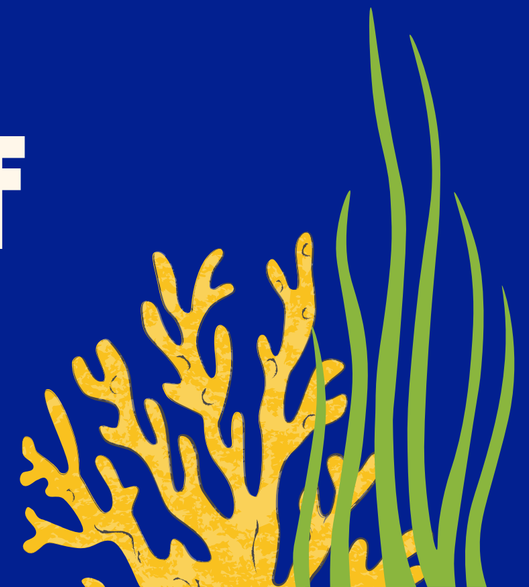
STAT3926: Statistical Consulting

# Assessing Coral Recovery and Reassembly in the Great Barrier Reef



# Background

- Extensive research on factors influencing coral reef recovery rates.
- Less focus on various aspects of the recovery process itself.
    - Coral Recovery:
        - Return of hard coral cover to pre-disturbance levels.
        - Most widely used metric for assessing coral community recovery.
    - Reassembly:
        - Recovery of coral community composition.
        - Ensures relative abundances of taxa resemble pre-disturbance levels.
        - Crucial for restoring ecosystem function.
- Importance of Reassembly:
    - Maintains ecological function if new species fulfill roles of lost species.
    - Loss of function and reef degradation if roles are not fulfilled.

# Aims:

To analyse the recovery times of various coral morphologies across different regions and shelf locations.

To determine whether reefs that successfully recover also reassemble to have the same distribution of morphologies as prior to the disturbance.

To evaluate the impact of factors such as region, shelf location, and time taken for recovery on the likelihood of successful reassembly.

To investigate the role of different coral morphologies in driving successful reassembly.

To forecast the number of coral cover disturbances using sea surface temperature as the predictor.

# Methodology

Relative changes in coral cover are calculated year-on-year for the coral morphologies.

Flag significant changes where relative change > 2 standard deviations

Compute the number of years taken for reefs to recover.

Wilcoxon rank sum testing and pairwise tests for spatial variability.

Coral assemblage in the years prior to the disturbance is the benchmark.

Cover of morphologies transformed to relative abundance.

Bray-Curtis similarity.

Compare to benchmark and flag for successful reassembly.

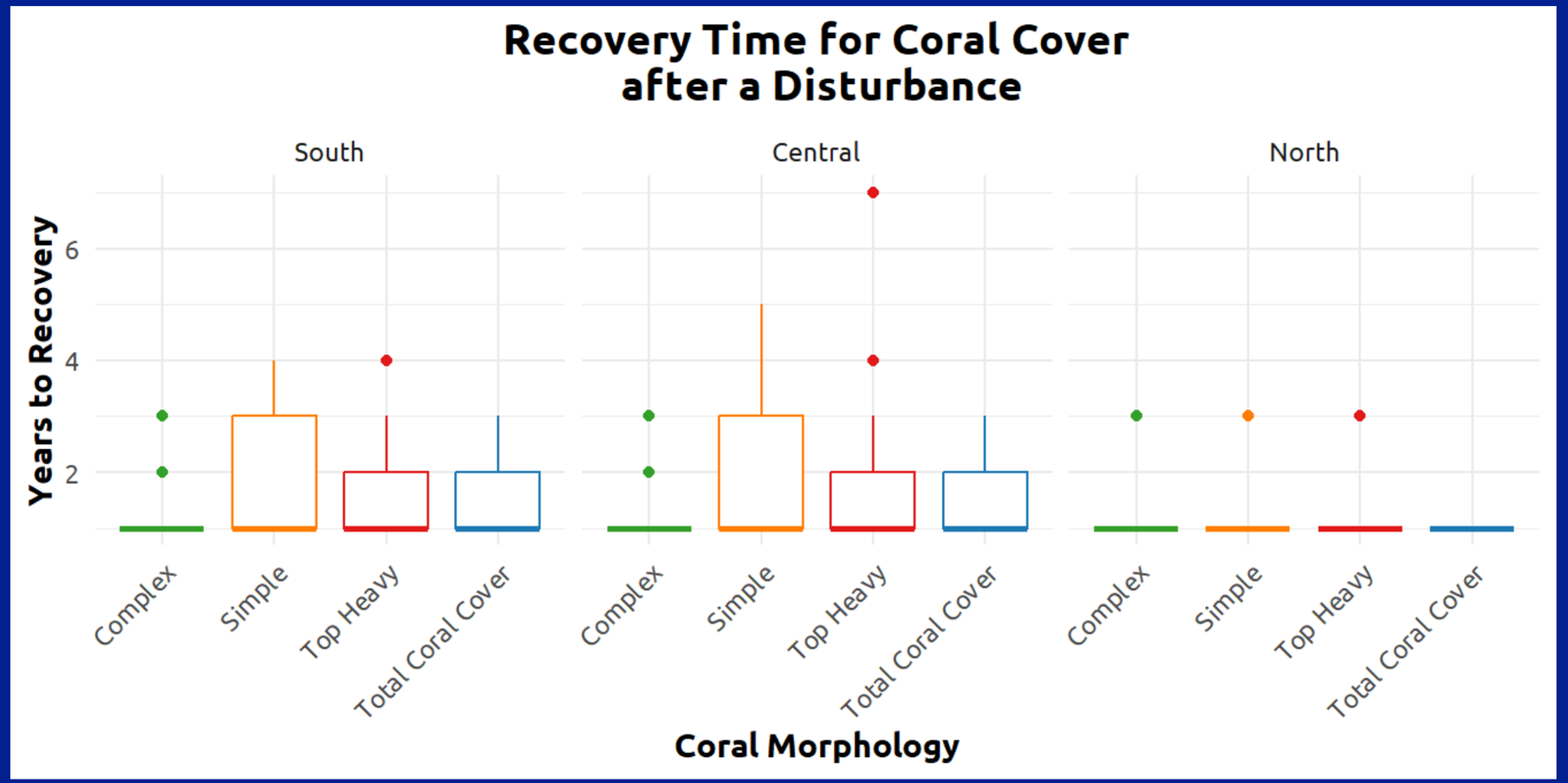
Logistic regression.

Fit models to explore SST and coral disturbances.

Model selection based on AIC and BIC.

Forecasts using RCP climate projections.

# Recovery Times for Coral Morphologies Across Regions and Shelves




## Wilcoxon Rank Sum

| Effect | Significant (p < 0.05) |
|---|---|
| Morphology | ✓ |
| Region | ✓ |
| Shelf | ✓ |

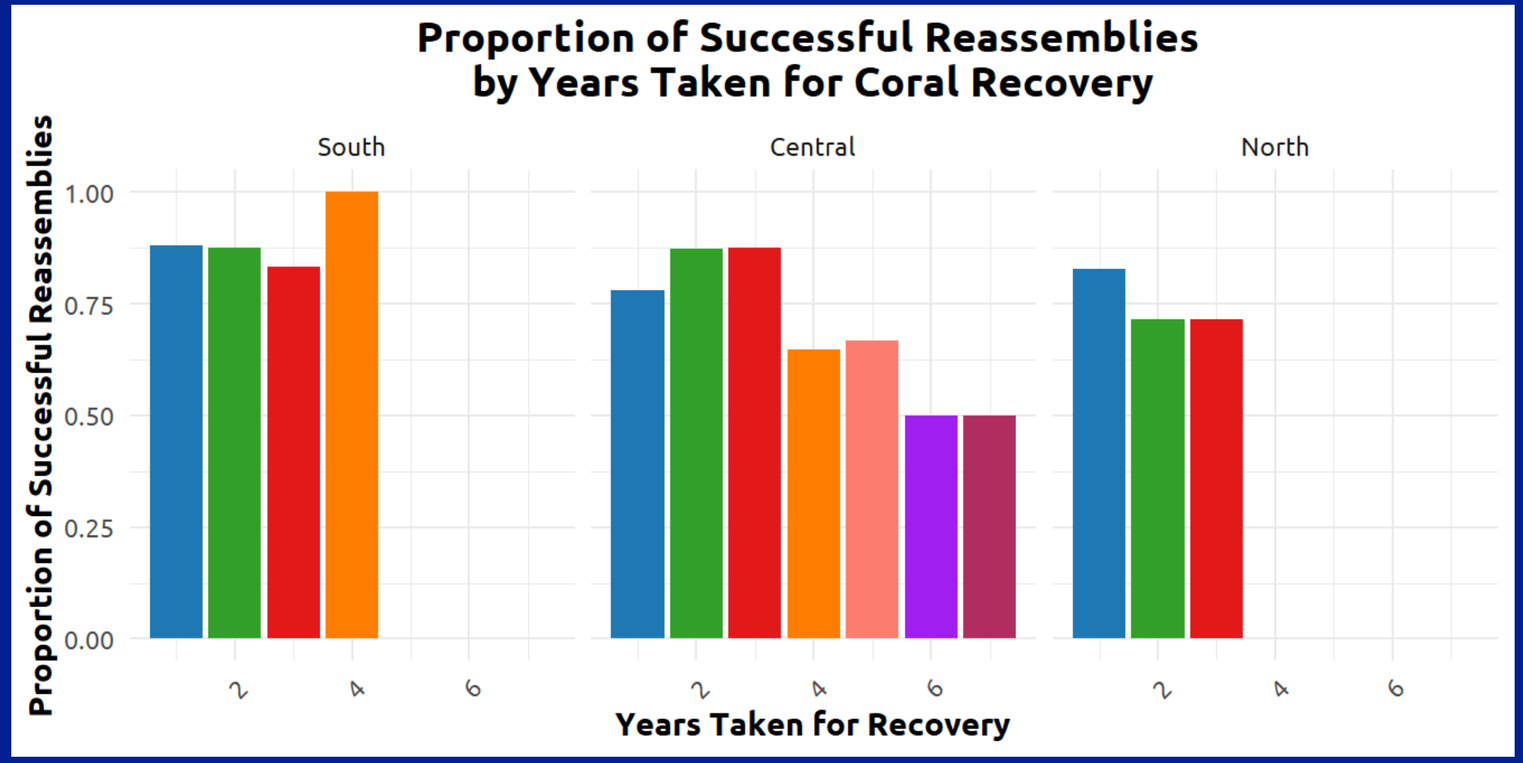
- Median recovery time for most reefs was 1 year.
- Simple morphologies in the Southern and Central regions had the widest distributions.
- All but 3 reefs in the Northern region recovered in 1 year.

# Coral Reassembly Analysis Using Bray-Curtis Similarity

- The average proportion of successful reassemblies across the entire reef system is 0.83.
- By region, the proportion of successful reassembly were 0.88, 0.8 and 0.8 for the Southern, Central and Northern regions, respectively.
- The mean reassembly benchmark was 80% with a range of 70 - 90%.

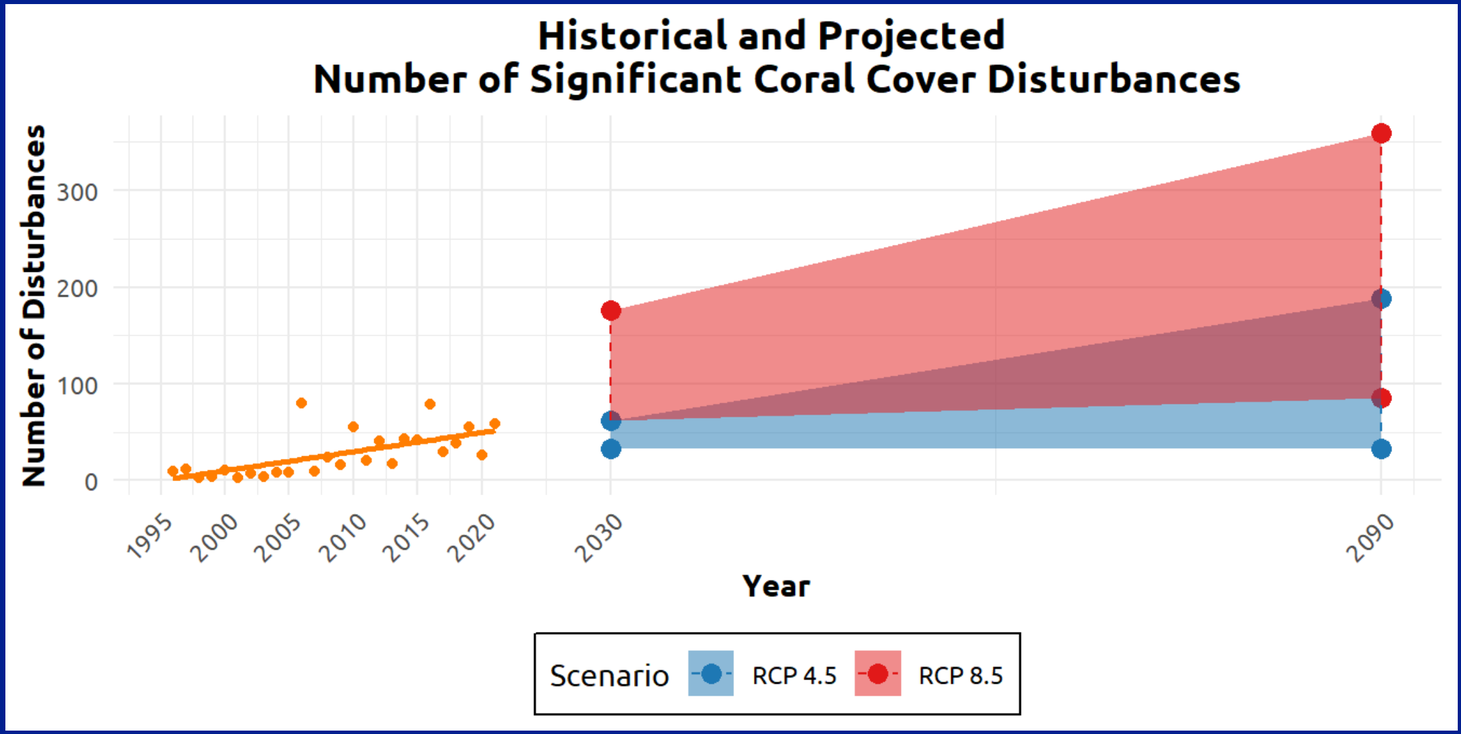
## Logistic Regression

| Effect | Significant (p < 0.05) |
|---|---|
| Number of Recover Years | ✓ |
| Region | ✗ |
| Shelf | ✗ |
| Morphology | ✗ |



# Modelling Coral Cover Disturbances and Sea Surface Temperature

- Generalised additive model
- Best model out of the three fit attempts but relatively poor fit.
  - Explained 21% of the variance.
  - Smooth term not significant.




- Number of significant coral cover disturbances in the GBR is projected to rise under both RCP 4.5 and 8.5 pathways.
- Many reefs historically demonstrated the ability to recover and, to a lesser extent, successfully reassemble to their pre-disturbance states, the increasing frequency and severity of disturbances pose a significant threat to their resilience.

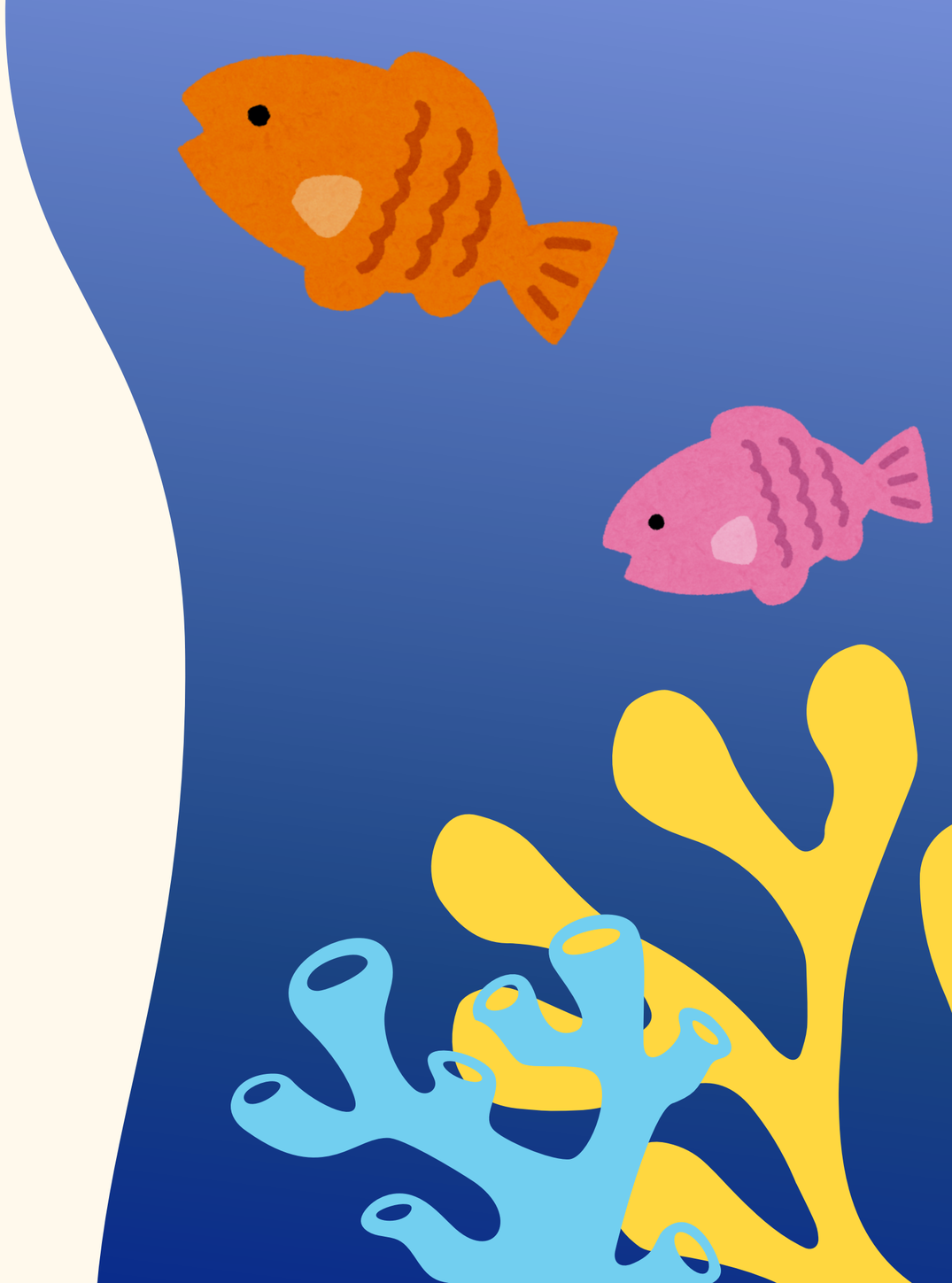
# Conclusion

Need both species and morphological data. Employ ordination technqiues.

Thermal stress is not the only environmental stressor.

Interdiscplinary consultation with marine scientists to isolate specific reefs or communities rather than a broad analysis.

Mapping recovery and reassembly with other biotic agents such as fish populations.



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