Appendix S2 - Supplementary results

Contents

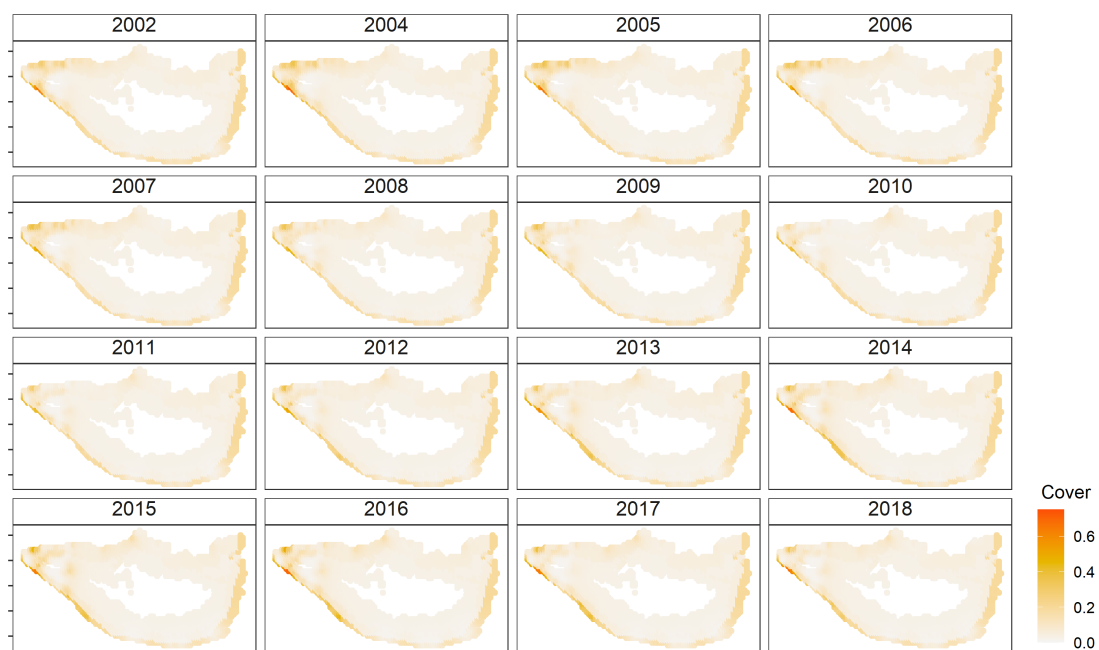# Spatial predictions

Estimated coral cover

Figure S21: Predictions of branching coral cover from 2002-2018 across the entire Heron Reef.
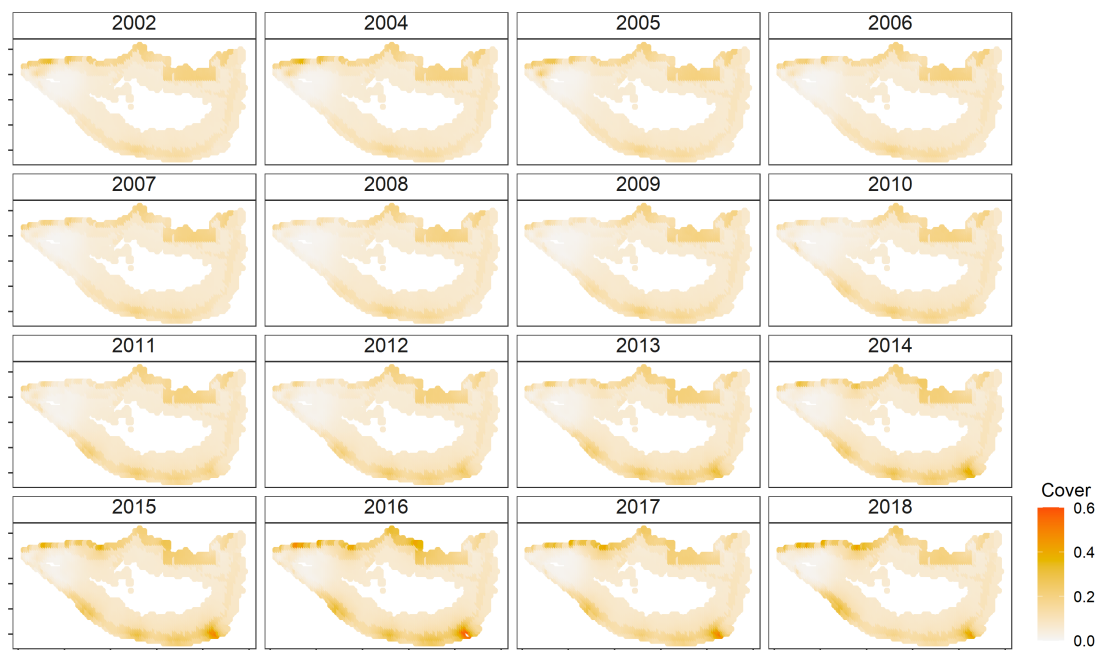
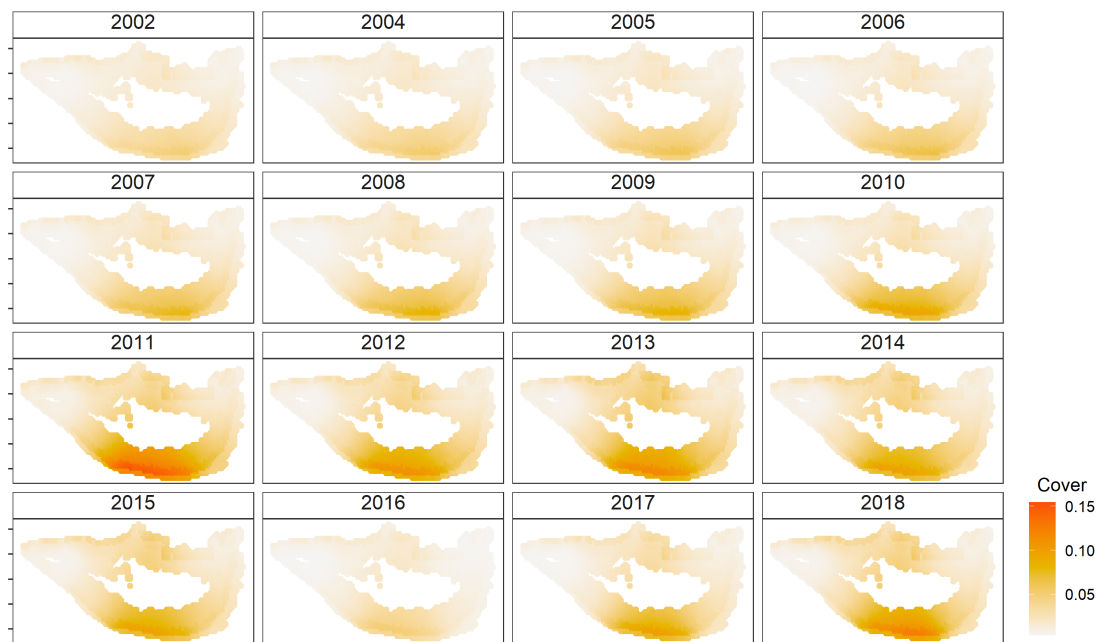Figure S22: Predictions of plate coral cover from 2002-2018 across the entire Heron Reef.

Figure S23: Predictions of massive coral cover from 2002-2018 across the entire Heron Reef.

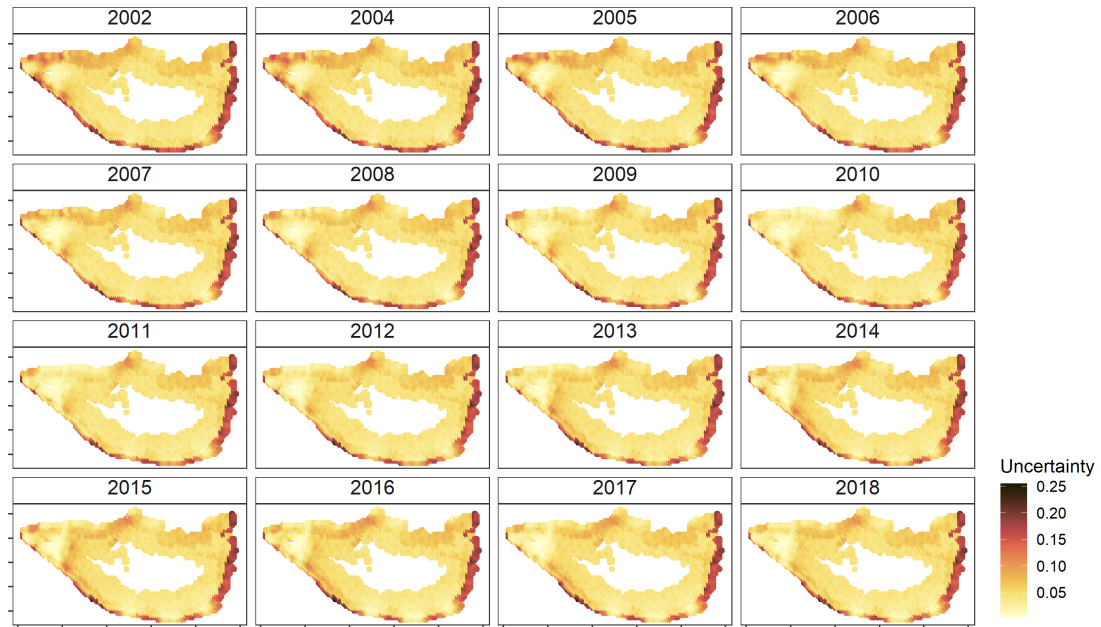Estimated uncertainty in predicted coral cover

Figure S24: Uncertainty associated with the predictions of branching coral cover expressed as the range of the 95% credible intervals.
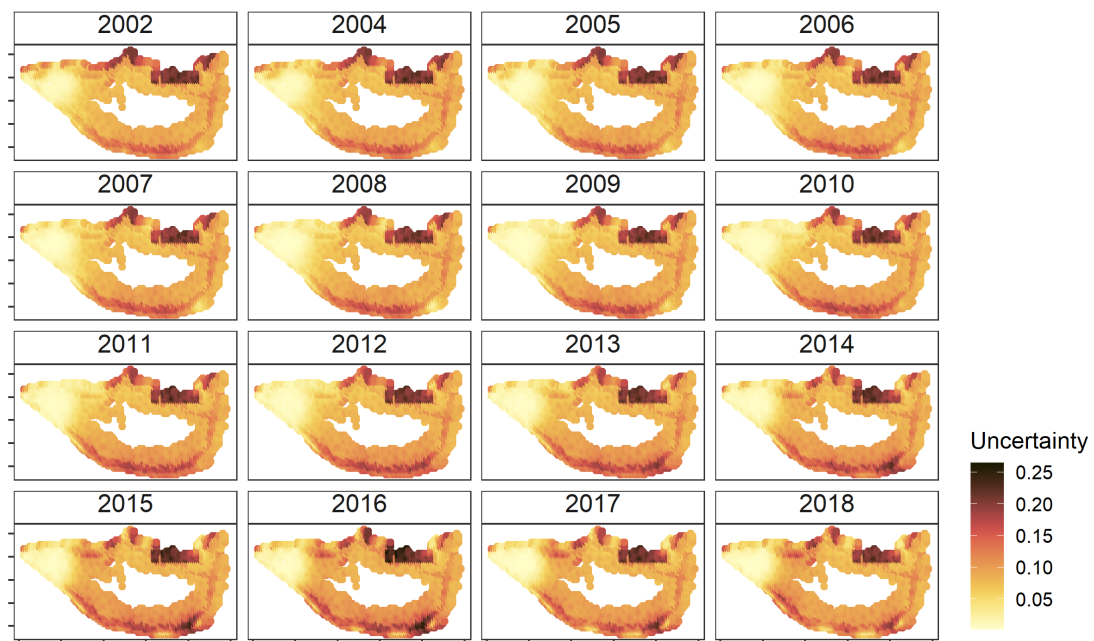
Figure S25: Uncertainty associated with the predictions of plate coral cover expressed as the range of the 95% credible intervals.
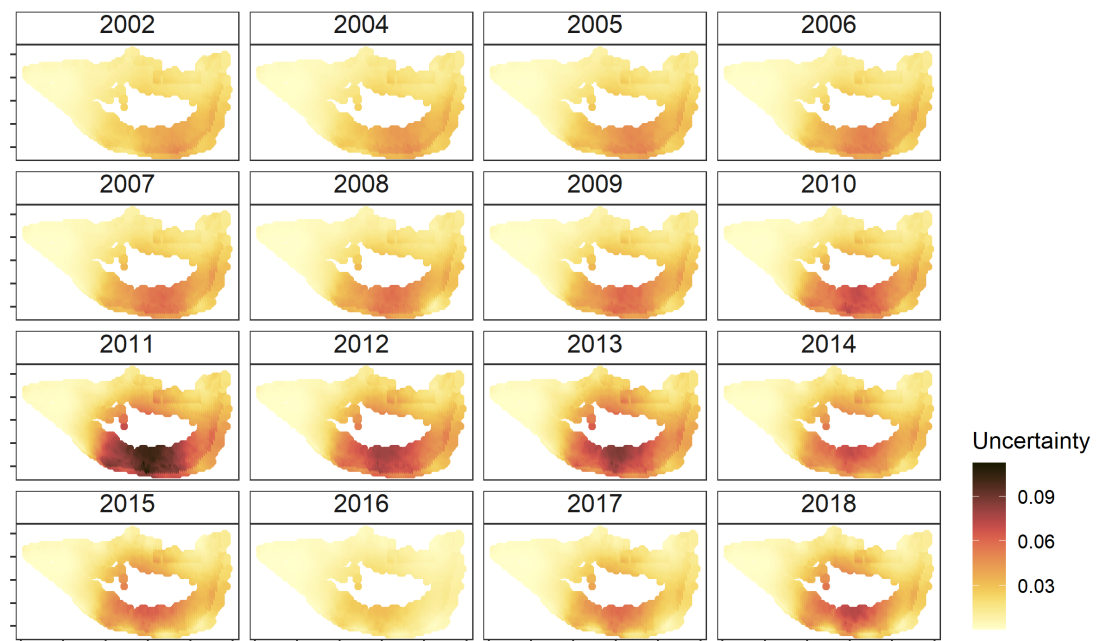
Figure S26: Uncertainty associated with the predictions of massive coral cover expressed as the range of the 95% credible intervals.

Metrics of coral recovery

Figure S27: Probability of branching coral recovery (top panels) and coral growth (bottom panels) across the entire Heron Reef and within the small focus area corresponding to the geographical extent of the data. Probability of recovery is interpreted at this spatial scale to ensure the detection of signals due to a higher uncertainty associated with the spatial predictions at locations further away from the data.
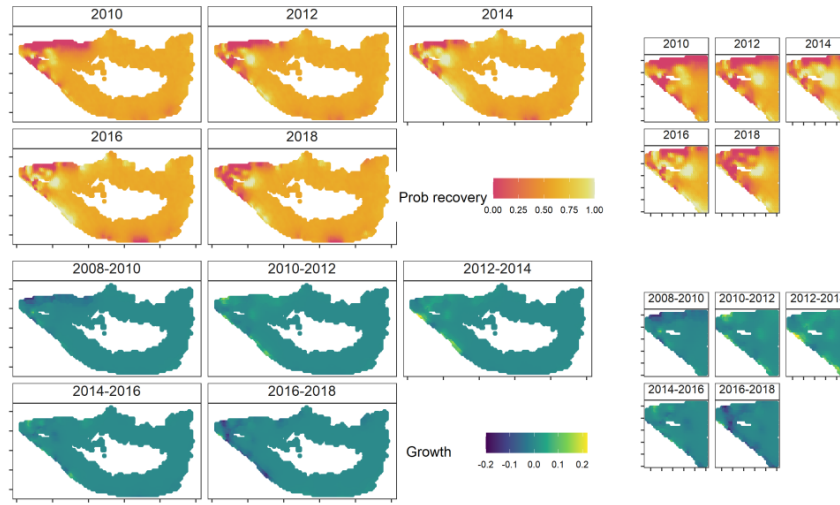
Figure S28: Probability of plate coral recovery (top panels) and coral growth (bottom panels) across the entire Heron Reef and within the small focus area corresponding to the geographical extent of the data. Probability of recovery is interpreted at this spatial scale to ensure the detection of signals due to a higher uncertainty associated with the spatial predictions at locations further away from the data.
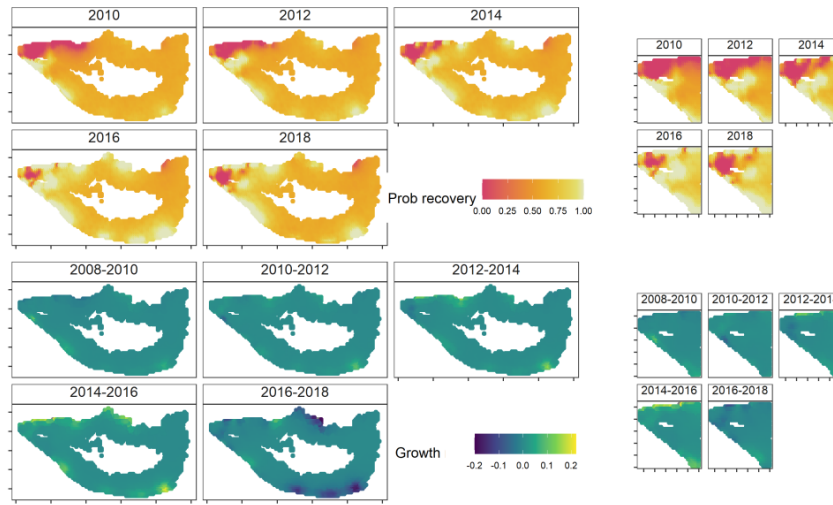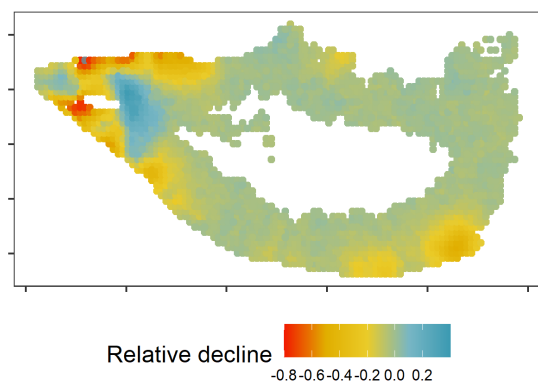
Coral decline

Figure S29: Decline in branching corals across the entire Heron Reef.
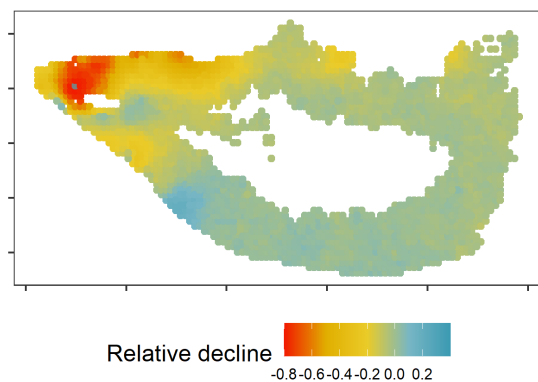

Figure S210: Decline in branching corals across the entire Heron Reef.

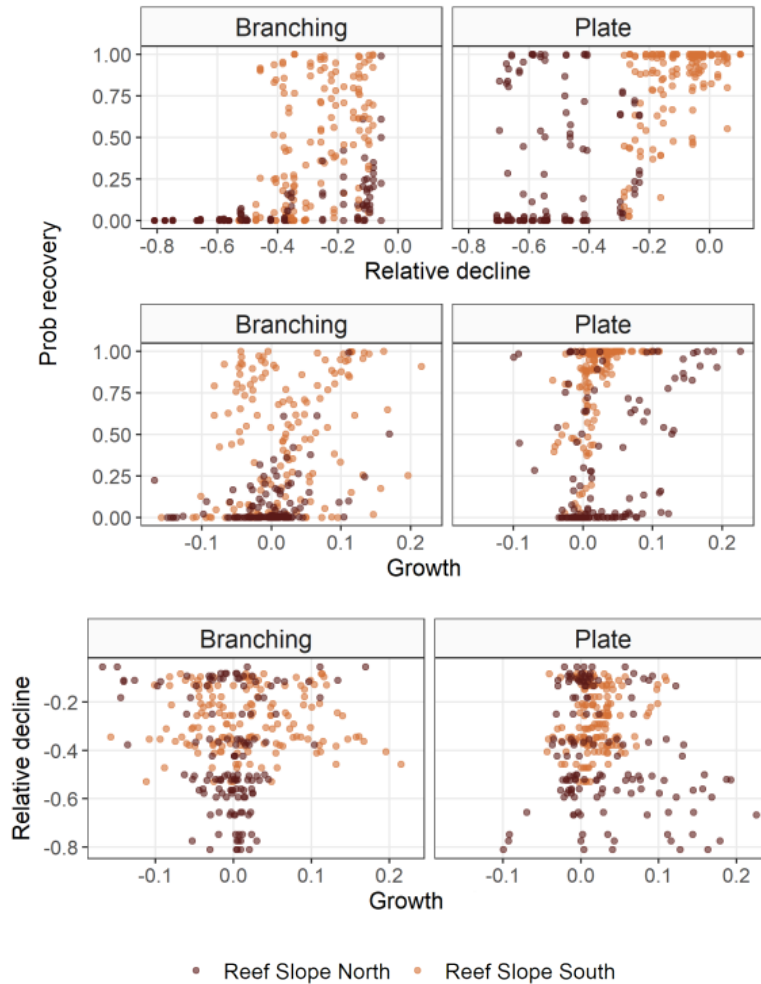Interplay between coral growth, decline and baseline cover

Figure S211: The top panels show the probability of recovery for branching and plate corals situated in reef slope north and south as a function of the decline and growth. These relationships vary according to the the spatial locations and coral types. The bottom panels denote the relationship between decline and growth.
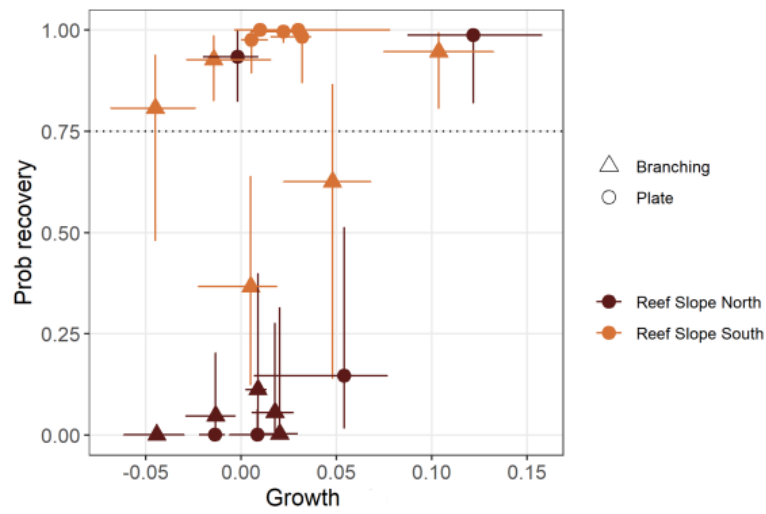
Summary figures

Figure S212: Uncertainty (2.5% and 97.5% quantiles) associated with the point estimates in Figure S13.
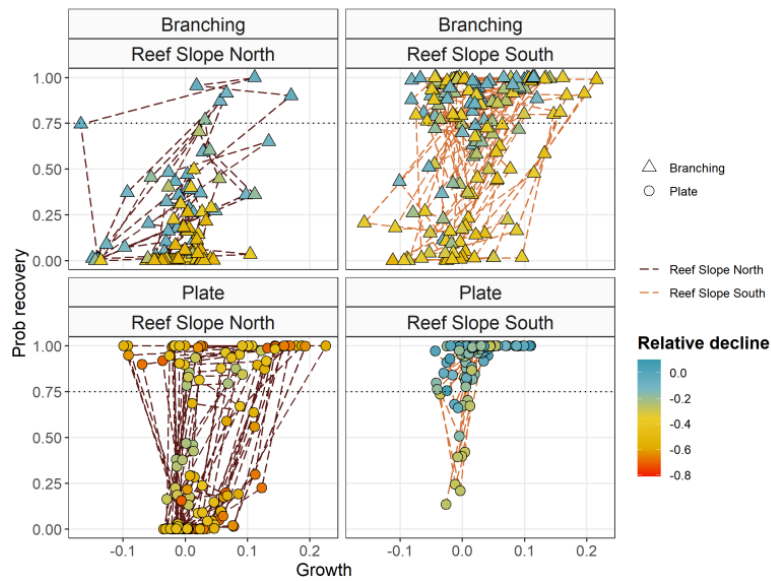

Figure S213: Visualisation of the interplay between the probability of recovery, growth and decline for branching and plate corals at the sub-site scale.

Logistic model

A logistic model was developed to estimate the minimum growth threshold that ensures successful recovery. For each coral form, the probability of recovery was transformed into a binary response with a value of 1 if the probability was greater than 0.75 and zero otherwise. We used specific habitat and year to fit the logistic models assuming that corals within these locations and time were starting the exponential phase of the recovery patterns. We used probability of recovery for the branching corals situated in the south slope in 2014 and plate corals in the north slope in 2016. Figures B13 and B15 have guided this choice.

The models were fitted using the R package "brms" [Bürkner, 2017] with two MCMC chains of a length of 5000 iterations including 1000 used for the warmup. The model validation diagnostics included assessing the following: (1) distribution of the model residuals to ensure that they met the assumption of normality; (2) relationship between the model residuals and predictions to confirm absences of unexplained residual correlations; and (3) posterior predictive fit to ensure that the posterior distributions included observed data.

The model fit is presented in Figure S214. Validation model diagnostics show normally distributed model residuals (Figure S215) and posterior predictive checks show that the model can retrieve the observations (Figure S216). The Bayesian version of R-squared for regression models shows that the model for the branching corals explains 57.9% (39.6 - 63.4%, 95% credible intervals, CI) of the total variation and for the plate corals R^2= 43.0% (13.4 - 55.7%, 95% CI).
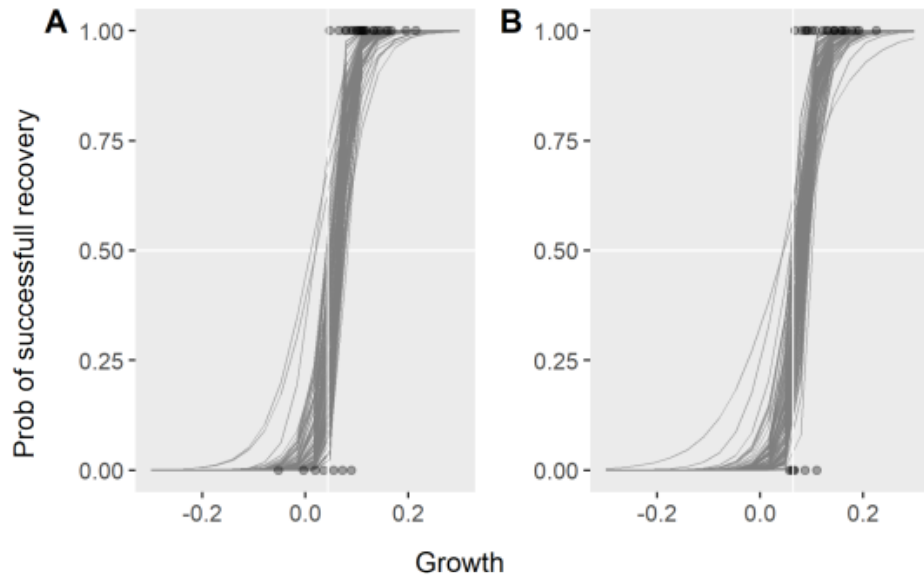
Figure S214: Logistic model fit of the probability of successful recovery using estimated branching growth (A) and plate growth (B) as a predictor. The horizontal white lines show the 50% chance of successful recovery threshold used to determine the growth threshold denoted by the vertical white lines. The dots are the transformed values of the probability of recovery with 1 when the probability was greater than 0.75 and 0 otherwise.
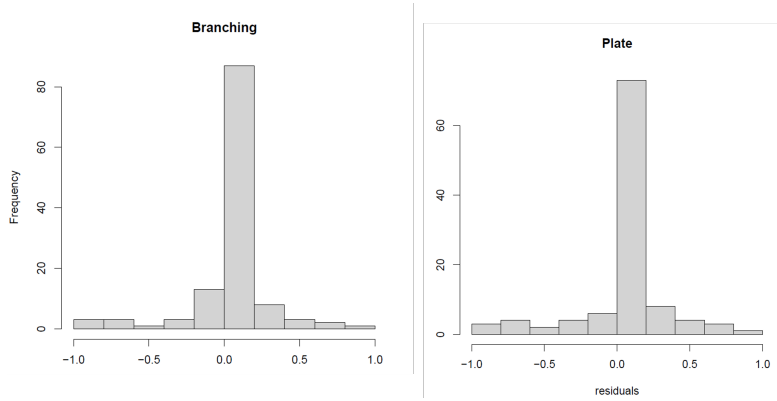

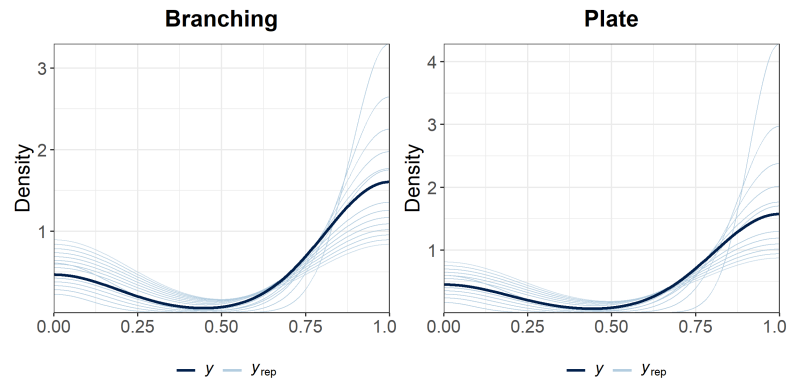Figure S215: Distributions of model residuals.

Figure S216: Posterior predictive check based on 900 draws from posterior distributions.

Bibliography

Paul-Christian Bürkner. brms: An r package for bayesian multilevel models using stan. *Journal of statistical software*, 80:1–28, 2017.