

Supplementary Material

Supplementary Figure 1. CPCe codes

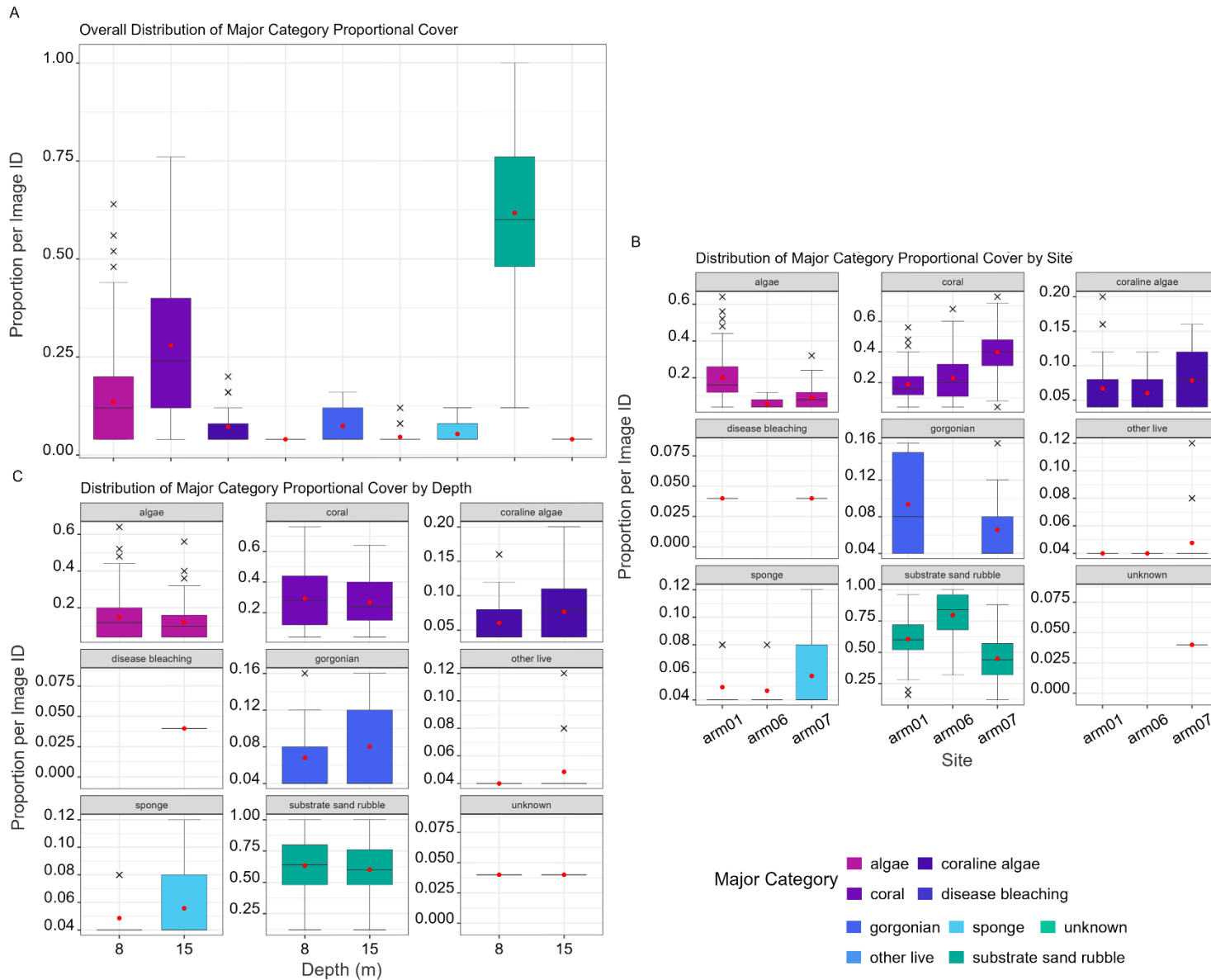
Name	ID	Category	Name	ID	Category	Name	ID	Category
"Acanthastrea"	ACAN	"CG"	"Goniastrea"	GONA	"CG"	"Plesiastrea"	PLES	"CG"
"Acropora"	ACRO	"CG"	"Gorgonian"	GOR	"G"	"Pocillopora"	POCI	"CG"
"Algae"	ALG	"A"	"Halomitra"	HALO	"CG"	"Porites"	PORI	"CG"
"Blastomussa"	BLAS	"CG"	"Herpolitha"	HERP	"CG"	"Psammocora"	PSAM	"CG"
"Bleaching"	BLE	"DB"	"Isopora"	ISOP	"CG"	"Rubble"	RUB	"SSR"
"Coraline algae"	CAL	"CA"	"Leptoseris"	LEPO	"CG"	"Sand"	SAN	"SSR"
"Coscinaraea"	COSC	"CG"	"Leptoria"	LEPT	"CG"	"Sponge"	SPO	"S"
"Cycloseris"	CYCL	"CG"	"Merulina"	MERU	"CG"	"Stylocoeniella"	STYC	"CG"
"Cyphastrea"	CYPH	"CG"	"Montipora"	MONP	"CG"	"Rock"	SUB	"SSR"
"Echinopora"	ECPO	"CG"	"Montastrea"	MONT	"CG"	"Symphyllia"	SYMP	"CG"
"Favites"	FAVI	"CG"	"Oulophyllia"	OULO	"CG"	"Turbinaria"	TURB	"CG"
"Fungia"	FUNG	"CG"	"Pachyseris"	PACH	"CG"	"Unknown"	UNK	"U"
"Galaxea"	GALA	"CG"	"Pavona"	PAVO	"CG"	"Other live"	ZOA	"Z"
"Gardineroseris"	GARD	"CG"	"Platygyra"	PLAT	"CG"	"Zoopilus"	ZOOP	"CG"

Where, "A" algae, "CA" coraline algae, "CG" coral, "DB" disease bleaching, "G" gorgonian, "S" sponge, "SSR" substrate, "U" unknown, "Z" other live.

Supplementary Figure 2. The spatial organisation of coral life history strategies and coral morphologies in wester Aldabra Atoll



Supplementary Figure 3. Benthic composition summary statistics overall, across sites and across depths.



Supplementary Figure 4. Glossary of terms used.

Benthic community - The organisms living on or in the seafloor substrate, including corals, macroalgae, sponges, and invertebrates.

Benthic landscape profile - A visual map of the seafloor along a transect that shows how the "fabric" of the reef shifts from coral to rock to rubble as you move across space.

Biological interactions - The relationships between organisms, such as competition for space, predation, and mutualism, which influence community composition.

Carbonate accretion - The process by which corals and other organisms build up the physical reef structure by depositing calcium carbonate. If "accretion" is lower than "erosion," the reef will eventually shrink.

Climax reef community - A stable, mature reef community that has reached a steady state of species composition following a long period without significant disturbance.

Community - An interacting group of various species in a common location.

Community structure / organisation - The composition of a biological community, including the number of species present (richness), their relative abundance, and how they are distributed in space.

Competitive "strategy" corals - Corals that prioritise rapid linear growth and high resource acquisition (e.g., branching *Acropora*), allowing them to dominate stable environments by overtopping neighbours.

[Deeper] Reef slope - The inclined section of a reef extending from approximately 15 m depth toward the ocean floor, where light levels attenuate and species composition shifts toward more shade-tolerant taxa.

Dispersion patterns - The spatial arrangement of individual organisms or colonies within a specific area (e.g., random, uniform, or aggregated/clustered).

Ecosystem recovery - The process of a degraded ecosystem returning to a state of high coral cover, structural complexity, and biodiversity following a decline.

Ecosystem services - The benefits provided by reef ecosystems to humans, such as coastal protection, fisheries support, and carbon sequestration.

Ecosystem / reef resilience - The ability of the entire ecosystem to recover its original structure and function after being subjected to a stressful event or disturbance. For coral reefs specifically, it is the capacity of a reef ecosystem to absorb shocks, resist phase shifts, and maintain its functional processes following a disturbance.

Environmental filtering - An ecological mechanism where abiotic factors (e.g., temperature, substrate stability) prevent certain species from establishing in a specific habitat.

Functional composition - The makeup of the reef community based on the ecological roles and biological traits of its species, rather than just their taxonomic names. It focuses on what the organisms *do* and how they grow, rather than just what they *are*.

Functional groups - Collections of species that perform similar ecological roles or share similar physiological traits, regardless of their taxonomic relatedness.

Functional identity (Refer to reef functional identity)

Generalist "strategy" corals - Corals possessing a flexible suite of traits that allow them to persist across a wide range of depths and environmental conditions without specialising in one specific niche.

Life history strategies - Sets of co-evolved biological “life history” traits (growth, reproduction, and survival) that determine a species' approach to competing for resources and enduring environmental stress.

Micro-refugia - Small, localised areas where environmental conditions (like cooler water or shade) are better than the surrounding area, allowing sensitive species to survive mass bleaching events that kill corals elsewhere.

Mid-successional reef - A "mid-successional" reef is one that is in the middle of recovering—it has moved past the first "pioneer" species but hasn't yet reached a stable "climax" state.

Multivariate Dispersion - A measure of "patchiness" or beta-diversity; it quantifies how much individual samples (quadrats) vary from the average community composition.

Niche theory vs. neutral theory - Niche theory posits that species occupy specific roles based on traits, whereas Neutral theory suggests that biodiversity is primarily driven by random birth, death, and dispersal events.

Niche utilisation - The specific way an organism or species uses the available biotic and abiotic resources within its environment.

Nucleated patches - A spatial pattern where recovery or growth starts from a central "nucleus" (a survivor or a successful recruit) and expands outward, often seen in fragmented landscapes.

Outer reefs - The reefs located furthest from the shoreline or lagoon, often forming the edge of an atoll or barrier system.

Pioneer reef community - The initial group of species (often weedy or ruderal) that colonises a bare or recently disturbed substrate, beginning the process of ecological.

Reef / community assemblage - The specific collection of coral and associated organisms that coexist in a particular reef area at a given time.

Reef / community assembly - The process through which species from a regional pool colonise a site and interact to form a local community, influenced by filters and interactions.

Reef framework - The primary biogenic structure of a reef, composed of the interlocking calcium carbonate skeletons of hermatypic (reef-building) corals and crustose coralline algae.

Reef function - The biological and geochemical processes that occur within a reef, such as primary production, calcification, and nutrient cycling.

Reef functional identity - The dominant functional traits within a reef community (e.g., growth forms, calcification rates) that dictate how the ecosystem processes energy and responds to disturbances.

Reef matrix / physical matrix - The complex, three-dimensional arrangement of living coral, dead skeletal material, and infill (such as sand and rubble) that creates the physical "fabric" of the reef habitat.

Reef structural complexity - The degree of three-dimensional topographical variation on a reef, which provides niche space, shelter, and surface area for marine organisms.

Reef structure / physical architecture - The physical configuration and spatial arrangement of the reef's biotic and abiotic components, determining the overall shape and rugosity of the ecosystem.

Reef zonation - The distinct horizontal or vertical bands of biological communities that form across a reef in response to environmental gradients like light, wave action, and depth.

Reef zones - The spatial categorisation of a reef into distinct areas (e.g., back-reef, reef flat, crest, slope) based on physical characteristics and biological dominance.

Scleractinian coral - The "stony" or hard corals that produce calcium carbonate skeletons and are the primary builders of modern reefs.

Seaward reefs - The portion of a reef system facing the open ocean, typically exposed to the highest levels of wave energy and oceanic flushing.

Shallow reef - The upper portion of a reef system, typically occurring from the low-tide mark to approximately 14 m meters, characterised by high light availability and high hydrodynamic energy.

Spatial autocorrelation - The degree to which the presence of an organism in one location influences the probability of its presence in a neighbouring location.

Spatial organisation - the specific physical arrangement and distribution of organisms (the "biological biography") across the reef substrate. Here, it describes how surviving corals and other benthic components are positioned relative to one another in a post-bleaching landscape.

Spatial organisation "signatures" - (1) **Aggregated Frameworks:** Dense, clustered areas that cover a lot of ground; these are the "anchors" of the reef; (2) **Nucleated Patches:** Small, intense clusters of growth (like "islands") that are restricted to specific spots; (3) **Homogeneous Veneers:** A thin, even layer of growth that covers the ground uniformly, like a

carpet; (4) **Stochastic Distributions:** Randomly scattered organisms whose position is driven by chance (e.g., where a larva happened to land).

Stochastic vs. deterministic - "Stochastic" refers to random processes (like random larval dispersal), while "deterministic" refers to predictable patterns driven by specific causes (like environmental filtering).

Stress-tolerant "strategy" corals - Corals with slow growth rates, dense skeletons, and long lifespans (e.g., massive *Porites*), capable of surviving chronic environmental stressors like high turbidity or thermal fluctuations.

Succession - The process of change in the species structure of an ecological community over time.

Variance-to-mean ratio (VMR) - A mathematical index used to determine spatial arrangement; a $VMR > 1$ indicates a clustered (aggregated) distribution, while a $VMR < 1$ indicates a uniform distribution.

Weedy/ruderal "strategy" corals - Opportunistic corals characterised by small colony size, rapid growth, and high reproductive output, allowing them to quickly colonise disturbed or unstable habitats.