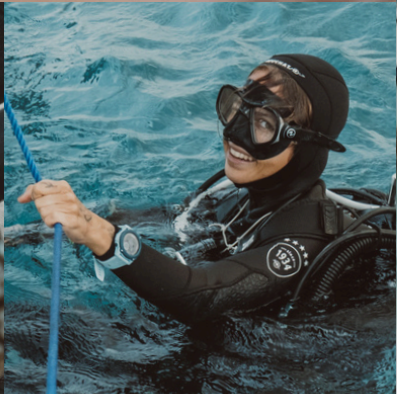




# PROJECT LAUT

## Dan's Reef Restoration Site Information Brochure

May 2024





## PROJECT LAUT DAN'S REEF RESTORATION SITE

Project Laut is a marine conservation initiative with a dual focus on Hawksbill Sea Turtle conservation and Coral Reef Restoration. Situated at the core of the Coral Triangle, we offer a unique divemaster training program that equips participants with the skills needed to actively engage in marine conservation efforts.

Nusa Penida's marine protected areas are under significant threat from coastal development, climate change, unsustainable tourism, destructive fishing, and excessive anchor use, leading to the formation of large, mobile coral rubble patches. These patches, moved by waves and tides, damage extensive areas of healthy coral reefs and create conditions that prevent the growth of new coral larvae, vital for ecosystem regeneration. Recognizing the critical role coral reefs play, Project Laut has extended its conservation initiatives from monitoring endangered sea turtles to actively restoring these damaged reefs, thereby enhancing their resilience and capacity to support diverse marine life.

We are seeking support from individuals, businesses, and environmental advocates to join us in our efforts. By investing in Project Laut, you contribute to the health of our oceans and gain the opportunity to be part of a vital environmental mission.

Whether you're looking to support a critical environmental cause or seeking a professional training program that contributes to real-world conservation, Project Laut offers a unique opportunity to make a difference. Your involvement can help ensure the survival of vital marine species and habitats.

**Invest in our oceans. Join Project Laut today.**



**WE DIVE**



**WE RESTORE**



**WE INSPIRE**

A close-up photograph showing a person's hands holding a black plastic basket. The basket is filled with a dense, brown, textured material, likely seaweed or coral. The background is a blurred blue, suggesting water. The text "WE GROW" is overlaid in white, bold, sans-serif font in the center of the image.

**WE GROW**

# CORAL RESTORATION PROJECT

## TIMELINE

### January 2022

Project Laut researched various reef restoration methods & determined MARRS Reef Stars as the most suitable & cost effective for our targeted habitat.

### September 2022

First Reef Stars deployed at Dan's Reef Restoration Site

### March 2023

50 Reef Stars deployed

### September 2023

Documented nearly 100% coral coverage on the initial patch of coral stars deployed between September 2022 - September 2023. Noticable stabilisation of the rubble area underneath the patch.

### December 2023

Project Laut acquires legal rights to Dan's Reef Restoration Site by leasing rubble patch from the Ministry of Marine Affairs.

### January 2024

Start of Collaboration with Go Ocean & Establishment of the Individual Donor Patch

### March 2024

156 Reef Stars deployed & over 2800 fragments attached, restoring over 51m<sup>2</sup> of habitat. Mixed Coral attachments showed strong resilience against a bleaching event that happened in January 2024.

### Latest Update

258 Reef Stars deployed & over 4644 fragments attached, restoring over 85m<sup>2</sup> of habitat. Plan to deploy more than 500 structures by the end of September 2024





## MARS ASSISTED REEF RESTORATION SYSTEM (MARRS)

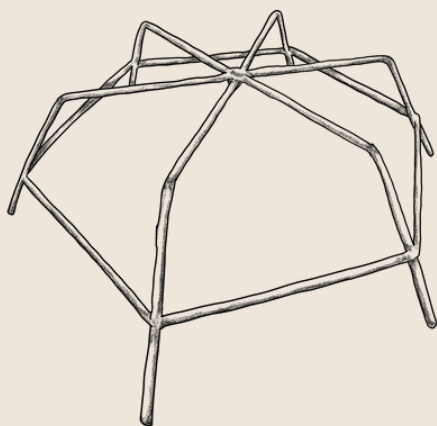
The Mars Assisted Reef Restoration System (MARRS) is a pivotal innovation in marine conservation, specifically designed to convert unstable rubble patches—often the aftermath of storms or human impacts—into robust, stable substrates. This transformation is crucial for coral larval settlement and subsequent colonisation.

The MARRS units or “reef stars”, typically constructed from rebar, are engineered to interlock and stabilise loose rubble, preventing further dislocation caused by currents and wave action. Each additional structure that gets added not only increases the overall coral density but also adds weight and offers more shelter for marine life.

The MARRS method not only revives coral populations but also reinstates the ecological functions they support, such as nutrient cycling, habitat provision for myriad marine species, and coastal protection against erosion. As the coral colonies establish and grow, they amalgamate further stability and complexity to the habitat. This is vital for the re-establishment of a diverse, functional ecosystem.

### STEP I

Reef Stars are produced by local villagers on Nusa Penida



### STEP III

After 3-4 weeks Reef Stars will be encrusted with Encrusting Corraline Algae



### STEP II

Reef Stars are coated in cement paint & dropped into the holding area on Dan's Reef

### STEP IV

Reef Stars are planted with mixed coral fragments

In our initial approach, we coated each star in resin and sand using the MARRS method. We later explored an alternative technique where we applied a cement coating to each star. Cement, rich in calcium carbonate, is effective in preventing iron leaching from the structures and is also cost-effective. After coating, we allowed the stars to be naturally covered with Coralline Encrusting Algae (CEA) for up to one month before deployment. This method proved to be as effective as the initial one, without the need for the potentially harmful and expensive resin, enabling us to deploy more stars.



## PROJECT LAUT MIXED CORAL ATTACHMENTS

The image above shows a fragment of *Heliopora* coral secured with two zip ties. Although using plastic is not ideal, plastic zip ties have proven most effective at securely attaching coral fragments & keeping the young, fragile fragments as stable as possible during their early growth stages.

As the coral matures, it expands and forms a calcium carbonate skeleton that gradually encapsulates the zip ties, effectively embedding them within the structure and minimising their environmental impact.

We continuously search for alternative methods to secure our coral fragments. We have tested metal wire, but it rusts quickly and harms the coral's growth. Marine superglue, while effective, is too costly to import in the large quantities needed for extensive restoration projects, especially in developing areas like Nusa Penida.



**MIXED CORAL ATTACHMENTS  
2 YEARS OLD**

# PROJECT LAUT

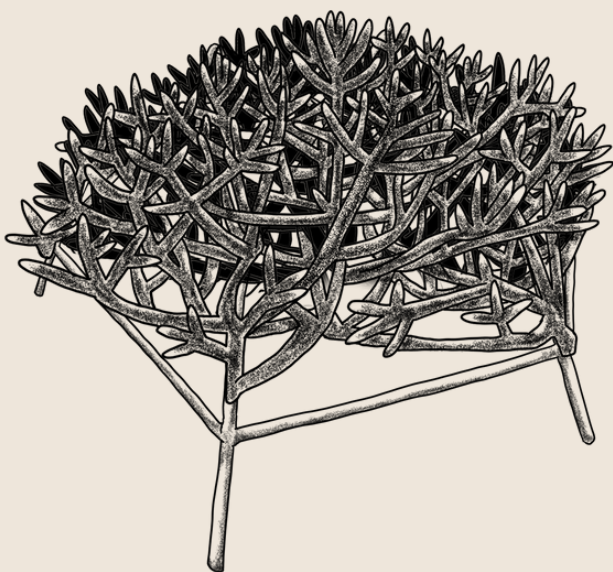
## MIXED CORAL ATTACHMENTS

At Project Laut we implement mixed planting techniques. Mixed coral stars will attract a more robust fish population, create more niches for juvenile fish, and will be more resilient in the face of environmental perturbations or bleaching events.

In contrast, most restoration initiatives within the Coral Triangle tend to adopt monoculture planting approaches, particularly favouring *Acropora* species. *Acropora* corals are preferred because they fragment easily, making them straightforward and quick to propagate. Additionally, their rapid growth rates are visually impactful, enhancing PR efforts and social media appeal. However, this approach has significant downsides; *Acropora* monocultures are notably more vulnerable to coral diseases and bleaching events.

At Project Laut, we prioritise a more diverse and time-intensive approach by planting mixed genera. Though it takes longer to collect and prepare these varied fragments, the benefits are substantial. Our mixed planting strategy leads to higher overall survivorship. Furthermore, if a disease or bleaching impacts one genus, others are likely to survive, ensuring the longevity and sustainability of the entire ecosystem.

Supporting this approach, research shows that coral diversity is critical for ecosystem resilience. Studies have found that regions with greater coral diversity suffered less from bleaching and recovered more quickly. Additionally, research highlights that genetic diversity within coral populations enhances their ability to withstand environmental stresses like temperature changes and disease. By fostering a variety of coral genera, Project Laut not only enhances the ecological stability of the restoration site but also contributes to the broader goals of coral conservation, maintaining ecosystem functionality and biodiversity.



**NON-MIXED REEF STAR**



**MIXED REEF STAR**



*Conservation is*

**TEAMWORK**



## DRY TEAM

The Dry Team is responsible for attaching coral fragments to the reef stars on the boat, where conditions allow for more secure fastening. It is crucial that the fragments are attached firmly because any movement can hinder their growth or their ability to adhere to the reef star.

The Dry Team must select high-quality coral fragments to maximise survival rates and is tasked with ensuring a diverse mix of coral genera are attached to maintain Project Laut's "Mixed Reef Star" standards.

## WET TEAM

The Wet Team is tasked with collecting healthy "Coral of Opportunity" fragments, placing them in a collection bucket, and transporting the bucket to the boat for direct planting. This task involves searching the reef for naturally detached but viable coral fragments, ensuring a diverse selection of genera for the Dry Team to choose from for planting.

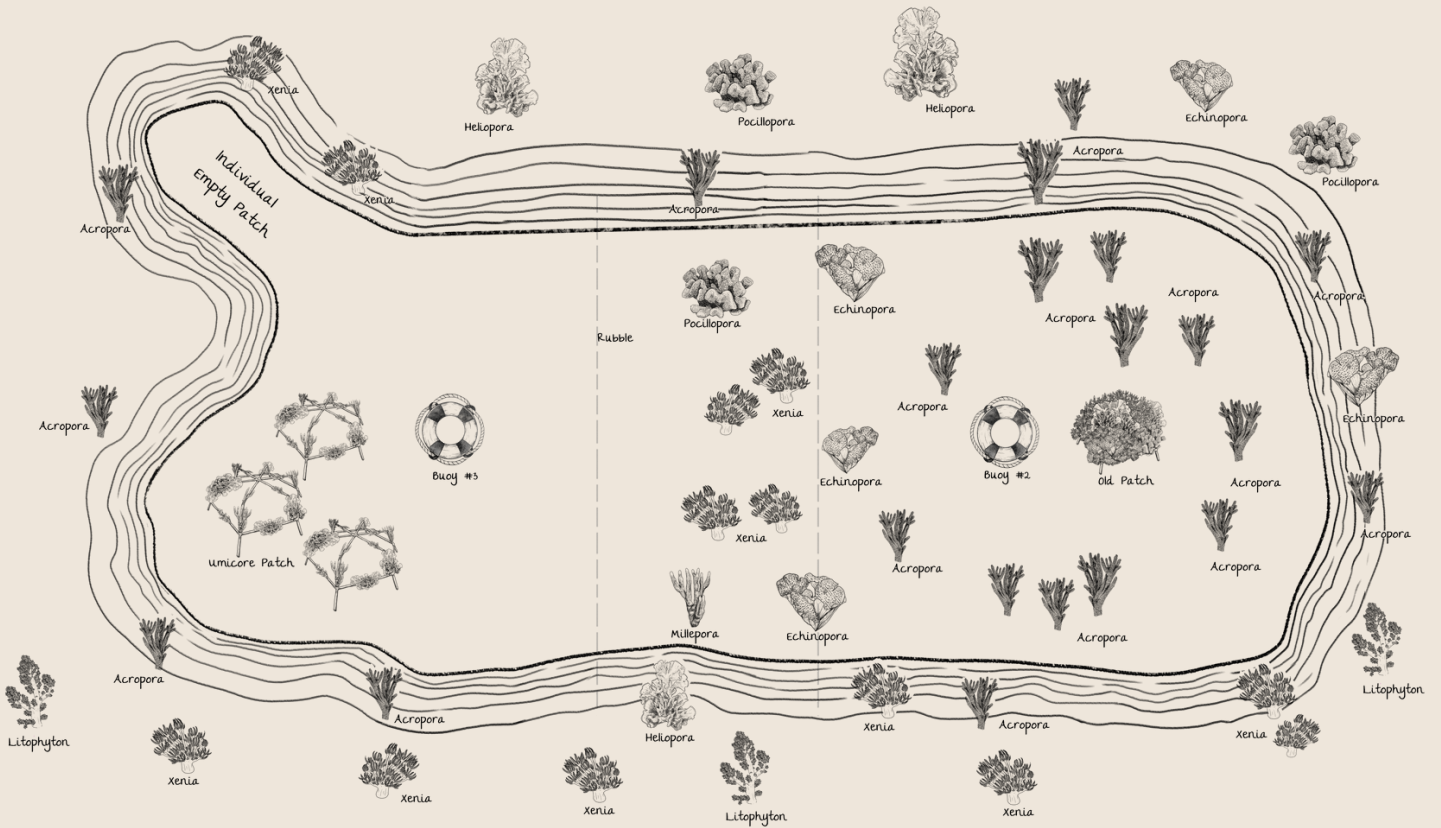
The team faces challenges such as dealing with surge action and strong drift currents that pass through the restoration area daily. Additionally, the Wet Team collects completed reef stars from the boat and chooses the best locations within our rubble patch for deploying these structures.



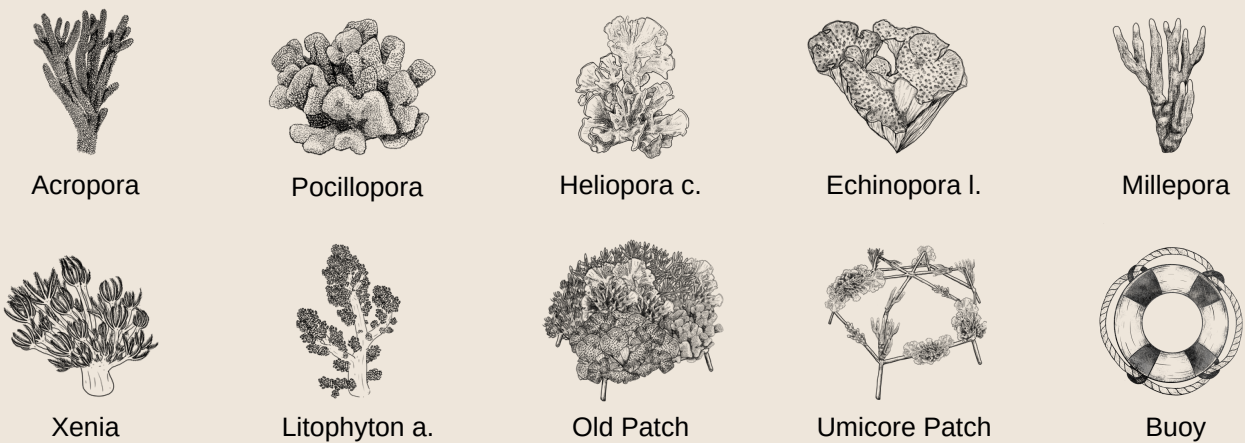
# Dan's Reef: Map of Coral Species

Dan's Reef is our home reef & the location of our first coral restoration site. It hosts a variety of coral species. When attaching mixed coral fragments to our structures, we aim to replicate the natural distribution & abundance of corals on the reef, ensuring our restoration site reflects the reef's original diversity.

## Dan's Reef Restoration Site

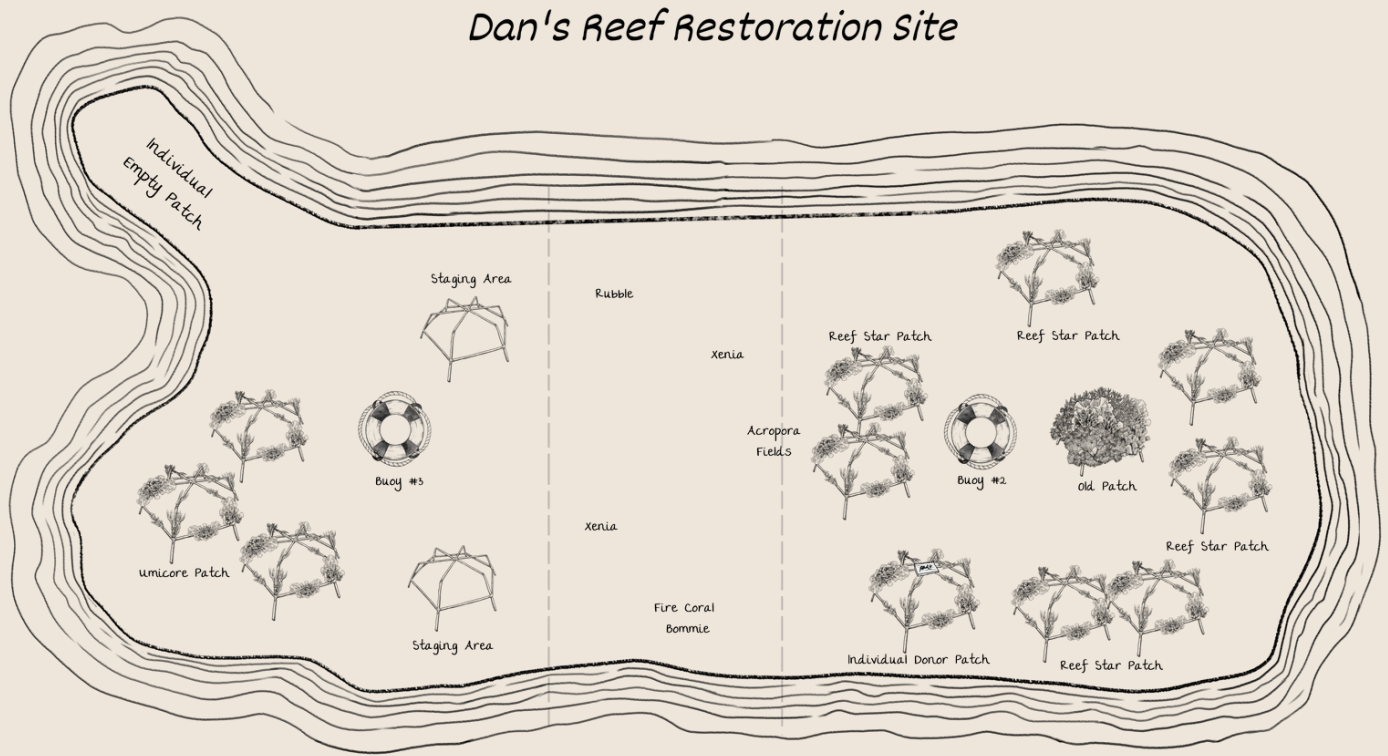


### KEY



## Dan's Reef: Map of Restoration Site

Dan's Reef Coral Restoration Site is divided into four areas: the original patch, the individual donor patch, the Go Ocean patch, and a holding area. The holding area is where new, empty structures are kept until they become encrusted with Encrusting Coralline Algae. After this natural process, the structures are moved & planted with a variety of coral fragments.



The *Umicore Patch* is our latest reef restoration initiative. By the fall of this year, it will host 500 reef stars. This project represents our first major donation, and our entire team is working diligently to transform the rubble-strewn area into a vibrant new reef. We are excited about the progress and look forward to witnessing the positive impact on marine life.

### KEY



Staging Area



Reef Star Patch



Old Patch



Individual Donors



Buoy





## PROJECT LAUT CONSERVATION IS TEAMWORK

At Project Laut, our team's commitment and collective effort have been key to the success of our coral restoration projects in Nusa Penida. As our organisation grows, we continue to benefit from the influx of conservation divemaster interns and research interns, who are essential in maintaining the high pace and quality of our restoration projects. We also benefit from eco-conscious tourists who participate in our activities. Their contribution during outings enhances the overall experience and broadens our outreach, significantly boosting the impact of our work.

Community engagement is central to our approach. Every month, we host events where local school children or groups of local fishermen get hands-on experience with coral restoration. This interaction is vital as many local families are involved in fishing. Educating and involving them not only helps in our restoration efforts but also instills a conservation mindset. The support from our community and team members is indispensable to our operations, and we are thankful for everyone's continued dedication and enthusiasm in helping us maintain and expand our impact on the marine environment.

**Invest in our oceans. Join Project Laut today.**

# **SIDE PROJECTS**

# Substantial Threats to Bali's Coral Reefs

## 1. Coral Bleaching

Coral bleaching poses a significant threat to Bali's reefs, with documented losses of 44.4% of live coral cover in North West Bali due to rising sea temperatures (Suparno et al., 2019). Recent observations by Project Laut in January 2024 recorded sea temperatures reaching up to 32 degrees Celsius, correlating with bleaching events across all of Nusa Penida's reefs.

## 2. Destructive Fishing Practices

Nusa Penida has seen a notable decline in harmful fishing methods, with no recent reports of dynamite or cyanide fishing. However, challenges persist as fishermen continue to catch species vital to reef health within the marine protected area. Additionally, the use of anchors in remote fishing locations causes considerable damage to the reefs. Shark fishing, particularly during nighttime, remains an issue around the island, underscoring the need for ongoing conservation efforts.

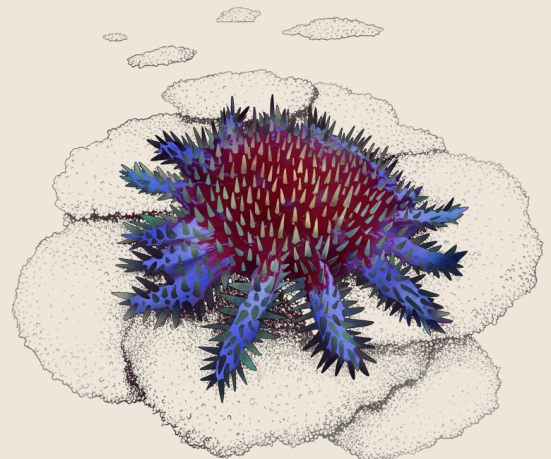
## 3. Plastic Pollution

Marine plastic pollution significantly impacts Bali's ecosystems, affecting key marine species like manta rays, molas and sea turtles. The accumulation of plastics in these animals poses a serious threat to their health and survival.

## 4. Crown of Thorns Starfish (CoTS)

Recent studies highlight the severe impact of CoTS outbreaks on Indonesia's coral reefs, including a significant 50% reduction in coral cover in some areas. Specifically, research on Menjangan Island, North West Bali, indicates that these outbreaks are more likely during Bali's wet season, linked to increased nutrient levels in the water.

While several community initiatives and NGOs are actively combating CoTS in Bali, the reefs around Nusa Penida have fortunately remained unaffected so far, with CoTS not posing a major threat to the island's typical reef ecosystems.



## 5. Coral Diseases

Coral diseases are prevalent across Indonesia's national marine parks and its biodiverse reefs, including areas in Buleleng and Nusa Penida. Due to limited monitoring and research, further studies are necessary to understand the origins of these outbreaks, assess their impact, and develop effective management strategies.

## 6. Damaging Scuba & Snorkel Practices

The increase in dive and snorkel tourism on Nusa Penida has led to environmental challenges, primarily due to insufficient management. A significant issue is the damage to coral reefs from inexperienced divers or those not following eco-friendly practices. Moreover, the increase in snorkel tourism, often poorly supervised, has resulted in tourists stepping on or bumping into corals and marine life, exacerbating the threat to the area's marine ecosystem.



## PROJECT LAUT NATURAL THREATS MONITORING

Barnabas Lelyemin, Project Laut's Marine Scientist and Divemaster from Java, Indonesia, is at the forefront of our natural threats monitoring initiative. He is currently focused on studying *Chalinula nematifera*, a coral-killing sponge that has been expanding across local reefs, including Dan's Reef restoration site. This sponge disrupts reef ecosystems by overgrowing coral structures, necessitating close monitoring and management.

Our project not only emphasises scientific research but also actively involves our divemaster and research interns in hands-on marine conservation efforts. Interns participate directly in data collection and help manage our *Chalinula nematifera* database, which tracks the sponge's distribution and growth rates.

We encourage exploration and support side projects that allow our team to investigate other potential threats or areas of interest in marine conservation. This approach ensures a broad, practical learning experience for our interns, contributing to their professional development and our conservation goals. Through these efforts, we aim to preserve the natural diversity of Nusa Penida's reefs and generate valuable scientific insights for the global conservation community.

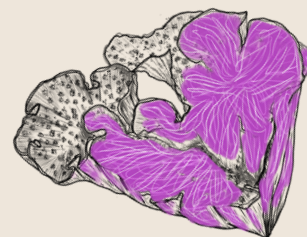
## Dan's Reef Restoration Site: Threat Monitoring

### *Chalinula nematifera*

Marine sponges are vital components of coral reef ecosystems, acting as both habitat builders and water filters. They form symbiotic relationships with various marine organisms, enhancing biodiversity. While most sponges coexist beneficially with corals, a few species, like *Chalinula nematifera*, can become threats by overgrowing and killing corals, competing for space and resources.

Thus, while sponges are generally beneficial, monitoring and studying their interactions with coral reefs is crucial to understanding their dual roles as both supporters and potential threats to these ecosystems.

*Chalinula n.* distinguishes itself with a mauve hue & the presence of white, wavy filaments. These filaments are a product of symbiotic fungi.



Echinopora sp. with *Chalinula n.*



Pocillopora sp. with *Chalinula n.*

The sponge overgrows live coral & effectively smothers coral colonies, using their skeletons as a foundation for its own expansion. This opportunistic takeover highlights a competitive edge that is silently devastating.

The threat it poses is amplified by its limited natural predators, allowing *Chalinula n.* to spread with few checks. This unchecked growth can lead to significant shifts in reef ecosystems, potentially reducing biodiversity & altering habitat structures.

Observations of *Chalinula nematifera* were conducted across eight dive sites surrounding Nusa Penida, predominantly within the depth range of 2 to 10 meters. This sponge was primarily noted for its propensity to overgrow live coral species such as *Acropora* spp., *Pocillopora* spp., and *Echinopora* spp., as well as a broad spectrum of other coral species.

Additionally, *Chalinula nematifera* was also observed on dead coral colonies previously covered by algae or sediment and on encrusting coralline algae, underscoring its ecological impact on both living and degraded coral communities.



*Acropora* sp. with *Chalinula n.*

# Dan's Reef Restoration Site: Threat Monitoring

## *Chalinula nematifera*

*Chalinula nematifera* was observed overgrowing several species at Dan's Reef Restoration Site. Our research team performs photographic surveys of the area every four weeks.

This data collection is essential for establishing a baseline distribution and abundance database, facilitating future monitoring.

### Photographic records of overgrown coral on Dan's Reef Restoration Site



*Goniopora* sp.



*Echinopora* sp.



*Echinopora* sp.



*Acropora* sp.



*Acropora* sp. with Zip Tie for Measurements



*Porites* sp.



*Pocillopora* sp.



*Echinopora* sp.



?