The following are methods for a coral species distribution paper that incorporates species traits. I’ve included some heading that won’t necessarily stay but I think help provide context because this is only half of my methods section. I‘m mostly curious about flow and level of detail provided.

Species Data

The distribution, abundance and geographic variation of corals were documented from Southern Papua New Guinea and Eastern Australia (Veron 1993). These observations were collected uniformly to maintain consistency in comprehensive presence/absence records for all species. The region was divided into three general biogeographic classifications representative of the Great Barrier Reef, temperate coral reefs, and high-latitude coral communities. Within these classifications, 15 specific locations were targeted and species at these locations were recorded with latitude and longitude measurements. In total, nearly 400 species documented represent diverse distributions across 27 degrees in latitude from Southern Papua New Guinea along eastern Australia to South Australia. Generally, species were most common in the tropics and distributions decreased further south. Discrepancies in overlapping abundances allow for additional investigation into the biotic and abiotic factors that contribute to the non-uniform distribution. Of the species found throughout this range, we selected a subset of 24 species (Table below) that represent diverse geographic distributions in order to determine the effect of various environmental conditions associated with the presence of specific species.

Table : will include description of these locations written out. x indicates presence and absent if no x (rather than lack of survey)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| species | SPNG | CS | TS | NGBR | CGBR | PSR | CBR | FLI | EMR | LHI | Sol | NNSW | SNSW | VIC | SA |
| Acropora.cuneata |  | x | x | x | x | x | x |  |  |  |  |  |  |  |  |
| Acropora.gemmifera | x | x | x | x | x | x |  | x | x | x |  |  |  |  |  |
| Acropora.glauca |  |  |  | x | x |  | x | x | x | x | x |  |  |  |  |
| Acropora.humilis | x | x | x | x | x | x | x | x |  |  |  |  |  |  |  |
| Acropora.hyacinthus | x | x | x | x | x | x | x | x | x | x | x | x |  |  |  |
| Acropora.microclados | x | x | x | x | x |  |  | x |  |  |  |  |  |  |  |
| Acropora.monticulosa | x | x | x | x | x |  |  |  |  |  |  |  |  |  |  |
| Acropora.solitaryensis | x |  | x | x | x |  |  | x | x |  | x | x |  |  |  |
| Caulastrea.tumida |  | x |  | x | x |  |  |  |  |  |  |  |  |  |  |
| Favia.favus | x | x | x | x | x | x | x | x | x |  | x |  |  |  |  |
| Favia.speciosa | x | x |  | x | x |  | x | x | x | x |  |  |  |  |  |
| Fungia.fungites | x | x | x | x | x | x | x |  |  |  |  |  |  |  |  |
| Goniastrea.australensis | x | x | x | x | x | x | x | x | x | x | x | x |  |  |  |
| Hydnophora.exesa | x | x | x | x | x |  | x | x | x | x | x |  |  |  |  |
| Mycedium.elephantotus | x | x | x | x | x | x | x | x |  | x |  |  |  |  |  |
| Pavona.decussata | x | x | x | x | x | x | x |  | x |  |  |  | x |  |  |
| Platygyra.sinensis | x | x | x | x | x | x | x | x | x |  |  |  |  |  |  |
| Plesiastrea.versipora | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Pocillopora.damicornis | x | x | x | x | x | x | x | x | x | x | x | x |  |  |  |
| Porites.stephensoni |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |
| Stylophora.pistillata | x | x | x | x | x | x | x | x | x | x | x |  |  |  |  |
| Turbinaria.mesenterina | x | x | x | x | x | x | x | x | x |  | x |  | x |  |  |
| Turbinaria.radicalis |  |  | x | x | x | x | x | x | x | x | x | x |  |  |  |

Environmental Data

Coral presence is in part a function of the abiotic conditions for which a species can tolerate and thrive. There are a number of environmental constraints that dictate coral distribution. Though not exhaustive, temperature, light, turbidity, substrate availability, turbulence, and water quality are recognized as primary filters of coral presence. For the purposes of this study, we selected attributes of two of these environmental conditions, sea surface temperature (SST) and total suspended matter (TSM) to assess the relationship of species, their traits, and their distribution among the environmental conditions associated with coral presence.

One of the main factors limiting coral distribution latitudinally is temperature. Species are restricted to a relatively narrow range of temperatures that are high enough to allow for reef development and in outcompeting algae while still maintaining a temperature low enough to not have a negative effect on zooxanthellae, when they are expelled and corals bleach (approximately 16-30°C). Corals typically cannot sustain temperatures for prolonged periods outside of this range and extremes can be detrimental. Derived SST variables selected for these analyses that represent potential important relationships with the distribution of specific coral species were: averaged weekly SST, SST standard deviation, and skewness of averaged weekly SST.

*SST*

Sea surface temperatures throughout 1981-2010 were acquired from the Coral Reef Temperature Anomaly Database (CoRTAD) at 4km resolution. These data provide averaged weekly temperatures across the entire time period. Averaged SST values were extracted for corresponding latitude and longitude coordinates where species were recorded.

*Variability*

Climatic conditions can vary as a function of latitude where the variability of temperature increases with increasing latitudes. The association of temperature variability as a function of geographical location can provide insight into the relationships with species traits more or less tolerant of fluctuations. Variability used to describe and predict coral distribution represents the standard deviation of the previously described averaged weekly sea surface temperatures.

*Skewness*

The probability distribution of averaged SST can have a normal or an asymmetrical distribution of temperatures about the mean. Asymmetrical distributions indicate whether temperatures would normally exceed or fall below the average. The inclusion of this detail indicates to which extreme species at specific locations would be subjected to and act as a filter of associated coral traits, thus presence of a certain species.

*TSM*

Coral sensitivity to water clarity varies by species. Increased sediment in the water column can interfere with the ability of zooxanthellae algae to photosynthesize creating a divide in specific tolerances and preferences for water clarity. Descriptions of water clarity can be assessed with measurements of total suspended matter (TSM) concentrations at specific locations. Medium Resolution Imaging Spectrometer (MERIS) from the polar orbiting Envisat Earth Observation Satellite was used to extract and quantify suspended matter at locations of coral observations. Relative differences in concentrations of total suspended matter represent the spectrum of preference for clear or turbid waters.

*Data preparation*

Environmental variables were log transformed to satisfy assumptions of linear relationships. All variables were centered on zero and scaled by subtracting means and dividing by the standard deviation. There were no strong correlations between SST, attributes derived from SST and TSM allowing the inclusion of all variables in analysis.

**To be developed & written**

Coral Traits/Measurements

It is essential to consider the most relevant biological explanation for how coral traits would be filtered across a certain set of environmental filters and where some environmental characteristics would have a stronger influence on certain traits than others.

Model Specifications

GLM in R using LME4 package…lots more detail