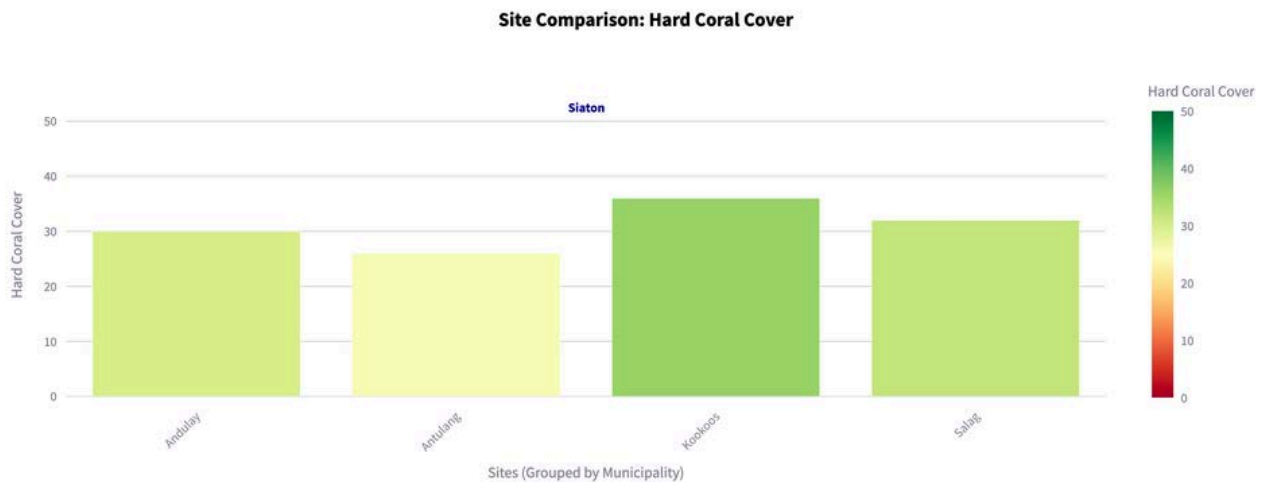


Figure 2. Average hard coral cover across survey sites in the Siaton Municipality June–August 2025 Data is expressed as average percentage cover.

Of the hard coral present, 98% was recorded as healthy, with approximately 2% observed to be affected by bleaching. Predation and silt were present, but only in small amounts. Globally, ocean temperatures are rising in response to human-caused climate change, and incidences of bleaching are becoming increasingly widespread and severe. However, it is interesting to note that the waters off the eastern and southern coasts of Southern Negros can be as much as 1 degree Celsius cooler than the waters of the Sulu Sea to the west, which does afford the area some natural protection against bleaching events. Events of bleaching in the municipality have gradually reduced since 2022, when 18% of hard corals were recorded as bleaching.

Surveys were not conducted in July for the Kookoos and Salag sites due to strong winds that prevented access to the sites, resulting in a minor data gap for this period. Adverse weather conditions, including Typhoon Crising in July and Tropical Depression Isang in August, also influenced fieldwork during this monitoring period.

1716
**SURVEYS
COMPLETED**

23%
Increase



30.5%
**HARD CORAL
COVER**

11.3%
Increase



14.5 KG
**COMMERCIAL
BIOMASS**

112.9%
Increase



Using science to understand how local and global pressures affect marine ecosystems, we empower, engage, and build local and national capacity to reduce and adapt to these pressures, aiming for a sustainable future for the Philippine people and environment.



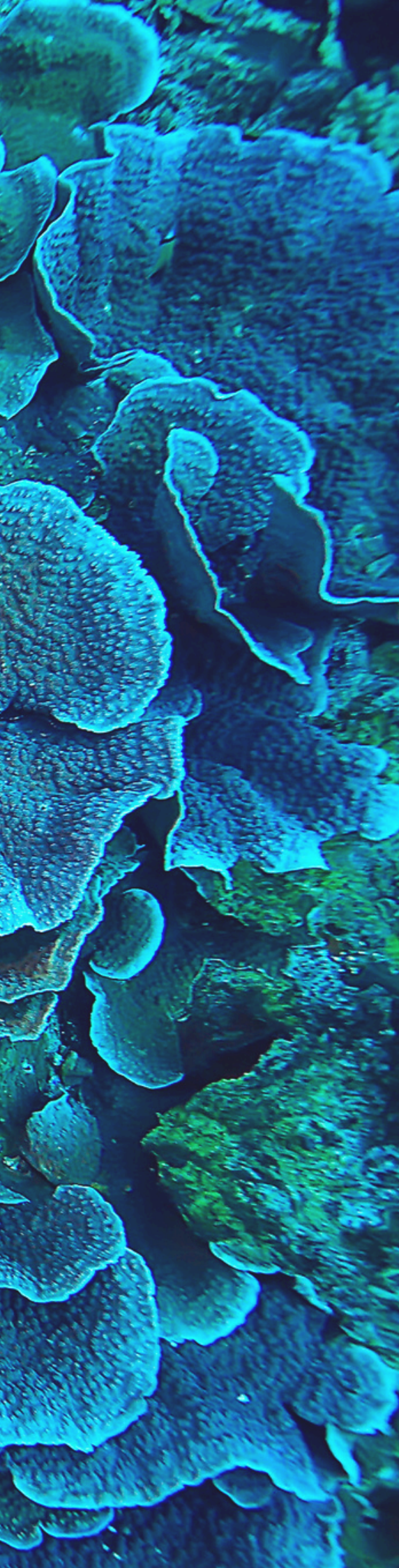


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MONITORING AND SCIENCE AT MCP



The Philippines, situated in the heart of the Coral Triangle, boasts the highest number of Marine Protected Areas (MPAs) of any country in the world, with approximately 1,600-1,800 protected areas. Some of these, such as Tubbataha Reef, are managed at a national level under the NIPAS program and have been implemented to protect and enhance biodiversity. However, the majority are much smaller in scale and managed in combination by the LGU and local community. These MPAs have been created to promote food security and sustainability for the local community. The 1998 Fisheries Code legislation calls for 15% of coastal municipal waters to be protected within no-take MPAs.

Despite the encouraging number of MPAs in the Philippines, they need to be managed effectively if they are to succeed in their goal of enhancing food security. Three things are of fundamental importance to effective management.

- Engagement with, and support from, the local community
- Effective demarcation of the boundaries of the MPA
- Consistent and sustained support from the LGU to patrol and enforce the MPA.

Through a volunteer-based scientific diving program, Marine Conservation Philippines focuses on collecting and analysing biophysical data on the effectiveness & resilience of locally managed MPAs, and offers support to local and regional management units.

MCP's expertise is focused on utilising a wide range of commercial biomass and MPA effectiveness as primary indicators of progress in ensuring long-term food security. Substrate composition and resilience are considered as indirect indicators, being essential for maintaining the commercial productivity of the ecosystem.



MCP's ecological monitoring program has been developed to provide a broad understanding of the regional health and abundance within the reef ecosystems. Its well-refined scope of data collection across all MPA sites, through all depth levels, ensures high coverage and accurate data input, with transparency and data quality remaining constant priorities.

The diversity, abundance, and fluctuations of commercial fish and invertebrates, as well as the composition & resilience of substrate lifeforms in the MPAs, are being monitored on a seasonal basis. By collecting the same representative dataset per season, change can be tracked, giving a much more detailed picture of change in the MPA over time. Seasons have been defined following PAGASA's (Philippines Atmospheric, Geophysical and Astronomical Services Administration) local recommendation ([December, January, February]; [March, April, May]; [June, July, August]; [September, October, November]).

The monitoring method employed uses 30m transects in a stratified random sampling strategy that recognises three depth ranges (3-7m, 9-13m, 15-19m). The depth ranges selected were chosen based on the spatial distribution of indicator life forms and the difference in indicator densities at different depths.

To collect a dataset representative of the ecosystem, it was necessary to identify these spatial differences and account for them to avoid bias. By observing each depth range and treating the results as an ecologically representative set, it is possible to generate an accurate model of the entire reef structure and community, determine its relative health, and track changes in the ecosystem over time.

The challenge in collecting an ecologically representative dataset lies in conducting a sufficient number of replicates to ensure that all present life forms are accounted for. For each of our sites, monitoring is therefore conducted across the three depth ranges and repeated a calculated number of times to ensure high validity. At least 12 replicates were conducted per site, per season, and for each ecological indicator group (invertebrates, substrate, and fish) to accurately represent the ecosystems of interest. These replicates were used to create a representative average of the ecosystem for each site and season.



MONITORING SITES

Siaton Municipality



MCP has been conducting its Long-Term Monitoring Program since 2017, although monitoring at some sites began later. The complete list of survey sites, along with some key details, can be found below.

Site Name	Status	Size (hectares)	Established	Monitored Since
Andulay	MPA	6	1993	2017
Antulang	Non-MPA	-	-	2017
Kookoos	Non-MPA	-	-	2017
Salag	MPA	10	2001	2019

SIATON

Community Projects



Marine Conservation Philippines is pleased to continue our work for and with the local community. The following is a summary of the community projects we have undertaken in the last report period of March - August 2025

- **Turtle Monitoring**

Through MCP's ongoing Turtle monitoring program, assisted by DENR, Bantay Dagat, and local community members, we have successfully protected five nests in Turtle Island, Guinsuan, and Mojon. Over 300 turtle hatchlings safely made it to the water.

- **Ghost nets**

Our Tec-trained diving team has successfully removed a 10 m² ghost net from a depth of 45m-50m in Malatapay. MCP volunteers have also helped to remove ghost nets in Latason and Guinsuan.

- **Summer camp 2.0**

After the successful return of our summer camp program last year, MCP again hosted local youth leaders for a 3-day immersion program. Participants from previous years returned as facilitators and helped ensure a smooth running of all activities.

- **Ridge to Reef**

In MCP's first-ever partnership with Endangered Species International, we hosted a 2-day youth camp, highlighting the importance of forest biodiversity, native trees, and fish and coral conservation.

- **UNSDSN**

MCP was invited to join the United Nations Sustainable Development Solutions Network, which brought together over 100 participants for presentations and conservation activities.

- **Scholarships**

MCP is excited to welcome two brand-new scholars who will undergo dive training all the way to Divemaster level, as well as being trained to teach our science program.

- **International Mangrove Day**

Joining the Siaton Coast Guard in Turtle Island to celebrate their 1st founding anniversary, we assisted in the planting of mangrove trees. We conducted a beach cleanup alongside the local Bantay Dagat.

FOOD SECURITY

Biomass of Commercial species



One fundamental measure of an MPA's success is the amount of fish biomass it produces. If there is higher fish biomass within an MPA, then more fish will be available for the community to harvest outside of the MPA. This is known as the '**spillover effect**', and is one of the main ways in which an MPA can promote food security.

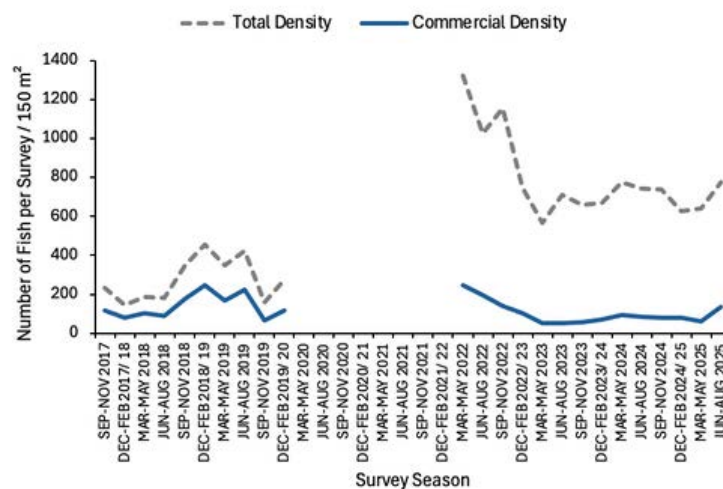


Figure 3. Temporal trends in total fish density and commercial fish density across the Siaton Municipality, Sep-Nov 2017 to Jun-Aug 2025. Values represent average individuals per 150m² recorded during seasonal surveys. Data gaps (2020–2022) reflect periods when surveys were suspended due to COVID-19.

Current Status:

In June–August 2025, Siaton recorded an average **total fish density of ~775 individuals per 150 m²** (per survey), with commercial species contributing ~134 individuals per 150 m² (Figure 3). We consider these data separately as we monitor some non-commercial fish that often occur in high numbers (particularly Damselfish), which would misrepresent the data if they were combined. The average fish density of the reefs in this municipality has remained relatively consistent, with minor seasonal fluctuations. Damselfish were added to the indicator list after the COVID-19 gap, resulting in a significant increase in total density.

Commercial biomass reached approximately 14.9 kg per 150 m² (~960 kg/ha), one of the highest biomass levels observed for the municipality in recent years (Figure 4). Herbivores were the dominant group (~624 individuals per 150m²), followed by carnivores (~112), omnivores (~11), corallivores (~11), and detritivores (~15). The increase in biomass this season is likely due to both higher densities and larger average body sizes, particularly among fusiliers and snappers, indicating that fish populations are benefiting from local management and protection efforts.

Figure 5. Temporal trends in commercial fish biomass (kg per 150m²) across the Siaton Municipality, Sep–Nov 2017 to Jun–Aug 2025. Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness. Data gaps (2020–2021) reflect periods when surveys were suspended due to COVID-19.

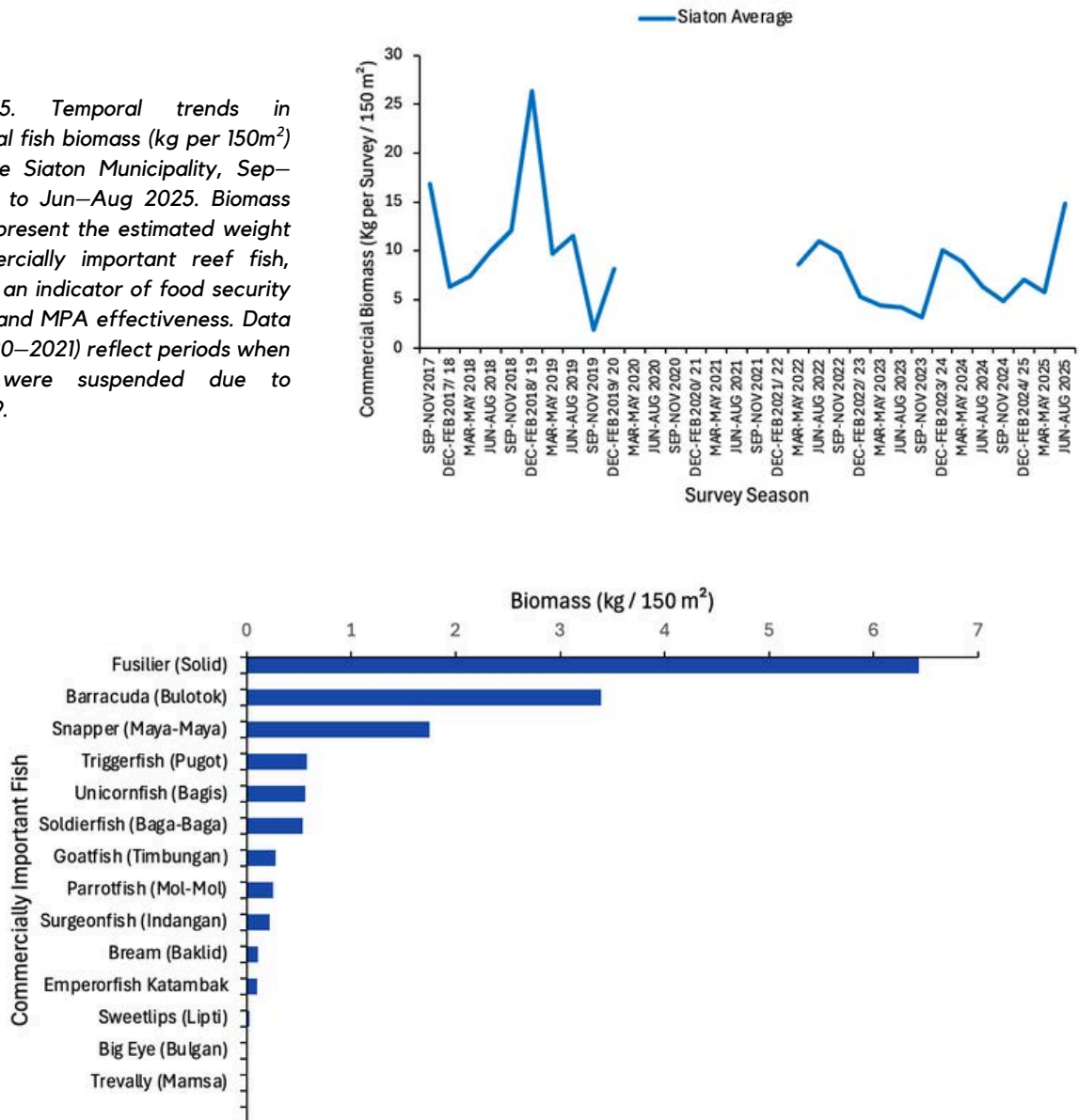


Figure 5. Biomass (kg per 150m²) of commercially important reef fish groups in Siaton Municipality, averaged across MPAs during June–August 2025. The values represent the average (mean) biomass observed on each survey, highlighting variation in key target families that contribute to local fisheries, food security, and ecosystem resilience.

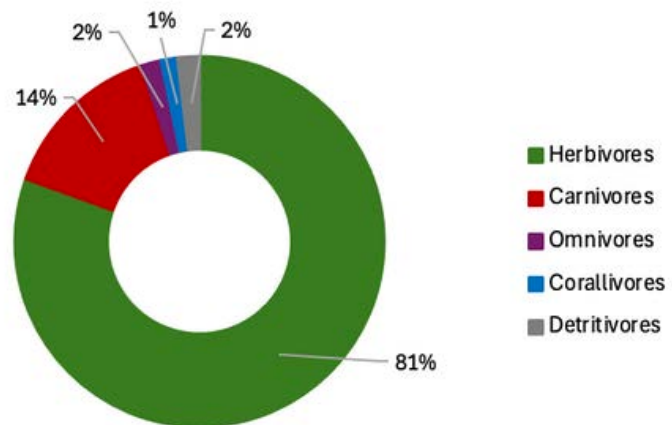
The biomass of commercially important reef fish in Siaton Municipality is strongly skewed toward fusiliers, which dominate the assemblage at over 6 kg per 150 m² (Figure 5). Barracudas and snappers follow as secondary contributors, while most other groups occur at very low biomass (<1 kg per 150 m²). The dominance of fusiliers highlights their ecological and economic importance, but the generally low biomass across most groups indicates depleted stocks and reduced diversity of commercially valuable species.

The high intra-annual variation is likely due to the seasonal appearance of fish visiting the area to feed or breed. Breeding aggregations have been observed in some sites. There's not the same degree of inter-annual variation as seen in Zamboanguita, suggesting that harvesting intensity is consistent. This may reflect that 50% of the monitored sites in this municipality are non-MPA compared to 12.5% in Zamboanguita.

Recent Change:

Compared with the previous reporting season, commercial biomass doubled (7.03 → 14.9 kg per 150m²) and commercial density almost doubled (79 → 134 individuals per 150m²). Herbivores increased from ~487 to ~624 individuals per 150m², and carnivores rose from ~67 to ~112. These shifts indicate a strong recovery in both fish numbers and biomass across functional groups, especially among commercially important species.

Figure 6. Proportional contribution (%) of dietary groups to total fish density for the Siaton Municipality during Jun–Aug 2025. Data include both commercial and non-commercial species, highlighting the ecological importance of abundant herbivores in supporting algal–coral balance.



Dietary Structure:

The dietary balance in Siaton is herbivore-dominated, with these grazers making up ~80% of total fish density (Figure 6). This dominance is critical for suppressing algal growth and facilitating coral recovery. Carnivores are showing encouraging signs of recovery, while omnivores and corallivores contribute smaller but stable numbers. Detritivores remain low but consistent, reflecting background ecosystem processes. The structure reflects a community with strong functional herbivory, which underpins the resilience of the reef.

Long-term Context:

Since monitoring began, Siaton's commercial fish biomass has fluctuated, with lower values often recorded between 2021 and 2023 (commonly <7 kg per 150m²). The recent increase to ~14.9 kg per 150m² marks a significant recovery, more than doubling the long-term average. Despite this, current biomass still falls short of levels reported in long-established no-take MPAs in the wider Coral Triangle (>1,500 kg/ha or 22.5 kg/150 m²). It is essential to note that this is a total biomass target, not a commercial one. Continued upward trends are possible but will require consistent enforcement and reduced fishing pressure.

Ecological Interpretation:

Siaton's reef fish assemblages exhibit strong positive recovery signals, characterised by increasing biomass and density, particularly among commercially essential groups. The herbivore base remains robust, supporting coral–algal balance, while growing carnivore densities indicate improving trophic structure. However, the limited presence of large-bodied predators (e.g., groupers, trevallies) shows that fishing pressure still constrains full ecological recovery. Sustained enforcement, along with measures to protect herbivores and rebuild top predators, will be key to maintaining resilience and promoting further recovery.

REEF HEALTH AND RESILIENCE

Substrate Composition



The Philippines is situated in the Coral Triangle, an area of huge biodiversity that contains 30% of the world's reefs. Many factors determine the health of coral reefs, but two of the most important are Hard Coral Cover (HCC) and Algae Cover. Hard corals build the reef itself, providing habitat for thousands of other species, many of which are commercially important. Algae, particularly fleshy macroalgae, compete with coral for space. Too much algae can lead to algae dominating the reef. Without the coral and the living space it provides, much of the biodiversity of the reef is lost. Globally, hard coral cover has been decreasing since 2010.

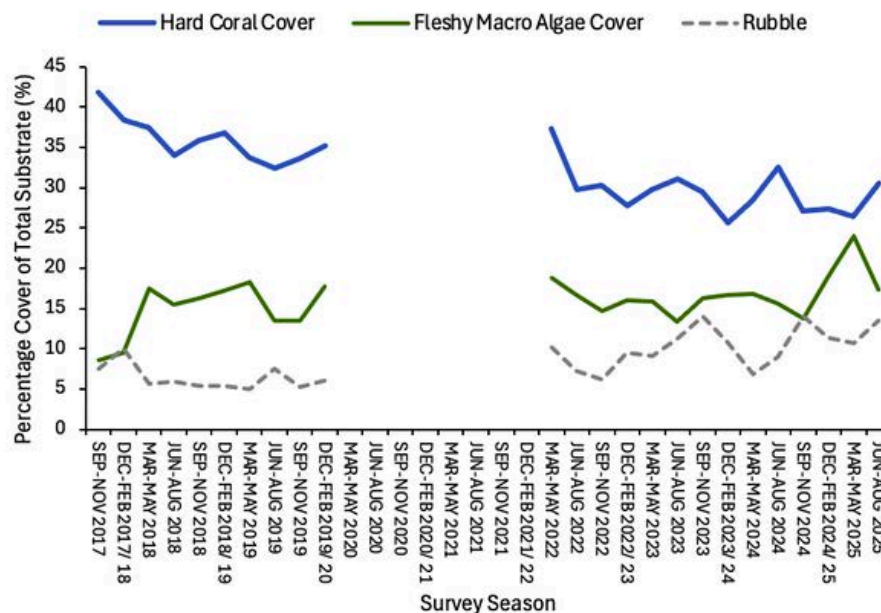


Figure 7. Temporal trends in average hard coral cover, fleshy macroalgae cover, and rubble across the Siaton Municipality (2017–2025). Data is expressed as average percentage cover per survey season.

Current status:

In Jun–Aug 2025, reefs across the Siaton municipality **averaged ~30.5% hard coral cover**, **~17.3% fleshy macroalgae**, and **~13.5% rubble** (Figure 7). The broader composition indicates that corals remain the dominant benthic group, though macroalgae and rubble form substantial fractions of the substrate. Bleaching was low (~2.2%), suggesting limited visible stress across sites at the time of survey.

Algae are less biodiverse than corals and support fewer species of fish and invertebrates. A shift from hard corals to algae will result in lower climate change resilience, as well as significantly reduced commercial value. Current observations do not suggest a risk of algae becoming dominant on the reef, though monitoring must continue to track future changes. Average rubble cover has increased to 14%. This is a return to a high of almost 15% in 2023, after a brief dip during the first half of 2024. There has still been a general increase in rubble since monitoring resumed following the COVID-19 pandemic. Rubble suggests destructive events, including typhoons, poor anchorage or positioning of fishing gear, or dynamite fishing. Persistent rubble reduces habitat stability and recruitment potential, limiting the reef's resilience.

Fluctuations across the depth ranges follow the natural ecology of substrate organisms present on the reef. A higher abundance of hard coral is to be expected on shallow reefs, as most coral polyps have a symbiotic relationship with photosynthetic algae (zooxanthellae). Hard corals are highly dependent on this relationship, getting up to 90% of their energy from zooxanthellae. As sunlight decreases with depth, these zooxanthellae-dependent corals will be predominantly found in shallow, clear, calm waters.

Recent change:

Since the last report, average hard coral cover increased (27.4% → 30.5%), continuing a modest upward recovery trend. Fleshy macroalgae decreased (18.9% → 17.3%), a positive shift for reef resilience. Rubble, however, rose (11.4% → 13.5%), indicating persistent disturbance and substrate instability at the municipal scale. Bleaching also increased slightly (0.9% → 2.2%), though still far below historic highs. Compared to the last reporting period, Siaton's reefs are showing a gradual recovery of coral, paired with generally stable algal competition, although rubble levels warrant continued concern.

Structural implications:

The municipal average reflects a reef system with encouraging coral recovery, but still under moderate stress. Coral cover at ~31% is relatively strong compared with regional baselines, but the consistently high rubble fraction (>10%) limits stability and may slow consolidation of coral growth. Macroalgae levels at 17% remain a significant competitor, although not yet dominant. Low bleaching indicates that corals are currently resilient to thermal stress; however, their recovery potential depends on whether rubble consolidates and whether herbivory pressure remains strong.



Bleaching incidence has been highly variable, ranging from 1% to 17%, with severe peaks during regional heat stress events in 2022–2023. Encouragingly, bleaching has since declined to around 2% in mid-2025, highlighting some recovery capacity within coral assemblages.

Long-term context:

Siaton's reefs have shown notable variability over the monitoring record. Coral cover was highest in the late 2010s (~35–42%), but declined through 2022–2024, reaching lows of ~25–27% in some seasons. High bleaching in 2022–2023 (up to ~17%) coincided with reduced coral dominance and spikes in macroalgae (>20%). Since 2024, bleaching has remained very low (<5%), allowing corals to begin recovering. Macroalgae, although still a significant presence, has declined from its peak of ~24% earlier in 2025. The long-term pattern suggests resilience, but also repeated setbacks tied to disturbance and the accumulation of rubble.

Ecological interpretation:

The Siaton municipality's reefs are in a phase of cautious recovery. Hard coral cover has increased since early 2025, while macroalgae have declined slightly; bleaching stress remains minimal — all positive indicators. However, high rubble fractions across sites remain a structural limitation, highlighting disturbance legacies that could prevent stable coral regrowth. Continued protection, adequate grazing pressure, and active MPA enforcement will be crucial to ensure coral dominance strengthens rather than being eroded by algae or further disturbance. Overall, Siaton's reefs demonstrate both resilience and fragility, with encouraging recovery potential if current low bleaching and improving coral trends persist. Continued monitoring will be essential to track these dynamics and guide local conservation actions.



TOURISTIC VALUE

Iconic and Charismatic Species



Southern Negros not only hosts some beautiful coral reefs, but is world famous for the abundance of small, rare animals found in its waters. This is a significant draw for divers and contributes substantially to the local tourism industry.

Tourism has an increasingly important role to play in the success of Marine Protected Areas, provided it is managed in a thoughtful and conservation-minded manner. The effective ticketing of recreational diving activities will generate income for the communities around an MPA, as well as help to cover ongoing maintenance costs. This will enhance the MPA's ability to provide food security.

The table below summarises a wide range of animals with high potential tourism value that divers and snorkellers would be interested in seeing. The figures represent the percentage of times an indicator was observed during dives between March and August 2025 (Table 1). This provides a representation of how likely divers are to encounter these creatures, aiding dive operations in selecting sites that suit customers.

	Andulay MPA	Antulang	Kookoos	Salag MPA	Municipal Average
Barracudas	12.95	20.08	16.98	2.71	13.18
Cephalopods	4.59	14.94	10.27	5.39	8.80
Cowries	42.79	32.90	30.46	7.31	28.37
Eels and Snakes	37.70	36.80	54.58	28.24	39.33
Frogfish	0.76	8.34	1.76	-	2.72
Giant Clams	33.30	21.43	46.17	50.76	37.92
Porcupinefish and Pufferfish	73.78	72.19	86.79	77.38	77.54
Scorpaenidae	38.60	54.33	49.81	42.03	46.19
Sharks	-	0.65	-	-	0.16
Shrimps	44.02	45.24	40.46	43.69	43.35
Slugs	76.84	62.84	76.14	71.90	71.93
Stingrays	-	0.76	0.88	5.46	1.78
Syngnathidae/ Pegasidae	16.16	21.97	15.14	5.53	14.70
Turtles	14.65	16.13	24.49	2.71	14.50

Table 1- Average percentage frequency of sightings for key charismatic species across sites in the Siaton Municipality between March and August 2025.

The Siaton municipality presents a strong and diverse portfolio of marine tourism values, with several sites excelling in different niches. On average, Siaton delivers particularly high encounters with porcupinefish and pufferfish (77.5%), slugs (71.9%), and giant clams (37.9%), making it especially attractive for divers seeking macrofauna and vibrant reef invertebrate experiences (Figure 8). Scorpionfish (46.2%), eels and snakes (39.3%), and shrimps (43.4%) add consistent value across sites. Scorpionfish (46.2%), eels and snakes (39.3%), and shrimps (43.4%) add consistent value across sites.

In terms of megafauna, sightings are more variable. Turtles (14.5%) are regularly encountered, though they peak at Kookoos (24.5%) and remain scarce at Salag (2.7%). Barracudas (13.2%) are seen at most sites, especially Antulang (20.1%) and Kookoos (17.0%), while sharks are very rare, recorded only occasionally at Antulang (0.65%). Stingrays are infrequent overall (1.8%), though Salag offers slightly higher chances (5.5%).

The sighting of a **whale shark** at Antulang in July highlights the potential for world-class encounters with megafauna, while the discovery of an **electric clam** at Kookoos adds unique value for niche macro divers. Together, these sightings elevate the municipality's profile by combining the draw of large pelagic species with rare and specialised invertebrate fauna.

Overall, Siaton's tourism value lies in its reliable macro-diversity and reef invertebrates, complemented by moderate opportunities to encounter turtles, barracudas, and rays. These sites offer dependable encounters with iconic species and unique opportunities to observe rarer taxa. This makes it highly attractive to underwater photographers, macro enthusiasts, and recreational divers, although less so to visitors focused on high-frequency shark or pelagic sightings.

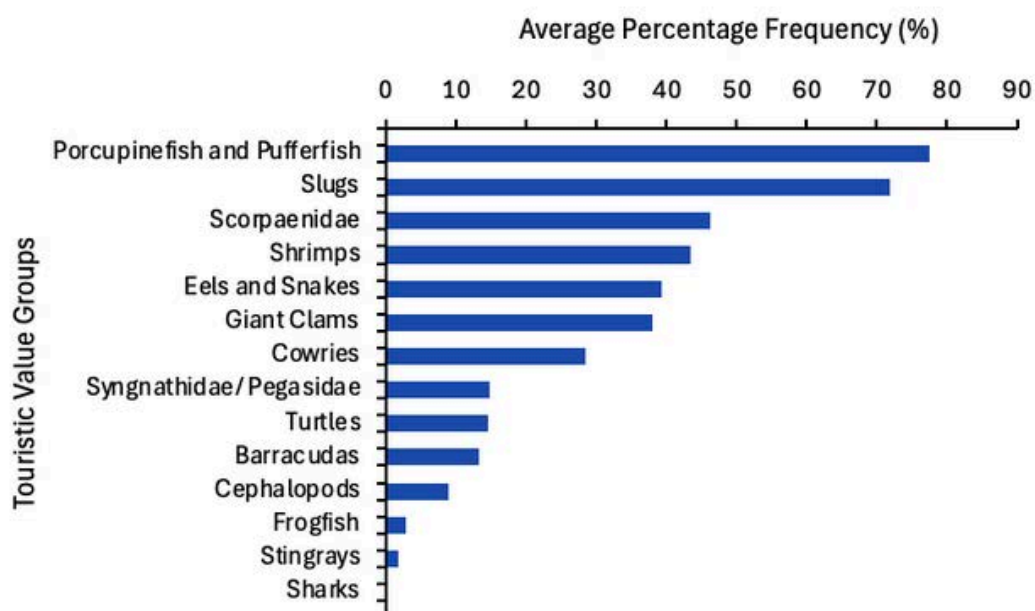


Figure 8. Sightings of high-value tourist species across the Siaton Municipality during the Mar–Aug 2025 survey season. Data is presented as the percentage of dives in which each group was recorded.

In this context, Scorpaenidae refers to lionfish, scorpionfish, and stonefish, while Syngnathidae and Pegasidae includes seahorses, pipefish, sea moths, and sea dragons.



+ PROCEAN



About 200 million tons of trash are currently circulating our global oceans, with about 11 million tons being added each year. The Philippines is responsible for about 2.7 million tons of plastic waste alone being introduced into the oceans.

This trash can have devastating effects on marine and coastal ecosystems, from ghost nets killing animals that go to waste and large pieces physically smothering the reef, to microplastics being ingested and concentrated in animals that we ultimately eat, introducing potentially dangerous plastics into our own bodies.

Our partner NGO, Pro Ocean conducts beach cleans 6 days a week along the coastline from Sibulan to Bayawan, playing a vital role in limiting the ecological damage that trash can cause. The following chart summarises the trash they've collected from March - August 2025 (Figure 9).

In addition, MCP conducted bi-weekly beach cleans throughout 2025, collecting a further 590 kg of trash, complementing Pro Ocean's ongoing efforts.

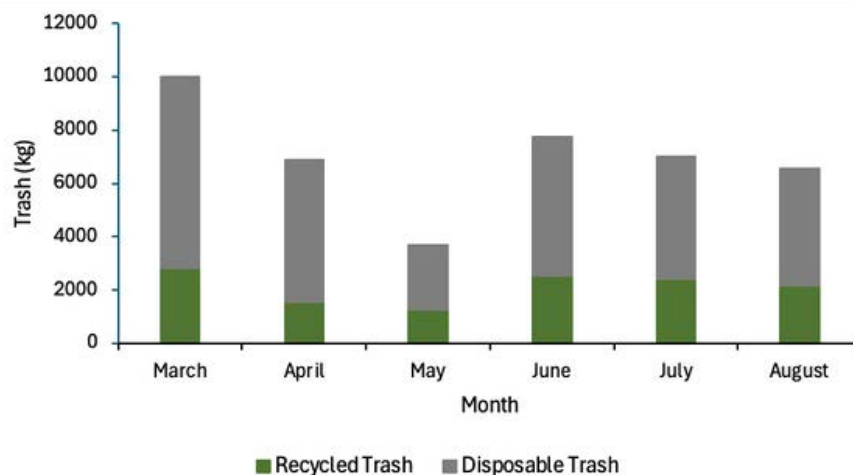


Figure 9. Monthly totals of recycled and disposable trash (kg) collected by Pro Ocean during beach cleans along the Sibulan–Bayawan coastline, March–August 2025. Regular clean-up efforts play a key role in reducing the ecological impacts of marine debris in a region where plastic pollution poses a major threat to coastal ecosystems.



MANAGEMENT SUGGESTIONS



- Demarcation is ongoing for sites in Siaton.
- Develop enforcement strategies.
- Consideration of temporary restriction on herbivorous fish in sites of algal domination.
- Community engagement.
- Conduct regular beach and dive cleans.
- Continue monitoring.
- Consider MPAs in coastal activities that could lead to runoff, especially sites in the vicinity of river mouths.
- Use of safe materials in artificial reefs:
<https://www.marineconservationphilippines.org/wp-content/uploads/2018/02/factors-and-principles-artificial-reef-creation.pdf>
- Increased focus on the collection of ticketing revenue for recreational water activities.





**Marine
CONSERVATION
PHILIPPINES**

Semiannual Report

SIATON

Section 2

Site Specific Results

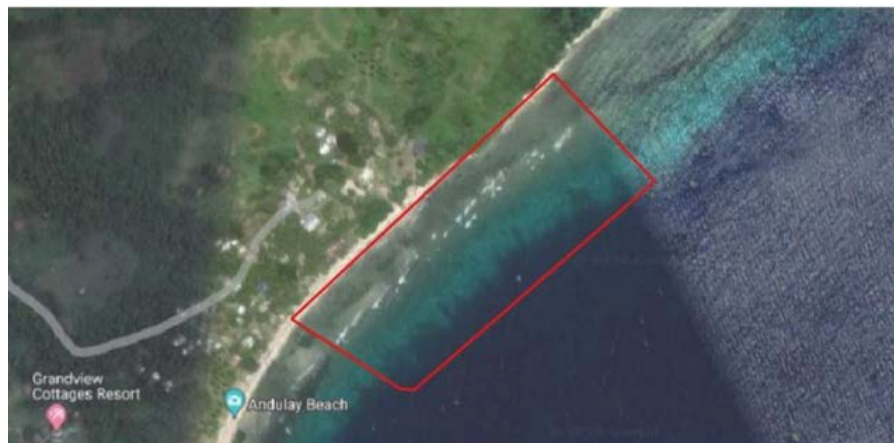


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2025**

ANDULAY MPA



Andulay MPA has an area of 6 hectares and is one of the oldest MPAs in the region, having been established in 1993. It consists of dense and continuous coral reefs ranging from 1 - 25 m, with seagrass beds present in the shallows. The substrate between the shore and the beginning of the shallow reef is densely covered in macroalgae. Due to the location, the reef is moderately exposed and occasionally experiences longshore currents and strong wave action.



MPA demarcation based on DENR coordinates

ANDULAY MPA

Food Security



Current Status:

During the most recent survey season (Jun–Aug 2025), Andulay MPA recorded an average total fish density of ~862 individuals per 150 m², with commercial species contributing ~63 individuals per 150 m² (Figure 10).

The **average commercial biomass observed at Andulay MPA was approximately 5.6 kg of fish** per survey area of 150 m² (~373kg/ha). This places Andulay as the lowest performing MPA in the municipality, although it does have strong densities driven largely by herbivores and smaller schooling species.

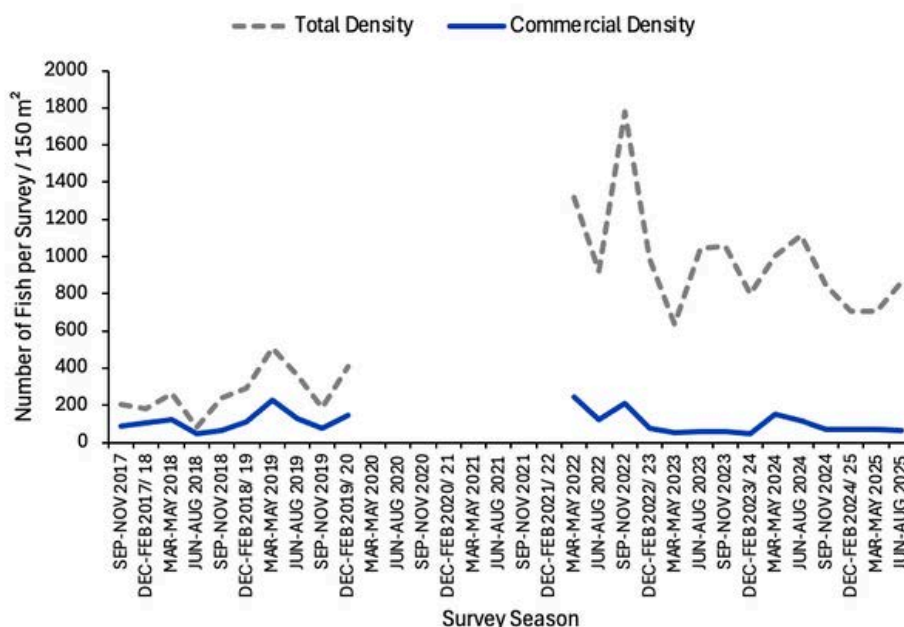


Figure 10. Temporal trends in total fish density and commercial fish density across at Andulay MPA (2017 - 2025). Values represent average individuals per 150m² recorded during seasonal surveys.

Recent Change:

Compared to the previous reporting season, total fish density increased (739 → 862 individuals per 150 m²), indicating an overall rise in fish numbers. However, **commercial density declined slightly (72 → 63 individuals per 150m²)**, and **commercial biomass decreased from ~6.7 kg per 150m² (~447 kg/ha) to ~5.6 kg per 150m² (~373 kg/ha)** (Figure 11). This suggests that while total fish abundance grew, commercial fish are slightly fewer and smaller, reflecting seasonal fluctuations or fishing pressure outside MPA boundaries.

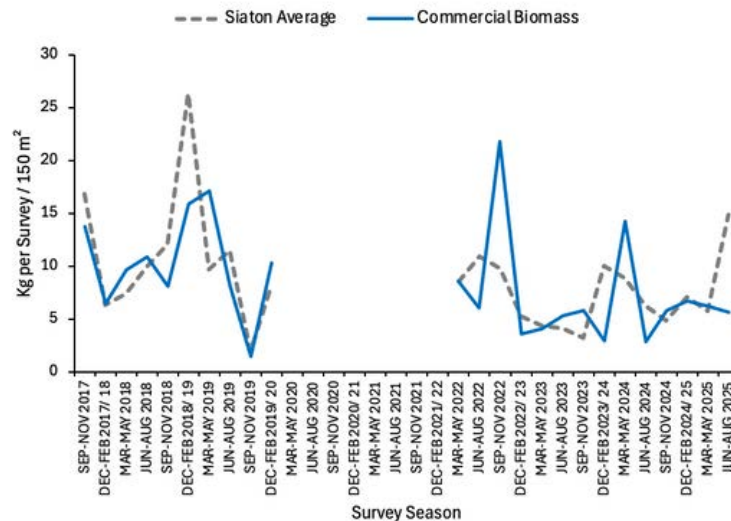
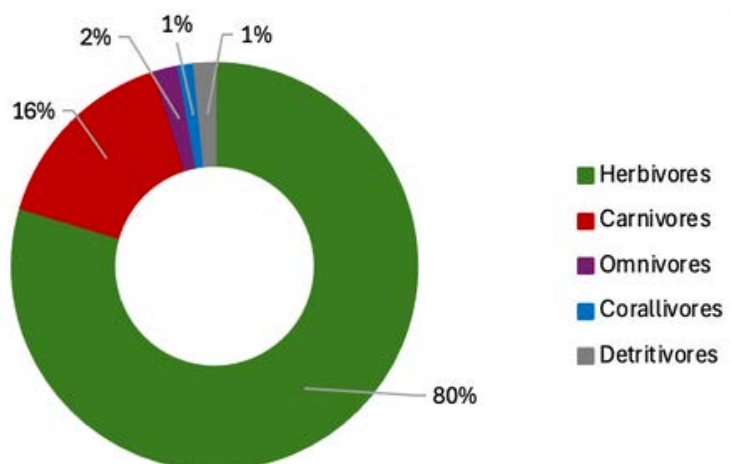


Figure 11. Temporal trends in commercial fish biomass (kg per 150m²) at Andulay MPA, (2017-2025). Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness. Data gaps (2020–2022) reflect periods when surveys were suspended due to COVID-19.

Dietary structure:

Herbivores were the dominant feeding group, averaging ~686 individuals per 150 m² in June–August 2025, up from ~555 individuals in December–February (Figure 12). Carnivores (~135 → 135 individuals per 150m²) remained stable, while omnivores and corallivores showed slight increases. Detritivores were consistent but low. The steady dominance of herbivores is beneficial for reef resilience, as it helps suppress algal growth and supports coral recovery.

Figure 12. Proportional contribution (%) of dietary groups to total fish density at Andulay MPA during Jun–Aug 2025. Data include both commercial and non-commercial species, highlighting the ecological importance of abundant herbivores in supporting algal–coral balance.



Commercial Groups:

Fusiliers remain the most abundant commercial taxa at Andulay, often schooling in large numbers and contributing strongly to biomass (Table 2). Snappers, triggerfish, and surgeonfish provide secondary contributions, while goatfish and emperors remain less abundant. Larger-bodied predators such as groupers are still scarce, limiting biomass recovery despite high densities.

Fusilier	1.27	Goatfish	0.38
Triggerfish	1.17	Unicornfish	0.22
Grouper	0.55	Emperor	0.19
Soldierfish	0.55	Parrotfish	0.18
Barracuda	0.42	Sweetlips	0.11

Table 2 - Mean biomass (kg per 150m²) of the ten most abundant commercial fish groups at Andulay MPA during Jun–Aug 2025. Values represent average biomass per survey and highlight the dominant contributors to the commercial fish community.

Long-term context:

Since MCP monitoring began in 2017, Andulay has consistently shown some of the highest fish densities in Siaton. Commercial biomass has fluctuated but has generally increased since 2022, likely reflecting improved enforcement. However, biomass levels (~373 kg/ha) remain below values reported for strictly enforced no-take MPAs elsewhere in the Coral Triangle (>1,000 kg/ha), highlighting scope for further recovery if large predators are allowed to rebuild.

Ecological interpretation:

Andulay's fish assemblage remains dominated by herbivores, which is a positive sign for maintaining coral–algal balance. However, the decline in commercial biomass since the last report suggests that larger-bodied commercial fish remain vulnerable, with populations fluctuating between survey seasons. The scarcity of groupers and other apex predators highlights that trophic recovery is incomplete. Strengthening enforcement and reducing external fishing pressure will be crucial for building biomass stability and restoring full ecological function.

ANDULAY MPA

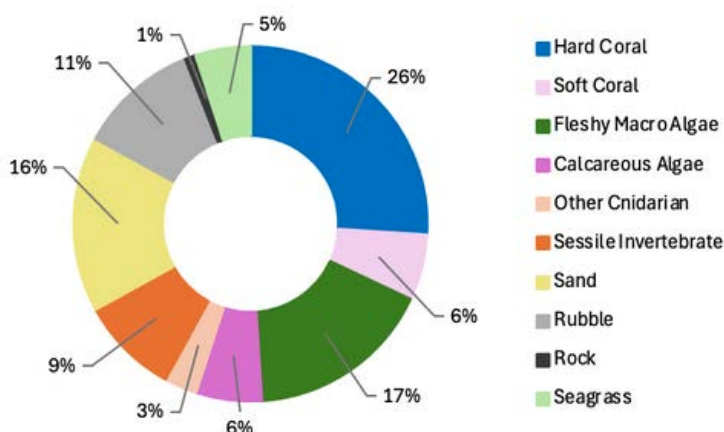
Reef Health And Resilience



Current status:

In June–August 2025, Andulay MPA recorded an **average hard coral cover of ~29.9%**, **fleshy macroalgae of ~15.9%**, and **rubble of ~17.0%**. The broader substrate composition shows hard coral (~30%) as the dominant category, followed by rubble (~17%) and fleshy macroalgae (~16%). Soft corals (~8%), calcareous algae (~8%), and sessile invertebrates (~7%) add further complexity, while sand (~8%) and smaller fractions of rock (~3%) and seagrass (~3%) contribute to habitat diversity (Figure 13). Bleaching levels were low (~3.3%), indicating moderate stress but no large-scale bleaching at the time of surveying.

Figure 13. Average benthic substrate composition at Andulay MPA (June-August 2025). Values represent the proportional contribution (%) of different benthic categories pooled across all surveys.



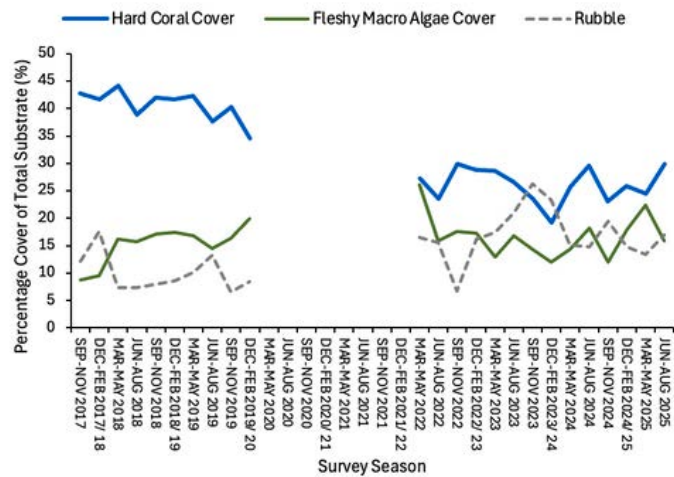
Recent change:

Since the last report, the hard coral cover has increased (from 25.9% to **29.9%**), marking a **seasonal recovery** (Figure 14). Macroalgae declined (18.0% → 15.9%), indicating a positive shift that suggests reduced competition for space. Rubble increased (14.8% → 17.0%), reflecting persistent disturbance and substrate turnover. Bleaching also increased (0.7% → 3.3%), although this remains within the lower range compared to the peaks observed in 2022–2023. Overall, these changes suggest coral recovery is ongoing but still constrained by disturbance and moderate stress events.

Structural implications:

The balance between hard coral (~30%) and macroalgae (~16%) suggests a resilient reef that remains vulnerable to algal expansion if herbivory weakens. The relatively high rubble (~17%) underscores instability, potentially limiting coral settlement unless rubble consolidates. The consistent presence of calcareous algae and soft corals enhances structural diversity, but their expansion may compete with hard corals for space. Low bleaching pressure is encouraging, but the recent rise suggests that vigilance is needed to track potential stress accumulation.

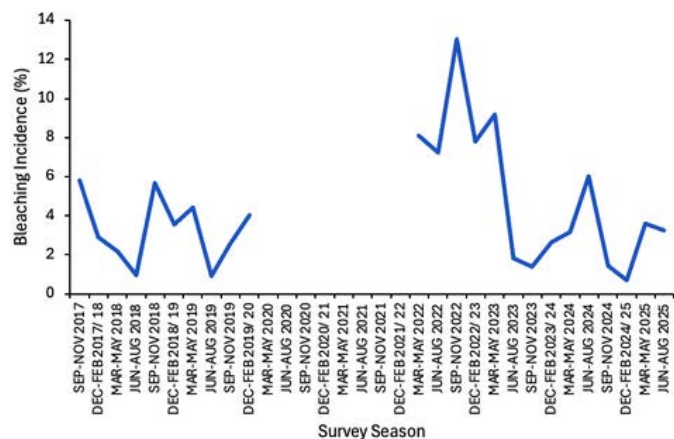
Figure 14. Temporal trends in hard coral cover, fleshy macroalgae cover, and rubble at Andulay MPA (2017–2025). Data is expressed as average percentage cover per survey season.



Long-term context:

Andulay has historically supported some of the highest coral cover in Siaton, with values exceeding 40% during 2017–2019. Since then, coral cover has declined but stabilised in the range of 20–30% across recent years. Macroalgae have fluctuated between ~12–22%, never thoroughly dominating but often competing strongly with coral. Rubble levels have increased since 2022, reflecting the impacts of disturbance, while bleaching has exhibited episodic peaks (exceeding 7–13% in 2022–2023) but is currently at a much lower level (Figure 15). The current state suggests moderate resilience but a slower recovery compared to its earlier high baselines.

Figure 15. Seasonal bleaching incidence at Andulay MPA (2017–2025), shown as average percentage of colonies observed with visible bleaching (either partially or fully bleached) per survey season.



Ecological interpretation:

Andulay's reef community reflects a moderately resilient system where coral recovery is ongoing but hindered by rubble and algal competition. The relatively high hard coral cover, compared to other Siaton sites, is a positive sign, as is the decline in macroalgae since early 2025. However, sustained rubble levels highlight underlying fragility, and the recent uptick in bleaching points to ongoing susceptibility to thermal or other stressors. If herbivore biomass remains strong and disturbance is minimised, Andulay has the potential to sustain coral recovery and maintain its role as one of Siaton's structurally complex reef habitats.

ANDULAY MPA

Reef Health And Resilience



Andulay MPA has recently experienced an outbreak of crown-of-thorns sea stars (*Acanthaster planci*). These corallivorous species can cause severe declines in hard coral cover when present in high densities. Between March and July 2025, monitoring and intervention dives recorded outbreak-level densities, with hundreds of individuals observed and over 80% culled using targeted vinegar injections. The outbreak was concentrated in shallow zones (<7 m), where most individuals were found feeding on branching and tabulate corals—low-resilience growth forms that dominate the site. While culling efforts have been effective in reducing immediate coral predation pressure, densities remain above the outbreak threshold, indicating the need for continued monitoring and control. Details of this intervention are provided in a separate report available on the Marine Conservation Philippines website.



ANDULAY MPA

Tourism Value



Barracudas	12.95	Scorpaenidae	38.60
Cephalopods	4.59	Sharks	0
Cowries	42.79	Shrimps	44.02
Eels and Snakes	37.70	Slugs	76.84
Frogfish	0.76	Stingrays	0
Giant Clams	33.30	Syngnathidae and Pegasidae	16.16
Porcupinefish and Pufferfish	73.78	Turtles	14.65

Table 3. Mean encounter rates (%) of selected indicator and charismatic taxa recorded at Andulay MPA from March - August 2025. Values represent the percentage of dives in which each group was observed, providing an indication of their relative tourism and ecological value.

Andulay benefits from a passionate and engaged local community that strives to protect the MPA, as well as relatively good infrastructure, including the Bantay Dagat Guardhouse that overlooks the site, and comprehensive demarcation in the form of buoys that mark the MPA's boundaries. The MPA itself is pretty compact, making it convenient to explore.

Andulay offers substantial tourism value, with very high encounter rates for slugs (76.8%) and porcupinefish and pufferfish (73.8%), both of which are well above the municipal average (Table 3). Cowries (42.8%), giant clams (33.3%), and shrimps (44.0%) also contribute substantially to the site's macro-diving appeal. Sightings of eels and snakes (37.7%) and scorpionfish (38.6%) add to the interest for divers.

In contrast, megafauna sightings are more limited: turtles occur occasionally (14.7%), and frogfish are rare (0.8%). The relatively **frequent presence of syngnathidae and pegasidae** (16.2%) adds niche tourism value for macro enthusiasts. Overall, Andulay is a strong site for invertebrate and cryptic species, with particularly reliable sightings of molluscs and pufferfish; however, it offers fewer opportunities for larger, charismatic megafauna compared to other MPAs.

ANTULANG



Antulang does not have protected status and, as such, functions as a non-MPA control site. It is close to Andulay and displays similar broad characteristics. The reef ranges from 2 to 25 m deep and consists of a relatively narrow band of shallow reef before the reef slope. Due to the location, the reef is moderately exposed and occasionally experiences longshore currents and strong wave action.

ANTULANG

Food Security



Current Status:

In the most recent survey season (June–August 2025), Antulang recorded an **average total fish density of ~901 individuals per 150 m²**, with commercial species contributing ~137 individuals per 150 m² (Figure 16). **Commercial biomass was approximately 18.3 kg per 150 m² (~1,220 kg/ha)**, one of the highest biomass values observed among the monitored sites. Herbivores were the most abundant feeding group (~724 individuals per 150m²), supported by moderate numbers of carnivores (~125) and omnivores (~23), alongside consistent corallivore and detritivore contributions.

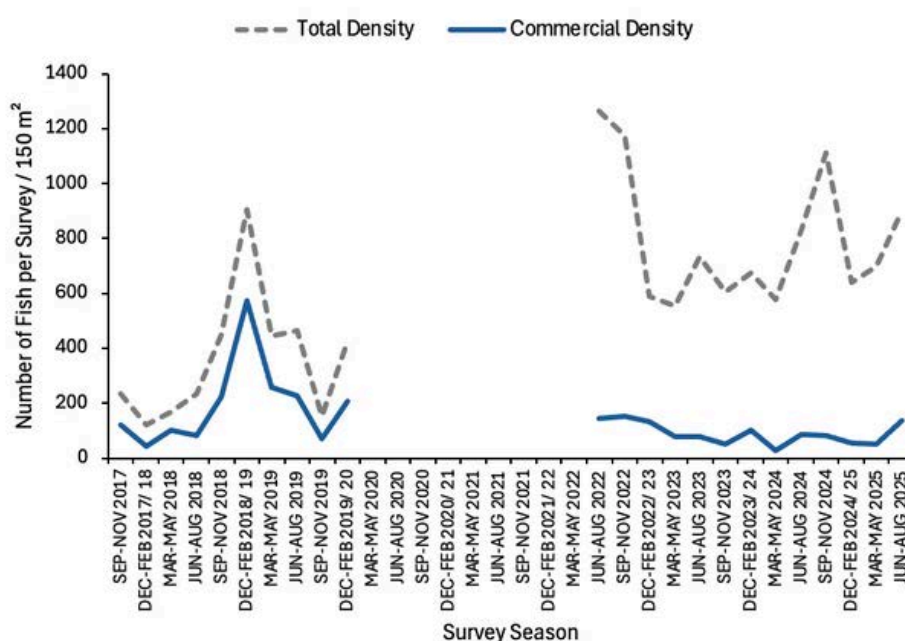


Figure 16. Temporal trends in total fish density and commercial fish density across at Antulang from Sep–Nov 2017 to Mar–May 2025. Values represent average individuals per 150m² recorded during seasonal surveys.

Recent Change:

Compared with the previous reporting period, Antulang showed substantial improvements. Total density increased from ~639 to ~901 individuals per 150m², commercial density more than doubled (56 → 137), and biomass rose sharply from ~8.2 kg per 150m² (~547 kg/ha) to ~18.3 kg per 150m² (~1,220 kg/ha). Herbivore density also increased substantially (496 → 724), while carnivores (59 → 125) and omnivores (18 → 23) grew in parallel. This indicates both an increase in fish numbers and a shift towards larger-bodied individuals, reflecting the recovery of the fish assemblage.

ANTULANG

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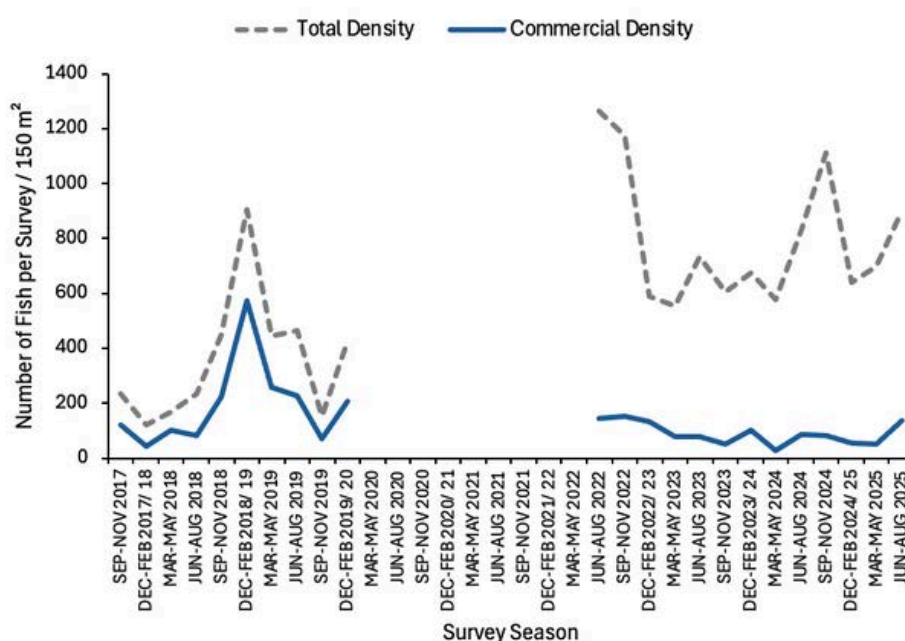


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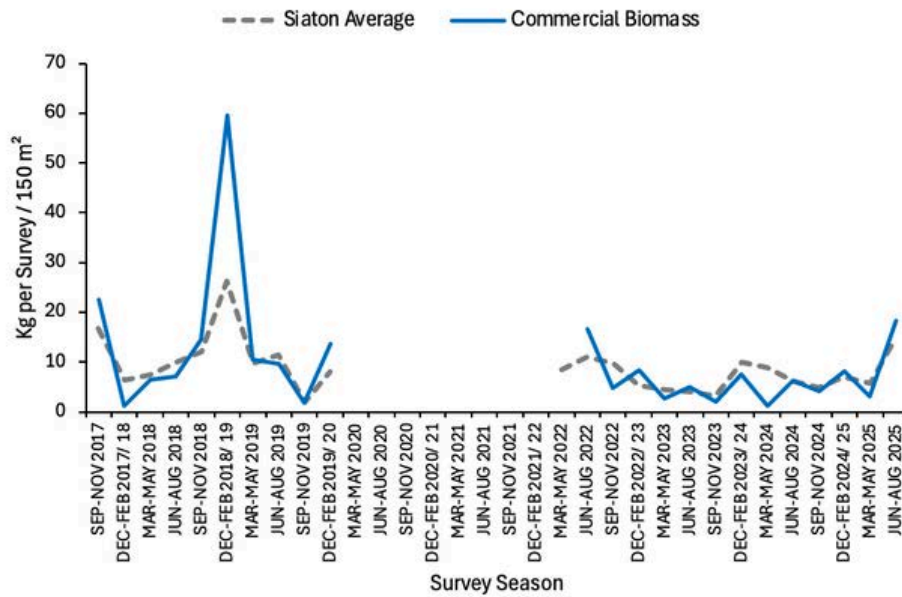
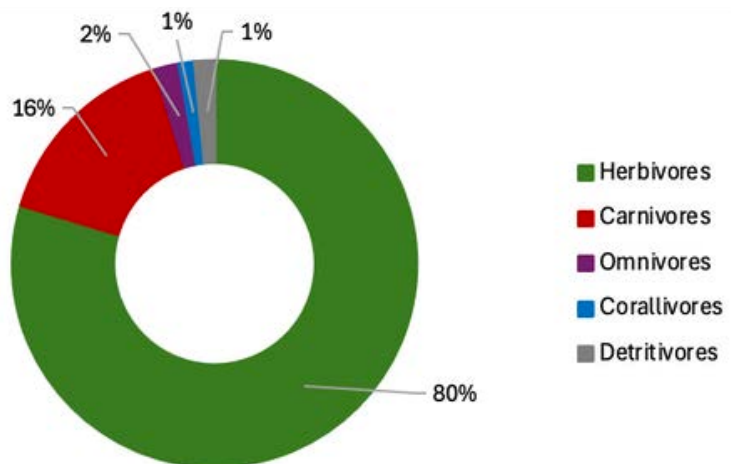


Figure 17. Temporal trends in commercial fish biomass (kg per 150m²) at Antulang MPA, Sep–Nov 2017 to Jun–Aug 2025. Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness.

Dietary structure:

Herbivores dominate the assemblage, a positive sign for reef resilience as these species maintain algal–coral balance (Figure 18). Carnivore density more than doubled compared with the last season, suggesting an encouraging rebound of mid-level predators. Corallivores and detritivores were stable, indicating that they maintained steady ecological roles. The assemblage appears more balanced than in earlier survey seasons, although it is still herbivore-heavy.

Figure 18. Proportional contribution (%) of dietary groups to total fish density at Andulay MPA during Jun–Aug 2025. Data include both commercial and non-commercial species, highlighting the ecological importance of abundant herbivores in supporting algal–coral balance.



Commercial Groups:

At Antulang, barracuda dominate commercial fish biomass, accounting for nearly twice the biomass of fusiliers, the second-ranked group (Table 4). Groupers, triggerfish, and parrotfish provide modest contributions, while goatfish, bream, snappers, and surgeonfish occur at very low levels. Soldierfish are present but minor. Overall, the assemblage is strongly skewed toward predatory barracuda with limited mid-trophic and herbivorous biomass, a pattern typical of non-MPAs where fishing pressure reduces diversity and suppresses recovery of key commercial taxa.

Barracuda	10.84	Goatfish	0.18
Fusilier	5.88	Bream	0.12
Grouper	0.36	Snapper	0.11
Triggerfish	0.35	Surgeonfish	0.10
Parrotfish	0.27	Soldierfish	0.03

Table 4. Mean biomass (kg per 150m²) of the ten most abundant commercial fish groups at Antulang during Jun–Aug 2025. Values represent average biomass per survey and highlight the dominant contributors to the commercial fish community.

Long-term context:

Since monitoring began, Antulang has consistently shown variable but sometimes high fish biomass for a non-protected marine area (MPA) site. The current value (~1,220 kg/ha) is among the highest recorded here, representing a sharp increase compared with recent years when biomass often fell below 500–600 kg/ha. This rise likely reflects short-term reductions in fishing pressure or seasonal influxes of schooling species such as barracuda and fusiliers, rather than sustained protection. While overall biomass now approaches levels typical of moderately enforced MPAs in the Coral Triangle, the very low abundance of groupers highlights that recovery of large predators is still absent without formal protection.

Ecological interpretation:

Antulang's fish assemblage shows signs of short-term recovery, with density and biomass rising strongly since the last report. Herbivores continue to dominate, supporting reef resilience, while moderate increases in carnivores point to some improvement in trophic structure. However, the continued scarcity of top predators reflects ongoing fishing pressure, which is a predictable outcome for an unprotected site. Without formal protection, these gains may be temporary, but the current biomass levels demonstrate the site's ecological potential if stronger management or community-based restrictions were introduced.

This is a marked increase from the previous reporting period. Considering it's an active fishing ground and not an MPA, this is a positive result. Antulang still occasionally sees relatively high amounts of biomass, likely due to the seasonal appearance of fish coming to the area to feed and breed.

ANTULANG

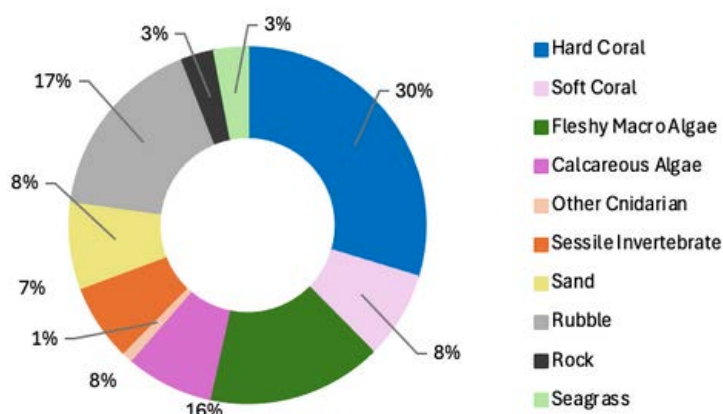
Reef Health And Resilience



Current status:

In June–August 2025, Antulang MPA recorded an **average hard coral cover of ~26.3%**, **fleshy macroalgae of ~17.0%**, and **rubble of ~10.9%**. The broader substrate composition shows hard coral (~26%) as the leading category, followed by sand (~16%), fleshy macroalgae (~17%), and rubble (~11%) (Figure 19). Sessile invertebrates (~9%), soft corals (~6%), and calcareous algae (~6%) enhance structural diversity, while smaller contributions come from seagrass (~5%), other cnidarians (~3%), and rock (~1%). Bleaching levels were low (~1.1%), suggesting minimal visible stress at the time of survey.

Figure 19. Average benthic substrate composition at Antulang (June–August 2025). Values represent the proportional contribution (%) of different benthic categories pooled across all surveys.



Recent change:

Since the last report, the hard coral cover has increased (20.5% → 26.3%), indicating a **strong seasonal recovery** (Figure 20). Macroalgae declined (19.5% → 17.0%), a positive signal of reduced competition. Rubble rose (7.0% → 10.9%), pointing to continued disturbance and habitat instability. Bleaching also increased slightly (0.6% → 1.1%), though it remains at very low levels compared to historic peaks (e.g., >13% in 2022) (Figure 21). These results suggest that the reef is trending toward recovery, with coral growth and reduced algal pressure offset by ongoing rubble accumulation.

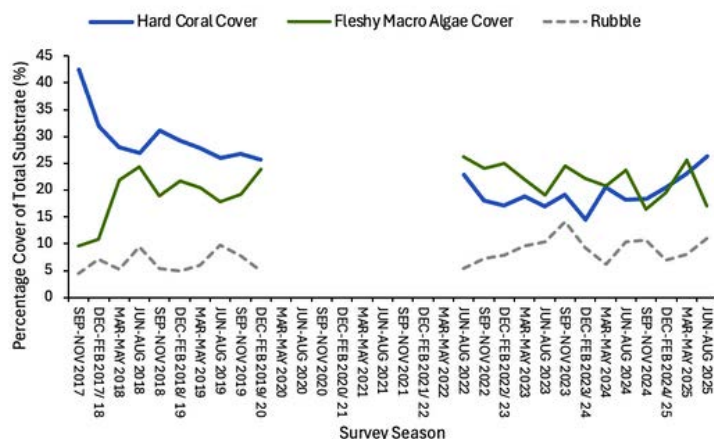
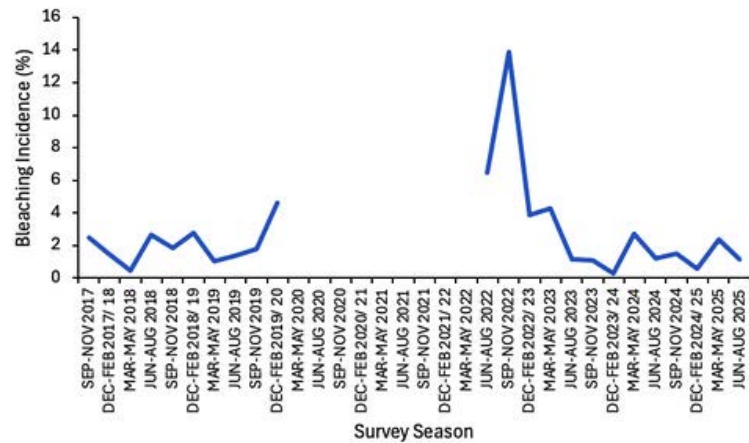


Figure 20. Temporal trends in hard coral cover, fleshy macroalgae cover, and rubble at Antulang (2017–2025). Data is expressed as average percentage cover per survey season.

Figure 21. Seasonal bleaching incidence at Antulang (2017–2025), shown as average percentage of colonies observed with visible bleaching (either partially or fully bleached) per survey season.



Structural implications:

The increase in hard coral alongside a reduction in macroalgae indicates that ecological balance is improving, likely supported by herbivore grazing. However, the elevated rubble fraction (~11%) signals persistent instability, which may limit coral recruitment if unconsolidated. Sand (~16%) remains a significant portion of the benthos, reducing available hard substrate for coral settlement but providing some ecological niches. The low bleaching levels are encouraging, but the rise since February suggests corals remain somewhat vulnerable to stress events.

Long-term context:

Antulang has experienced a long-term decline in coral cover since values greater than 40% were recorded in 2017, stabilising at ~15–26% over the last three years. Macroalgae have fluctuated between ~16% and 26%, often remaining competitive with corals. Rubble levels have gradually increased since 2022, reflecting the impacts of disturbance, while bleaching has varied from lows near 1% to peaks of ~14% (2022), indicating episodic vulnerability. The present increase in coral and reduction in algae represent positive trends, but recovery remains fragile.

Ecological interpretation:

Antulang's reef is in a transitional state, showing encouraging signs of coral recovery but still constrained by rubble and sand. The modest but steady presence of soft corals, sessile invertebrates, and calcareous algae adds complexity to the habitat. The decline in macroalgae since early 2025 is a particularly positive shift, easing competitive pressure. However, persistent disturbance reflected in rubble levels highlights the need for continued management to stabilise the substrate and sustain coral growth. With strong herbivore grazing and possible protection, Antulang has the potential to rebuild toward higher coral dominance, though its current state reflects both resilience and fragility.

ANTULANG

Tourism Value



Barracudas	20.08	Scorpaenidae	54.33
Cephalopods	14.94	Sharks	0.65
Cowries	32.90	Shrimps	45.24
Eels and Snakes	36.80	Slugs	62.84
Frogfish	8.34	Stingrays	0.76
Giant Clams	21.43	Syngnathidae and Pegasidae	21.97
Porcupinefish and Pufferfish	72.19	Turtles	16.13

Table 5. Mean encounter rates (%) of selected indicator and charismatic taxa recorded at Antulang from March - August 2025. Values represent the percentage of dives in which each group was observed, providing an indication of their relative tourism and ecological value.

Antulang provides high tourism value with strong and diverse sightings across multiple groups (Table 5). Porcupinefish and pufferfish (72.2%), slugs (62.8%), and scorpionfish (54.3%) are all recorded at high frequencies, while shrimps (45.2%), cowries (32.9%), and eels and snakes (36.8%) add consistent macro-diving appeal.

Frogfish (8.3%) are encountered more often here than at most other sites, and syngnathidae and pegasidae (22.0%) occur at relatively high levels, further strengthening Antulang's macro-diversity profile.

Turtles are seen occasionally (16.1%), and barracuda encounters (20.1%) are above municipal averages, increasing the site's megafauna interest.

Sharks (0.65%) and stingrays (0.8%) are recorded rarely, but the site gained exceptional value this season through a **whale shark sighting in July**, highlighting its potential for rare pelagic encounters.

Overall, Antulang stands out as one of the municipality's strongest sites for both macro-diversity and the occasional occurrence of high-value megafauna.

KOOKOOS



Kookoos does not have protected status and, as such, functions as a non-MPA control site. The reef ranges from 1 to 20m deep and consists of a wide area of irregular, shallow reef and extensive, dense reef at deeper depths, characterised by high amounts of soft coral. It is often subject to fishing activity, particularly in the shallow portion of the reef.



KOOKOOS

Food Security

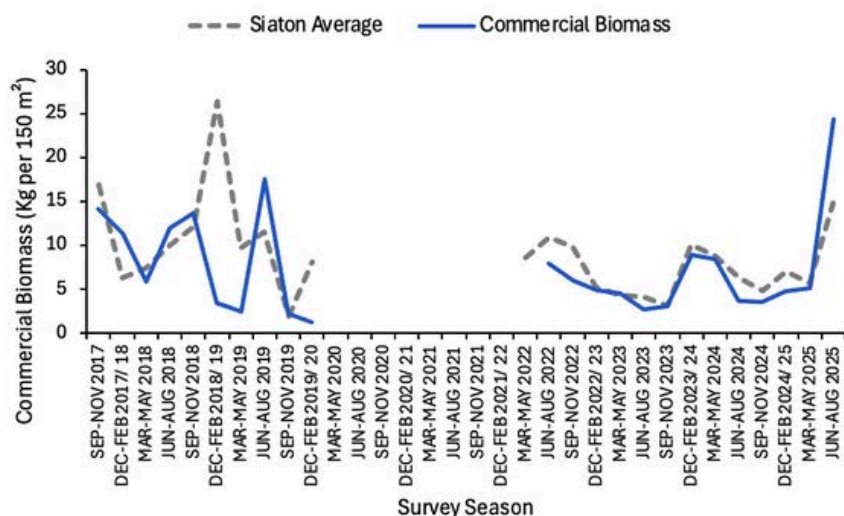


There is anecdotal support for the idea that the local fishing community is fishing thoughtfully and limiting their extraction of fish. It should be noted when considering any data collected at this site in the current period that it may have been influenced by recent nearby dredging activity for the expanded port at adjacent Tambobo Bay.

Current Status:

In June–August 2025, Kookoos recorded an average total fish density of ~850 individuals per 150 m², with commercial species contributing around 268 individuals per 150 m². **Commercial biomass reached approximately 24.3 kg per 150 m² (~1,620 kg/ha)**, the highest value recorded for this site to date and one of the strongest among all monitored sites. Interestingly, this value is highest despite Kookoos lacking the protections of MPA status. Herbivores dominated the assemblage (~719 individuals per 150m²), supported by substantial carnivore presence (~97), with omnivores, corallivores, and detritivores providing smaller but consistent contributions.

Figure 22. Temporal trends in commercial fish biomass (kg per 150 m²) at Kookoos (2017–2025). Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness.



Recent Change:

Compared with the previous reporting season, when biomass was just ~4.8 kg per 150m² (~320 kg/ha), Kookoos displayed **a dramatic improvement in commercial biomass (4.8 → 24.3 kg per 150m²)**, representing more than a fivefold increase (Figure 22). Commercial density also rose sharply (54 → 268 individuals per 150m²) (Figure 23). Herbivore density increased significantly (470 → 719), while carnivores roughly doubled (47 → 97). This shift reflects not just higher numbers but also larger average body sizes, particularly among schooling fusiliers and snappers.

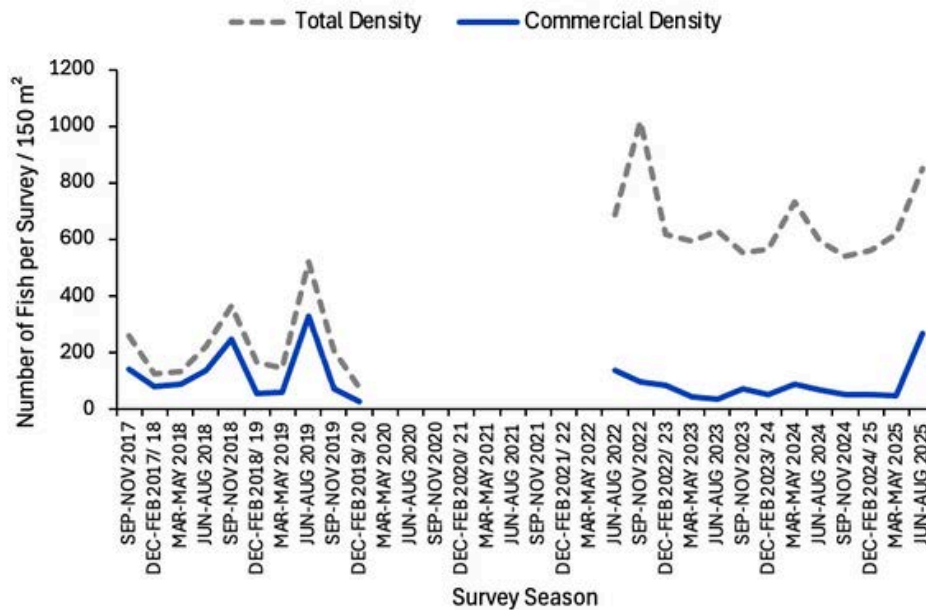


Figure 23. Temporal trends in total fish density and commercial fish density at Kookoos (2017-2025). Values represent average individuals per 150 m² recorded during seasonal surveys.

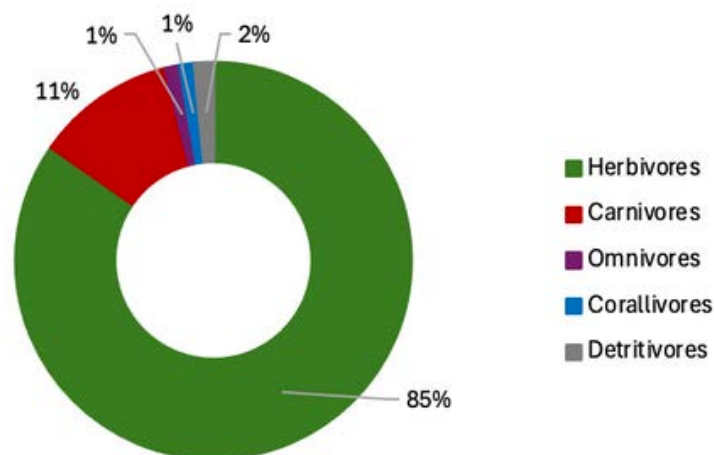


Figure 24. Proportional contribution (%) of dietary groups to total fish density at Kookoos during Jun–Aug 2025. Values include both commercial and non-commercial species, ensuring that the role of abundant herbivores in maintaining algal–coral balance is represented.

Dietary structure:

Kookoos is strongly herbivore-driven, a positive sign for reef resilience as grazing pressure controls algal competition and maintains substrate availability for corals (Figure 24). Carnivores showed encouraging increases, suggesting partial rebuilding of predatory functions. Omnivores and corallivores remained stable, and detritivores contributed consistently across surveys. The assemblage appears both abundant and balanced, with improved representation across multiple trophic levels.

Commercial Groups:

At Kookoos, fusiliers dominate the assemblage, contributing nearly an order of magnitude more biomass than any other group, which drives much of the recent biomass increase (Table 6). Barracuda provide the primary predator input, while snappers and soldierfish add moderate mid-trophic biomass. Triggerfish and groupers occur at lower but consistent levels, alongside unicornfish and parrotfish, which represent the herbivorous component. The notable surge in biomass this season suggests improved survivorship and growth of mid-sized schooling fish, which are particularly sensitive to fishing pressure.

Fusilier	17.88	Grouper	0.37
Barracuda	2.33	Unicornfish	0.36
Snapper	1.58	Parrotfish	0.29
Soldierfish	0.56	Goatfish	0.16
Triggerfish	0.52	Rabbitfish	0.12

Table 6. Mean biomass (kg per 150 m²) of the ten most abundant commercial fish groups at Kookoos during Jun–Aug 2025. Values represent average biomass per survey and highlight the dominant contributors to the commercial fish community.

Long-term context:

Since monitoring began, Kookoos has shown variable fish biomass, typically ranging between ~3–9 kg per 150 m². The current value (~24.3 kg per 150 m², ~1,620 kg/ha) is more than double the long-term site average (~9 kg per 150 m²) and marks the clearest signal of recovery observed at this site. Compared with no-take MPAs across the Coral Triangle (often exceeding 1,000–1,500 kg/ha), Kookoos is now performing at or above regional benchmarks — a remarkable turnaround given that it is not an MPA.

Ecological interpretation:

Kookoos demonstrates exceptional improvement in fish biomass and density in 2025, with strong herbivore dominance supporting coral–algal balance and steadily increasing carnivore presence, suggesting trophic recovery. The dramatic rise in commercial biomass indicates both the effectiveness of nearby protection and reduced fishing pressure. However, the low abundance of large-bodied apex predators (e.g., groupers, reef sharks) shows that recovery is still ongoing. Continued enforcement and spillover benefits from adjacent MPAs could consolidate these gains, positioning Kookoos as one of the municipality’s most resilient reef sites.

KOOKOOS

Reef Health And Resilience

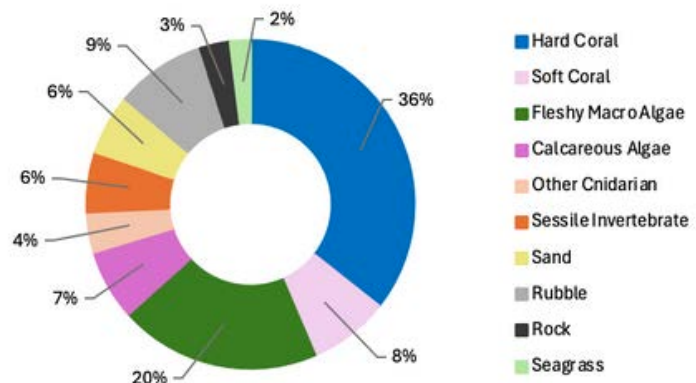


Kookoos is remarkable for its high coverage of hard coral, which was the highest level recorded anywhere in Siaton. This is classified as high cover by the Australian Institute of Marine Science.

Current status:

In June–August 2025, Kookoos MPA recorded an **average hard coral cover of ~36%**, fleshy **macroalgae of ~20.4%**, and **rubble of ~9.1%**. The broader substrate composition shows hard coral (~36%) as the dominant category, followed by fleshy macroalgae (~20%), rubble (~9%), and sand (~6%) (Figure 25). Soft coral (~8%), calcareous algae (~7%), and sessile invertebrates (~6%) contribute to structural diversity, while smaller contributions come from other cnidarians (~4%), rock (~3%), and seagrass (~2%). Bleaching levels were very low (~1.3%), suggesting minimal stress during the survey period.

Figure 25. Average benthic substrate composition at Kookoos (June–August 2025). Values represent the proportional contribution (%) of different benthic categories pooled across all surveys.



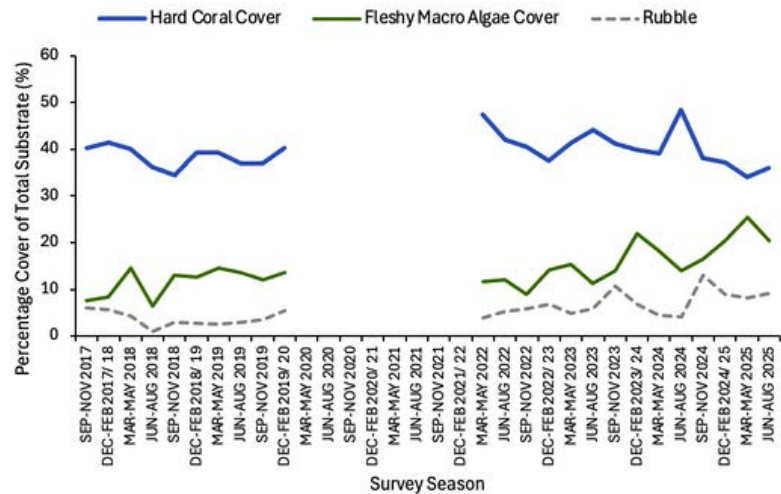
Recent change:

Since the last report, hard coral cover decreased slightly (37.2% → 36.0%, essentially stable), while fleshy macroalgae decreased (20.3% → 20.4%, again stable). Rubble rose moderately (8.9% → 9.1%), indicating persistent substrate disturbance. Bleaching decreased slightly (1.5% → 1.3%), continuing the recent trend of low thermal stress compared to historic peaks (>20% in 2022). Overall, the last report highlighted concerns over high macroalgal pressure, but the latest data suggest that conditions remain balanced, with strong coral presence.

Structural implications:

The high coral cover (~36%) alongside moderate macroalgae (~20%) indicates a reef with ongoing competition for space, yet still maintaining coral dominance. The relatively small but consistent rubble fraction (~9%) highlights disturbance legacies but also provides settlement space. The combined presence of soft corals, calcareous algae, and sessile invertebrates supports structural complexity, while low levels of bleaching reinforce ecological stability. If macroalgae levels can be further reduced, Kookoos has strong potential to enhance coral recruitment and consolidation.

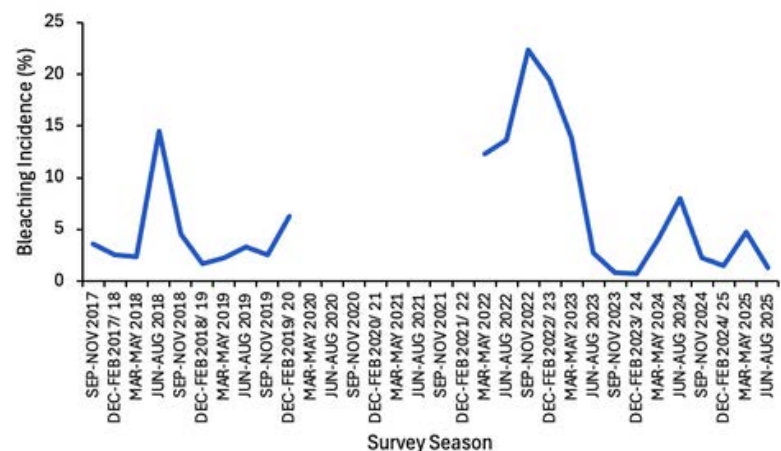
Figure 26. Temporal trends in hard coral cover, fleshy macroalgae cover, and rubble at Kookoos (2017–2025). Data is expressed as average percentage cover per survey season.



Long-term context:

Kookoos has historically maintained some of the highest coral cover across Siaton, with values generally ~35–45% since 2017, though it has rarely exceeded early peaks (~42–44%) (Figure 26). Macroalgae levels have fluctuated between ~8–25%, occasionally rising sharply (e.g., exceeding 25% in 2025), but never overwhelming coral dominance. Bleaching has exhibited episodic spikes, reaching over 22% in late 2022, but has since declined to very low levels (<2%) (Figure 27). This long-term stability in coral cover, even amid fluctuations in algal and bleaching, highlights the site’s resilience compared to many other MPAs.

Figure 27. Seasonal bleaching incidence at Kookoos (2017–2025), shown as average percentage of colonies observed with visible bleaching (either partially or fully bleached) per survey season.



Ecological interpretation:

Kookoos supports one of the most coral-rich reefs in Siaton, with strong ecological resilience reflected in stable coral cover and consistently low bleaching in recent years. Macroalgal competition remains the key challenge, but current levels (~20%) are not sufficient to cause a phase shift. Persistent rubble and sand indicate disturbance but also offer opportunities for coral recruitment. With continued herbivore presence and nearby MPA protection, Kookoos is well-positioned to maintain its role as a coral-dominated reef and a source of resilience for the wider Siaton municipality.

KOOKOOS

Tourism Value



Barracudas	16.98	Scorpaenidae	49.81
Cephalopods	10.27	Sharks	0
Cowries	30.46	Shrimps	40.46
Eels and Snakes	54.58	Slugs	76.14
Frogfish	1.76	Stingrays	0.88
Giant Clams	46.17	Syngnathidae and Pegasidae	15.14
Porcupinefish and Pufferfish	86.79	Turtles	24.49

Table 7. Mean encounter rates (%) of selected indicator and charismatic taxa recorded at Kookoos from March - August 2025. Values represent the percentage of dives in which each group was observed, providing an indication of their relative tourism and ecological value.

Kookoos is well known for its interesting underwater topography and landscape. There are large-scale features, such as coral bommies and small canyons, that provides very rewarding diving and highlight its potential for dive tourism. There is easy access to the public beach, which makes diving there relatively easy.

Kookoos demonstrates a very high tourism value, particularly through exceptionally frequent sightings of porcupinefish and pufferfish (86.8%), slugs (76.1%), and giant clams (46.2%), all of which are well above municipal averages (Table 7).

Eels and snakes (54.6%), scorpionfish (49.8%), and turtles (24.5%) add further to its appeal, while cowries (30.5%) and shrimps (40.5%) support strong macro-diving opportunities. Frogfish (1.8%) and stingrays (0.9%) are recorded occasionally, though sharks were absent.

The site gained additional uniqueness this season with the sighting of an electric clam in August, a rare invertebrate species that significantly enhances its niche tourism value for macro divers.

Overall, Kookoos combines reliable megafauna sightings with macro-diversity, making it one of the most attractive dive sites in the Siaton municipality.

SALAG MPA



Salag MPA has an area of 10 hectares and is surrounded by no seagrass or mangroves. MCP began monitoring at Salag in 2019. The dense reef ranges from 1 to 15 m in depth and then becomes patchy, with sandy areas extending up to 19m in depth. Due to its location, the reef is well protected from prevailing winds and generally experiences little to no longshore current or wave action.



MPA demarcation based on DENR coordinates

SALAG MPA

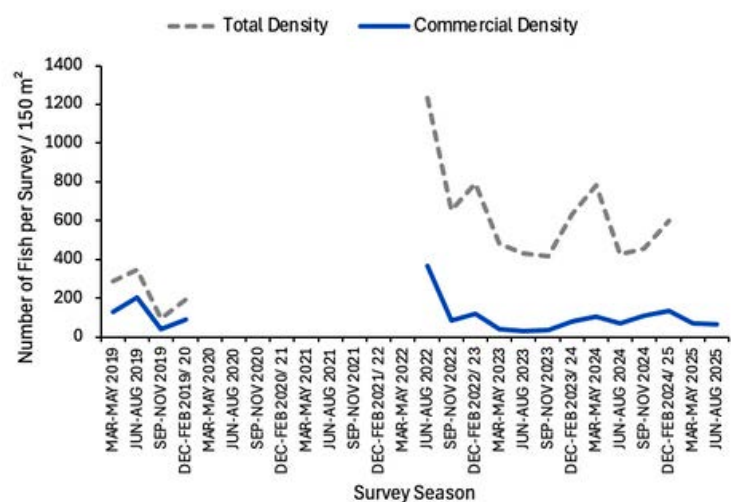
Food Security



Current Status:

In Jun–Aug 2025, Salag MPA recorded an average total fish density of ~489 individuals per 150 m², with ~66 commercial species per 150 m² (Figure 28). **Commercial biomass reached approximately 11.2 kg per 150 m² (~623 kg/ha)**, a moderate value compared to other sites (Figure 29). Herbivores dominated the assemblage (~366 individuals per 150 m²), supported by carnivores (~90) and smaller but consistent contributions from corallivores, omnivores, and detritivores.

Figure 28. Temporal trends in total fish density and commercial fish density at Salag MPA from (2019-2025). Values represent average individuals per 150 m² recorded during seasonal surveys.



Recent Change:

Compared to the previous report, when commercial biomass was ~8.5 kg per 150m² and density was ~133 individuals per 150m², **biomass has increased (from 8.5 to 11.2 kg per 150m²)**, but commercial density has declined (from 133 to 66 individuals per 150 m²). Herbivore density also decreased (427 → 366), while carnivores increased (76 → 90). This suggests that, although overall biomass remains stable, the assemblage structure is shifting toward a higher representation of carnivores, potentially reflecting changes in size

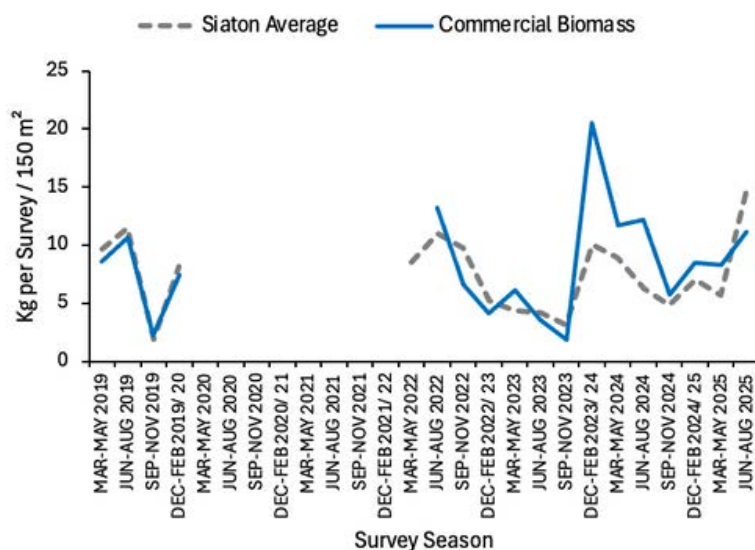
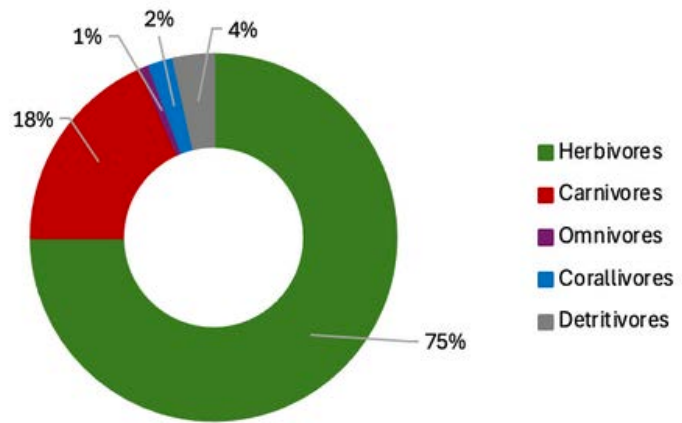


Figure 29. Temporal trends in commercial fish biomass (kg per 150m²) at Salag MPA (2019-2025). Biomass values represent the estimated weight of commercially important reef fish, providing an indicator of food security potential and MPA effectiveness.

Figure 30. Proportional contribution (%) of dietary groups to total fish density at Salag MPA during Jun–Aug 2025. Data include both commercial and non-commercial species, highlighting the ecological importance of abundant herbivores in supporting algal–coral balance.



Dietary structure:

Herbivores remain the dominant feeding group, a positive sign for maintaining the algal–coral balance (Figure 30). Carnivores are present at encouraging levels, and their increase this season may suggest improvements in mid-level predatory control. Corallivores, omnivores, and detritivores occur in small but stable densities, helping to maintain trophic diversity. However, omnivores remain relatively low in comparison to other sites, potentially limiting functional redundancy.

Snapper	5.02	Grouper	0.55
Unicornfish	1.59	Goatfish	0.40
Soldierfish	1.26	Parrotfish	0.29
Fusilier	0.71	Emperor	0.21
Surgeonfish	0.66	Bream	0.18

Table 8 - Mean biomass (kg per 150 m²) of the ten most abundant commercial fish groups at Salag MPA during Jun–Aug 2025. Values represent average biomass per survey and highlight the dominant contributors to the commercial fish community.

Commercial Groups:

At Salag, snappers dominate the commercial fish biomass, supported by moderate contributions from unicornfish, soldierfish, and fusiliers. Surgeonfish and groupers add further diversity, though at lower levels (Table 8). Goatfish, parrotfish, emperors, and bream make smaller but consistent contributions. Overall, the assemblage is characterised by a strong mid-trophic presence, but with relatively limited biomass of large-bodied predators.

Long-term context:

Since monitoring resumed after the COVID-19 pandemic, Salag has shown variable commercial biomass, typically ranging between 4 and 12 kg per 150 m². The most recent value (~11.2 kg per 150 m², ~623 kg/ha) is above the site's long-term average but remains below the exceptional peaks recorded at sites such as Kookoos (>20 kg per 150 m²). Biomass levels are higher than in earlier post-COVID years (2022–2023), when values often fell below 7 kg per 150 m², indicating a gradual improvement. However, density values remain lower than at other sites, showing that the reef is still in recovery.

Ecological interpretation:

Salag demonstrates moderate resilience, with stable biomass and a healthy herbivore base supporting reef processes. The recent increase in carnivore density is encouraging, but the simultaneous decline in herbivore numbers highlights the delicate balance required to maintain reef function. Compared with other sites, Salag sits in a mid-range position; stronger than some post-COVID low performers, but not yet reaching the high biomass benchmarks of the best-protected reefs. Continued enforcement is crucial to sustain the recovery of the size structure and prevent fishing pressure from undermining current gains.

SALAG MPA

Reef Health And Resilience

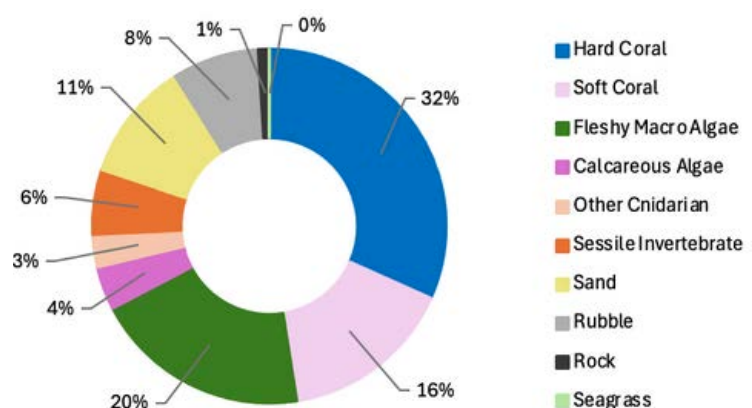


Salag MPA is most similar to Kookoos in terms of underwater landscape and general features.

Current status:

In June–August 2025, Salag MPA recorded an **average hard coral cover of ~31.8%**, **fleshy macroalgae of ~19.7%**, and **rubble of ~8.2%**. The broader substrate composition highlights hard coral (~32%) as the dominant category, followed by fleshy macroalgae (~20%), soft coral (~16%), and sand (~11%) (Figure 31). Rubble (~8%), sessile invertebrates (~6%), calcareous algae (~4%), and other cnidarians (~3%) provide additional structural variety, while rock and seagrass were minimal. Bleaching levels were very low (~2.2%), indicating limited visible stress during this period.

Figure 31. Average benthic substrate composition at Salag MPA (June–August 2025). Values represent the proportional contribution (%) of different benthic categories pooled across all surveys.



Recent change:

Since the last report, the hard coral cover has increased (24.6% → 31.8%), indicating a notable seasonal recovery. Fleshy macroalgae decreased slightly (23.2% → 19.7%), a positive trend that may reflect improved grazing pressure. Rubble rose modestly (7.4% → 8.2%), suggesting minor disturbance but within natural variation. Bleaching increased slightly (0.8% → 2.2%) but remains far below historic peaks (>18% in 2022–2023). Compared to the last report, conditions suggest improved coral dominance alongside stable algal control.

Structural implications:

The rise in coral cover, alongside a reduction in macroalgae, points to a reef regaining balance, with herbivory likely playing a role in keeping algae in check. Soft corals form a substantial fraction (~16%), adding complexity but also competing for substrate. Rubble and sand together (~19%) highlight disturbance legacies but also offer recruitment surfaces for new coral. Continued low bleaching is an encouraging sign of resilience, although monitoring is necessary to ensure that coral gains are not offset by future algal resurgence.

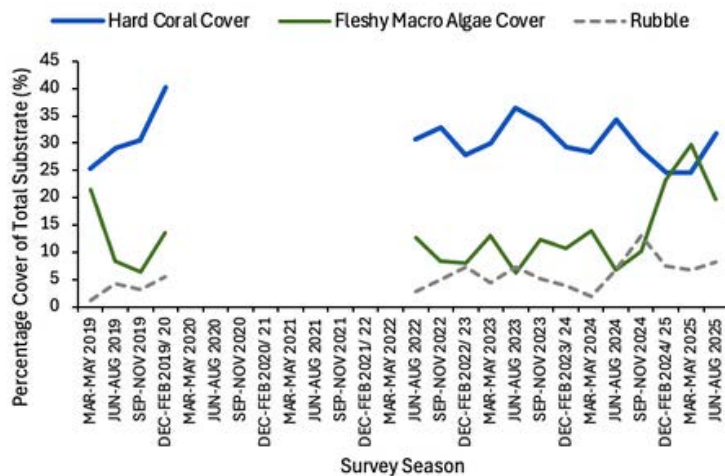


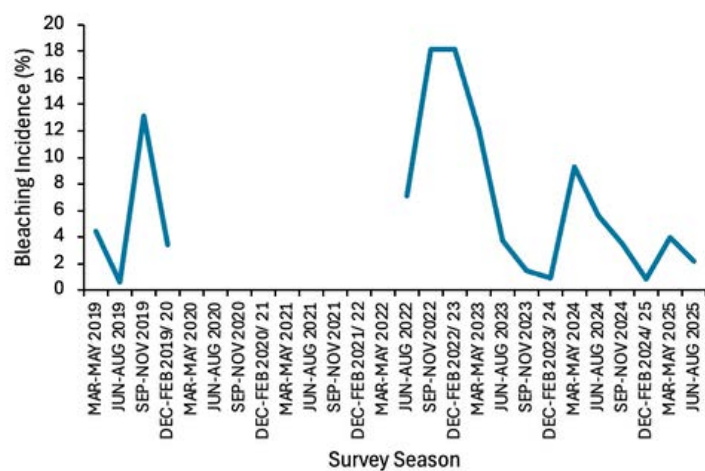
Figure 32. Temporal trends in hard coral cover, fleshy macroalgae cover, and rubble at Salag MPA (2019–2025). Data is expressed as average percentage cover per survey season.

Long-term context:

Salag has historically maintained moderate to high coral cover, typically around 30–40% since 2019, with occasional dips observed during periods of high macroalgae or bleaching (Figure 32). Bleaching stress peaked dramatically in 2022–2023 (>18%), but has since dropped to very low levels (<5%), allowing corals to recover (Figure 33). Macroalgae levels have fluctuated widely (6–30%), at times rivalling coral cover but not yet driving a lasting phase shift. The recent recovery of coral, alongside reduced macroalgal dominance, indicates improved resilience compared to earlier stress periods.

Another health concern that has been noted at Salag MPA but isn't reflected in the data is the presence of large amounts of fabric and textile trash. These have been observed to smother and damage corals.

Figure 33. Seasonal bleaching incidence at Salag MPA (2019–2025), shown as average percentage of colonies observed with visible bleaching (either partially or fully bleached) per survey season.



Ecological interpretation:

Salag MPA supports a diverse benthic community, featuring strong coral representation and significant structural contributions from soft corals and other invertebrates. The reef exhibits signs of recovery, with increasing coral cover, decreased macroalgae, and lower bleaching stress compared to recent years. While rubble and sand remain moderately high, these substrates provide opportunities for recruitment if algal overgrowth is controlled. With sustained herbivore populations and continued MPA enforcement, Salag has strong potential to build resilience and maintain its role as a structurally complex and coral-rich reef within the Siaton municipality.

SALAG MPA

Tourism Value



Barracudas	2.71	Scorpaenidae	42.03
Cephalopods	5.39	Sharks	0
Cowries	7.31	Shrimps	43.69
Eels and Snakes	28.24	Slugs	71.90
Frogfish	0	Stingrays	5.46
Giant Clams	50.76	Syngnathidae and Pegasidae	5.53
Porcupinefish and Pufferfish	77.38	Turtles	2.71

Table 9. Mean encounter rates (%) of selected indicator and charismatic taxa recorded at Salag MPA from March - August 2025. Values represent the percentage of dives in which each group was observed, providing an indication of their relative tourism and ecological value.

Salag MPA is renowned for its fascinating underwater topography and landscape. There are large-scale features, such as coral bommies and small canyons, that make for very rewarding diving and highlight its potential for dive tourism. It is also the site of 'Hidden Beach', which is already established as a popular destination.

Salag provides moderate tourism value, with very strong encounters for porcupinefish and pufferfish (77.4%), slugs (71.9%), and giant clams (50.8%) (Table 9).

Scorpionfish (42.0%), shrimps (43.7%), and eels and snakes (28.2%) add further appeal for divers, especially those interested in macro-diversity.

In contrast, megafauna are limited: turtles are rarely observed (2.7%), and barracudas are infrequent (2.7%). Stingrays are seen occasionally (5.5%), providing some larger-species interest. Cowries are relatively scarce (7.3%), and frogfish and sharks were not recorded. This is potentially due to the lack of surrounding and adjacent seagrass ecosystems that play a crucial role in supporting their presence, particularly that of turtles.

Overall, Salag offers substantial value for divers seeking invertebrates, slugs, and pufferfish; however, its low turtle frequency and limited pelagic encounters make it less competitive for megafauna-focused tourism compared to other sites in the municipality.

FISH MONITORING

Our fish surveys are conducted using a visual census method based on a 30-meter x 5-meter belt transect. This yields an area of 150 square meters per survey. All target fish that enter the survey zone, from the seafloor to the surface, are counted and sized. The transect is left undisturbed for 15 minutes after it has been laid out, allowing fish to return to the survey area. Surveys are timed to last 10 minutes.

The following is our complete fish indicator list (commercial in bold):

- Angelfish - Bicolor
- Angelfish - Keyhole
- Angelfish - Midnight
- Angelfish - Pearl-Scale
- Angelfish - Other
- Anthias
- **Barracuda**
- **Big Eye**
- **Bream**
- Bristletooth
- Brushtail Tang
- Butterflyfish
- Cornetfish
- Damselfish - Other
- Damselfish - Sergeant
- **Emperorfish - Other**
- **Emperorfish - Long Face**
- **Fusilier**
- **Goatfish**
- **Grouper - Barramundi**
- **Grouper - Brown-Marbled**
- **Grouper - Other**
- Long-Jawed Mackerel
- Moorish Idol
- Needlefish
- **Rabbitfish**
- **Parrotfish - Other**
- **Parrotfish - Bumphead**
- **Parrotfish - Raggedtooth**
- **Parrotfish - Stareye**
- **Pufferfish - Other**
- **Pufferfish - White-Spotted**
- Scad
- Sea Rays
- Sea Snakes
- Sharks
- **Snapper**
- **Soldierfish**
- Squid
- Spadefish
- **Surgeonfish - Other**
- **Surgeonfish - Whitetail**
- **Surgeonfish - Yellow Mask**
- **Sweetlips**
- **Trevally - Other**
- **Trevally - Scad**
- **Triggerfish - Other**
- **Triggerfish - Redtooth**
- **Triggerfish - Titan**
- **Tuna**
- Turtles - Green
- Turtles - Hawksbill
- **Unicornfish - Blue-Spine**
- **Unicornfish - Orangespine**
- **Unicornfish - Other**
- Wrasse - Cleaner
- Wrasse - Humphead
- Wrasse - Other

SUBSTRATE MONITORING

Our substrate surveys utilise a Point Intercept Method, based around a transect length of 30 meters. The substrate directly below every 25 cm increment on the line is identified and recorded. This yields a total of 120 data points per survey.

The following is our comprehensive list of substrate indicators.

Hard Coral

- Branching
- Tabulate
- Plate-like
- Encrusting
- Submassive
- Columnar
- Massive
- Solitary

Soft Coral

- Other Soft Coral
- Gorgonian
- Organ Pipe

Other Cnidarians

- Anemone
- Corallimorph
- Hydroid
- Zoanthid

Sessile Invertebrates

- Sponge - Barrel
- Sponge - Encrusting
- Sponge - Irregular
- Ascidian - Regular
- Ascidian - Encrusting
- Bryozoan

Algae

- Coralline
- Halimeda
- Filamentous
- Macro
- Turf

Health and Vulnerability

- Bleaching
- Disease
- Infestation
- Predation - Coralliophila
- Predation - Crown of Thorns
- Predation - Drupella
- Silt

Substrate

- Giant Clam
- Live Coral Fragment
- Rock
- Rubble
- Sand



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THANK YOU

Please contact us if you would like any additional information, or require assistance with any conservation activities

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