Changing Functional Group Abundances of Octocorals and Zoantharians, across Environmental Gradients in the Indo-Pacific.

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Introduction

Global warming causes functional shifts and reorganisation through range shifts in high-latitude reefs and bleaching mortality in the tropics. The integrity and structure of marine communities are threatened by these changes, especially as species are reduced or lost. The extent of range shifts and their ecological consequences for octocorals and zoantharians (O+Z) on shallow coral reefs is unknown.

Here, we:

- Detect functional shifts in O+Z reef communities across a latitudinal gradient in the Kuroshio region of southern Japan;
- Create a trait database to gather information on 35 species found in field surveys;
- Calculate functional groups to determine abundance changes along the latitudinal gradient;
- Identify which traits contributed most to the variation of soft coral composition between sites.

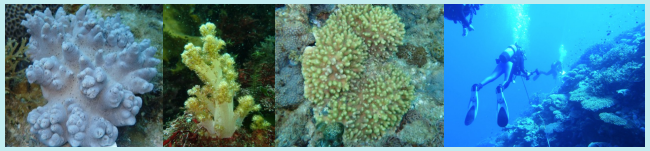

Fig 1. left to right: O+Z *species Klyxum; Stereonephthya Japonica; Sinularia*; data collecting on coral reefs.

Methods

- O+Z data collected across 31 sites along Japan's Pacific Coast.
- O+Z traits and values were found from literature, databases and survey data to create the database.
- A phylogenetic dendrogram of O+Z species was created in R via trait cluster analysis.
- The dendrogram was cut to create five functional groups (**Fig 1**).
- Environmental variables were found for functional group analyses; maximum and minimum sea surface temperature (sstMX, sstMIN), mean chlorophyll A.
- General additive models (GAM) were formed for each functional group.
- Significant correlations were identified.
- Functional indices were calculated in R.
- Regression models formed for env. variables and latitude.

Results

- The first database for O+Z was created with 35 species and 40 trait levels.
- Five functional groups were created to divide species by their functional roles (**Fig 2**).
- Functional groups 2 and 5 showed significant relationships with at least one environmental variable.
- Functional group richness (FGR) and species richness (SR) showed statistically significant relationships with latitude (**Fig 3**).
- Analysis showed traits average colony size and depth range contributed most to trait variation between sites (**Fig 4**).

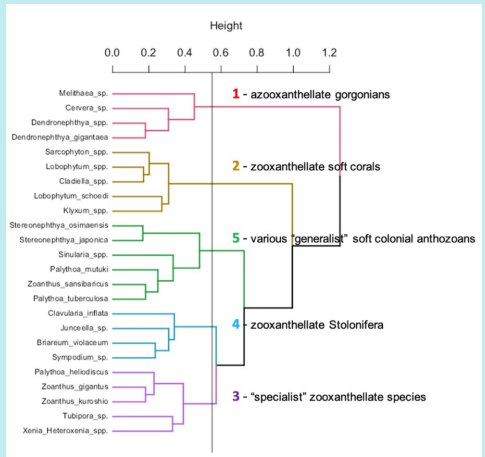

Fig 2. Dendrogram showing functional groups of SCA based upon trait similarity.

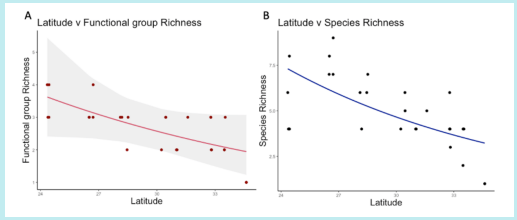

Fig 3. Generalized linear regressions across increasing latitude for a) functional group richness (FGR); b) species richness.

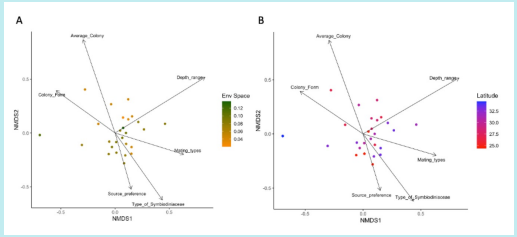

Fig 4. NMDS describes traits contributing most to trait composition variation between sites, associated with; a) Environmental Space; b) Latitude.

Discussion

- Creating the database for O+Z highlighted the need for more general zoological data for many of these taxa.
- Analyses of O+Z functional groups along environmental gradients revealed restructuring of communities with increasing latitude.
- Functional group abundance and species richness (SR) showed negative significant correlations with higher latitude, suggesting:
- **1.** the functions of soft coral communities shift with latitude as species traits define their functions;
- **2**. higher abiotic stress in colder subtropical-to-temperate regions decreases species and functional diversity of communities.
- GAM models showed sstMIN and chlorophyll A levels correlated with significant non-linear relationships for groups 2 and 5.
- Functional splits among zooxanthellate zoantharians and massive soft corals, suggest there may be further splits due to different functional roles which have not yet been identified.

Conclusions

- Our study considers functional roles and shifts of O+Z across communities correlating with environmental gradients and latitude.
- Filling gaps in knowledge identified in this study will allow more accurate analyses to characterise global shifts, benefitting worldwide marine ecosystems with more efficient protection and support.
- These characterisations will help efforts towards preparing coastal communities' reactions to climate change - many of these depend on coral ecosystems for their livelihoods.

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