

Exploring the suitability of corals of opportunity for direct transplantation onto Mauritian sediment-impacted reefs

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ABSTRACT

Coral reefs decline in Mauritius, driven by rising temperatures, sedimentation, and physical disturbance, has rendered passive conservation insufficient. This 27-month study assessed the survival and growth of naturally dislodged but viable coral fragments (corals of opportunity; COOs) left at a sediment-impacted site in Pointe aux Feuilles, as compared to COOs collected and immediately attached in situ to elevated metal frames. COOs of five species were used namely: *Acropora selago*, *Acropora muricata*, *Acropora Cytherea*, *Pocillopora damicornis* and *Millepora alicornis*. A controlled field experiment was conducted in which growth was quantified from standardized photographs using ImageJ, while survival and bleaching patterns were statistically analyzed to determine species-specific responses under natural and nursery conditions. Substrate-elevated modules significantly enhanced coral performance: *Pocillopora damicornis* and *Millepora alicornis* showed the highest growth (55.8 cm² and 36.2 cm²), while three branching *Acropora* species exhibited lower survival and greater bleaching. Final bleaching rates were lowest in *P. damicornis* (0 %) and highest in *A. muricata* (46.7 %) on nursery modules, while in situ COOs suffered bleaching rates up to 66.7 % and over 25 % dislodgement. Sediment accumulation was consistently higher on natural reefs (Welch's $t = 18.9$, $p < 0.001$), highlighting site exposure as a key stressor. These results show that COOs, when stabilized in elevated, higher-flow environments, support reef recovery without harming donor colonies or donor reefs. Often overlooked, COOs offer a sustainable restoration option when identified early and maintained under favorable conditions.

1. Introduction

Mauritius, nestled in the Southwestern Indian Ocean, is a renowned oceanic biodiversity hotspot, known for its crystal-clear lagoons, extensive coral reef systems, and exceptional marine biodiversity [1,2]. Surrounded by approximately 150 km of fringing and barrier reefs, these ecosystems are more than ecological treasures, as they are foundational to the island's socio-economic identity, sustaining fisheries, tourism, coastal protection, and cultural heritage ([3,4]; Chadee et al., 2024). Once hailed as a marine paradise, with vibrant reef flats and coral-laden slopes showcasing the richness of tropical island biodiversity, Mauritius is now witnessing the fast decline of these vital ecosystems [5-8]. Increasingly pressures by both anthropogenic and climatic change, the coral reefs of Mauritius are undergoing rapid, and in many areas, irreversible degradation [9,10].

The southeastern coastline of Mauritius, particularly the lagoonal

system at Pointe aux Feuilles, exemplifies the island's accelerating reef decline. Once home to thriving coral assemblages, the site is now marked by shattered skeletons, eroded seabeds, and fragmented reef structures [11]. A combination of acute and chronic stressors has compromised the structural integrity of the reef [12,13]. Among the most immediate threats are physical disturbances, including mechanical breakage from wave surges and careless anchoring, especially by artisanal and recreational vessels [14-16]. Equally damaging, though less conspicuous, is the impact of sedimentation. When coral fragments are dislodged, they often settle onto sandy substrates where shifting sediments and burial drastically reduce their viability [17-19]. Though still biologically viable, these displaced fragments are physiologically stressed and ecologically vulnerable, often succumbing to sediment smothering, reduced light availability, and microbial infections within days or weeks of detachment [20-22].

At Pointe aux Feuilles, the reef's closeness to broad sandy flats

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amplifies storm-driven sedimentation [23,24]. Suspended sediments cloud the water, reducing light for photosynthetic symbionts [25–27], while settled particles smother coral polyps, limit oxygen, and disrupt metabolism [27]. Naturally dislodged but still viable coral fragments can be stabilized in suitable environments, offering a low-impact alternative to harvesting donor colonies [28]. This approach is particularly relevant in Mauritius, where reef decline is driven more by physical and sediment-related stress than by bleaching.

This study examines the viability and restoration potential of coral of opportunity (COO) fragments within a site-specific context, emphasizing the importance of active intervention in areas experiencing physical and sediment-related reef degradation. Several studies have already targeted the use of COO, suggesting the beneficial employment of using this source material for active reef restoration [29–31] (refs). As passive conservation alone is increasingly insufficient to reverse coral reef decline, active conditions offer a tangible means for ecosystem recovery [32,33]. While we cannot substitute for global efforts such as carbon emissions reduction, habitat protection, sustainable fisheries, restoration complements these strategies by reinforcing reef resilience, rebuilding structural complexity, and restoring ecosystem services [34–36]. Restoration success also depends on species-specific traits, such as morphology, growth rate, and sediment tolerance [37–39]. Selecting fragments with appropriate traits, combined and using techniques that minimize stress during collection and transplantation, are critical components of effective nursery-based restoration.

This study aimed to (1) compare the survival and growth of COO in nursery settings versus natural reef environments; (2) investigate how sedimentation and hydrodynamics affect coral viability; and (3) provide empirical data to inform scalable reef restoration strategies in sediment-impacted coastal lagoons. As Mauritius faces accelerating reef degradation, this research offers a science-based foundation effective restoration and pathway toward safeguarding its diminishing marine ecosystems.

2. Methodology

2.1. Study area

The study was conducted at Pointe aux Feuilles on the southeastern coast of Mauritius, a volcanic island in the southwest Indian Ocean (Fig. 1). This region is home to Mauritius' only operational marine aquaculture facility (fish farm), comprising a land-based hatchery and

nursery, a lagoon-based fish feeding area, and a land-based processing facility. Boat support for the research was provided by the fish farm. Two distinct sites were selected (Fig. 2): a coral nursery site ($20^{\circ}20.349'S$; $57^{\circ}47.540'E$) and a nearby natural reef site ($20^{\circ}20.329'S$; $57^{\circ}47.577'E$). Once characterized by a healthy coral substrate, the area has experienced significant degradation over recent decades due to localized anthropogenic pressures, including anchor damage and sediment movement, all leading to reef degradation and extensive coral dislodgement.

2.2. Source material and controls

Coral fragments were collected as Corals of Opportunity (COO), defined as naturally detached yet viable coral colonies dislodged by mechanical forces such as wave action, irresponsible anchoring, or storm events. COOs included *Acropora selago*, *Acropora muricata*, *Acropora Cytherea*, *Pocillopora damicornis* (all listed as 'endangered' on the IUCN Red List) and *Millepora alicornis* (Not Evaluated). These COOs were collected from shallow inner reef zones at Pointe aux Feuilles, at depths 1.5–2.0 m. During each collection, approximately 40–50 % of coral fragments were manually located and gently retrieved by hand to minimize further disturbance of the benthic environment.

For monitoring long term survivorship of dislodged COO in the natural reef site, 20 *A. selago* and 15 individuals of each of the other four species were marked using a 30 cm galvanized metal rod hammered 15 cm into the sand adjacent to the COO. Only colonies showing no sign of disease, algal overgrowth and less than 50 % tissue loss were selected.

2.3. COO transplantation on artificial objects

To reduce stress and prevent desiccation during transfer, COOs destined for the nursery were transported to the coral nursery site. Transplantation was carried out on the same day to reduce handling time and physiological stress. The coral nursery setup (Fig. 2) comprised 16 spider reef modules, constructed from 16/12 mm diameter galvanized metal bars, each with a leg height of 50 cm that was deployed at depths between 1.5 to 2.0 m. The modules were anchored on sandy substrates adjacent to the reef, providing a stable and elevated framework to reduce sediment accumulation and macroalgal overgrowth. Fragments were evenly distributed across the modules (5 fragments per spider frame, totaling 20 *Acropora selago*, 15 *A. muricata*, 15 *A. Cytherea*, 15 *Pocillopora damicornis* and 15 *Millepora alicornis*) to optimize water

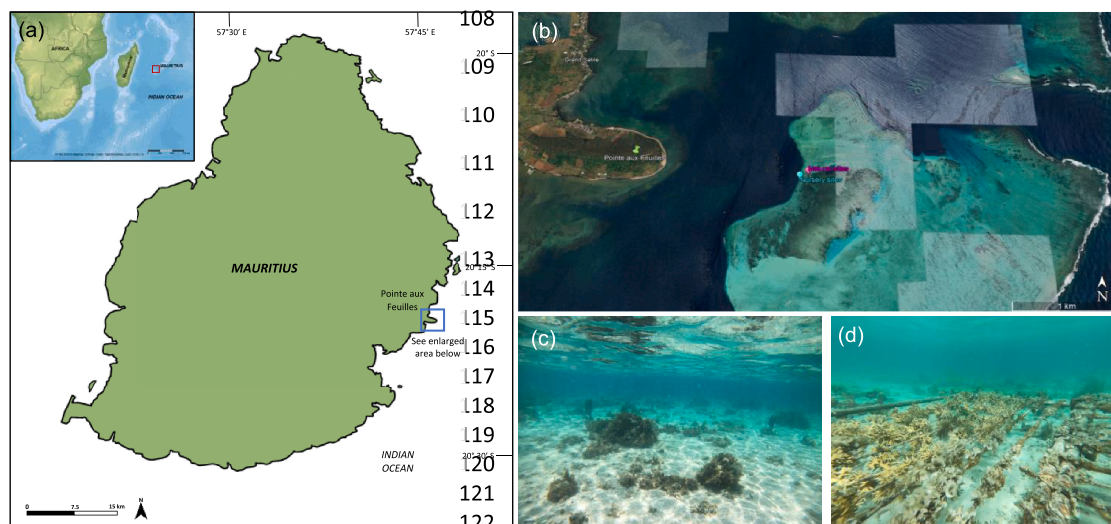


Fig. 1. (a) Map indicating the position of Pointe aux Feuilles in the south-eastern coast of Mauritius, with reference to Mauritius location in the southwest Indian Ocean (b) Aerial view of the site showing the GPS location of the coral nursery and the adjacent natural reef site. Underwater photographs showing sites at (c) natural reef and (d) coral nursery.

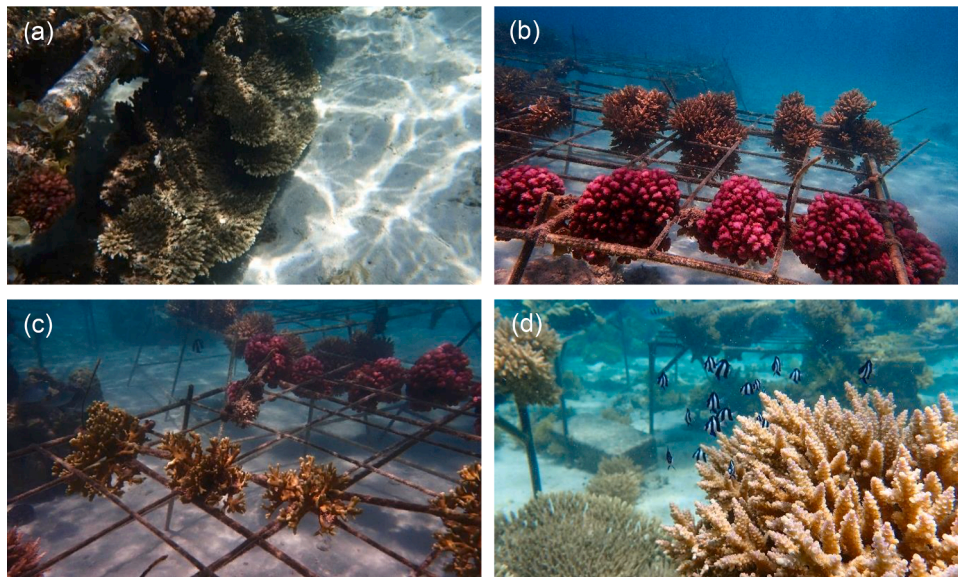


Fig. 2. Corals on spider coral modules deployed at Pointe aux Feuilles after 27 months: (a) *Acropora cytherea*, (b) *Pocillopora damicornis* (pink) and *Acropora muricata* (brown), (c) *Millepora alcicornis* (brown), (d) *Acropora selago*.

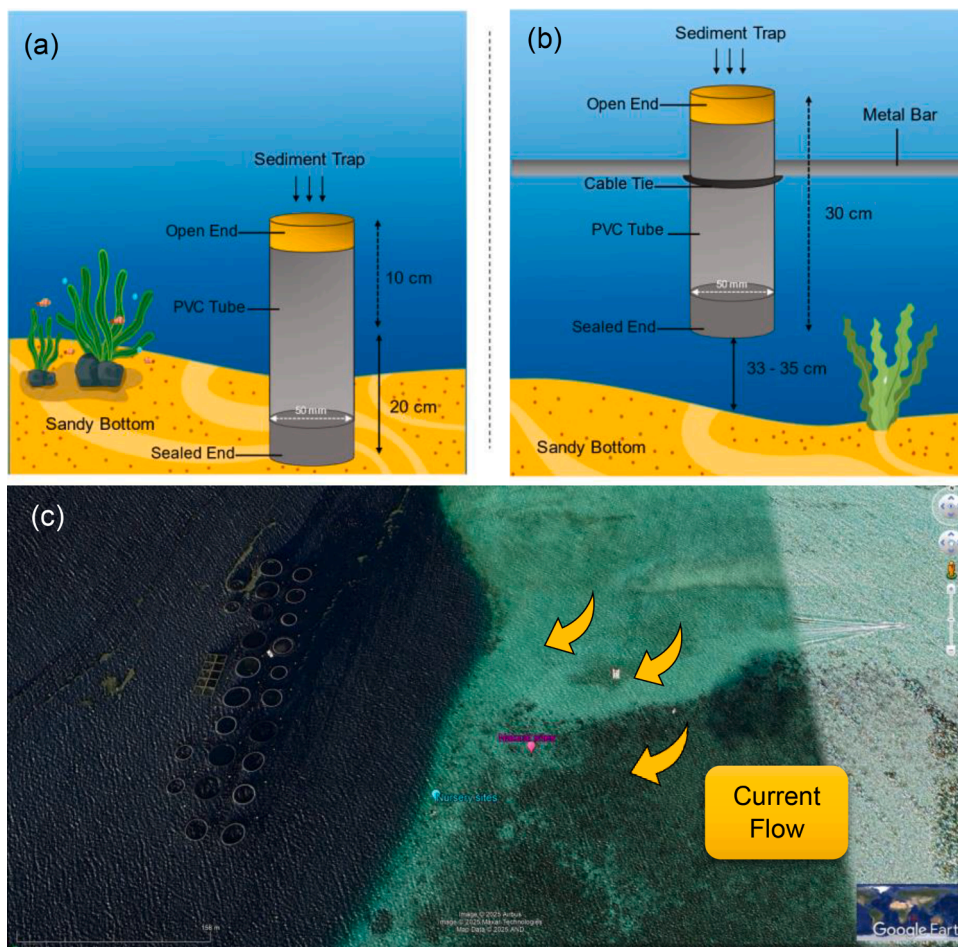


Fig. 3. Schematic illustration of sediment trap deployment at (a) natural nursery site, where the trap is partially buried in the seabed, and (b) table nursery site, where the trap is elevated above the seafloor and secured to the nursery frame. (c) Overview of the study area showing water flow directions as recorded by the Marotte HS Tilt Current Meter. Arrows indicate the prevailing currents affecting both natural and nursery sites.

flow, light penetration, and minimize interspecific and intraspecific competition. Each fragment was secured using cable ties, positioned with live tissue facing upward, and placed to avoid direct contact with the seafloor.

2.4. Sedimentation assessment

To measure sediment accumulation at the (natural and nursery sites, standardized sediment traps were deployed. Traps were constructed from 30 cm long, 50 mm diameter (PVC tubes, sealed at one end and open at the top. At the natural sites, traps were embedded vertically into the seabed, with 20 cm buried and 10 cm exposed. At the table nurseries, traps were attached to the metal frames using cable ties, positioned 33–35 cm above the seafloor to capture sediments (Fig. 3a, and b). Three replicate traps were used at each site (N1–N3 for the natural reef, and TN1–TN3 for the table nurseries) to compare sedimentation patterns. Sediment traps were collected every six months, sealed with caps underwater to prevent sediment loss and transported to the laboratory. There, the contents were dried in an oven at 60 °C to a constant weight and weighed on a benchtop scale with results expressed in grams.

2.5. Hydrodynamic flow characterization

To characterize sedimentation patterns, water current direction was measured at the coral nursery site using a centrally positioned Marotte HS Tilt Current Meter, as the natural and nursery sites were in close proximity. A directional map based on these measurements was developed using satellite imagery to visualize current flow at the study site (Fig. 3c).

2.6. Monitoring and data analysis

Following transplantation, coral fragments were monitored every six months over a 27-month period (January 2023 to April 2025). Each fragment at the nursery sites was individually tagged to track survivorship and growth. Owing to extensive sediment deposition and sand burial, fragments at natural sites could not be reliably monitored, and therefore were excluded from growth and survivorship assessments. At the nursery, standardized photos were taken for surface area analyses using ImageJ software. Bleaching was recorded using a lowercase 'x' in the monitoring matrix, highlighting partial or complete tissue loss. During each survey, coral status was categorized as: ✓ –healthy and surviving; X –bleached; N/A –missing or dislodged. Monitoring was conducted via *in-situ* visual inspection while snorkeling, with data recorded on sheets and later digitized into Microsoft Excel. This method enabled tracking of survival rates, bleaching frequencies, and fragment loss over time. A detailed species inventory was also maintained, documenting each fragment's identity and IUCN Red List status to assess species-specific performance under nursery conditions only.

2.7. Statistical analysis

All statistical analyses were performed using JAMOV (version 2.3.28.0) and R (version 4.1). Data normality was assessed using the Shapiro–Wilk test, and variance homogeneity with Levene's test. When parametric assumptions were violated, non-parametric alternative tests were used. Coral growth across species over time was analyzed using Welch's one-way ANOVA with Tukey's post hoc tests to determine pairwise differences. Kruskal–Wallis tests were applied for non-parametric support for interspecific growth differences, with chi-squared values and p-values reported. Sedimentation differences between natural reef and nursery sites were analyzed using Welch's independent samples *t*-test and the Mann–Whitney U test, with assumptions checked via (Shapiro–Wilk and Levene's, and Q–Q plots used to visualize deviations from normality. Temporal sediment trends were evaluated using one-way ANOVA and Tukey's HSD, though no

significant differences were observed across dates. Coral survivorship, being categorical, was summarized using stacked bar plots and interpreted qualitatively based on trends in survival, bleaching, and loss across coral species.

3. Results

3.1. Coral growth and bleaching on artificial structures

Quantitative coral growth assessments were conducted on fragments attached to spider frame structures over a 27-month period from January 2023 to April 2025. Surface areas (cm²) were measured at seven intervals to assess changes in coral fragment size and species-specific performance over time. Growth varied significantly among taxa (Fig. 4). *Pocillopora damicornis* demonstrated the greatest overall expansion, reaching a mean planar surface area of 55.8 cm² by April 2025. *Millepora alicornis* followed with 36.2 cm². In contrast, *A. muricata*, *A. cytherea*, and *A. selago*, exhibited slower growth, averaging 27.0 cm², 29.3 cm², and 28.9 cm², respectively.

A one-way Welch's ANOVA at each time point revealed significant interspecific growth differences ($p < 0.001$ for all time points), confirmed by Tukey post hoc tests, which consistently distinguished *P. damicornis* from all other species ($p < 0.001$). Kruskal–Wallis tests further supported these findings ($\chi^2 = 46.3–61.3$, $df = 4$, $p < 0.001$), highlighting species identity as a key factor influencing coral growth under nursery conditions. While the *Acropora* species showed early growth stagnation and increased fragment loss over time, often linked to fishing gear and collisions with swimmers, *Pocillopora* and *Millepora* appeared more resilient, suggesting that morphological and ecological traits may strongly affect fragment performance on artificial structures.

Bleaching incidence was monitored across nursery-attached fragments at the final sampling point (April 2025) to assess species-specific resilience under artificial structure conditions. *Pocillopora damicornis* exhibited the highest tolerance, with no recorded bleaching among its 15 fragments. *Millepora alicornis* followed, with a bleaching rate of 20.0 % (3 out of 15). In contrast, branching *Acropora* species showed higher vulnerability: *A. muricata* recorded the highest bleaching incidence (46.7 %), followed by *A. selago* (40.0 %) and *A. cytherea* (33.3 %). These patterns indicate that encrusting and massive coral forms demonstrated greater resistance to environmental stressors in the nursery setting, while branching morphologies were more prone to partial tissue loss over time.

3.2. Survivorship of *in situ* left COO

For the 80 naturally dislodged COOs, a progressive decline in survival was recorded, with visible signs of bleaching emerging by June 2023 and increasing fragment loss by April 2025 (Fig. 5), suggesting long-term impacts by environmental conditions.

Species-level differences in survivorship were pronounced (Fig. 5): *Acropora selago* ($n = 20$) showed the steepest decline, with early bleaching (June 2023), and substantial loss (over 60 %) by the study's end, while *Acropora muricata* and *Acropora cytherea* had moderate to high bleaching, with over half of the fragments affected by tissue loss. In contrast, *Pocillopora damicornis* and *Millepora alicornis* were more resilient, with several fragments remaining healthy throughout the 27 months, though some still experienced bleaching or dislodgement. Furthermore, the results (Fig. 5) suggest that species with massive or encrusting morphologies (e.g., *Millepora*, *Pocillopora*) are more tolerant of ambient reef stressors compared to branching *Acropora* species (Table 1).

A comparison of bleaching and fragment loss between *in situ* and nursery-grown corals revealed markedly higher stress incidence at the natural reef site. For the *Acropora selago*, 60 % of fragments bleached and 25 % were missing by April 2025, compared to 40 % bleaching and no loss on nursery frames. *A. muricata* and *A. cytherea* similarly showed

Mean surface area of fragments

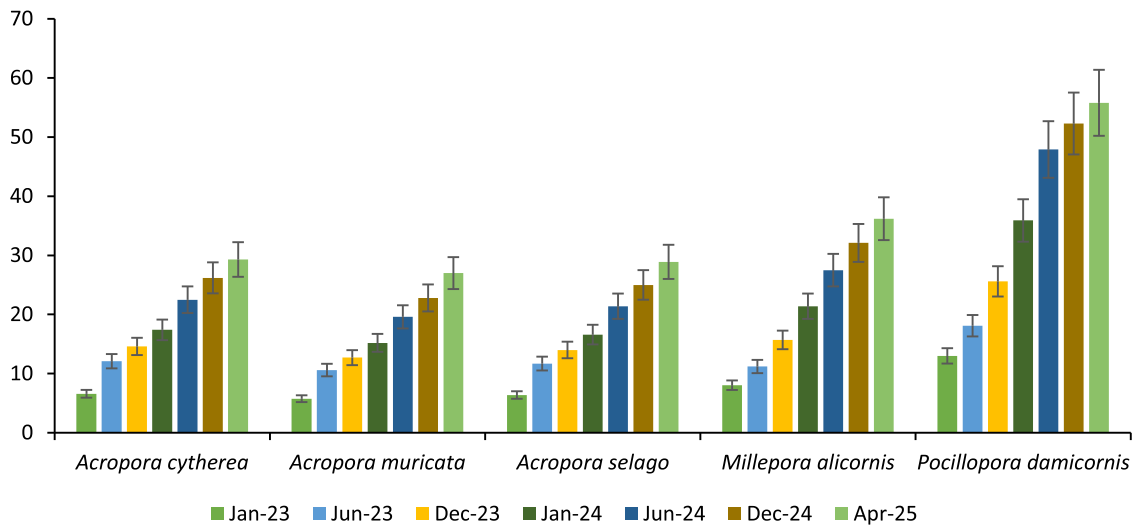


Fig. 4. Bar chart showing the mean surface area (cm²) of coral fragments by species over time, across seven time points. Error bars indicate standard deviation.

high bleaching rates (60 % and 66.7 %, respectively) and over 25 % loss in situ, while their nursery-grown counterparts experienced lower bleaching (46.7 % and 33.3 %) and no dislodgement. Even typically resilient taxa such as *Pocillopora damicornis* and *Millepora alicornis* showed elevated stress at the natural site (60–66.7 % bleaching; 20–27 % loss), while those on spider frames performed significantly better (0–20 % bleaching; 0 % loss). A pooled Chi-square test comparing bleaching status between natural and nursery sites across all species confirmed that nursery-grown fragments exhibited significantly lower bleaching incidence ($\chi^2 = 14.58$, $df = 1$, $p = 0.00013$). These results indicate that nursery structures provide greater environmental buffering, likely through elevated positioning, reduced sedimentation, and protection from physical abrasion.

3.4. Sedimentation and hydrodynamics

Sedimentation rates (Fig. 6) differed significantly (Welch's $t(21.1) = 18.9$, $p < 0.001$) between the natural reef sites (N1, N2, N3) and the nursery sites (TN1, TN2, TN3) across the studied period (Jan 2023 – Apr 2025).

A Shapiro–Wilk test confirmed non-normality in sand weight data ($W = 0.897$, $p = 0.001$), while Levene's test indicated unequal variances between groups ($F(1, 40) = 27.9$, $p < 0.001$). These assumption violations are visually corroborated by the Q–Q plot (Fig. 7), which shows clear deviations from the expected diagonal, highlighting the non-normal distribution. One-way ANOVA test showed no statistically significant difference in sand weights across sampling dates ($F(6, 35) = 0.0825$, $p = 0.998$).

4. Discussion

This study offers key insights into long term (27 months) COO performance under elevated artificial structures and natural reef conditions, focusing on growth, bleaching and survivorship. Results highlight species-specific differences with implications for coral reef restoration in the western Indian Ocean Islands subjected to high erosion of sands.

The fate of naturally dislodged COO fragments compared to those secured on spider frames reveals distinct survival patterns. Naturally left fragments exhibited higher bleaching incidence and fragment loss, particularly among branching *Acropora* species, whereas nursery-grown corals on frames showed lower stress indicators and negligible dislodgement. These differences likely stem from the protective benefits

of elevated nursery structures, which reduce sedimentation, limit physical abrasion, and improve light conditions ([40]; Razak et al., 2024). In contrast, fragments left in situ are subject to sediment accumulation, physical disturbances, and biotic threats such as predation from crown of thorns starfish, which collectively reduce survivorship and hinder growth. Indeed, sedimentation rates were significantly higher at natural sites, and the inability to reliably measure in situ growth was largely due to sediment cover and fragment displacement, emphasizing challenges for natural recovery in these environments.

These divergent outcomes in COO survival parallel findings from reef restoration projects across diverse biogeographic regions. For instance, Feliciano et al. [30] and Dela Cruz et al. [29] reported significantly improved survivorship and growth when dislodged fragments were rapidly secured to artificial substrates, highlighting the importance of prompt intervention and strategic placement. Similarly, Zhang et al. [31] demonstrated that framed reef modules significantly enhance survival and growth of COO fragments from multiple coral species in degraded environments, with results closely resembling those presented here. Together, these studies reinforce the notion that COO fragments, if stabilized promptly in appropriate microhabitats, offer a viable and low-impact alternative to conventional coral harvesting methods.

Species-specific responses underscore the varying resilience and vulnerabilities inherent to coral taxa. *Pocillopora damicornis* and *Millepora alicornis* demonstrated greater tolerance to environmental stressors, reflected in higher growth rates and lower bleaching, consistent with their compact and encrusting morphologies [41,42]. Conversely, branching *Acropora* species, despite their rapid growth potential, were more susceptible to fragmentation and bleaching, exacerbated by anthropogenic impacts such as fishing gear entanglement and crown-of-thorns starfish predation [43,44].

These species-specific variations have direct implications for restoration approaches. Restoration involving fragile branching taxa may benefit from an extended nursery phase on elevated artificial structures, where physical support is provided during vulnerable early growth stages. Natural reef transplantation, however, may favour encrusting or massive forms that can better withstand sediment loads and physical abrasion. This is supported by studies such as Tortolero-Langarica et al. [45], Forrester et al. [46], and Ng and Chou [47], who emphasized the importance of matching species traits with environmental conditions to guide coral outplanting. In this study, *Acropora* spp. consistently recorded higher bleaching and loss percentages on natural sites, reinforcing that restoration success depends not only on species identity, but also on

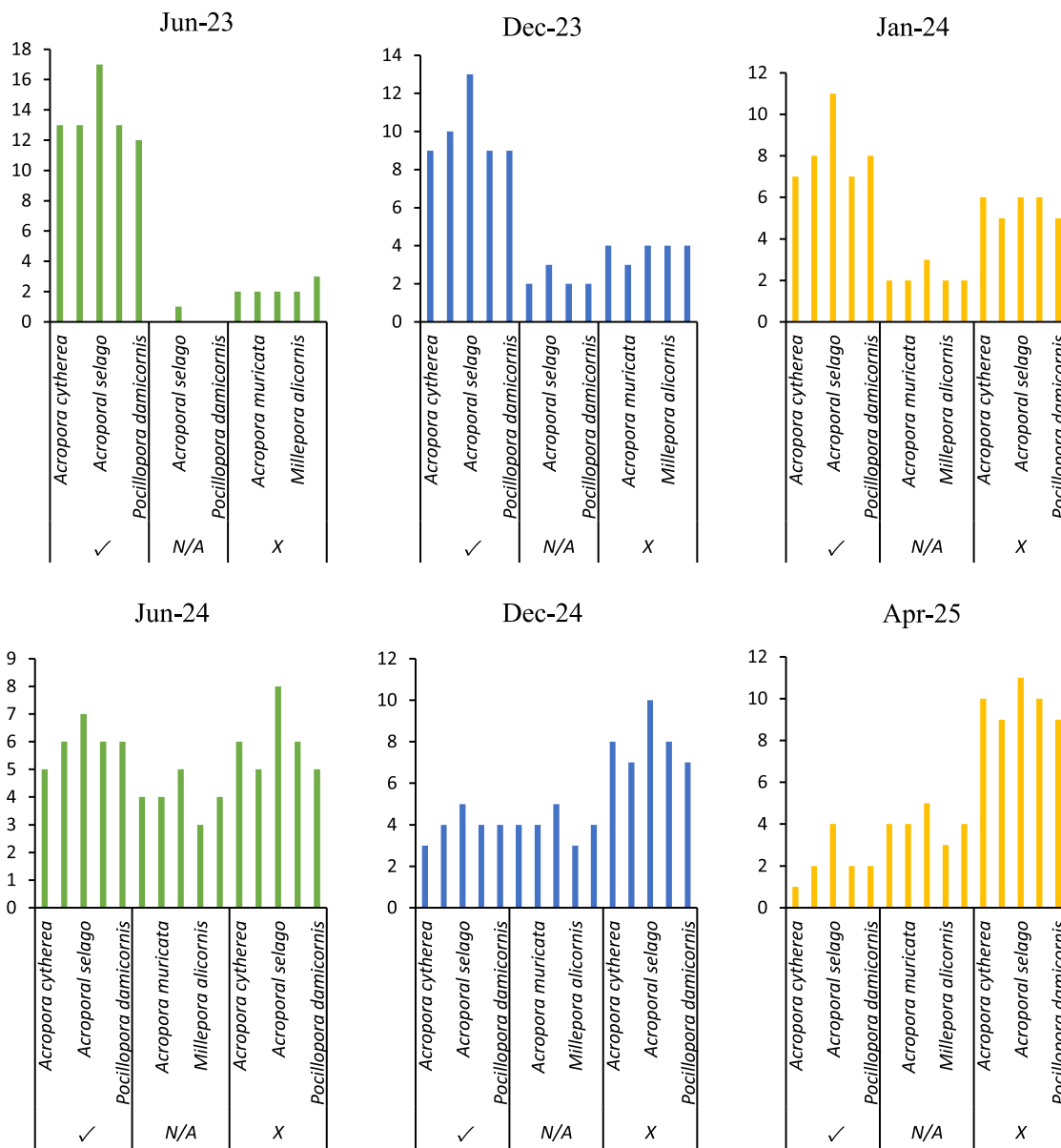


Fig. 5. Survival, dislodgment and bleaching of nursery grown COOs from the five coral species along 27 months monitoring period (✓ –healthy and surviving; X –bleached; N/A –missing or dislodged).

microhabitat selection, structural positioning and temporal stability of the transplantation site.

Several studies corroborate the importance of COO material when integrated into a strategic restoration design. Zhang et al. [31] showed positive survival and growth of COO fragments from ten coral species transplanted onto framed modules, a finding supported by the outcomes of this study. Likewise, Ow Yong et al. (2025) reported that even in marginal and extreme reef conditions, certain corals of opportunity persisted when provided appropriate support. These global case studies align with observations from Mauritius, where environmental conditions such as sedimentation, light limitation and water flow remain major drivers of fragment fate. Furthermore, the effective use of micro-fragmentation techniques in remote settings (Tortolero-Langarica et al., 2019; [48]) and shorter nursery phases for resilient taxa [29] provide additional strategies that could be adapted for Mauritian reefs in the future.

The success of coral restoration also depends on mitigating human-induced damage. Frequent collisions with swimmers and fishing

activities within nursery sites have been observed to cause mechanical stress and fragment loss. Implementing protective measures such as legally designated marine restoration zones, buffer areas marked with signage and buoys, and community-based monitoring programs can reduce these impacts and enhance restoration outcomes [49-51]. Collaborative engagement with local fishermen and tourism operators, as undertaken in this study, fosters stewardship and vigilance that contribute positively to nursery ecosystem health [52,53].

While this study provides valuable insights, limitations include its geographical scope confined to a single Mauritian reef and focus on a subset of coral species. Additionally, microbial community dynamics and detailed hydrodynamic measurements were not incorporated but represent important avenues for future research [54,55]. Expanding taxonomic breadth, integrating microbiome profiling, and deploying quantitative flow sensors will improve understanding of coral resilience mechanisms and optimize restoration techniques in the face of climate change and local stressors.

Collectively, these findings confirm the practical relevance of COO-

Table 1

Summary of bleaching and fragment loss (%) among five coral species at the nursery and natural reef sites as of April 2025. Values are based on final monitoring observations. Bleaching refers to partial or full tissue whitening. Loss represents missing or dislodged fragments not observed in situ.

Species	Site	Bleached	Missing	Total	% Bleached	% Lost
<i>A. selago</i>	Natural	12	5	20	60.0 %	25.0 %
	Nursery	8	0	20	40.0 %	0.0 %
<i>A. muricata</i>	Natural	9	4	15	60.0 %	26.7 %
	Nursery	7	0	15	46.7 %	0.0 %
<i>A. cytherea</i>	Natural	10	4	15	66.7 %	26.7 %
	Nursery	5	0	15	33.3 %	0.0 %
<i>P. damicornis</i>	Natural	9	4	15	60.0 %	26.7 %
	Nursery	5	0	15	33.3 %	0.0 %
<i>M. alicornis</i>	Natural	10	3	15	66.7 %	20.0 %
	Nursery	0	0	15	0.0 %	0.0 %
	Nursery	3	0	15	20.0 %	0.0 %

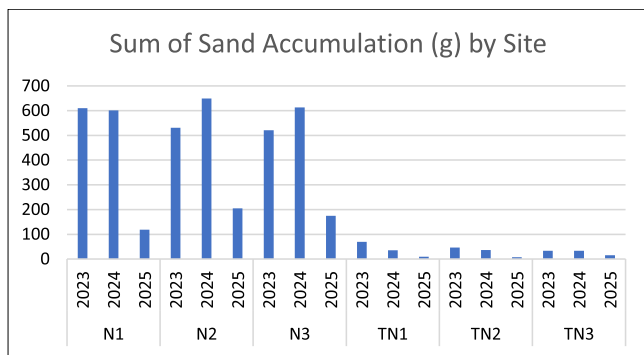


Fig. 6. Sand accumulated (g) across sites) over time.

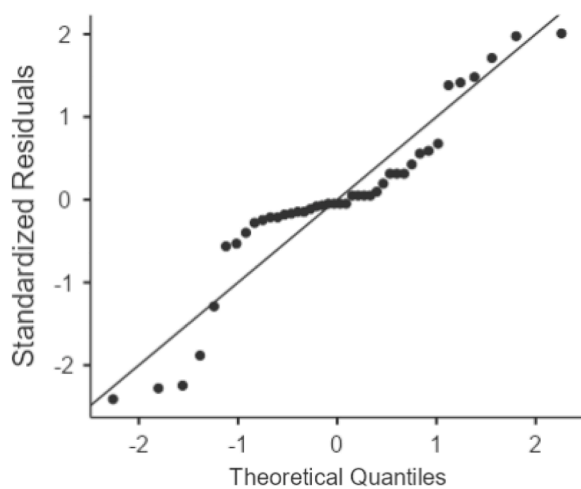


Fig. 7. Q-Q plot of sand weight values showing deviation from normality assumption.

based restoration strategies in sediment-impacted reef systems, where early intervention, species selection, and structural elevation can markedly improve ecological outcomes. The observed variation in species resilience, combined with the demonstrated benefits of elevated nursery modules, shows the importance of restoration frameworks that are site-specific and based on coral growth forms. As reef degradation continues in the western Indian Ocean, applying such context-driven

methods presents a viable way to maintain reef structure and biodiversity using naturally available, low-impact resources.

5. Conclusion

This study demonstrates that the use of elevated artificial structures, such as spider frames, substantially improves the survivorship and resilience of coral fragments compared to those left on the natural reef substrate. Species differences in growth and stress tolerance are critical considerations in restoration planning, with *Pocillopora damicornis* and *Millepora alicornis* showing superior performance relative to branching *Acropora* species. To maximize restoration success, future projects should prioritize the protection of nursery and transplantation sites through the establishment of marine restoration zones with regulated human activities, and buffer zones clearly marked to reduce physical disturbances (Razak et al., 2024; [49]). Community-based monitoring programs involving local fishers and sea users can enhance protection and stewardship, contributing to long-term ecosystem recovery [52,51]. Further research is recommended to expand taxonomic coverage, incorporate microbiome and genetic analyses, and apply quantitative hydrodynamic and sedimentation monitoring. Long-term, multi-site studies will improve understanding of coral restoration dynamics under varying environmental stressors and inform adaptive management strategies in the face of climate change and anthropogenic impacts.

Environmental

The study demonstrates that stabilizing corals of opportunity on elevated structures reduces bleaching and mortality, enhancing reef resilience in sediment-impacted areas without damaging donor reefs offering a low-impact method for ecosystem restoration in degraded tropical marine environments.

Economic

Utilizing naturally dislodged corals eliminates the need for costly coral propagation or donor site harvesting, reducing restoration expenses and enabling scalable, cost-effective rehabilitation of reefs near aquaculture and coastal development zones.

Social

This restoration technique supports local stakeholder involvement including fish farms and coastal communities by improving reef health, which in turn benefits fisheries, tourism, and coastal protection, contributing to sustainable livelihoods and climate adaptation in island nations like Mauritius.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used artificial intelligence exclusively to enhance the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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CRedit authorship contribution statement

Nadeem Nazurally: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources,

Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Bipasha Soorkun:** Writing – review & editing, Writing – original draft, Formal analysis. **Tashika Kalloo:** Writing – review & editing, Writing – original draft, Formal analysis. **Baruch Rinkevich:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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