

First record of *Annella mollis* (Octocorallia) from Rodrigues Island, Western Indian Ocean

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Abstract. Brihatee M, Marwyn A, Shakeel JY, Ashfaaq K, Maria RA, Homesha B, Ramkalam M, Deepeeka K, Beatriz CE, Yoshimi S, Hakim AA, Lalas JAA, Reimer JD, Wijayanti DP, Nascimento B, Ranjeet B. 2025. First record of *Annella mollis* (Octocorallia) from Rodrigues Island, Western Indian Ocean. *Indo Pac J Ocean Life* 9: 133-139. Gorgonians octocorals inhabit environments ranging from shallow tropical reefs to deep and polar waters. A habitat-forming species, they contribute significantly to habitat structural complexity and biodiversity, yet their occurrence in the Western Indian Ocean (WIO) remains poorly documented. Rodrigues Island, in particular, has lacked formal records in gorgonian species. To address this gap, ecological surveys were conducted in April 2024 at seven fore-reef sites around Rodrigues using triplicate 10×5 m belt transects surveyed by SCUBA. Results showed that only one species, *Annella mollis*, was recorded and was restricted to two outer reef slope sites, Tombant Coco and Ti Paté, at depths of approximately 27 m. Mean densities were low (0.17±0.01 and 0.15±0.01 individuals m⁻², respectively), and colonies were dominated by medium size classes (76-150 cm), with few larger individuals. Colonies were attached to consolidated rocky substrates on steep slopes associated with higher coral cover relative to other surveyed sites. No gorgonians were observed at the remaining five, shallower sites. These findings provide the first baseline record of gorgonians from Rodrigues Island and contribute to the limited knowledge of octocorals in the WIO. Our observations highlight the apparent restriction of *A. mollis* to deeper reef slope habitats around the island and underscore the need for broader surveys, temporal monitoring, and complementary morphological and genetic analyses to better understand gorgonian diversity and ecological roles in the region.

Keywords: Gorgonian, habitat preferences, marine ecology, species distribution, zonation

Abbreviations: SCUBA: Self-Contained Underwater Breathing Apparatus, SIDS: Small Islands Developing States, WIO: Western Indian Ocean

INTRODUCTION

Gorgonians are colonial octocorals (class Octocorallia, phylum Cnidaria) characterised by a flexible internal axis and diverse branching morphologies, contributing to the three-dimensional structural complexity of reef habitats. Although once treated as a distinct group, recent phylogenomic analyses (McFadden et al. 2021) and taxonomic revisions (McFadden et al. 2021) have shown that gorgonians are polyphyletic. Nevertheless, the term remains useful to describe upright and branching octocorals

as a functional ecological group (Bayer 1961). Octocorals, including gorgonians, are characterized by eight pinnate tentacles surrounding each polyp (Bayer 1961) and the colonies display diverse morphologies such as bushy, branched, whip-like, and fan-shaped forms (Fabricius and Alderslade 2001; Panero et al. 2023). These suspension feeders rely on ocean hydrodynamics to capture particulate and dissolved organic matter, including microscopic plankton (Ribes et al. 1999; Al-Marayati and Edmunds 2018), and occur from shallow tropical reefs to deep waters exceeding 1500 m, where they often serve as foundation

species (McFadden et al. 2010). Gorgonians enhance the spatial heterogeneity of reef systems and contribute to marine biodiversity as components of Marine Animal Forests (Abeytia et al. 2013; Rossi et al. 2017). Beyond their ecological importance, they are valued for producing bioactive compounds (Häder 2021), serving as bioindicators of metal pollution (Velayutham et al. 2003), and attracting recreational divers (Cebrian et al. 2012; Renfro and Chadwick 2017).

Their distribution and morphology are shaped by multiple environmental factors, including depth, current, and habitat structure, as well as the presence or absence of symbiotic zooxanthellae (Sánchez et al. 2019). Gorgonian abundance often increases with depth, where reduced competition with scleractinian corals and suitable substrates promote growth (Panero et al. 2023). Assemblages in deeper habitats commonly include fan-shaped species (Rodríguez-Lanetty et al. 2003). Hydrodynamics influence both distribution and colony morphology, with current strength affecting orientation and feeding efficiency (Rowley 2018; Panero et al. 2023), while site-specific variation in water flow and reef topography can shape assemblage composition (Sánchez et al. 1997).

Like many ecosystem engineers and habitat-forming taxa, gorgonians face increasing pressures from rising sea temperatures, pollution, and disease outbreaks (Tignat-Perrier et al. 2022; Bellin and Rossi 2024; Rovira et al. 2024). Although some species exhibit greater resilience than scleractinian corals, they remain vulnerable to environmental stressors and may experience declines in abundance and health under worsening ocean conditions (Sánchez et al. 2019). Many gorgonians are also considered components of Vulnerable Marine Ecosystems (VMEs), as defined by the FAO, underscoring their ecological importance and the need for conservation (FAO 2009).

Despite their ecological and structural importance, most studies on gorgonian distribution have focused on the Caribbean (Kahng et al. 2010). Knowledge from the Indo-Pacific, particularly the Western Indian Ocean (WIO), remains scarce (Pérez et al. 2016). Rodrigues Island, a small volcanic island in the Republic of Mauritius and part of the Small Island Developing States (SIDS) and is surrounded by extensive coral reefs yet lacks any published record of gorgonians. These organisms are not currently included in reef monitoring programs despite the island's reliance on marine ecosystems for tourism and fisheries. Given their ecological significance and vulnerability to environmental change, establishing baseline data for gorgonians in Rodrigues is essential. This study provides the first formal record of gorgonians around Rodrigues Island, documenting the presence, distribution, and size classes of *A. mollis* from fore-reef slope habitats offering a baseline for gorgonian occurrence in the region and highlights potential habitat conditions associated with their presence. This preliminary dataset establishes a foundational reference point for Rodrigues Island and contributes to the broader understanding of octocoral biodiversity in the Western Indian Ocean.

MATERIALS AND METHODS

Study sites

Rodrigues Island, part of the Republic of Mauritius, is located in the Western Indian Ocean (WIO), approximately 600 km northeast of the main island of Mauritius (19.7245°S, 63.4272°E), near the boundary of the southern hemisphere's tropical belt. The island is surrounded by about 90 km of fringing reefs that enclose a shallow lagoon (Soondur et al. 2023).

Distribution surveys

Seven fore-reef sites were surveyed around Rodrigues Island between 22 and 25 April 2024 (Figure 1). The surveyed sites (Table 1) ranged between 9 to 28 m depth. At each site, a single dive was conducted within recreational SCUBA depth limits. The sites were selected to represent the typical depth range and reef slope habitats where gorgonians are commonly found and that can be safely surveyed using SCUBA. Depth was limited to approximately 30 meters to comply with SCUBA safety and no-decompression limits, which allowed sufficient bottom time for comprehensive belt-transect surveys while ensuring diver safety. The number of sites was constrained by logistical feasibility and environmental conditions during fieldwork, reflecting the exploratory nature of this preliminary baseline study. We acknowledge that this limited spatial coverage represents a constraint of the study design and recommend that future research expand sampling to additional sites and deeper reef zones to capture broader habitat variability.

At each site, three belt transects measuring 10×5 m were laid parallel to the reef slope, resulting in a total surveyed area of 150 m² per site (Abeytia et al. 2013). All visible gorgonian colonies within each transect were counted and measured using a 3 m fibreglass tape measure. Colony height was recorded from the base to the farthest tip of the tallest branch, following standard protocols (Camps-Castellà et al. 2024). Each colony was then assigned to one of four size classes: 0-75 cm, 76-150 cm, 151-225 cm, and 226-300 cm, to enable comparison of colony size distributions between sites. Hard coral cover was also assessed at each site using the Line Intercept Transect (LIT) method (English et al. 1997) along the same transects used for gorgonian surveys, allowing for comparable habitat description.

Table 1. Coordinates and depth of the seven fore-reef slope sites surveyed around Rodrigues Island, Western Indian Ocean

Site name	Latitude (°S)	Longitude (°E)	Depth surveyed (± SE)
Antonio's Finger	-19.66111	63.43944	9±0
Aquarium	-19.66639	63.43694	12.8±0
Plateau Bénitier	-19.66722	63.43556	11.4±0
Ti Trou	-19.66250	63.43890	10.7±0
Couzoupa	-19.76250	63.46390	21.6±0
Tombant Coco	-19.70770	63.28520	27.4±0
Ti Paté	-19.63370	63.43740	27.1±0

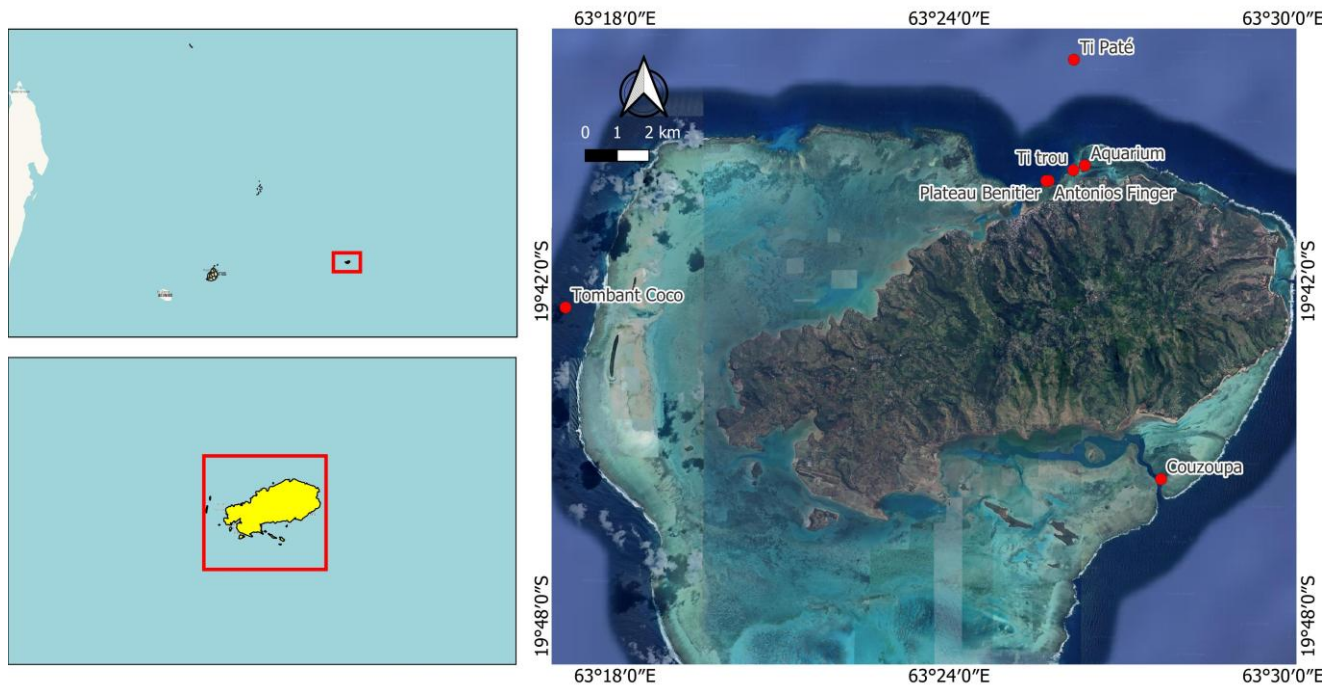


Figure 1. Map of Rodrigues Island with the study sites in the Western Indian Ocean

Taxonomic identification

Annella mollis was identified in-situ based on diagnostic macromorphological features and photographic records consistent with established descriptions (Nutting 1910; Bayer and Grasshoff 1995; Fabricius and Alderslade 2001). Colonies displayed a broad, planar fan structure with a regular, reticulate branching pattern and flattened, flexible branches. Polyps were arranged on both sides of the branches, characteristic of the genus *Annella*. Colony coloration ranged from pale yellow to light beige, occasionally with reddish-brown tints. These features are consistent with previous reports of *A. mollis* from the Indian Ocean and Western Pacific, including the coasts of East Africa, the Maldives, and the South China Sea (Goh and Chou 1996; Grasshoff 1999; McFadden et al. 2010). The species is known to occur primarily on deeper fore-reef slopes between approximately 12 and 50 m depth (Goh and Chou 1996; Pérez et al. 2016), which matches the depths (20–27 m) where colonies were observed at Rodrigues. The morphological consistency with these regional records supports the identification of the Rodrigues specimens as *A. mollis*.

Environmental and biological data collection

Depth (m) and temperature (°C) were recorded in-situ using a Cressi Goa diving computer to characterize site conditions and support qualitative comparisons of gorgonian occurrence and density. The Line Intercept Transect (LIT) method (English et al. 1997) was used to quantify scleractinian coral cover along each 10 m transect laid in the same area as the belt transects. Coral species intercepted by the transect line were identified in-situ and from photographic or video footage, and percentage coral

cover was calculated for each site based on the cumulative length of coral intercepts relative to total transect length.

To describe the general environmental context of the surveyed reefs, seawater samples ($n = 3$) were collected at each site for analysis of chlorophyll-*a*, physico-chemical parameters, and nutrients. For chlorophyll-*a*, samples were taken at the same depth as gorgonian surveys and stored frozen until spectrophotometrical analysis to determine concentrations following Sandooyee et al. (2020), using wavelengths of 630, 647, 664, and 750 nm. For physico-chemical parameters, samples collected and were analyzed at the surface using a Milwaukee pH meter and a Milwaukee Digital Salinity Refractometer. Nutrient concentrations were determined following standard methods: nitrate by the cadmium reduction method (Margeson et al. 1980), silicate by the oxalic acid method (Strickland and Parsons 1968), and phosphate by the colorimetric method (Murphy and Riley 1962). Nutrient and chlorophyll-*a* data were used to provide general water-quality context for each site rather than for statistical analysis.

RESULTS AND DISCUSSION

Occurrence and habitat of *Annella mollis*

Throughout the survey, only a single gorgonian species, *A. mollis*, was recorded. The species was identified based on morphological identification. Colonies were observed at two of the seven fore-reef sites, Tombant Coco and Ti Paté, both located on exposed slopes facing the open ocean. Colonies were attached primarily to consolidated rock and rubble and were absent from sand substrates.

At Tombant Coco, the reef forms a stair-like cliff descending into deeper water, with colonies occurring from the upper steps (~15m) into deeper flanks. Colonies were mostly upright and scattered individually from few centimetres to several meters apart, although small clusters of up to three colonies were occasionally present.

At Ti Paté, colonies were observed on a dome-shaped rocky structure, concentrated along the rim and lower flanks. Colonies commonly grew oriented along the slope and exhibited a flattened fan-like morphology (Figure 2.D).

Across both sites, colonies were associated with diverse coral assemblages, including massive and encrusting forms (e.g., *Porites*, *Platygyra*, *Lobophyllia*, *Goniastrea*), as well as soft corals (Figures 2.E and F). All observed colonies appeared healthy, with no visible signs of tissue loss, necrosis, fragmentation, or overgrowth by epibionts. No sediment accumulation or biofilm coverage was observed on colony surfaces.

Distribution and environmental conditions

Annella mollis was recorded only at Tombant Coco and Ti Paté, both located on the outer reef slope at

approximately 27 m depth. Colonies occurred at low densities of 0.17 ± 0.01 and 0.15 ± 0.01 individuals m^{-2} , respectively. Environmental characteristics for all seven sites are summarized in Table 2. The two sites with gorgonian presence were among the deepest surveyed and shared similar conditions, with in-situ temperatures of $28^{\circ}C$, salinity of 35 ppt, slightly alkaline pH values (8.19-8.25) and relative high coral cover (≈ 28 -29%).

In comparison, the remaining five sites, ranging from 9 to 22 m depth, generally exhibited lower coral cover ($\leq 7\%$), similar or slightly higher temperatures (29 - $31^{\circ}C$). Salinity values were comparatively similar (35-36 ppt) and pH was marginally lower (7.7-8.1) at these sites. Nutrient concentrations, including silicate, phosphate, and nitrate, varied widely but showed no consistent trend across the island. Overall, colonies of *A. mollis* were observed only at the deeper, outer-slope sites characterized by stable temperature, moderate alkalinity, and higher coral cover, while absent from shallower or nearshore reefs (Table 2).

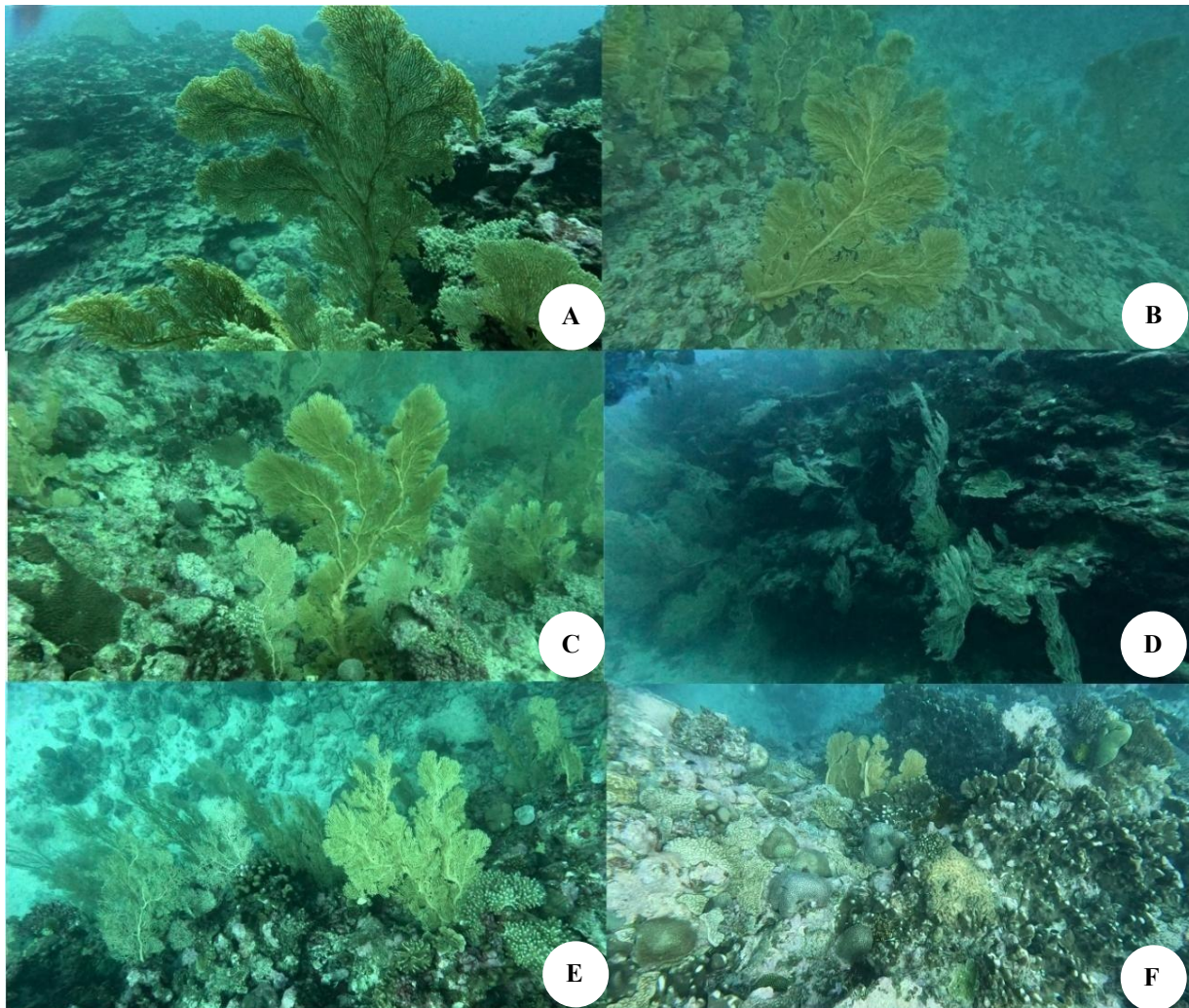


Figure 2. *Annella mollis* observed at Rodrigues Island, Western Indian Ocean. A, D, E. Ti Paté and B, C, F. Tombant Coco

Colony size structure

At both Tombant Coco and Ti Paté, *A. mollis* colonies were distributed across three size classes (0-75 cm, 76-150 cm, and 151-225 cm), with no colonies exceeding 225 cm in height at Ti Paté and only one large colony (>225 cm) recorded at Tombant Coco (Figure 3). The majority of colonies belonged to the 76-150 cm class, representing 9 colonies at Tombant Coco and 10 at Ti Paté, followed by smaller colonies (0-75 cm). Larger colonies (151-225 cm) were observed at both sites but were more frequent at Tombant Coco (8 colonies) than at Ti Paté (3 colonies). Mean colony height was approximately 120 cm at Tombant Coco and 110 cm at Ti Paté. Overall, *A. mollis* populations at Rodrigues were dominated by medium-sized colonies, with few individuals in the largest size class.

Discussion

This study documented for the first time records, as well as density, and size structure, of shallow-water gorgonians around Rodrigues Island. Only a single species, *A. mollis*, was recorded, restricted to two fore-reef slope sites, Tombant Coco and Ti Paté. These represent the first records of gorgonians from Rodrigues. *Annella mollis* is a reef-associated gorgonian distributed across the tropical Indian Ocean and Western Pacific, typically inhabiting deeper reef slopes exposed to strong tidal currents (Goh and Chou 1996). As an azooxanthellate species, it relies entirely on plankton and dissolved or particulate organic matter for nutrition (Sánchez et al. 2019).

In this preliminary survey, *A. mollis* was only observed at deeper reef slope sites of ~27 m with relatively higher scleractinian coral cover and diversity, and the species was absent from shallower, more sediment-impacted and less structured sites. This pattern aligns with ecological principles of habitat specialization and flow-mediated resource acquisition: strong currents enhance food delivery for suspension feeders, while mesophotic depths reduce competition from scleractinian corals, resulting in higher gorgonian abundances and colony sizes (Rodríguez-Lanetty et al. 2003; Pérez et al. 2016; Panero et al. 2023). Observations of colonies growing perpendicular to reef slopes at Ti Paté are also consistent with reports of gorgonian orientation with currents to optimize suspension feeding (Rodríguez-Lanetty et al. 2003). Preliminary

statistical analyses indicate positive associations with depth, coral cover, and reef rugosity, although limited site replication precludes fully robust inference. Other environmental factors, including lower temperature (25-28°C), optimal pH (>8.0), and moderate salinity (32-37 ppt), may further favour *A. mollis* persistence at these sites. Sites closer to land or riverine input (Antonio's Finger, Aquarium, Plateau Bénitier and Ti Trou), with higher sedimentation or elevated nitrate levels, were devoid of gorgonians, suggesting sensitivity to water quality and turbidity (Yoshioka 2009; Tseng et al. 2011).

Colony size distributions were dominated by medium-sized individuals (76-150 cm), with few larger colonies. This pattern is consistent with observations from other Indo-Pacific sites, in which deeper habitats supported large fan-shaped species such as *A. mollis* (Goh and Chou 1996; Panero et al. 2023). The orientation of colonies perpendicular to the slope at Ti Paté is consistent with current-mediated feeding strategies. Low densities and restricted distribution likely reflect a combination of natural patchiness, environmental constraints, and sampling limitations, as only seven sites within a limited depth range were surveyed.

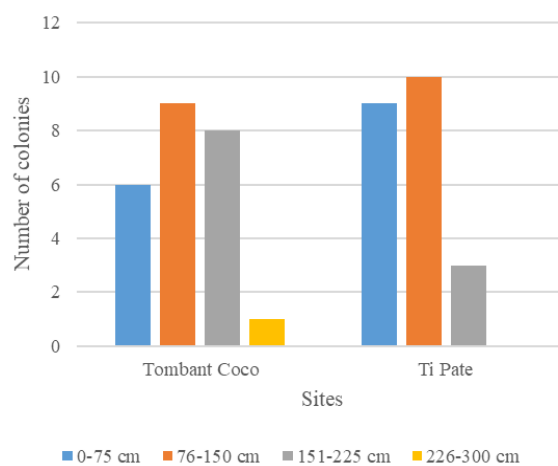


Figure 3. Size class distribution of *Annella mollis* colonies at the two sites where gorgonians were observed at Rodrigues Island, Western Indian Ocean

Table 2. Mean environmental and biological variables (\pm SE) across seven fore-reef sites at Rodrigues Island, Western Indian Ocean. *Annella mollis* was recorded only at the two deepest sites (Tombant Coco and Ti Paté), which exhibited greater coral cover and diversity compared to shallower sites

Site	Coral cover (%)	Coral diversity (H')	Gorgonian density (ind·m ⁻² ±SE)	Temp. (°C)	pH	Salinity (ppt)	Silicate	Phosphate	Nitrate
Tombant Coco ✓	28.9	0.86±0.33	0.12±0.01	28	8.25±0.00	35.00	2.32±0.22	1.95±0.82	0.02±0.004
Ti Paté ✓	28.6	0.90±0.33	0.15±0.01	28	8.19±0.08	35.00	8.77±2.82	2.05±0.86	0.02±0.005
Antonio's Finger X	0.12	0	0	30	7.80±0.00	35.00	5.43±0.25	9.42±5.74	-
Aquarium X	0.33	0	0	29	7.70±0.00	36.00	2.96±0.42	0.07±0.08	0.02±0.01
Plateau Benitier X	5.57	0.75±0	0	30	7.80±0.00	36.00	1.68±0.31	0.28±0.21	0.57±0.11
Ti Trou X	7.27	0.97±0	0	30	7.80±0.00	35.00	2.90±0.66	0.04±0.05	0.09±0.04
Couzoupa X	27.63	0.93±0	0	31	8.10±0.00	35.00	1.12±0.44	0.39±0.76	0.40±0.21

Note: Nitrate data were unavailable for Antonio's Finger due to sample loss during processing

Environmental conditions at the Rodrigues sites likely influenced the restricted distribution of *A. mollis*. Sites with higher pH (>8.0) supported gorgonian presence, consistent with previous findings that mesophotic gorgonians favour slightly alkaline conditions (Venn et al. 2013). Moderate salinity (32-37 ppt) was also associated with *A. mollis* occurrence, whereas sites with higher salinity lacked gorgonians, reflecting the species' vulnerability to abrupt salinity changes (Bayer 1961). Nutrient concentrations appeared to play a role in local gorgonian densities: sites with higher nitrate levels tended to have lower densities, suggesting that excessive nitrate may negatively affect growth or settlement, while weak positive associations were observed with silicate and phosphate, potentially reflecting their contributions to primary productivity and the availability of particulate organic matter for suspension feeding (Bellin and Rossi 2024). These observations indicate that water chemistry, including pH, salinity, and nutrient concentrations, interacts with depth and structural habitat characteristics to influence *A. mollis* distribution on Rodrigues mesophotic reefs.

These results provide the first baseline record of gorgonians at Rodrigues Island and extend the knowledge of their distribution within the Western Indian Ocean. Given the ecological importance of gorgonians as suspension feeders and habitat-forming taxa (Ponti et al. 2014; Sánchez et al. 2019), further surveys are needed to better document gorgonians' distributions and ecological roles in Rodrigues reef communities.

In conclusion, this study provides the first formal records of gorgonians at Rodrigues Island, documenting a single species, *A. mollis*, at two fore-reef slope sites. Colonies occurred at low densities and were dominated by medium size classes. These findings highlight the restricted distribution of gorgonians in the surveyed areas and provide an important baseline for future research in the Western Indian Ocean.

Although this study bridges a significant knowledge gap in the biodiversity of Rodrigues Island, several limitations should be acknowledged. The survey encompassed only seven sites and was limited to depths shallower than 30 m, providing a spatially restricted snapshot of the island's gorgonian assemblages. Future studies should therefore broaden spatial coverage to include deeper reef slopes and additional habitat types, while incorporating repeated surveys to capture temporal dynamics to assess long-term population stability.

Furthermore, species identification relied exclusively on macromorphological characteristics visible during in-situ observations. While diagnostic characters clearly matched *A. mollis*, the absence of sclerite and molecular analyses introduces some uncertainty. Future research incorporating genetic tools (e.g., COI barcoding) and detailed morphological examinations will be essential to confirm species identity and refine regional taxonomic records. Such integrative approaches, combined with expanded spatial and temporal surveys, will be essential to understanding the diversity, ecology, and resilience of gorgonians at Rodrigues, and to informing conservation

strategies across the Western Indian Ocean under changing environmental conditions.

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