THE EVOLUTION OF PHOTOSYMBIOSIS IN SCLERACTINIAN CORALS

BY

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Abstract

Of the >1600 species of stony corals (Scleractinia), 55% form a nutritional endosymbiosis with photosynthetic dinoflagellates. This 'photosymbiosis' is key to the success of corals forming shallow tropical reefs, yet we still know little of its evolutionary history. Sampling the posterior sets of a comprehensive species-level supertree and molecular tree and fitting hidden-rates models allowing among-lineage variation in the rate of trait evolution, we reconstruct the history of photosymbiosis within Scleractinia and characterize the evolutionary stability of the interaction. The ancestral states of Complexa and Robusta were confidently reconstructed as non-photosymbiotic. Photosymbiosis has been independently gained at least seven times in Robusta and at least five times within Complexa. Almost all photosymbiotic species are found in large clades and are evolutionarily stable for the trait, that is, they show no evidence of loss. Nevertheless, several smaller clades across Scleractinia evince high rates of gains and losses of photosymbiosis. This pattern of variation in the rate of acquisition and reversal suggests that there exist multiple strategies for coexistence between corals and their photosymbionts, ranging from epochal-scale dynamism to irreversibility. This study identifies model taxa for comparative genomic approaches to elucidate the proximate mechanisms governing these broad evolutionary patterns.

Keywords: *scleractinia, photosymbiosis, phylogenetic comparative methods, hidden rates models, ancestral state reconstruction*

Acknowledgements

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Introduction

Symbioses are persistent associations between individuals of different species from which all partners benefit (Douglas, 2010). By combining traits from separate species, symbiosis is an important source of evolutionary novelty (Moran, 2007) and it is now recognized that symbioses are ubiquitous in nature and have played major roles in the history of life (Douglas, 2010). Because symbioses involve interactions between two or more species, it is thought that they may be evolutionarily unstable due to conflicts of interest between participants. Most research has focused on elucidating the mechanisms by which symbioses can form and persist in the face of these conflicts (Douglas, 2010; Herre et al., 1999). However, the evolutionary patterns of symbioses and the evolutionary fates of the participants are less well understood (Sachs and Simms, 2006). How often symbioses evolve and how often they break down—through reversion to autonomy, shifts to parasitism, or extinction of one or both partners—are empirical questions whose answers lie in the evolutionary history of symbiotic systems. Reconstructing the evolutionary history of symbiosis across a wide range of symbiotic systems can shed light on the evolutionary patterns of symbiosis and the factors that underlie them.

Photosymbiosis is a nutritional mutualism between animals and photosynthetic algae or cyanobacteria. The animal host gains access to photosynthetically derived carbon in exchange for providing nutrients and shelter to its algal partner. Photosymbiosis occurs mainly in aquatic animals and has evolved multiple times across a wide range of benthic marine taxa in the phyla Porifera, Cnidaria, and Mollusca (Venn et al., 2008). Photosymbiosis within Cnidaria is most prevalent within the class Anthozoa, which includes ceriantharians, soft corals, gorgonians, anemones, corallimorpharians, and scleractinian corals (Venn et al., 2008). Many photosymbiotic cnidarians, including scleractinian corals, associate with dinoflagellates of the family Symbiodiniaceae (LaJeunesse et al., 2018). These otherwise free-living dinoflagellates are commonly acquired from the surrounding water column although the host transmits them maternally in some cases. The symbionts are hosted intracellularly where they transfer large amounts of photosynthate to their host in exchange for nutrients (Stat et al., 2006; Trench, 1979). By serving as a reliable source of energy, photosymbiosis allows the animal hosts to meet their metabolic needs when external food is limiting. This is dramatically evident among the scleractinian corals. By accelerating the rate of skeleton formation, photosymbiosis allows scleractinians to accrete the massive frameworks of coral reefs, thereby shaping entire ecosystems in tropical, oligotrophic waters.

Of the 1619 species from the demonstrably monophyletic Scleractinia (Fukami et al, 2008; Lin et al., 2016; Kitahara et al., 2014), about 800 are photosymbiotic (Madin et al., 2016). These "zooxanthellate" corals are limited to the photic zone in tropical to sub-tropical waters, where they are the main builders of shallow-water reefs. Over 700 "azooxanthellate" corals do not participate in photosymbiosis and are more widely distributed latitudinally and bathymetrically (Cairns, 2009). A further 12 species of facultatively symbiotic ("apozooxanthellate") corals are photosymbiotic in suitable habitats and non-photosymbiotic in others. This diversity of habit makes Scleractinia a good system with which to study evolutionary patterns of gain and loss of symbiosis. But despite the evolutionary and ecological significance of this trait, the history of photosymbiosis remains obscure. Even with a rich fossil record spanning most of scleractinia's evolutionary history, key gaps in the early record and difficulties in phylogenetically placing fossil specimens continue to hinder our ability to infer the history of photosymbiosis from the geological record alone. Moreover, historical difficulties inferring the evolutionary relationships among extant corals has until recently hindered our ability to reconstruct the evolution of this trait. However, molecular phylogenetic methods have greatly advanced our understanding of coral evolution and we now possess a robust phylogenetic hypothesis for the order, including broad sampling of photosymbiotic and non-photosymbiotic corals. Here, we will use posterior sets of both a 579-species multi-gene molecular phylogeny and a 1471-species supertree phylogeny of Scleractinia to reconstruct the evolutionary history of photosymbiosis within the group to address several key questions.

First, are scleractinians ancestrally photosymbiotic or non-photosymbiotic? The origin of Scleractinia remains unclear. The first unambiguous scleractinians abruptly appear in the fossil record in the mid-Triassic (ca. 240 mya) and display skeletal variation comparable to modern corals (Stanley, 2003). This, combined with molecular clock estimates that place the origin of Scleractinia deep in the Paleozoic (Stolarski et al., 2011), suggests a long evolutionary history which is unrecorded or as yet undiscovered in the geological record. There is evidence that some corals possessed photosymbiosis by the late-Triassic expansion and diversification of corals in reef settings (Frankowiak et al., 2016; Stanley & Swart, 1995). This suggests that photosymbiosis evolved in the Triassic and facilitated the success of corals as reef builders. However, without a well-corroborated record of scleractinian origins, the phylogenetic arrangement of azooxanthellate and zooxanthellate corals forms an important puzzle piece in determining the likely ancestral symbiotic state of the order. The finding that an exclusively azooxanthellate clade diverges basally within the order (Stolarski et al., 2011; Kitahara et al., 2010) has been interpreted as indicating an azooxanthellate ancestor for the order.

This is congruent with the possibility that photosymbiotic corals arose from non-photosymbiotic, deep-water lineages.

Second, how many times has photosymbiosis evolved within Scleractinia and how many times has it been lost? A robust understanding of the phylogenetic relationships between zooxanthellate and azooxanthellate taxa—both extinct and extant—is necessary to answer this question. However, the morphological characters traditionally used to infer evolutionary relationships between fossil and extant corals have been shown to be incongruent with relationships inferred using molecular markers (Budd et al., 2010). While progress is being made in finding informative morphological characters, integrating fossil specimens into a phylogenetic framework remains problematic (Budd et al., 2010; Stolarski & Roniewicz, 2001). Over the last two decades, molecular phylogenetic methods have greatly advanced our understanding of the evolutionary relationships among extant corals. However, early studies had limited taxonomic sampling, especially of azooxanthellate corals. Those that included multiple azooxanthellate species found closely related azooxanthellate and zooxanthellate clades suggesting a lively history of gains and losses (Le Goff-Vitry et al., 2004; Romano & Palumbi, 1996; Romano & Cairns, 2000). Barbeitos et al. (2010) formally reconstructed the evolutionary history of photosymbiosis within Scleractinia using an 80-species tree that included 19 azooxanthellate corals. They found that all azooxanthellate corals were nested within clades inferred to be ancestrally zooxanthellate and concluded that azooxanthellate clades were derived from multiple losses of photosymbiosis. However, they did not sample from the deeply diverging basal clade which may have led to the conclusion that at least some azooxanthellate corals did not descend from zooxanthellate ancestors.

Finally, does the rate of evolution of photosymbiosis vary between different lineages. Most methods of ancestral state reconstruction assume that the rate of evolution is constant across the entire phylogeny. This assumption is unrealistic, especially for large and ancient groups (Beaulieu et al., 2013). It is unlikely that rates of evolution have remained constant over Scleractinia's ~425 million years of evolutionary history (Huang et al., 2018). Furthermore, most photosymbiotic corals are found in large clades that are monophyletic for the trait, but a few smaller clades consist of closely related zooxanthellate and azooxanthellate corals. This suggests that photosymbiosis may be more evolutionarily stable in some clades and more labile in others.

To answer these questions, we will fit "hidden-rates" models (HRMs) that accommodate lineage-specific variation in the rate of trait evolution. We will select among models of evolution that allow for different levels of variability in the rate of trait evolution to determine if the rate of gain and loss of photosymbiosis varies among different lineages. Under the best-fit model, we will then reconstruct the most likely ancestral states at internal nodes of the tree to determine the evolutionary history of photosymbiosis within Scleractinia.

Methods

Phylogenetic trees

We used two sets of phylogenetic trees for our analyses. First, we used a previously published posterior set of 1000 time-calibrated, fully resolved supertree phylogenies of 1547 species and constructed via Matrix Representation with Likelihood (Nguyen et al., 2012; Huang & Roy, 2015). This is the most complete phylogeny for Scleractinia (96% of extant species) and is comprised of a backbone molecular phylogeny of 474 species (based on seven mitochondrial DNA markers), 13 morphological trees, and a taxonomic tree. The posterior supertree set is comprised of 755 zooxanthellate and 700 azooxanthellate species. See Huang (2012) and Huang and Roy (2013, 2015) for a detailed description of the methods used to construct the supertree phylogeny. Due to computational limitations, we randomly sampled 100 trees from the full posterior set.

Because the molecular-source tree for the supertree uses only linked mitochondrial markers, we also used a 579-species molecular phylogeny constructed using both partial mitochondrial DNA (12S rDNA, 16S rDNA, ATP synthase subunit 6, cytochrome c oxidase subunit 1, control region, cytochrome b, and NADH dehydrogenase subunit 5) and partial nuclear DNA (18S rDNA, 28S rDNA, histone H3, internal transcribed spacers and Pax-C 46/47 intron) markers (Kitahara et al., 2016). This set is comprised of 442 zooxanthellate species but only 125 azooxanthellate species, although all three basal-most clades, Complexa, Robusta, and Micrabaciida (= “basal clade” sensu Stolarski et al. 2011), are recovered. Eight Markov chain Monte Carlo (MCMC) runs were conducted in BEAST 2 (Bouckaert et al., 2014). Each chain ran for 50-million iterations and sampled every 1000 iterations to ensure lack of autocorrelation amongst trees. The first 10% of each chain was discarded as burn-in and the rest were combined for a posterior distribution of 360,000 trees. From this set, we randomly sampled 100 trees due to computational limitations.

We then standardized nomenclature across trees using the taxonomy from the World Register of Marine Species (WoRMS) (Horton et al., 2018) accessed via the R (R Core Team, 2018) package ‘worrms’ (Chamberlain, 2018). After pruning synonyms, nomina nuda, and nomina dubia, the 1472 species remained in the supertree posterior set. However, no species needed to be pruned from the molecular posterior set.

Trait data

Each species is scored as being azooxanthellate, obligately zooxanthellate, or facultatively zooxanthellate (Appendix 1, Appendix 2) based on data obtained from the Coral Trait Database (Madin et al., 2016), WoRMS, Cairn's (2008) online appendix of azooxanthellate corals, or the original species description. Five species (*Astreopora acroporina*, *Astreopora cenderwasih*, *Astreopora monteporina*, *Meandrina jacksoni*, and *Stephanocyathus (Stephanocyathus) isabellae*) lacked data on symbiotic state and were pruned from the phylogenies.

Hidden rates models and rate estimation

We used the "hidden-rates" models (HRMs) of Beaulieu et al. (2013) to test if the rate of evolution of photosymbiosis varies throughout the tree. HRMs allow for linage-specific variation in the rate of evolution by partitioning the model into multiple rate categories that can be fit to different parts of the phylogeny. These rate categories are treated as unobserved, or "hidden", states. For an HRM with multiple rate categories, a species in an observed state (such as zooxanthellate) has uniform prior probability of being in each of the unobserved rate categories. Within each rate category there can be unequal transition rates between the binary character states. Transitions can occur between states within a rate category or between rate categories within a given state. Because rates are instantaneous, simultaneous transitions between state and rate categories cannot occur. Biologically, the rate categories can be thought of as correlating with some unobserved trait that affects the rate of evolution of the observed trait. The rate categories are not specified a priori but are estimated from the data, allowing one to identify areas of the tree where evolution proceeds at different rates.

We used the R package corHMM (Beaulieu et al., 2017) to fit HRMs with one to four rate categories (Table 1) to each of the 100 subsampled supertree and molecular phylogenies via maximum likelihood. To broadly sample parameter space, the transition rates for each model were estimated over 100 random restarts. Then we calculated the median value of the estimated transition rates over the subsampled phylogenies. The 95% confidence intervals were calculated by bootstrapping the median 100,000 times. We used the mean Akaike Information Criterion corrected for small sample size (AICc) to assess each model's fit across the subsampled phylogenies.

Table 1. List of hidden rates models with corresponding number of rate classes and parameters.

Model	Number of Rate Classes	Number of Parameters
TH	1	2
HRM+2	2	8
HRM+3	3	14
HRM+4	4	20

Power to distinguish between models

Boettiger at al. (2012) showed that information theoretic criteria can have high error rates when comparing models of evolution, therefore we used their method to assess our ability to select between different models of evolution. This involves simulating trait evolution on a phylogeny using the maximum-likelihood rate estimates from each model, refitting each model to the simulated data, and then performing multiple pairwise comparisons of model fit to each simulated dataset. For a given simulated dataset, model fit is assessed via the likelihood-ratio statistic δ,

$$\delta = -2[lnL(Model\,1) - lnlL(Model\,2)] \qquad \text{(Equation 1)}$$

where *Model 1* has fewer parameters than *Model 2*.

For example, to assess our power to distinguish between the fitted TH and HRM+2 models on a given phylogeny, we first simulated trait data using the transition rates estimated under the simpler (TH) model. We fit the TH and HRM+2 models to the simulated data and calculated δ. Next, we simulated data using the maximum-likelihood transition rates estimated under the HRM+2 model, fit the TH and HRM+2 models to the simulated data, and calculated delta. We repeated this multiple times to construct two distributions of the likelihood ratio statistic. The first distribution is the expected likelihood difference between the two models if a time-homogenous process generated the data. The second is the expected likelihood difference if the HRM+2 model generated the data. Finally, we calculated the observed δ for the models used to generate the data. The position of the observed δ relative to the distribution of δ simulated under the simpler model provides a test of the null hypothesis that the simpler model is true. The overlap of the two simulated distributions approximates the power of the test.

To incorporate the effect of phylogenetic uncertainty on model selection, we performed the simulations across all 100 supertree phylogenies sampled from the posterior. We performed 4 simulations for each tree resulting in 400 total simulations. We performed two pairwise comparisons of models: TH vs. HRM+2, and HRM+2 vs. HRM+3. For both comparisons, we calculated the observed δ using the mean likelihood of each model fit across the 100 phylogenies. If greater than 95% of the null distribution fell below this observed δ, we rejected the null model, *i.e.*, with a probability of a Type I error at $\alpha = 0.05$. To determine the power of this test, we calculated the percent of the alternative distribution that fell below the 95% cutoff value of the null distribution.

Ancestral state reconstruction

To reconstruct the evolutionary history of photosymbiosis and identify areas of the phylogeny with differing rates of evolution, we calculated the marginal probabilities of each state at internal nodes of the supertree and molecular phylogenies using the corHMM package. We also calculated the probability of each extant species being in a particular rate category for its observed trait. We used a flat prior on the root where each state/rate-category combination is equally likely. To incorporate phylogenetic uncertainty, we performed ancestral-state reconstruction for each of the 100 posterior trees, with results summarized as a 95%-consensus tree. For each bifurcating node in the consensus tree, we calculated the mean likelihood of being in each state/rate-category across the corresponding nodes in posterior set. Also, for each extant species, we calculated the mean likelihood of being in each rate-category across the posterior set.

To estimate the minimum number of transitions between states and rate-categories, we used the marginal probabilities at the internal nodes and tips of the phylogeny. We assigned to each tip and internal node the state and rate-category with the highest probability. Then, assuming only one change can occur per branch, we summed the gains and losses of each state and rate-category. This gives the minimum number of transitions over the phylogeny implied by the marginal ancestral state reconstruction. To incorporate phylogenetic uncertainty, we calculated the median number of changes across the posterior set. We calculated 95% confidence intervals by bootstrapping the median 100,000 times.

To estimate the minimum number of gains and losses of photosymbiosis we summed the marginal probabilities for each state across all rate categories. We then assigned each internal node the character state with the highest probability. We again assumed only one change per branch and summed the number of gains and losses of both character states. To incorporate phylogenetic uncertainty, we calculated the median number of changes across the 100 subsampled phylogenies. We calculated 95% confidence intervals by bootstrapping the median 100,000 times.

Sensitivity to state assignment

All facultative corals were found in clades inferred to be in the "Volatile" or "Labile" rate categories. Hence, to determine if facultative corals were driving the rate assignment of these clades, as well as overall model structure, we pruned all facultative species from the phylogenies and re-ran the corHMM analyses for the first three models (TH, HRM+2, and HRM+3).

Results

Supertree: CorHMM analysis

The model that best explains the evolution of photosymbiosis is a hidden-rates model (HRM) with three rate classes (AICc weight of 98.36%; Table 2). The addition of even a single hidden rate category (HRM+2) yielded an increase in log likelihood of 31 units over a time-homogenous (TH) model of evolution (Figure 1) with a ΔAICc of 50 (Figure 2), indicating a strong signal of heterogenous rates. Fitting the HRM+3 yielded an increase in log likelihood of 11 units and ΔAICc of 9 units over the HRM+2. Fitting the HRM+4 only increased the log likelihood by 1 unit and yielded a higher AICc than the HRM+2, so we did not fit an HRM with more rate classes.

Supertree: Power analysis

We first compared the TH model to the HRM+2. We found that 100% of the TH distribution lies below the observed difference in likelihood so we rejected the TH model (Figure 3). Surprisingly, we have fairly low power to distinguish between the TH and HRM+2 models as 56% of the HRM+2 distribution lies below the observed difference in likelihood (Figure 3).

We next compared the HRM+2 model with the HRM+3 model. The entirety of the HRM+2 distribution lies below the observed difference in likelihoods, so we rejected the (HRM+2) (Figure 4). However, we again have low power to distinguish between the two models as 73% of the HRM+3 distribution lies below the observed difference in likelihood. Despite this, we still found that the HRM+3 model fits better than the HRM+2 as measured by AICc.

Table 2. Summary of AICc scores for each model fit to the 100 supertree phylogenies.

Model	Number of Rate Classes	Number of Parameters	Mean AICc	AICc Weight (%)
TH	1	2	336.813	0
HRM+2	2	8	286.587	0.966
HRM+3	3	14	277.339	98.36
HRM+4	4	20	287.306	0.674

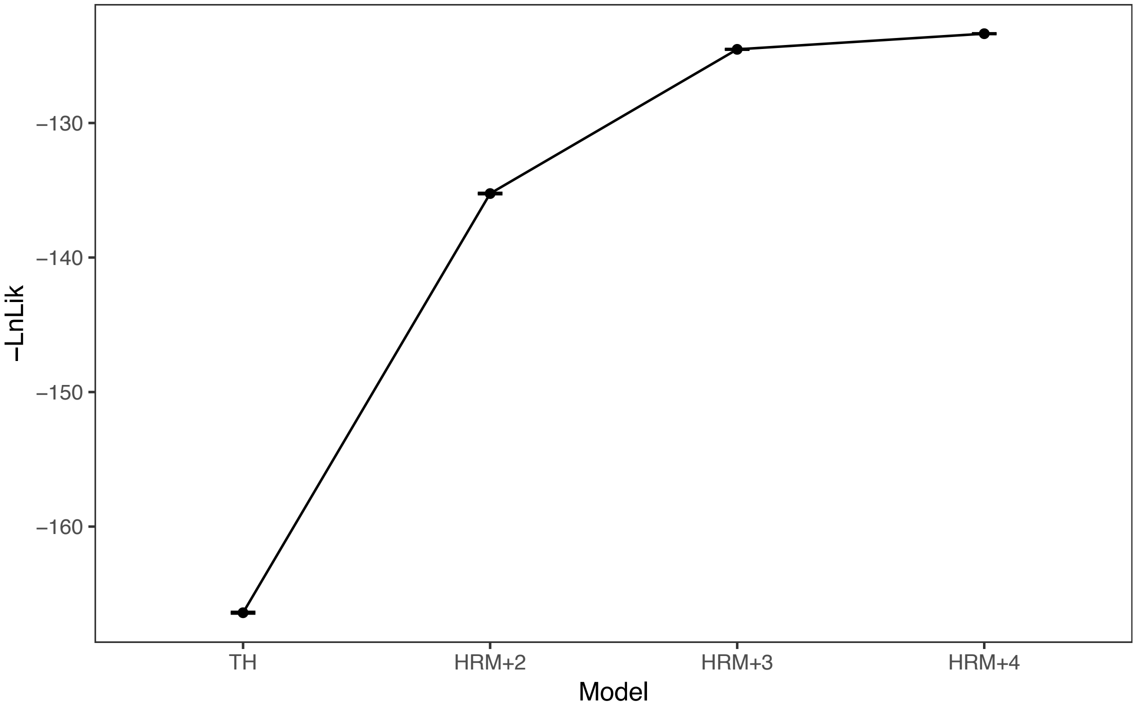

Figure 1. Plot of the mean log-likelihoods for each model fit to 100 supertree phylogenies. Error bars represent the standard error around the mean.

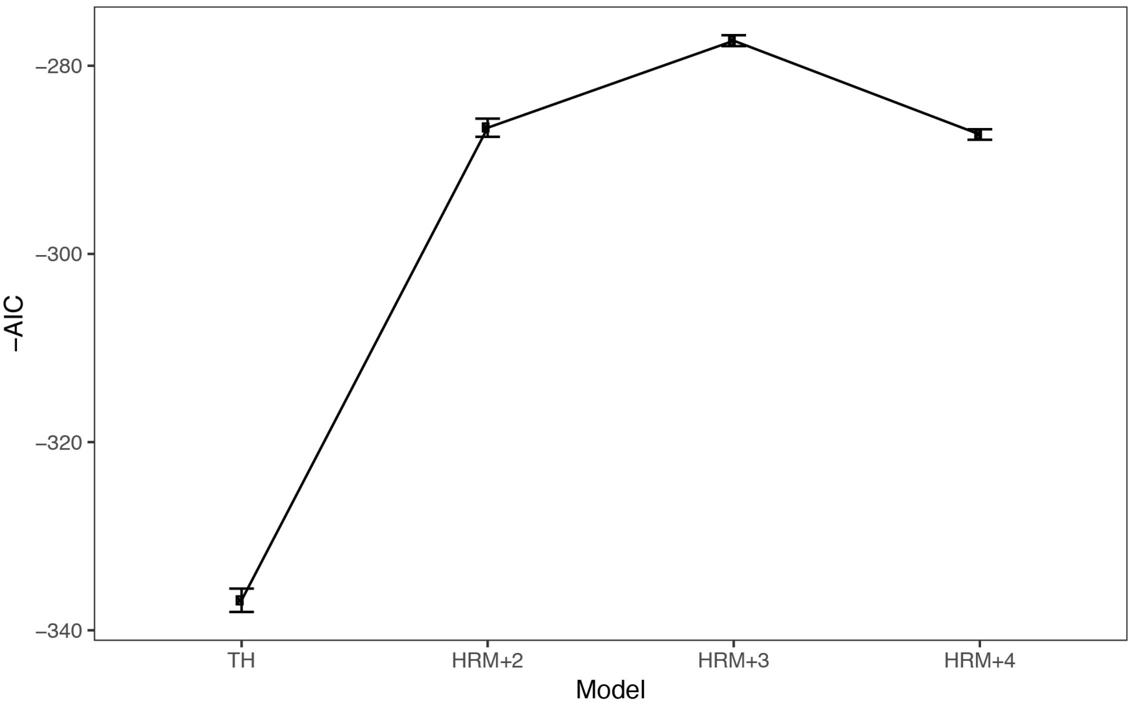

Figure 2. Plot of the mean AICc scores for each model fit to 100 supertree phylogenies. Error bars represent standard error around the mean. AICc scores were multiplied by negative one so model fit improves vertically along the y-axis.

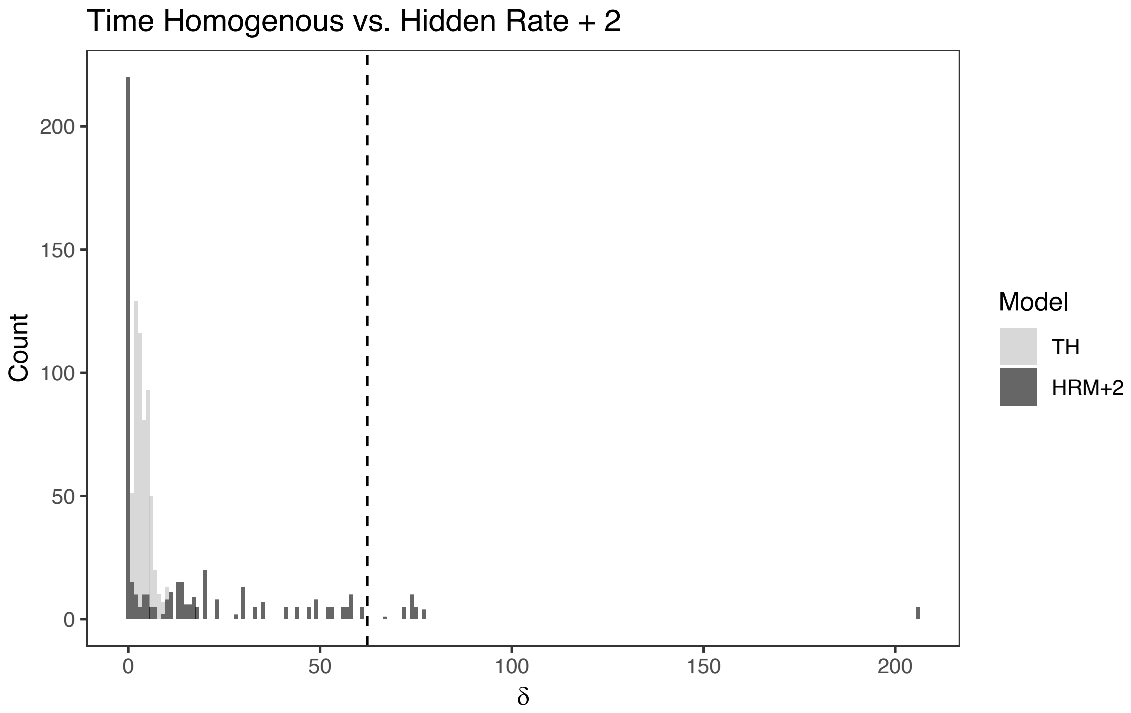

Figure 3. Distribution of the likelihood ratio statistic (delta) of equation (1) for the Time Homogenous (TH) and Hidden Rates Model with two rate categories (HRM+2) fit to 100 supertree phylogenies. The dotted line denotes the observed likelihood ratio statistic.

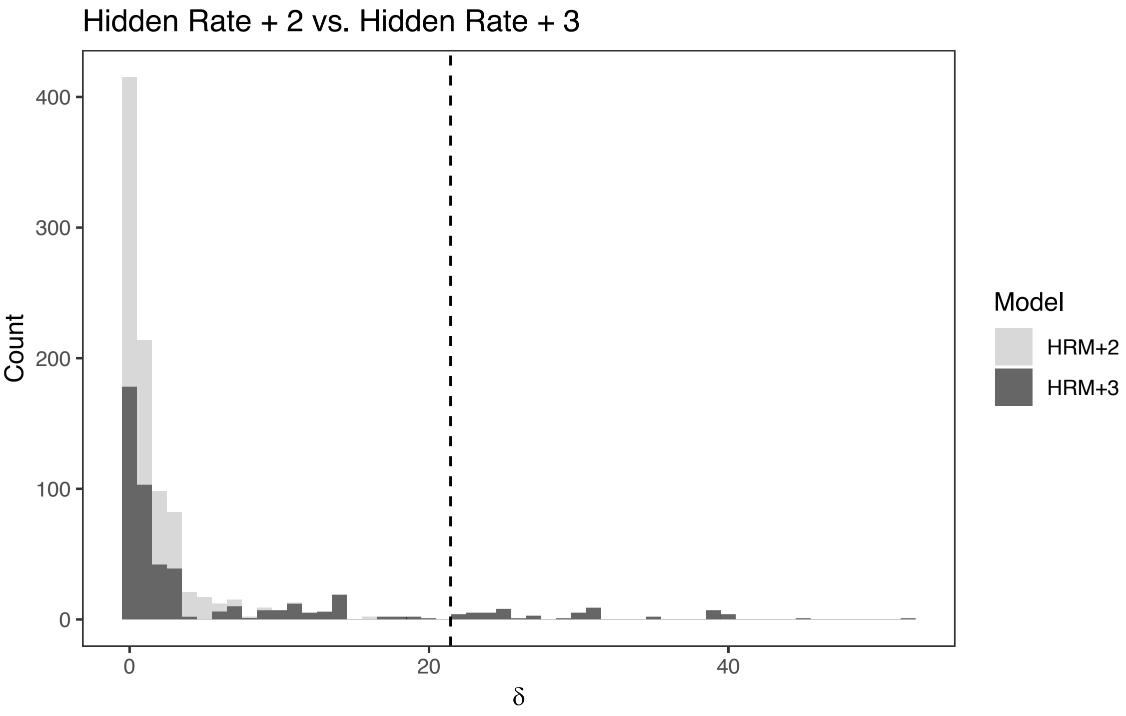

Figure 4. Distribution of the likelihood ratio statistic (delta) of equation (1) for the Hidden Rates Model with two rate categories (HRM+2) and Hidden Rates Model with three rate categories (HRM+3) fit to the 100 supertree phylogenies. The dotted line denotes the observed likelihood ratio statistic.

Supertree: Main features of the best-fit model

Under the HRM+3 model, there are three distinct categories of evolutionary stability of photosymbiosis: a “Stable” category where transitions very rarely, if ever, occur; a “Labile” category where transitions are more likely; and an extremely labile, or “Volatile”, category where transitions are very likely (Figure 5a). Note that in this context stability is a phylogenetic concept and refers to the probability of a lineage retaining a trait over evolutionary time. According to the best-fit model, stable photosymbiosis (Zoox Stable) is never gained directly from the stable azooxanthellate (Azoox Stable) state (Figure 5a). Rather, evolution of photosymbiosis proceeds through the Labile and Volatile categories before settling into the Stable category where symbiosis is seldom, if ever, lost.

Azoox Stable corals first transition into the Azoox Labile rate category. From this Azoox Labile state, stable photosymbiosis can be gained directly, after which it is rarely, if ever, lost. Even so, evolution of photosymbiosis is more likely to proceed from Azoox Labile through the “Volatile” category where transition between states is very rapid. The “Volatile” category appears to be transient and the Zoox Volatile state does not persist long, either reverting back to Azoox Labile or transitioning into the Zoox Stable category after which photosymbiosis is never lost. The Zoox Labile category occupies an odd position within the model and its placement within the model and role in the evolution of photosymbiosis is uncertain and subject to phylogenetic uncertainty (see Phylogenetic Uncertainty section below).

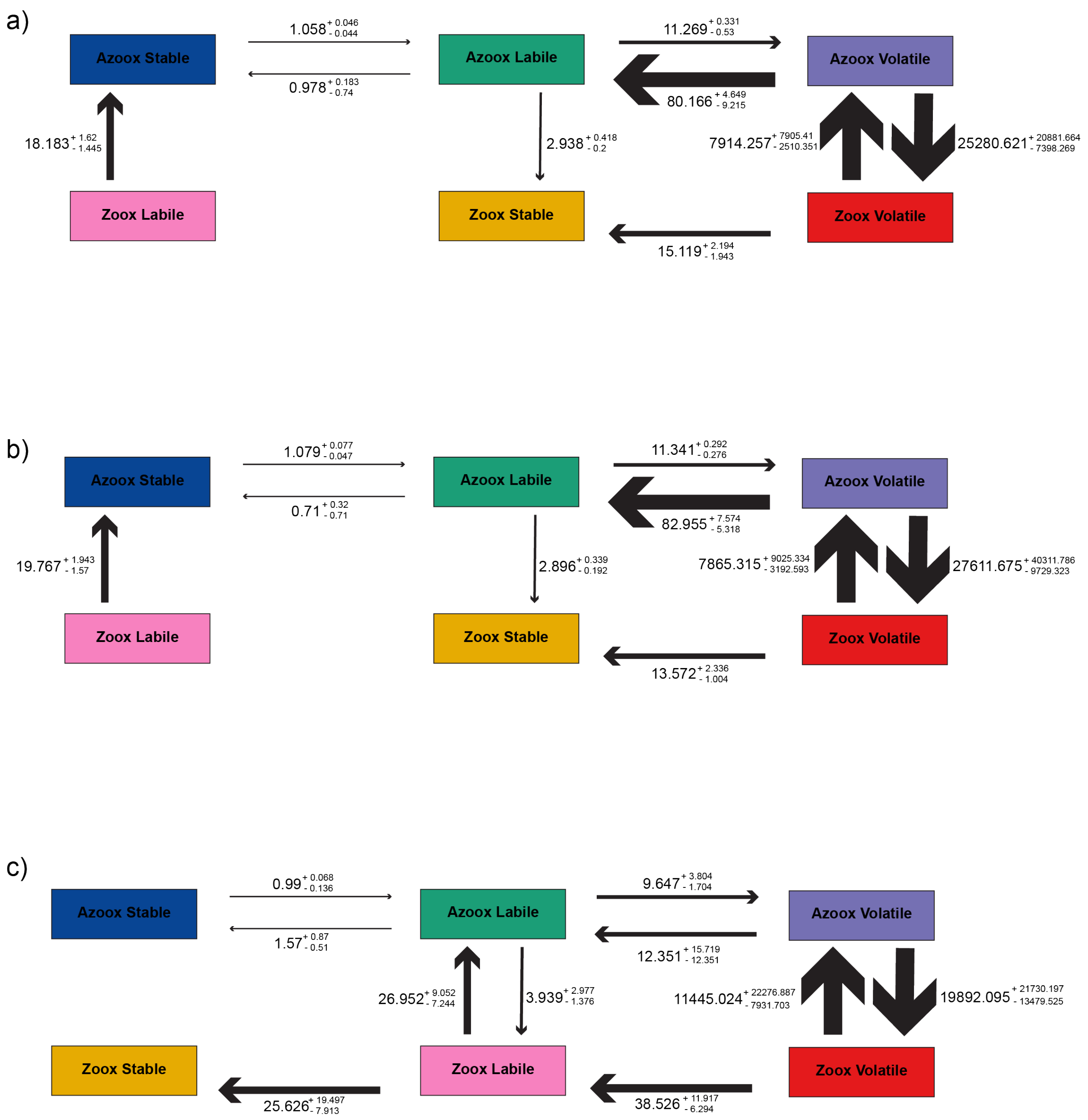

Figure 5. Schematic version of the transition matrix of the Hidden Rates Model with three rate categories (HRM+3) fit to the 100 supertree phylogenies. Transition rates printed here are the median of the transition rates estimated for various subsets of the 100 supertree phylogenies. Errors printed here represent the 95% quantile around the median as estimated via bootstrapping. Median values and errors are multiplied by 1000 to aid interpretation. The width of the arrows corresponds to relative magnitude of the rates. (a) Transition rates as summarized across 100 supertree phylogenies. (b) Transition rates summarized across the 81 supertree phylogenies for which Zoox Labile is not a transitional state in the evolution of photosymbiosis. (c) Transition rates summarized across the 19 trees for which Zoox Labile is a transitional state in the evolution of photosymbiosis.

Supertree: Ancestral state reconstruction

The ancestral state of the order was unable to be confidently reconstructed (Figure 6 and 7). The most likely state at the root of the tree is subject to phylogenetic uncertainty and varies depending on the placement and role of the Zoox Labile state in the model (see Phylogenetic Uncertainty section below). However, the ancestral state of the Complexa/Robusta split was confidently reconstructed as Azoox Stable. The ancestral state of Micrabaciida was also confidently reconstructed as Azoox Stable. Both Complexa and Robusta were confidently reconstructed as ancestrally Azoox Stable. Two large groups retain the ancestral Azoox Stable state; one in Robusta and one in Complexa. The grade in Robusta consists of Anthemiphylliidae, Deltocyathidae, and Caryophylliidae. The clade in complexa consists of Stenocyathidae, Fungiacyathidae, Turbinoliidae, Deltocyathidae, and Flabellidae. We observed relatively few transitions away from the Azoox Stable state (median of 3^{+1}_{-2} transitions away from the Azoox Stable state across the 100 sampled supertree phylogenies; Table 3).

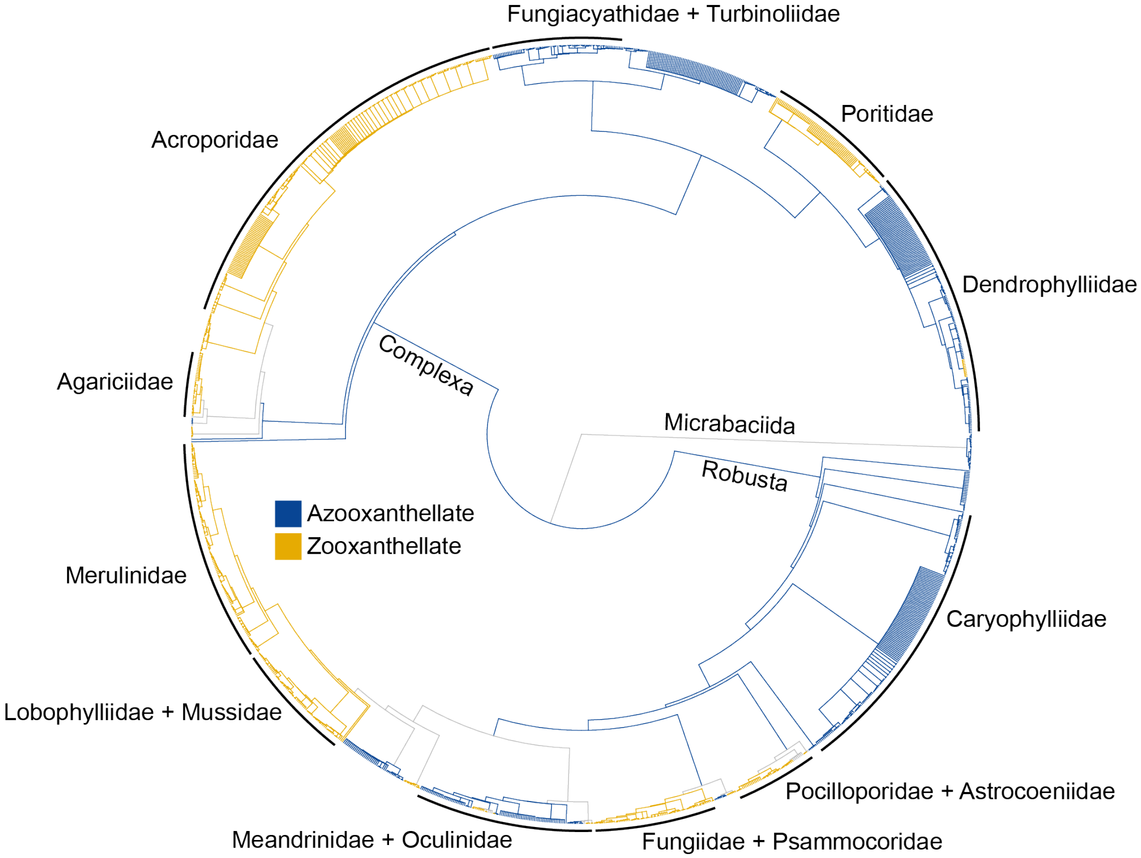

Figure 6. Ancestral state reconstruction of photosymbiosis within Scleractinia inferred across the 100 supertree phylogenies. Phylogeny shown is the 95% consensus tree of all 100 supertree phylogenies used for the analysis. Branches are painted according to the probability of being at either state at each internal node. To calculate the probability at each internal node, each state (Zoox or Azoox) was summed across all rate categories (Stable, Labile, and Volatile) at each node on each of the 100 phylogenies. The mean of each state was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches were painted only if the probability of being in either state was greater than or equal to 75%. Grey branches denote lineages whose ancestral node was less than 75% likely to be in either state.

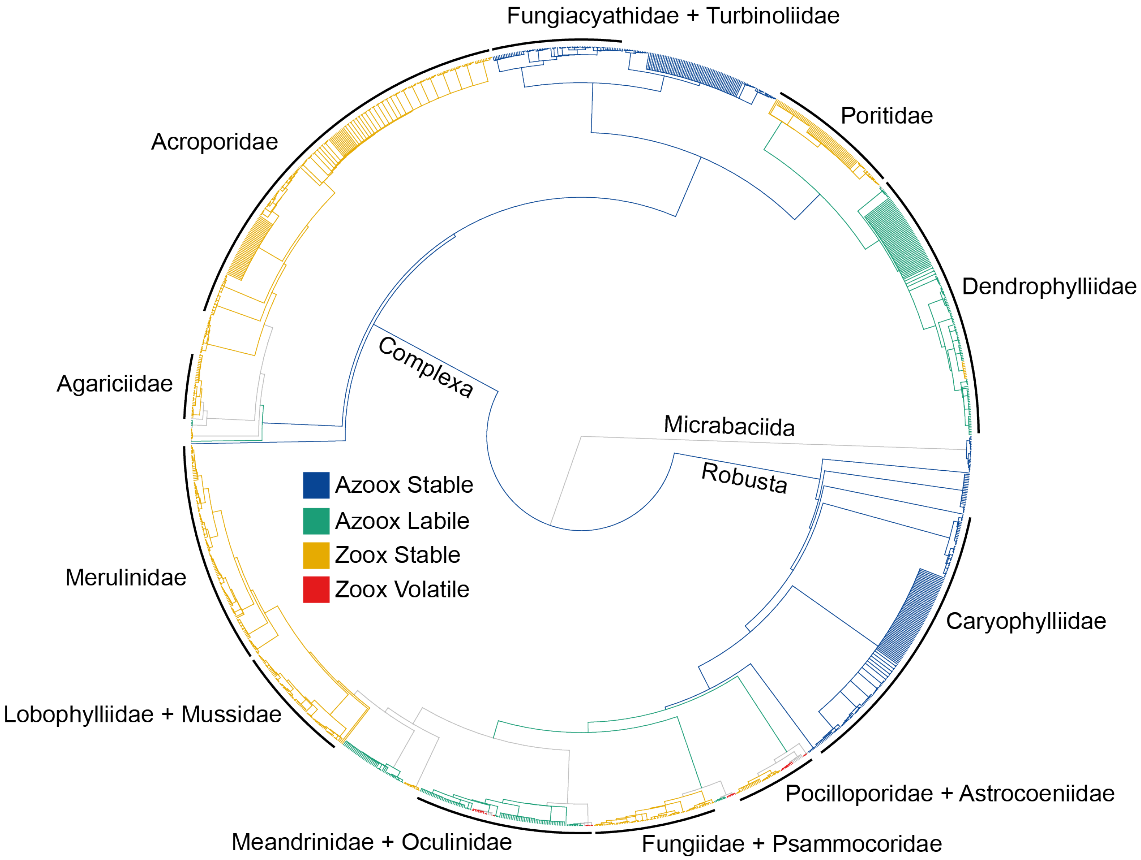

Figure 7. Ancestral state reconstruction of each state/rate-category combination inferred across the 100 supertree phylogenies. Phylogeny shown is the 95% consensus tree of all 100 supertree phylogenies used for the analysis. Branches are painted according to the probability of being in each state/rate-category at each internal node. To calculate the probability at each internal node the mean of each state/rate-category across all 100 supertree phylogenies was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches are painted according to the state that is most likely at each internal node. Grey branches denote uncertainty in the assignment of Zoox or Azoox at internal nodes as calculated for the reconstruction shown in Figure 6. Zoox Labile and Azoox Volatile are not assigned to any internal nodes so they are not shown in the legend.

Table 3. Number of gains and losses of each state/rate-category combination estimated across the 100 supertree phylogenies. Values are the median calculated across all 100 supertree phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Azoox Stable Losses	3^{+0}_{-1}
Azoox Stable Gains	2^{+1}_{-0}
Zoox Stable Losses	0^{+0}_{-0}
Zoox Stable Gains	10^{+0}_{-1}
Zoox Labile Losses	2^{+0}_{-0}
Zoox Labile Gains	0^{+0}_{-0}
Azoox Labile Losses	24^{+0}_{-0}
Azoox Labile Gains	6^{+0}_{-0}
Azoox Volatile Losses	0^{+0}_{-0}
Azoox Volatile Gains	10^{+0}_{-1}
Zoox Volatile Losses	14^{+1}_{-1}
Zoox Volatile Gains	16^{+0}_{-1}

The Azoox Labile state has multiple origins in both Robusta and Complexa (6^{+0}_{-0}) and a high number of losses (24^{+0}_{-0}). Two large clades within Robusta are reconstructed as Azoox Labile, both of which consist mainly of Caryophylliidae. The first clade is largely comprised of *Paracyathus* and *Polycyathus* and also contains Rhizangiidae (*Astrangia* and *Culicia*) while the second clade is mainly comprised of *Monohedotrochus* and *Tethocyathus*. Two small, separate clades that both contain *Phyllangia* and *Rhizosmilia* were also reconstructed as Azoox Labile. Some members of *Madracis* (Pocilloporidae) were also inferred to be Azoox Labile. Within Complexa, the only large clade reconstructed as Azoox Labile is comprised entirely of Dendrophylliidae. *Thalamophyllia*, a small group of Caryophyllids sister to Agariciidae, was also inferred to be Azoox Labile.

Azoox Volatile is not reconstructed confidently at any internal nodes. Only ten species are estimated to be in the Azoox Volatile state (Appendix 1). All ten species represent recent losses of photosymbiosis and are found in clades reconstructed as Zoox Volatile.

The Zoox Stable state has multiple, independent origins in both Robusta and Complexa (10^{+0}_{-1}) and once gained is never lost (0^{+0}_{-0}). Within Robusta, four clades independently gained Zoox Stable. The first is composed entirely of Pocilloporidae. The second consists of Coscinaraeidae, Fungiidae, and Psammocoridae. The third is composed of *Blastomussa*, *Nemenzophyllia*, *Physogyr*a, and *Plerogyra* (incertae sedis). The fourth is comprised of Diploastreidae, Montastreaidae, Lobophylliidae, Mussidae, and Merulinidae. Within Complexa, as many as five clades independently gained Zoox Stable. The first is composed of the Siderastreidae. The second is composed of the Agariciidae. The third is composed of Euphylliidae and Acroporidae. The pattern of gains and losses among these three groups is somewhat uncertain however, so it is possible that all three do not represent derived gains. The fourth gain is the Poritidae and the fifth is *Turbinaria* within the Dendrophylliidae.

No extant species are inferred to be in the Zoox Labile state (Appendix 1) nor are any internal nodes reconstructed confidently as Zoox Labile. The placement of the Zoox Labile state in the model, its role in the evolution of photosymbiosis, and its reconstruction in the phylogeny are subject to phylogenetic uncertainty (see Phylogenetic Uncertainty section below).

Zoox Volatile has been gained 16^{+0}_{-1} times and lost 14^{+1}_{-1} times. Very few extant species are estimated to be Zoox Volatile (Appendix 1). The Zoox Volatile state occurs in only a few small clades that represent recent gains of photosymbiosis. Within Robusta five small clades are reconstructed as Zoox Volatile. The first consists entirely of Astrocoeniidae. The second is composed of *Madracis* and *Palauastrea*, which are sister to the Zoox Stable members of the Pocilloporidae. The third consists of *Oulastrea* and *Heterocyathus*. The fourth is composed entirely of Meandrinidae. The fifth is comprised entirely of Oculinidae. Within Complexa there are only a few scattered species inferred to be Zoox Volatile. These include *Stephanocoenia intersepta* (Astrocoeniidae), *Helioseris cucullata* (Agariciidae), and five species within Dendrophylliidae: *Balanophyllia (Balanophyllia) europaea*, *Duncanopsammia axifuga*, *Dichopsammia granulosa*, and two species of *Heteropsammia*. Notably all facultative species are inferred to be Zoox Volatile (Appendix 1), with *Dichopsammia granulosa* being the only possible exception with a probability of only ~64% of being in the Volatile rate category. All facultative corals are found in clades reconstructed as Zoox Volatile with the exception of

Dichopsammia granulosa and *Astrangia Poculata* which are found in Azoox Labile clades.

When each state (Azoox and Zoox) is summed across rate categories (Stable, Labile, Volatile), photosymbiosis has been gained an estimated 25_{-1}^{+0} times and lost an estimated 14_{-1}^{+0} times (Table 4).

Table 4. Number of gains and losses of photosymbiosis estimated across the 100 supertree phylogenies. Values are the median calculated across all 100 supertree phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Zoox Losses	14^{+0}_{-1}
Zoox Gains	25^{+0}_{-1}

Supertree: Phylogenetic uncertainty

Phylogenetic uncertainty does lead to differences in the results across the 100 subsampled phylogenies and these results fall into two distinct categories (Figure 5: b and c). The main difference between the two results is the relative placement and role of the Zoox Labile category within the model.

Across 81 phylogenies, Zoox Labile can transition directly into Azoox Stable after which Zoox Labile is never regained (Figure 5b). The ancestral state of the order is uncertain across these 81 phylogenies and the likelihood is split roughly equally between Azoox Stable and Zoox Labile with a slight preference for Zoox Labile. Figure 8 shows the ancestral state reconstructions for 4 of these 81 phylogenies. In most of the them, only the root is reconstructed as Zoox Labile (such as the leftmost two trees in Figure 8). However, in 12 of the 81 phylogenies, the Agariciidae is reconstructed as Zoox Labile (such as the rightmost two trees in Figure 8). In these 12 phylogenies, transitions from Zoox Stable to Zoox Labile can happen rarely after which photosymbiosis is quickly lost. In these 12 trees, the likelihood at the root is again split between Azoox Stable and Zoox Labile but with a slight preference for Azoox Stable.

Across 19 of the 100 phylogenies, Zoox Labile is a transitional state in the evolution of stable photosymbiosis (Figure 5c). Transitions can occur between Zoox Labile and Azoox Labile. Zoox Labile is equally likely to transition into Azoox Labile and Zoox Stable, but if a transition to Zoox Stable occurs the trait is never lost. Figure 9 shows the ancestral state reconstructions for 4 of these 19 phylogenies. Zoox Labile plays a more obvious transitional role in these reconstructions as its evolution generally precedes the evolution of Zoox Stable.

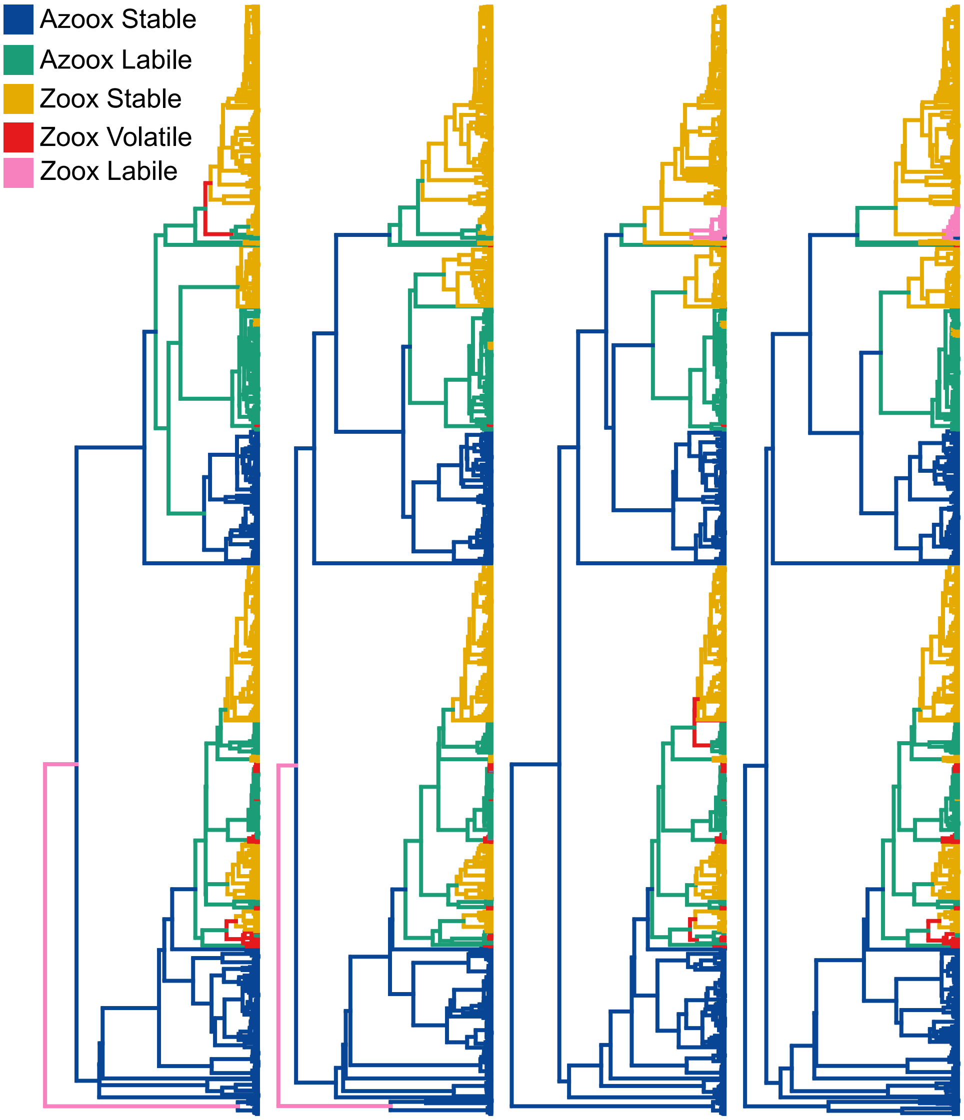

Figure 8. Individual ancestral state reconstructions of state/rate-category on a subsample of the 81 supertree phylogenies that correspond to the rate diagram in Figure 5b. Branches are colored according to the most likely state at their ancestral node.

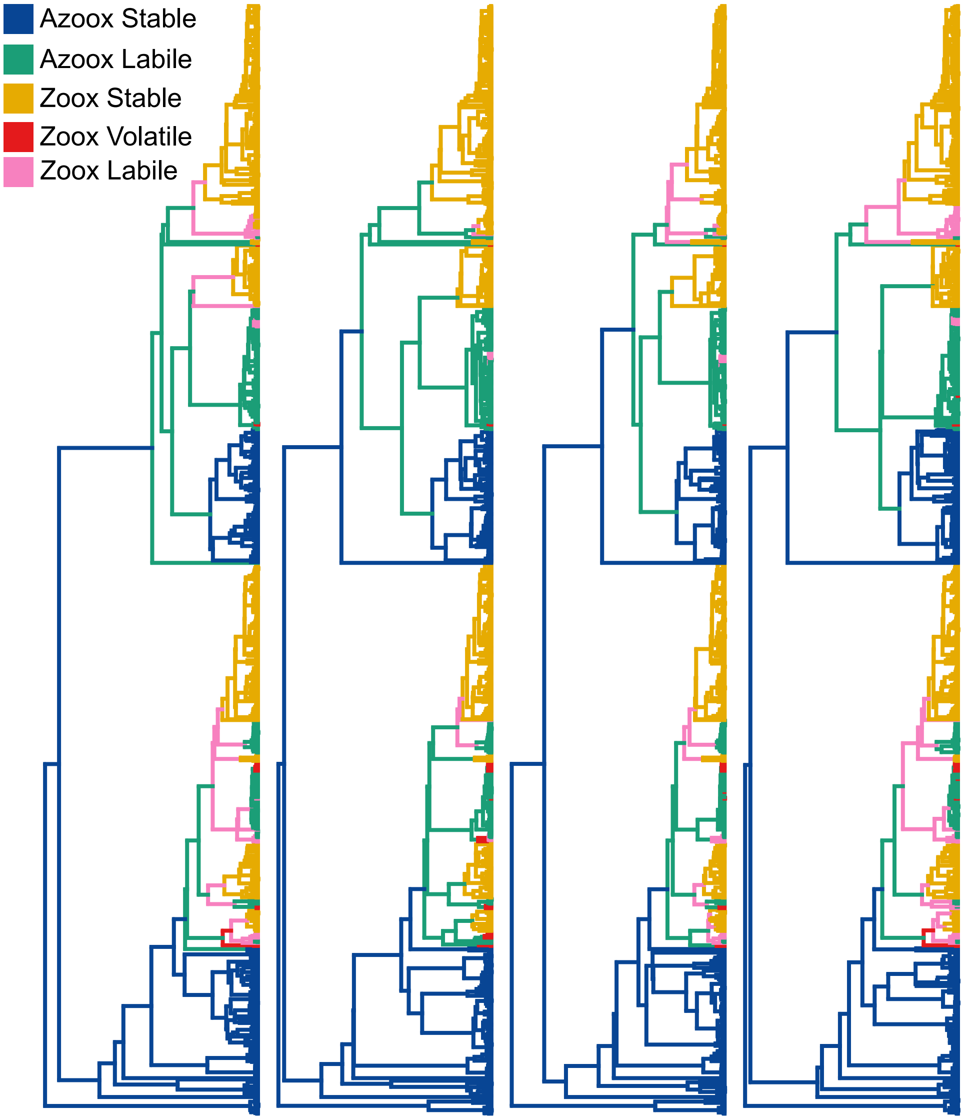

Figure 9. Individual ancestral state reconstructions of state/rate-category on a subsample of the 19 supertree phylogenies that correspond to the rate diagram in Figure 5c. Branches are colored according to the most likely state at their ancestral node.

Supertree: Facultative corals removed

Removing facultative corals from the supertree did not significantly alter the results. The model that best explains the evolution of photosymbiosis is still the HRM+3 (AICc weight of 51.7%; Table 5). However, the difference in log-likelihoods and AICc scores between the HRM+3 and HRM+2 is not nearly as pronounced and they fit the data almost equally well (Figure 10 and Figure 11).

The overall model structure of the HRM+3 when facultative corals are removed is identical to when they are retained in the phylogeny and the rate estimates are very similar (Figure 12). The largest difference in rates occurs in the Volatile rate category which is not surprising as there are fewer data point within the small Volatile clades with which to estimate the rates.

There are slightly fewer estimated gains and losses of photosymbiosis (Table 6) when facultative corals are removed but the broad patterns of gains and loss of photosymbiosis found by ancestral reconstruction remain the same (Figure 13 and 14). The number of gains and losses of state/rate-category combinations are similar as are the ancestral state reconstructions (Table 7). We found the same clades to be in the same rate categories including, most notably, the Volatile clades which contain almost all of the facultative corals.

Table 5. Summary of AICc scores for each model fit to the 100 supertree phylogenies with facultative corals pruned.

Model	Number of Rate Classes	Number of Parameters	Mean AICc	AICc Weight (%)
TH	1	2	275.779	0
HRM+2	2	8	244.378	48.289
HRM+3	3	14	244.241	51.711

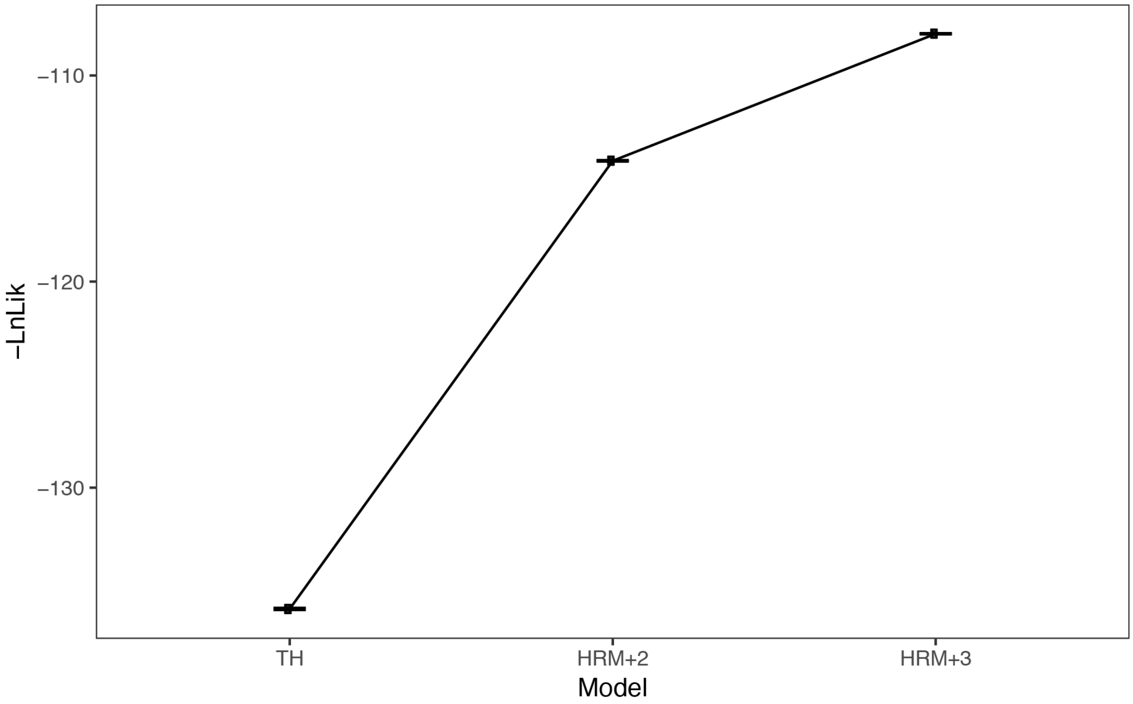

Figure 10. Plot of the mean log-likelihoods for each model fit to the 100 supertree phylogenies with facultative corals pruned. Error bars represent the standard error around the mean.

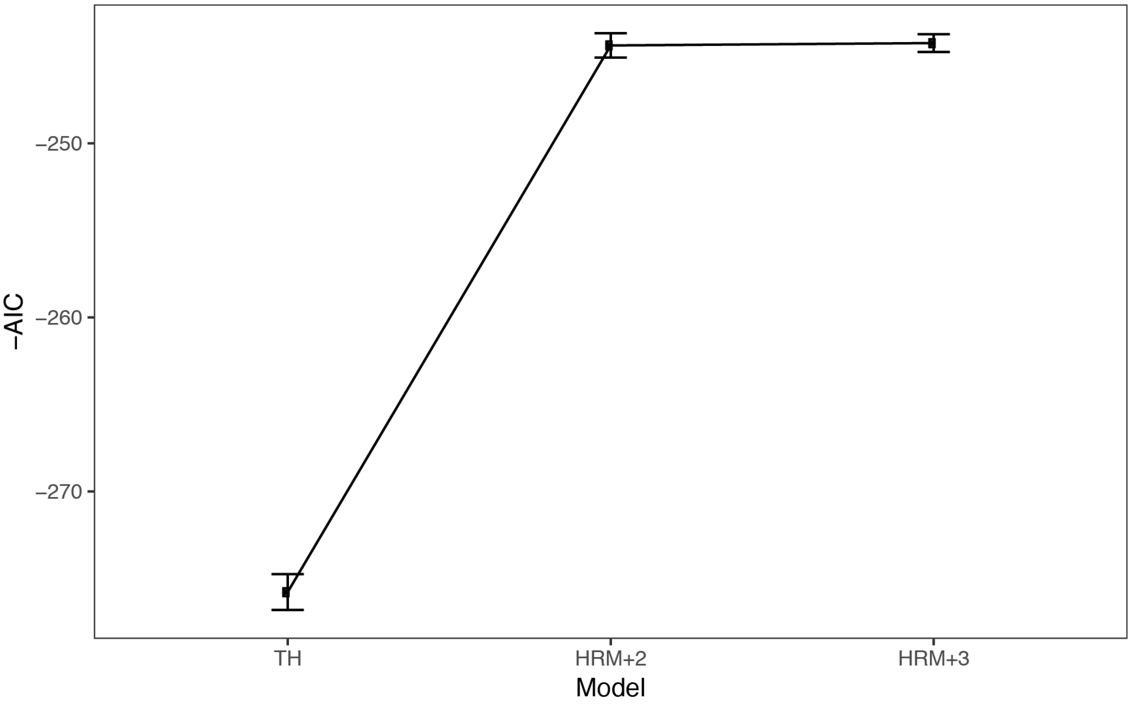

Figure 11. Plot of the mean AICc scores for each model fit to the 100 supertree phylogenies with facultative corals pruned. Error bars represent standard error around the mean. AICc scores were multiplied by negative one so model fit improves vertically along the y-axis.

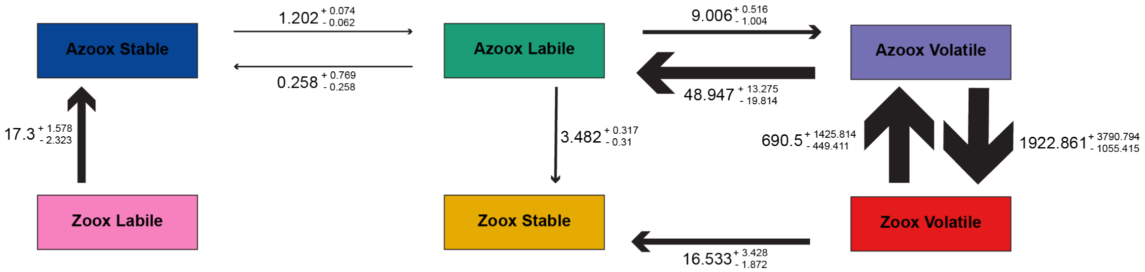

Figure 12. Schematic version of the transition matrix of the Hidden Rates Model with three rate categories (HRM+3) fit to the 100 supertree phylogenies with facultative corals pruned. Transition rates printed here are the median of the transition rates estimated for the 100 supertree phylogenies. Errors printed here represent the 95% quantile around the median as estimated via bootstrapping. Median values and errors are multiplied by 1000 to aid interpretation. The width of the arrows corresponds to relative magnitude of the rates.

Table 6. Number of gains and losses of photosymbiosis estimated across the 100 supertree phylogenies with facultative corals pruned. Values are the median calculated across all 100 supertree phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Zoox Losses	10^{+0}_{-1}
Zoox Gains	22^{+1}_{-0}

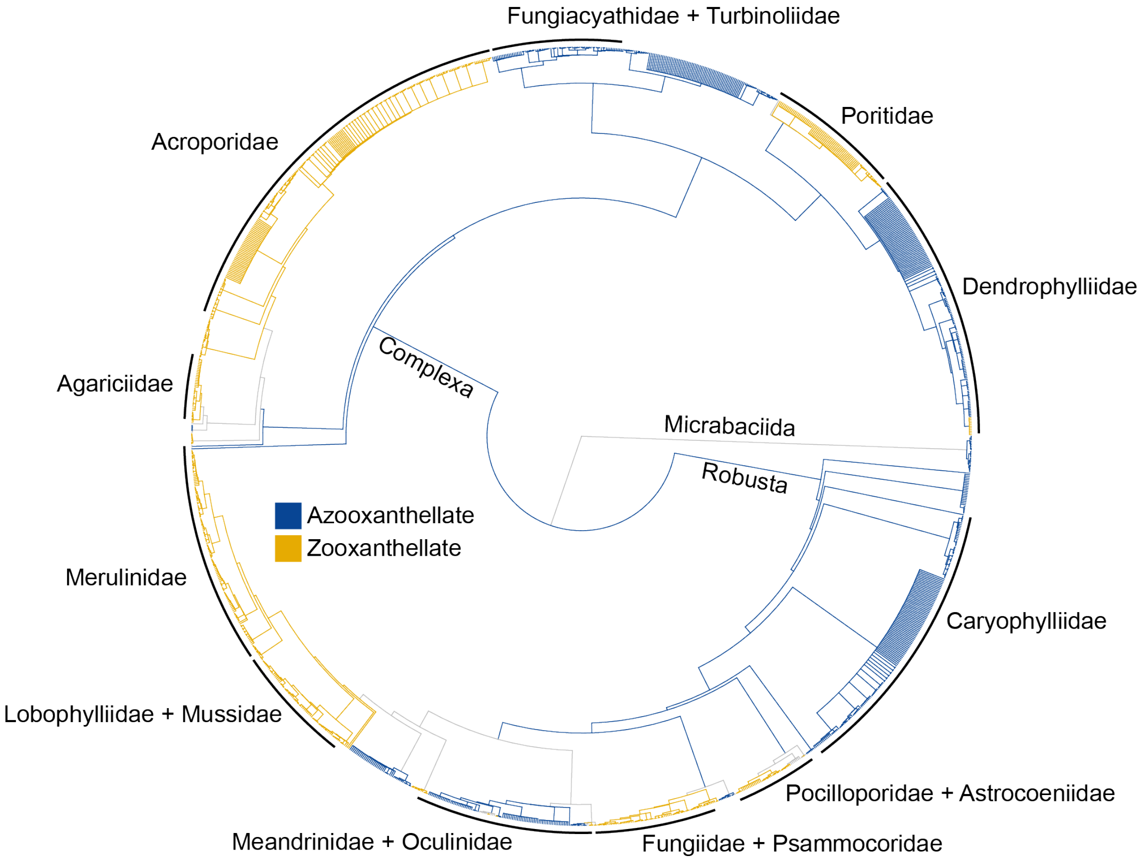

Figure 13. Ancestral state reconstruction of photosymbiosis within Scleractinia inferred across the 100 supertree phylogenies with facultative corals pruned. Phylogeny shown is the 95% consensus tree of all 100 supertree phylogenies used for the analysis. Branches are painted according to the probability of being at either state at each internal node. To calculate the probability at each internal node, each state (Zoox or Azoox) was summed across all rate categories (Stable, Labile, and Volatile) at each node on each of the 100 phylogenies. The mean of each state was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches were painted only if the probability of being in either state was greater than or equal to 75%. Grey branches denote lineages whose ancestral node was less than 75% likely to be in either state.

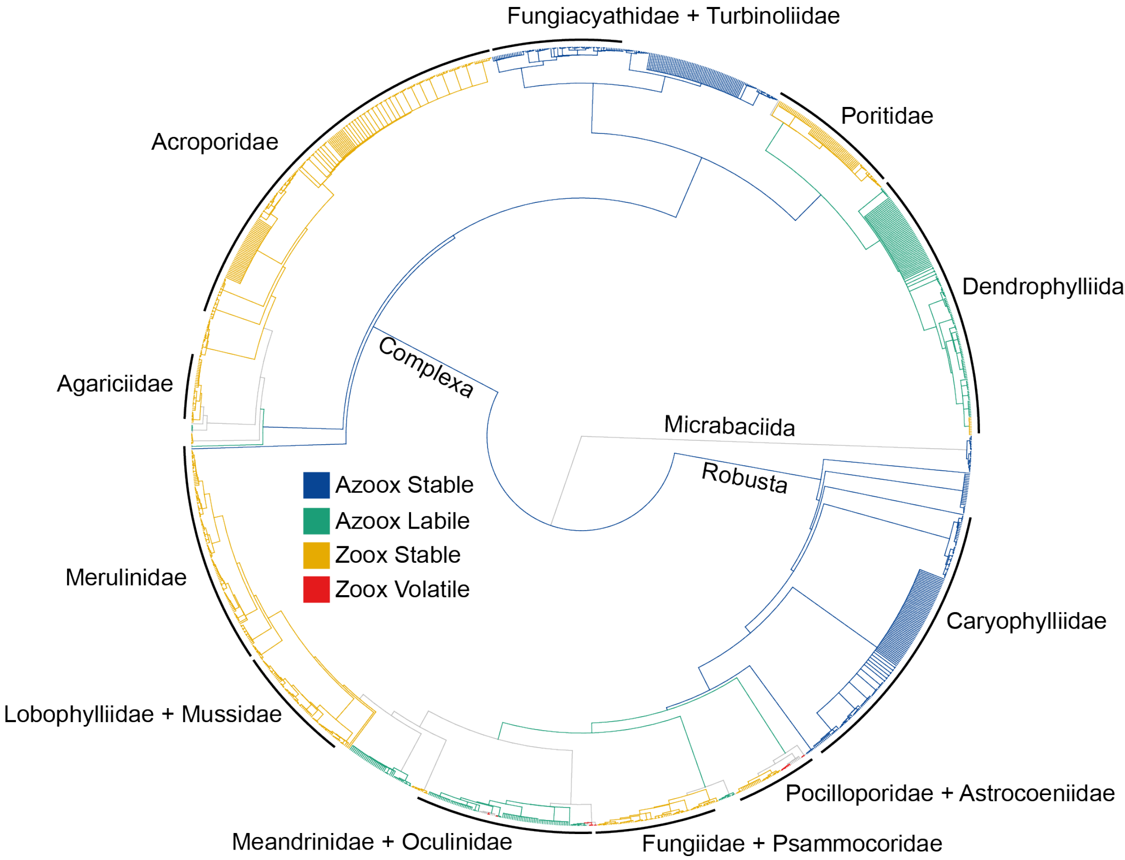

Figure 14. Ancestral state reconstruction of each state/rate-category combination inferred across the 100 supertree phylogenies with facultative corals pruned. Phylogeny shown is the 95% consensus tree of all 100 supertree phylogenies used for the analysis. Branches are painted according to the probability of being in each state/rate-category at each internal node. To calculate the probability at each internal node the mean of each state/rate-category across all 100 supertree phylogenies was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches are painted according to the state that is most likely at each internal node. Grey branches denote uncertainty in the assignment of Zoox or Azoox at internal nodes as calculated for the reconstruction shown in Figure 6. Zoox Labile and Azoox Volatile are not assigned to any internal nodes so they are not shown in the legend.

Table 7. Number of gains and losses of each state/rate-category combination estimated across the 100 supertree phylogenies with facultative corals pruned. Values are the median calculated across all 100 supertree phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Azoox Stable Losses	$3^{+0}_{-0.5}$
Azoox Stable Gains	2^{+0}_{-0}
Zoox Stable Losses	1^{+1}_{-1}
Zoox Stable Gains	10^{+1}_{-0}
Azoox Labile Losses	20^{+1}_{-1}
Azoox Labile Gains	5^{+1}_{-0}
Zoox Labile Losses	2^{+0}_{-0}
Zoox Labile Gains	$0.5^{+0.5}_{-0.5}$
Azoox Volatile Losses	$0^{+3.5}_{-0}$
Azoox Volatile Gains	7^{+0}_{-0}
Zoox Volatile Losses	9^{+1}_{-1}
Zoox Volatile Gains	12^{+1}_{-1}

Molecular tree: CorHMM analysis

The model that best explains the evolution of photosymbiosis is the HRM+2 (AICc weight 91.06%; Table 8). The HRM+2 yields an increase of log-likelihood of 12 units over the TH model and a delta-AIC of 12 units (Figure 15 and 16). This increase is not as striking as with the supertree but demonstrates that even with a third of the data, the molecular phylogeny still contains a signal of heterogenous rates of evolution. The HRM+3 yields a relatively modest increase in log-likelihood of 4 units but the increase in fit does not justify the increase in model complexity according to AICc. The HRM+4 yields an increase in log-likelihood of 1 unit over the HRM+3 but is a worse fit to the data than the TH model when penalized for model complexity so we did not fit a Hidden Rates Model with five rate categories.

Molecular tree: Main features of the best-fit model

Although the best fit model for the molecular tree has only two rate categories, it is qualitatively very similar to the HRM+3 model fit to the supertree. Under the HRM+2 there are two distinct categories of evolutionary stability of photosymbiosis: a Stable category where transitions rarely, if ever, occur; and a Labile category where transitions are much more common (Figure 17). Analogous to the HRM+3, photosymbiosis is never gained directly from the Azoox Stable category but rather proceeds through the Labile category before settling in Zoox Stable where the trait is never lost.

Table 8. Summary of AICc scores for each model fit to the 100 molecular phylogenies.

Model	Number of Rate Classes	Number of Parameters	Mean AICc	AIC Weight (%)
TH	1	2	181.469	0.225
HRM+2	2	8	169.462	91.055
HRM+3	3	14	174.163	8.682
HRM+4	4	20	185.059	0.037

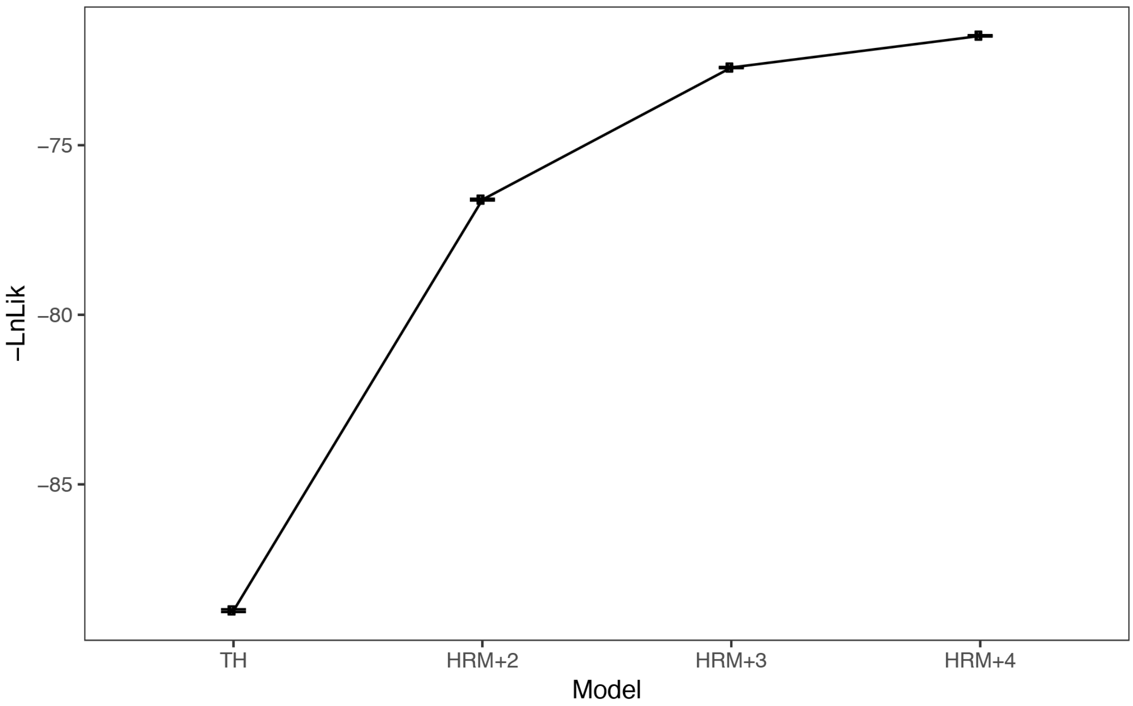

Figure 15. Plot of the mean log-likelihoods for each model fit to the 100 molecular phylogenies. Error bars represent the standard error around the mean.

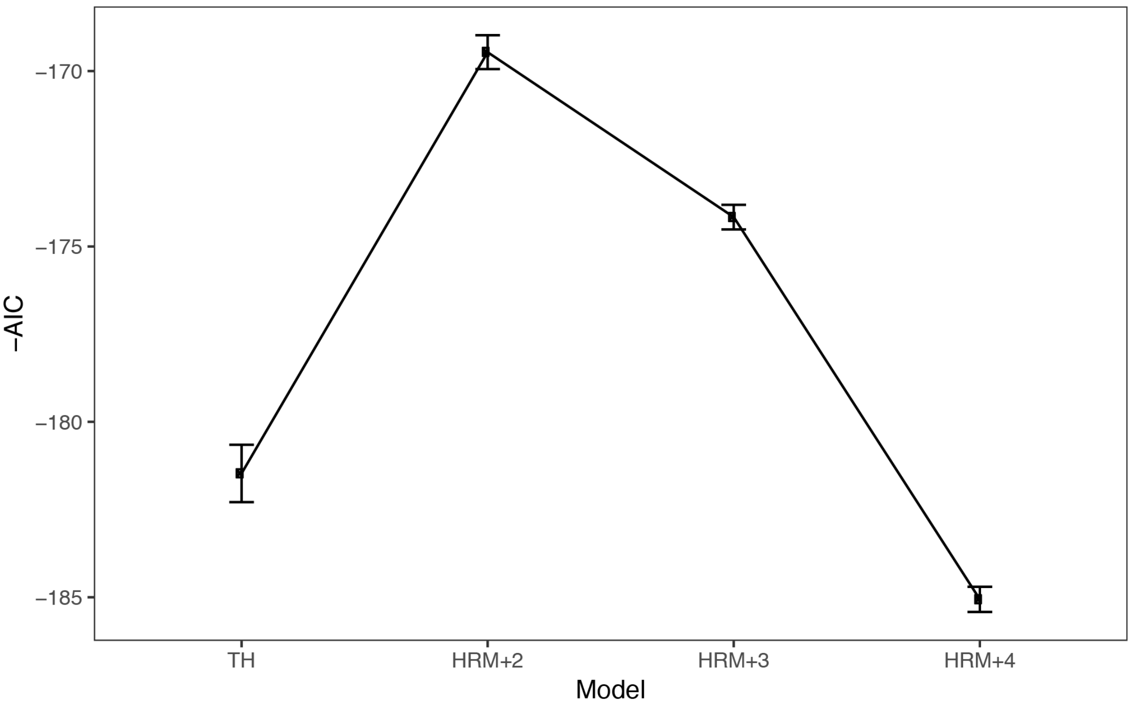

Figure 16. Plot of the mean AICc scores for each model fit to the 100 molecular phylogenies. Error bars represent standard error around the mean. AICc scores were multiplied by negative one so model fit improves vertically along the y-axis.

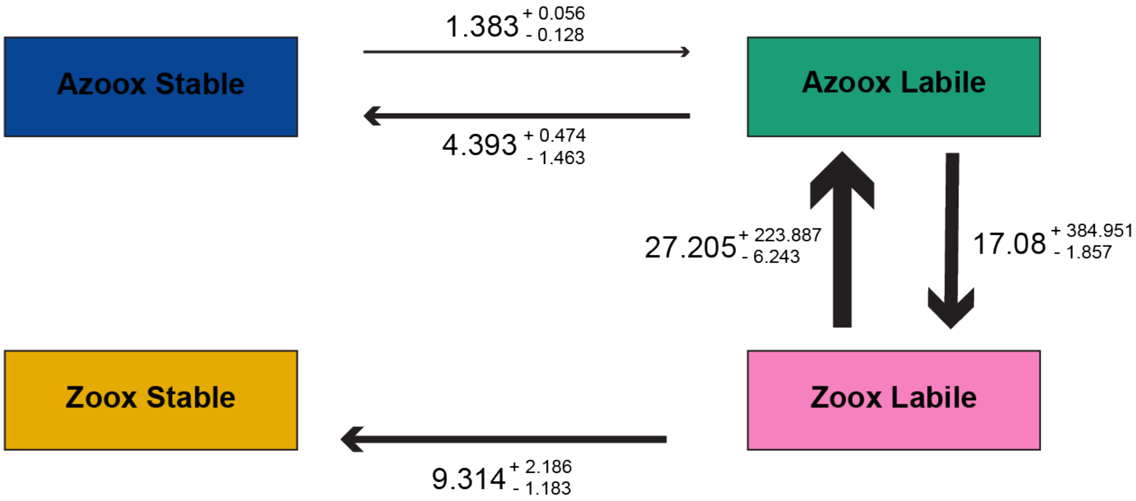

Figure 17. Schematic version of the transition matrix of the Hidden Rates Model with two rate categories (HRM+2) fit to the 100 molecular phylogenies. Transition rates printed here are the median of the transition rates estimated for the 100 molecular phylogenies. Errors printed here represent the 95% quantile around the median as estimated via bootstrapping. Median values and errors are multiplied by 1000 to aid interpretation. The width of the arrows corresponds to relative magnitude of the rates.

Molecular tree: Ancestral state reconstruction

The order was reconstructed as ancestrally Azoox Stable as was the Complexa/Robusta split (Figure 18 and 19). Robusta and Complexa were both reconstructed as ancestrally Azoox Stable. Micrabaciida was reconstructed as ancestrally Azoox Stable. Like in the supertree, two large groups retain the ancestral Azoox Stable state; one in Robusta and one in Complexa. The grade in Robusta consists of Anthemiphylliidae, Deltocyathidae, and Caryophylliidae. The clade in Complexa consists of Stenocyathidae, Fungiacyathidae, Turbinoliidae, Deltocyathidae, and Flabellidae. We again found relatively few losses of Azoox Stable $5^{+1}_{-0.5}$; Table 9).

Azoox Labile has multiple origins (9^{+1}_{-1}) and a high number of losses ($17^{+2}_{-3.5}$). The molecular tree contains far fewer Azoox corals than the supertree so there are correspondingly fewer Azoox Labile corals in the molecular tree. Of the shared species, the same groups in the molecular tree contain extant Azoox Labile corals (Appendix 2). The first is *Madracis* within the Pocilloporidae. The second is *Phyllangia* and *Rhizosmilia* (Caryophylliidae) which are sister to Meandrinidae. Third is two Caryophyllids within the Oculinidae clade (*Paracyathus* and *Polycyathus*) which are the only representatives of the large clade of Caryophyllids within which *Oculina* is nested in the supertree. And fourth is a clade consisting of *Trochocyathus*, *Tethocyathus*, and *Cyathelia*. Unlike the supertree, the monotypic *Madrepora*—which is now sister to the Astrocoeniidae + Pocilloporidae in the molecular tree—is reconstructed as Azoox Labile. Within Complexa, the Dendrophylliidae is again reconstructed as Azoox Labile but with less certainty. *Thalamophyllia* is also again reconstructed as Azoox Labile.

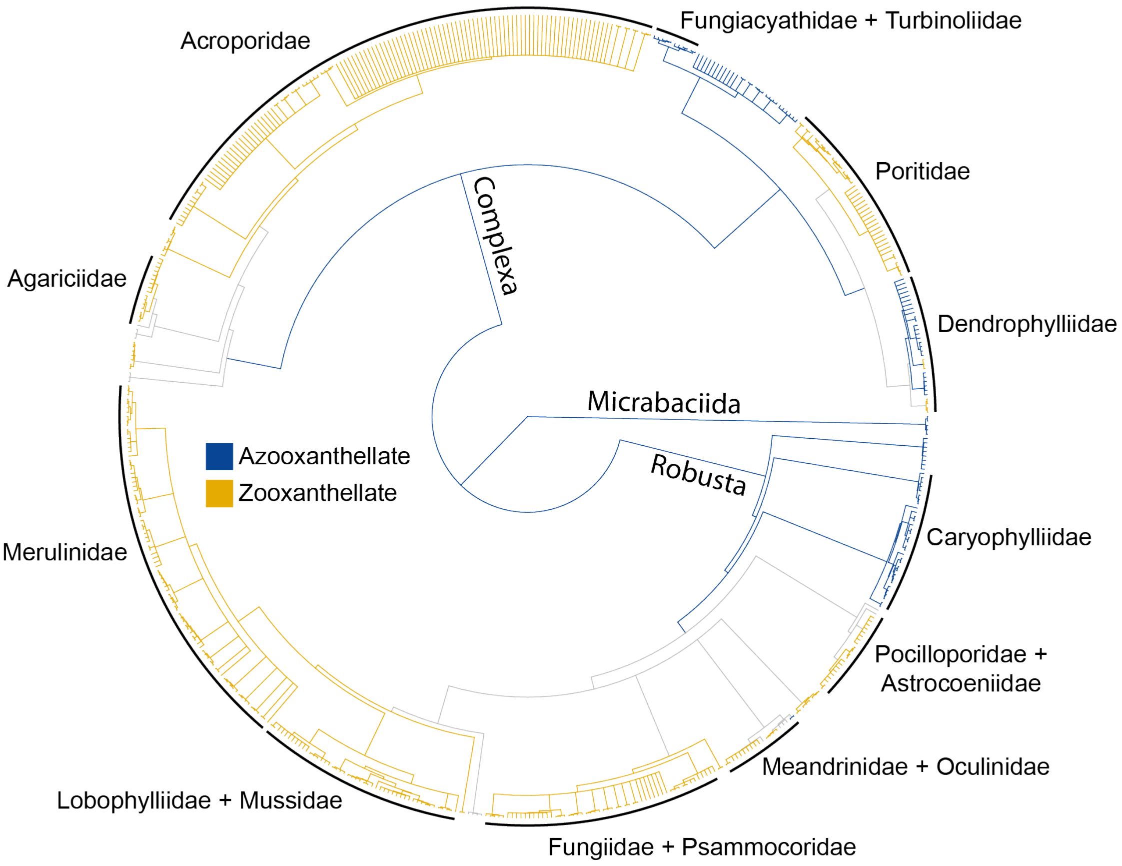

Figure 18. Ancestral state reconstruction of photosymbiosis within Scleractinia inferred across the 100 molecular phylogenies. Phylogeny shown is the 95% consensus tree of all 100 molecular phylogenies used for the analysis. Branches are painted according to the probability of being at either state at each internal node. To calculate the probability at each internal node, each state (Zoox or Azoox) was summed across all rate categories (Stable and Labile) at each node on each of the 100 phylogenies. The mean of each state was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches were painted only if the probability of being in either state was greater than or equal to 75%. Grey branches denote lineages whose ancestral node was less than 75% likely to be in either state.

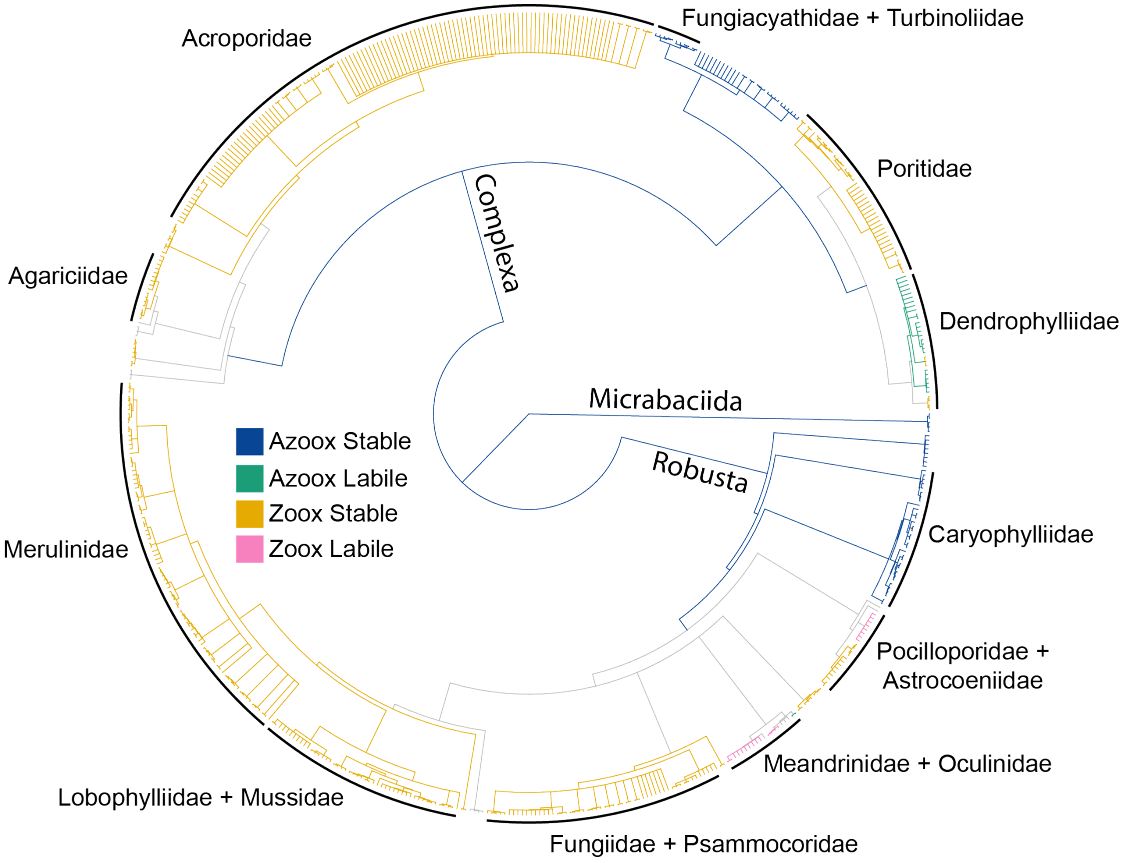

Figure 19. Ancestral state reconstruction of each state/rate-category combination inferred across the 100 molecular phylogenies. Phylogeny shown is the 95% consensus tree of all 100 molecular phylogenies used for the analysis. Branches are painted according to the probability of being in each state/rate-category at each internal node. To calculate the probability at each internal node the mean of each state/rate-category across all 100 phylogenies was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches are painted according to the state that is most likely at each internal node. Grey branches denote uncertainty in the assignment of Zoox or Azoox at internal nodes as calculated for the reconstruction shown in Figure 6. Zoox Labile and Azoox Volatile are not assigned to any internal nodes so they are not shown in the legend.

Table 9. Number of gains and losses of each state/rate-category combination estimated across the 100 molecular phylogenies. Values are the median calculated across all 100 molecular phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Azoox Stable Losses	$5^{+1}_{-0.5}$
Azoox Stable Gains	$3.5^{+2.5}_{-1.5}$
Zoox Stable Losses	0^{+0}_{-0}
Zoox Stable Gains	$14^{+1}_{-0.5}$
Azoox Labile Losses	$17^{+2}_{-3.5}$
Azoox Labile Gains	9^{+1}_{-1}
Zoox Labile Losses	17^{+2}_{-4}
Zoox Labile Gains	$9^{+1}_{-0.5}$

Zoox Stable has multiple independent origins ($14^{+1}_{-0.5}$ gains) and once gained it is never lost (0^{+0}_{-0} losses). There is, however, more uncertainty in the patterns of the major gains and losses of photosymbiosis within Robusta due to uncertainty in the placement of some of the major clades of Zoox Stable corals. Nevertheless, we found the same four major clades in Robusta represent potential independent gains of photosymbiosis. The first is composed of Pocilloporidae and now also includes a member of the Astrocoeniidae. The second consists of Coscinaraeidae, Fungiidae, and Psammocoridae and now also includes *Oulastrea* + *Heterocyathus* (Caryophylliidae). The third consists of *Blastomussa*, *Nemenzophyllia*, *Physogyra*, and *Plerogyra* (incertae sedis). And the fourth consists of Diploastreidae, Montastreaidae, Lobophylliidae, Mussidae, and Merulinidae. Within Complexa, we find the same five clades represent independent gains of Zoox Stable. The first is composed of the Siderastreidae, the second is composed of the Agariciidae, and the third is composed of the Euphylliidae and Acroporidae. Again, the pattern of gains and losses among these three is unclear so they potentially represent less than three independent gains. Poritidae represents the fourth independent gain. *Turbinaria* is the fifth independent gain although it does not form a monophyletic clade within the Dendrophylliidae.

Zoox Labile has been gained $9^{+1}_{-0.5}$ times and lost 17^{+2}_{-4} times. The Zoox Labile clades in the molecular tree correspond to the Zoox Volatile clades in the supertree. Zoox Labile occurs in the same small clades that represent recent gains of photosymbiosis. In Robusta we find three clades reconstructed as Zoox Labile. The first consists of Astrocoeniidae and *Madracis* (Pocilloporidae). The second consists of Meandrinidae. The third consists of Oculinidae. In Complexa, we found only a few scattered species inferred to be Zoox Labile. These include *Helioseris cucullata* (Agariciidae), *Balanophyllia (Balanophyllia)* *europaea* (Dendrophylliidae), and *Heteropsammia cochlea* (Dendrophylliidae). Again, almost all facultative corals are estimated to be in the Labile category (Appendix 2). The only exception is *Heterocyathus sulcatus*. In the supertree, *Heterocyathus* + *Oulastrea* are sister to an Azoox Labile clade of Caryophyllids. But in the molecular tree these Caryophyllids are absent so *Heterocyathus* + *Oulastrea* are sister to the Zoox Stable Psammocoridae + Fungiidae and are thus reconstructed as Zoox Stable. All facultative corals are found in clades reconstructed as Zoox Labile except for *Heteropsammia cochlea* which is found in an Azoox Labile clade.

When each state (Azoox and Zoox) is summed across both categories (Stable and Labile), photosymbiosis has been gained an estimated $12^{+4.5}_{-1}$ times and lost an estimated 10^{+1}_{-2} times (Table 10, Figure 18).

Table 10. Number of gains and losses of photosymbiosis estimated across the 100 molecular phylogenies. Values are the median calculated across all 100 molecular phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Zoox Losses	10^{+1}_{-2}
Zoox Gains	$12^{+4.5}_{-1}$

Molecular tree: Facultative corals removed

Removing facultative corals from the molecular tree did not significantly alter the results. The HRM+2 is still the model that best explains the evolution of photosymbiosis (AICc weight of 95%; Table 11) with the HRM+3 being a significantly worse fit according to AICc despite a modest increase in log-likelihood over the HRM+2 of 3 units (Figures 20 and 21)

The overall model structure of the HRM+2 when facultative corals are removed is identical to when they are retained (Figure 22). The estimated rates are similar except in the Labile category which is not surprising due to the relatively few data points within labile clades with which to estimate the rates.

There are a similar number of gains and loss of photosymbiosis (Table 12) as when facultative corals are retained and the broad patterns of evolution of photosymbiosis as found by ancestral state reconstruction remain the same (Figure 23). We found a similar number of gains and losses of state/rate-categories (Table 13) except for Azoox Labile. The large polytomy within Robusta is still uncertain but leans towards Zoox Labile rather than Azoox Labile when facultative corals are removed which leads to correspondingly fewer losses of Azoox Labile. The Dendrophylliidae is also no longer inferred to be Azoox Labile (Figure 24) which is not surprising as it was relatively uncertain even when facultative corals were retained.

Table 11. Summary of AICc scores for each model fit to the 100 molecular phylogenies with facultative corals pruned.

Model	Number of Rate Classes	Number of Parameters	Mean AICc	AICc Weight (%)
TH	1	2	170.324	0.363
HRM+2	2	8	159.183	95.202
HRM+3	3	14	165.316	4.435

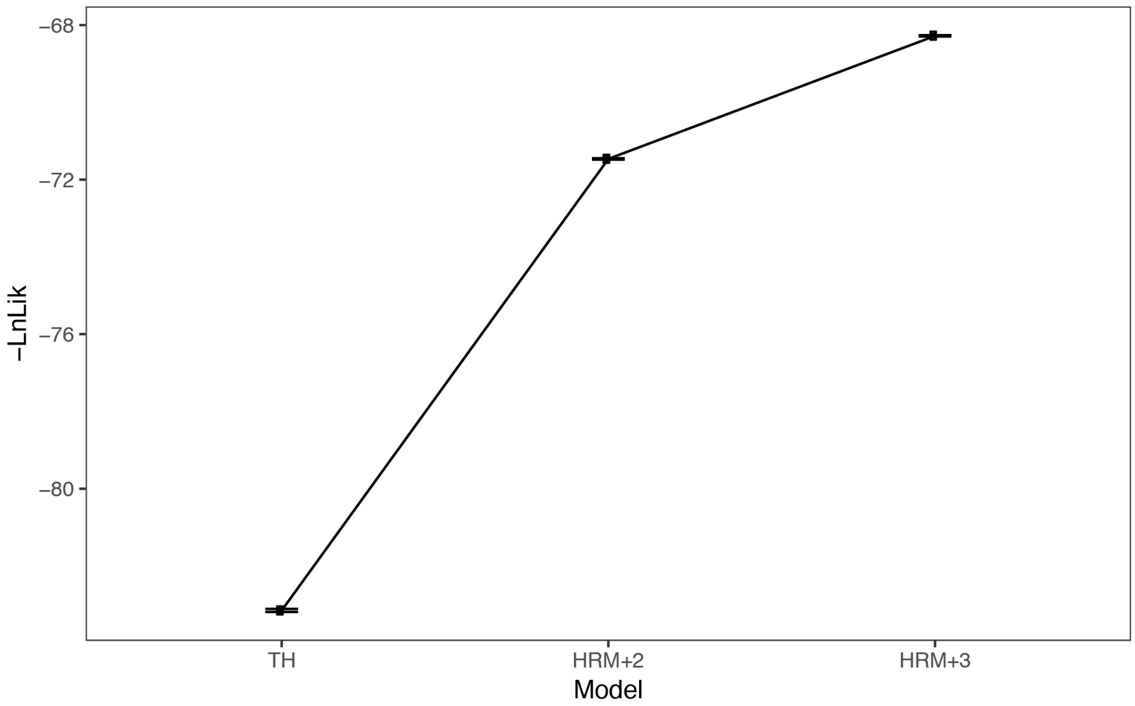

Figure 20. Plot of the mean log-likelihoods for each model fit to 100 molecular phylogenies with facultative corals pruned. Error bars represent the standard error around the mean.

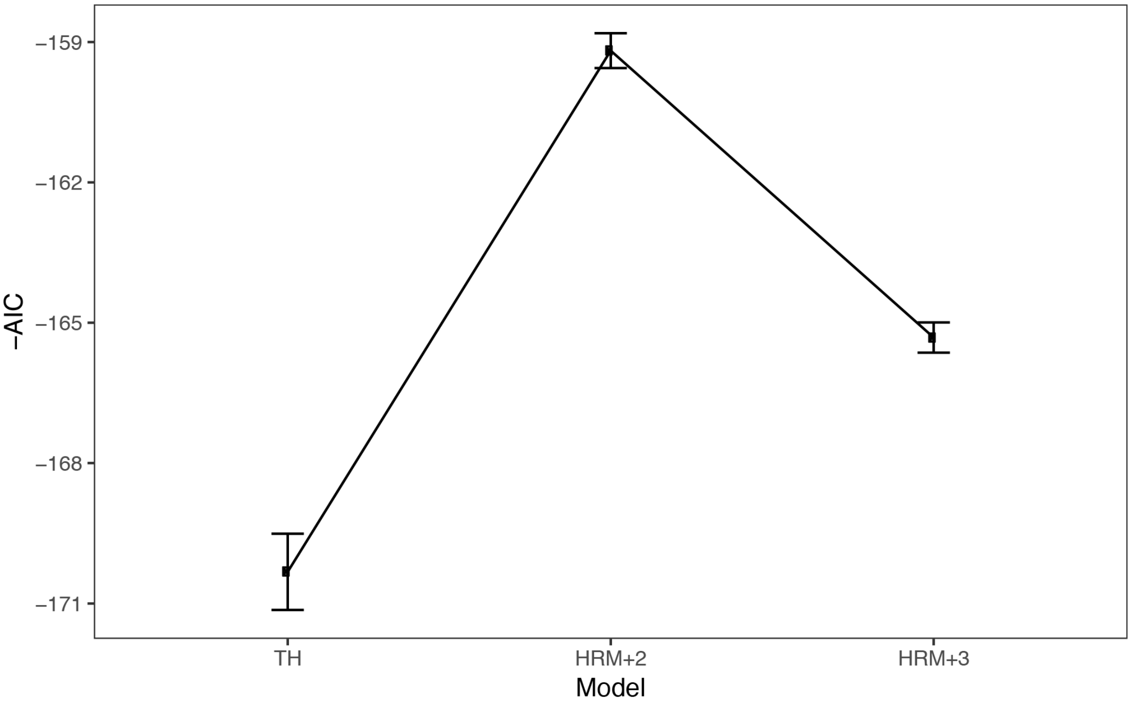

Figure 21. Plot of the mean AICc scores for each model fit to 100 molecular phylogenies with facultative corals pruned. Error bars represent standard error around the mean. AICc scores were multiplied by negative one so model fit improves vertically along the y-axis.

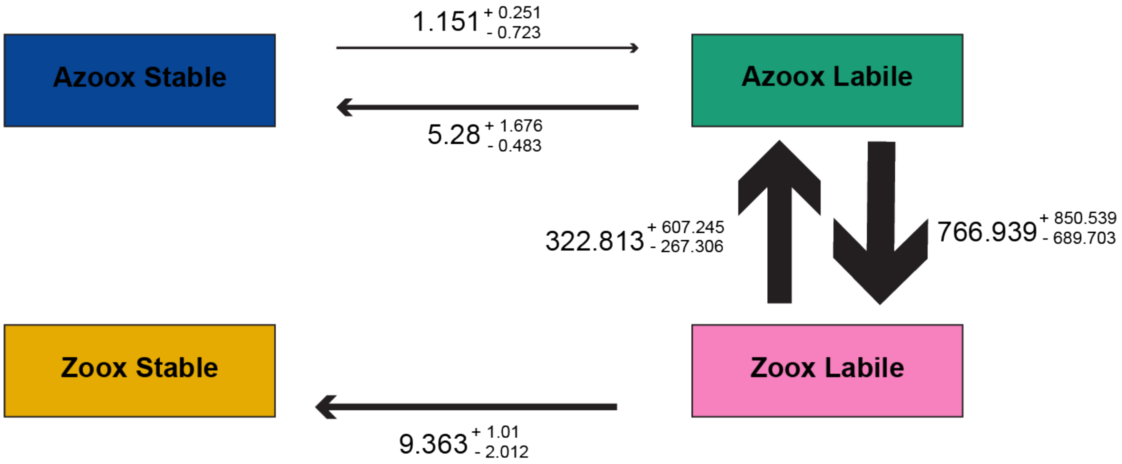

Figure 22. Schematic version of the transition matrix of the Hidden Rates Model with two rate categories (HRM+2) fit to the 100 molecular phylogenies with facultative corals pruned. Transition rates printed here are the median of the transition rates estimated for the 100 molecular phylogenies. Errors printed here represent the 95% quantile around the median as estimated via bootstrapping. Median values and errors are multiplied by 1000 to aid interpretation. The width of the arrows corresponds to relative magnitude of the rates.

Table 12. Number of gains and losses of photosymbiosis estimated across the 100 molecular phylogenies. Values are the median calculated across all 100 molecular phylogenies with facultative corals pruned. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Zoox Losses	11_{-0}^{+0}
Zoox Gains	$10_{-0}^{+0.5}$

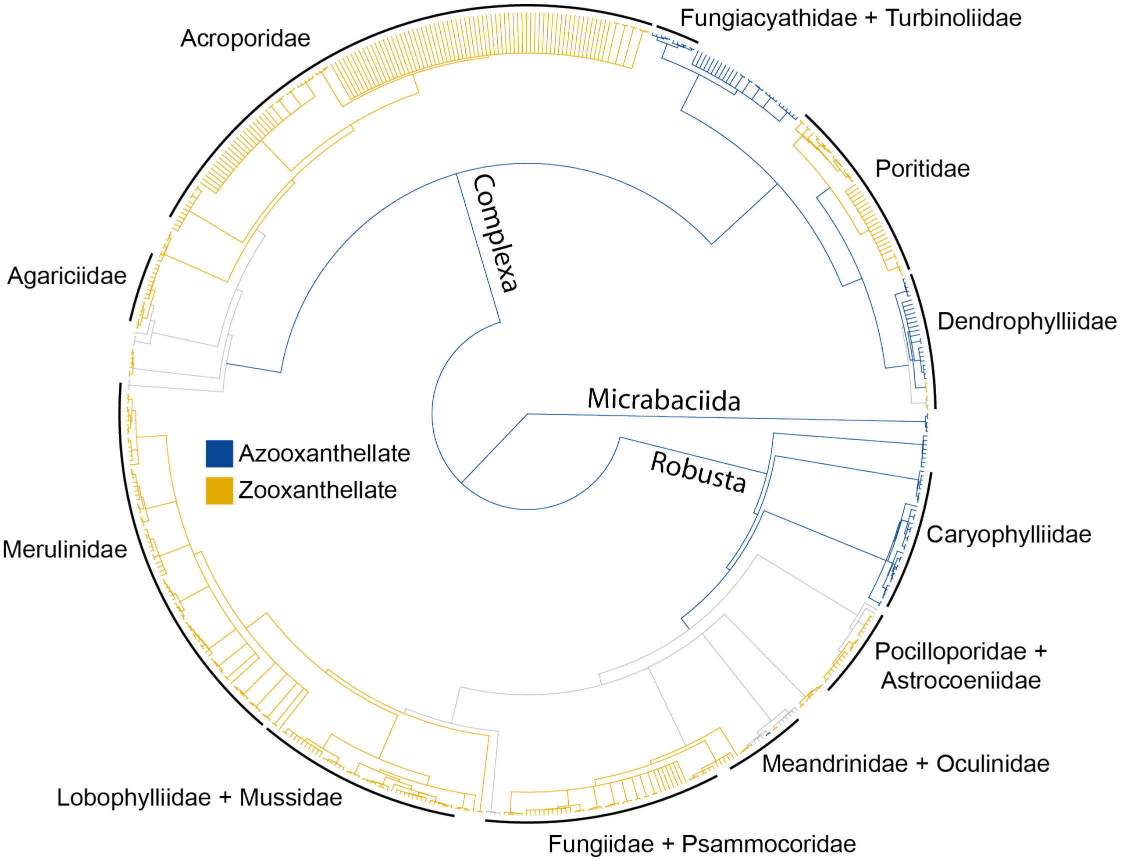

Figure 23. Ancestral state reconstruction of photosymbiosis within Scleractinia inferred across the 100 molecular phylogenies with facultative corals pruned. Phylogeny shown is the 95% consensus tree of all 100 molecular phylogenies used for the analysis. Branches are painted according to the probability of being at either state at each internal node. To calculate the probability at each internal node, each state (Zoox or Azoox) was summed across all rate categories (Stable and Labile) at each node on each of the 100 phylogenies. The mean of each state was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches were painted only if the probability of being in either state was greater than or equal to 75%. Grey branches denote lineages whose ancestral node was less than 75% likely to be in either state.

Table 13. Number of gains and losses of each state/rate-category combination estimated across the 100 molecular phylogenies with facultative corals pruned. Values are the median calculated across all 100 molecular phylogenies. Errors represent the 95% quantiles around the median as estimated via bootstrapping.

Type	Number
Azoox Stable Losses	8^{+0}_{-1}
Azoox Stable Gains	4^{+1}_{-1}
Zoox Stable Losses	0^{+0}_{-0}
Zoox Stable Gains	$13.5^{+1}_{-1.5}$
Azoox Labile Losses	$0^{+5.5}_{-0}$
Azoox Labile Gains	10^{+0}_{-1}
Zoox Labile Losses	21^{+1}_{-1}
Zoox Labile Gains	7^{+0}_{-1}

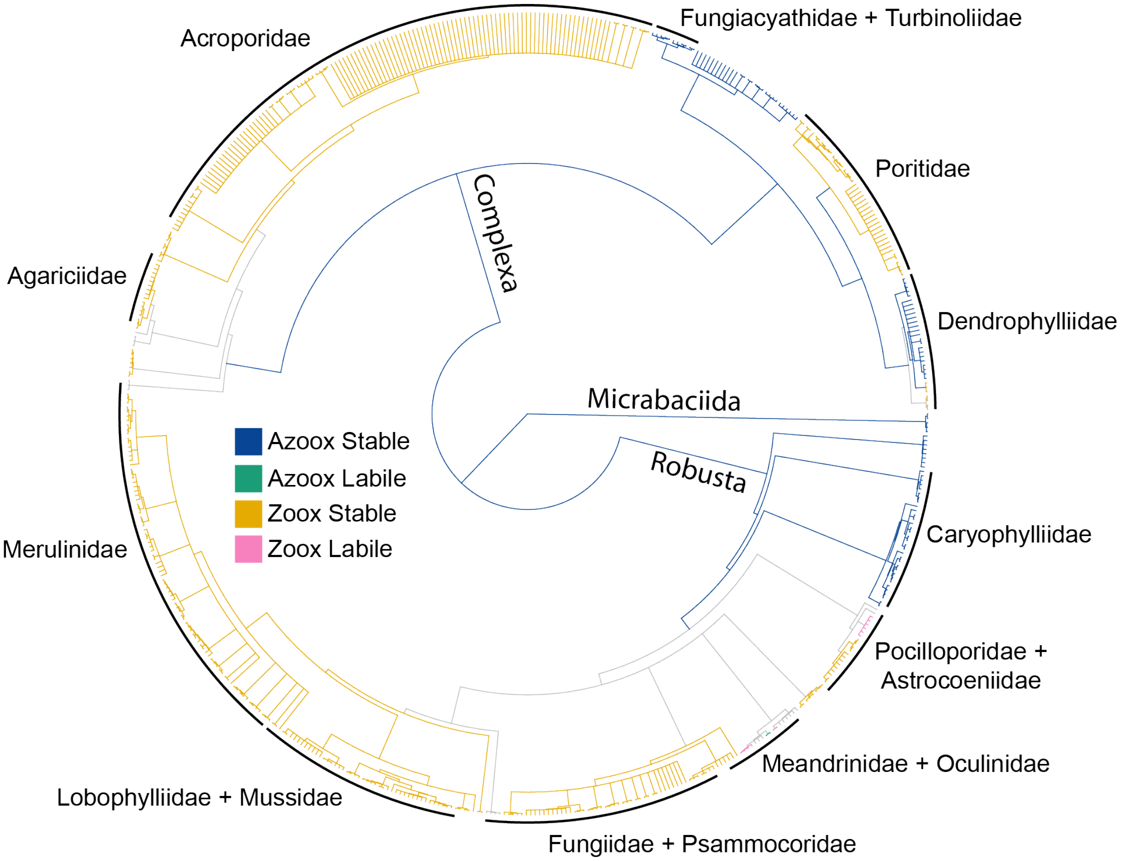

Figure 24. Ancestral state reconstruction of each state/rate-category combination inferred across the 100 molecular phylogenies with facultative corals pruned. Phylogeny shown is the 95% consensus tree of all 100 molecular phylogenies used for the analysis. Branches are painted according to the probability of being in each state/rate-category at each internal node. To calculate the probability at each internal node the mean of each state/rate-category across all 100 phylogenies was calculated for all nodes that are bifurcating in the 95% consensus tree. Branches are painted according to the state that is most likely at each internal node. Grey branches denote uncertainty in the assignment of Zoox or Azoox at internal nodes as calculated for the reconstruction shown in Figure 6. Zoox Labile and Azoox Volatile are not assigned to any internal nodes so they are not shown in the legend.

Discussion

We find that different lineages evince different rates of gain and loss of photosymbiosis. All corals fall into four categories: azooxanthellate corals that show no propensity for the evolution of photosymbiosis (Azoox Stable), azooxanthellate corals that show an increased propensity for the evolution of photosymbiosis (Azoox Labile), zooxanthellate corals that show high rates of loss of photosymbiosis (Zoox Volatile), and zooxanthellate corals that show no evidence of loss of photosymbiosis (Zoox Stable). Significantly, we find that there is a trend towards the evolutionary stability of photosymbiosis. Zoox Stable acts as an absorbing state that, once gained, cannot be abandoned. This suggests that photosymbiosis has become evolutionarily irreversible in most species of reef corals. It has been traditionally thought that conflicts of interest between symbiotic partners make symbioses unstable over evolutionary timescales and much work has sought to elucidate the factors that stabilize symbioses against conflicts of interest. Vertical transmission and intracellular integration of symbionts are thought to be important in mediating conflicts of interest thereby stabilizing the interaction (Herre et al., 1999). Paradoxically, most reef corals acquire symbionts horizontally from the environment (Fadlallah, 1983; Baird et al., 2009) and host more than one symbiont genotype (Silverstein et al., 2012) — both of which are factors hypothesized to destabilize the interaction (Herre et al., 1999). This suggests that reef corals have found other strategies, such as sanctions and rewards (Douglas, 2010), for managing partner conflict. While partner conflict is important in shaping the traits of symbioses, the causes of their evolutionary fates may lie elsewhere (Douglas, 2008). Different types of symbioses may tend towards different evolutionary outcomes (Sachs and Simms, 2006). For example, nutritional symbioses have been hypothesized to be more prone to abandonment if one partner can acquire the necessary nutrients from the environment (Sachs and Simms, 2006). Concordantly, it might expected that corals can abandon photosymbiosis in situations where there is little to no benefit to the trait (e.g. low-light conditions or when nutrients are readily available via heterotrophy). Contrary to this expectation, we find that in most clades the nutritional symbiosis between corals and their dinoflagellates is remarkably stable over evolutionary timescales.

The ancestral state of Scleractinia is equivocal under the best fit model for the supertree. However, rather than suggesting a potential zooxanthellate origin for the order, this may reflect uncertainty due to the increased complexity of the model relative to the available data. A number of results suggest the latter. First, on the supertree, both the time-homogenous model and the HRM+2 reconstruct the ancestral state of the order as confidently Azoox Stable. Second, on the molecular tree, the time-homogenous model and HRM+2 reconstruct the ancestral state of the order as Azoox Stable despite a marked sampling bias towards zooxanthellate corals and the inclusion of an exclusively zooxanthellate sample of corallimorpharians as the outgroup. Finally, similar uncertainty is introduced at the root of the molecular tree when fitting the HRM+3. However, the root of the molecular tree is the ancestor of Scleractinia + Corallimorpharia so that Scleractinia is still reconstructed as confidently Azoox Stable. On both the molecular tree and supertree, the root of the tree is split between Azoox Stable and Zoox Labile under the HRM+3. This puzzling behavior seems due to the model failing to find a clade that warrants this third, intermediate category. On both phylogenies, most zooxanthellate corals are found in large clades monophyletic for the trait while the minority are found in much smaller clades of closely related zooxanthellate and azooxanthellate species. There are no clades of intermediate size with potential losses of photosymbiosis and this may be driving the placement of Azoox Labile at the root. Notably, across some of the individual ancestral state reconstructions on the posterior supertrees, Agariciidae is placed in the Zoox Labile category and is inferred to represent a loss after a shared gain with Acroporidae + Euphylliidae. There is in fact an azooxanthellate member of Agariciidae (Hoeksema 2012) which was not included in the phylogeny for this analysis. Its inclusion might place Agariciidae in the Zoox Labile category and resolve the issue at the root.

If the uncertainty at the root is considered an artefact of model complexity, the inference of an azooxanthellate origin for the order is in line with both phylogenetic and fossil evidence. The finding that the exclusively deep-water, azooxanthellate Micrabaciida diverges before the Complex/Robust split, and that many deep-water, azooxanthellate species diverge deeply within Complexa and Robusta led to the suggestion that the evolutionary origin of the order may lie in deep water (Stolarski et al., 2011; Kitahara et al., 2010). Moreover, molecular clock estimates date the origin of the order deep within the Paleozoic, well before the appearance of the well-differentiated and diverse Triassic scleractinian fauna. This led Stolarski et al. (2011) to suggest that the Paleozoic scleractiniamorphs (Ezaki 1997, 1998, 2000; Scrutton and Clarkson, 1991) are true scleractinians. These early scleractinians were solitary and most likely deep-water and azooxanthellate, furthering the argument for a non-photosymbiotic origin of the order. Moreover, the first Triassic scleractinians were solitary and phaceloid which suggests they were originally azooxanthellate (Veron, 1995). Therefore, we suggest that the most recent common ancestor of living Scleractinia is likely azooxanthellate. However, assuming a zooxanthellate origin for the order would not change the results other than to suggest that the Azoox Stable clades do not represent the ancestral state but rather multiple losses of the capacity to form photosymbiosis followed by subsequent gains of the capability.

Complexa, Robusta, and Micrabaciida are all reconstructed as ancestrally Azoox Stable. Within Robusta, a large, deeply branching grade of azooxanthellate corals retain the Azoox Stable state. Within Complexa, a large monophyletic clade retains the ancestral Azoox Stable state. These clades show no propensity for evolving photosymbiosis. Over the entire history of the order, we find only three transitions from Azoox Stable to Azoox Labile — one in Robusta and two in Complexa. These transitions represent the evolution of some necessary trait that precedes the evolution of photosymbiosis. However, the identity of this trait is unclear. It could simply correlate with inhabitance of environments that select for the evolution of photosymbiosis. The Azoox Stable clades consist largely of deep-water, solitary corals. However, a number of Azoox Stable genera occur in mesophotic depths and co-occur with both Azoox Labile and zooxanthellate corals (Muir and Pichon, 2019) which makes a simple correlate such as depth unlikely. The Azoox Labile category could be correlated with some other organismal trait. Barbeitos et al. (2010) found evidence for the correlated evolution of photosymbiosis and coloniality and envisioned a scenario in which the evolution of coloniality precedes the evolution of photosymbiosis. A number of Azoox Labile corals are non-colonial, however, which makes this unlikely to be the sole correlate with Azoox Labile. Finally, the Azoox Labile state could represent the evolution of the molecular machinery necessary to form and mediate photosymbiosis. Werner at al. (2014) found a similar "precursor" state that precedes the evolution of nitrogen fixing symbiosis in angiosperms, and suggest that it may represent a modification of the molecular machinery that mediates the more ancient symbiosis between angiosperms and mycorrhizal fungi. The processes mediating coral photosymbiosis overlap with innate immunity pathways (Kvennefors et al., 2008; Cunning et al., 2017; Hamada et al., 2012; Shinzato et al., 2011; Shinzato et al., 2014; reviewed in Meyer and Weis 2012) which are involved in mediating interactions with both harmful and beneficial microbes. The transition to Azoox Labile may represent some modification of the pathways involved in maintaining the beneficial microbial community within corals. Most importantly, all photosymbiotic corals descend from these three transitions to Azoox Labile which raises the possibility that zooxanthellate corals descended from separate transitions may have evolved the capacity to form and mediate photosymbiosis distinctly.

Photosymbiosis has evolved independently multiple times within both Complexa and Robusta. The majority of photosymbiotic corals are found in clades that are stable for the trait but multiple small clades show high rates of gain and loss of photosymbiosis. High rates of gain and loss within Zoox Volatile clades suggest that losses within them do not represent a loss of the capacity to form photosymbiosis but rather a lability of the interaction that allows for loss and subsequent regain over evolutionary timescales. The fact that nearly all facultative corals are found in Zoox Volatile clades suggests that a more flexible relationship in ecological time is connected to a more flexible relationship over evolutionary timescales. Why is photosymbiosis stable in most clades but more labile in others? Does the Zoox Stable state represent true irreversible dependence? It's possible that the Zoox Stable state could simply correlate with environment, with species occupying environments that exert strong and constant selective pressure on the maintenance of photosymbiosis while Zoox Volatile species occupy environments where the benefit of photosymbiosis is context dependent. However, many Zoox Stable species have wide depth ranges and occupy mesophotic environments alongside Zoox Volatile species, including facultative corals that can be found with or without their photosymbionts depending on light and temperature (Muir and Pichon, 2019). In fact, some Zoox Stable genera such as *Acropora* contain deep-water specialists (Muir and Pichon, 2019) and species with temperate ranges (Nakamura et al., 2003) that retain photosymbionts at low irradiance and temperature. The fact that some Zoox Stable species occupy environments where there might be a selective advantage to temporarily abandon photosymbiosis makes it unlikely that a simple environmental correlate explains the difference between Zoox Stable and Zoox Volatile clades. The lack of evidence that Zoox Stable corals can abandon photosymbiosis over ecological and evolutionary timescales suggests that the Zoox Stable category represents irreversible dependence. What is the nature of this dependence? Gene loss may be an important component in the development of obligacy in symbioses (Douglas, 2010). Shinzato et al. (2014) found that *Acropora digitifera* is unable to biosynthesize cystein and suggested that metabolic dependence may underlie obligate photosymbiosis. Ying et al. (2018) found that Robust corals are able to biosynthesize histidine and suggested that this might have implications for coral symbiosis in Robusta. Notably, most Zoox Volatile species are found in Robusta. However, their sample included Zoox Stable corals from Robusta meaning that this metabolic capability might be linked to the concentration of Zoox Volatile species in Robusta but that Robust Zoox Stable species have developed obligacy via some other route. In fact, the multiple independent gains of irreversible photosymbiosis suggest that there are multiple pathways to developing obligacy. We currently lack the resources for comparative genomic studies across all of the Zoox Stable and Zoox Volatile clades, but sampling across these independent gains can elucidate the mechanisms governing the different evolutionary rates between these clades.

The methods of ancestral state reconstruction used here assume minimal extinction or equal extinction risk across all states. Differential extinction of photosymbiotic vs. non-photosymbiotic corals could bias ancestral state reconstruction, especially at deeper nodes. Has extinction afflicted zooxanthellate and azooxanthellate corals equally through time? There is evidence that photosymbiosis evolved in the Triassic (Stanley and Swart, 1995; Frankowiak et al., 2016). Scleractinians suffered a major bottleneck at the end of the Triassic during which nearly all species went extinct, including all photosymbiotic lineages (Simpson et al., 2011; Stanley, 2006). The absence of these early photosymbiotic lineages in the phylogeny means that the Azoox Stable clades may represent losses of the capacity to form photosymbiosis after which the capacity was reacquired via the inferred transitions to Azoox Labile. Alternatively, Azoox Stable may in fact be the ancestral state and these lineages survived the bottleneck and independently transitioned into the Azoox Labile state. If we are missing Triassic lineages of photosymbiotic corals, when did the modern photosymbiosis evolve? Almost all families in Zoox Stable clades appear in the fossil record by the Late Cretaceous (Veron, 1995; Baron-Szabo, 2006, 2008). With the exception of *Turbinaria* and *Blastomussa* + *Nemenzophyllia* + *Physogyra* + *Plerogyra*, all gains of Zoox Stable happened by the Late Cretaceous and possibly earlier. Based on *Montastraea*-like Jurassic fossils (Budd and Coates, 1992), the largest gain in Robusta (Diploastraeidae + Montastraeidae + Mussidae + Lobophylliidae + Merulinidae) could potentially be Jurassic in origin, coinciding with the origin and diversification of Symbiodiniaceae (LaJeunesse et al., 2018). Multiple photosymbiotic families originated in the Jurassic and went extinct by the end of the Cretaceous (Veron, 1995; Kiessling and Baron-Szabo, 2004). Because of the difficulty assigning higher taxonomic affinities to extinct Jurassic families, it is difficult to tell if these lineages represent independent acquisitions of photosymbiosis that are absent from our phylogeny or if modern Zoox Stable lineages descend from these Jurassic progenitors. In the former case, our results regarding the various categories of trait stability are not altered as long as these lineages do not ally with Azoox Stable clades. In the latter case, the gains of stable photosymbiosis are Jurassic in origin. Our results regarding the stability of photosymbiosis could be compromised if azooxanthellate lineages were pruned from Zoox Stable clades. This, however, is unlikely. Other than Agariciidae, Oculinidae, Rhizangiidae, and *Madracis*, no extinct zooxanthellate families show close affinities with azooxanthellate families. Given that morphological characters have proved more in line with molecular characters in inferring evolution relationships among azooxanthellate corals (Kitahara et al., 2016), it is unlikely that unwarranted taxonomic separation of azooxanthellate and zooxanthellate lineages have led us to miss instances of azooxanthellate lineages being pruned from zooxanthellate clades.

Taken together these results suggest the following scenario. The ancestral state of Scleractinia was most likely azooxanthellate with no propensity for the evolution of photosymbiosis (Azoox Stable). Deep in the evolutionary history of the order, three separate transitions to Azoox Labile occurred which represent the evolution of some necessary trait that precedes the evolution of photosymbiosis. Zooxanthellate corals descending from these three separate transitions may form and mediate photosymbiosis in distinct ways. Obligate photosymbiosis (Zoox Stable) evolved independently multiple times which suggests that there are multiple pathways towards the evolution of obligate dependence on photosymbiosis. Finally, we find that several small clades evince extremely high rates of gain and loss of photosymbiosis (Zoox Volatile). Almost all facultative corals are found in these clades which suggests that a lack of dependence on photosymbiosis in ecological timescales corresponds to greater evolutionary lability of the trait. These results provide a framework for future comparative studies. Our ancestral state reconstruction can be combined with models of correlated evolution to determine which ecological and organismal traits correlate with the different rate categories. Our identification of extant species in each rate category allows for the selection of model organisms for comparative genomic and molecular approaches to elucidate the proximate mechanisms governing these broad evolutionary patterns.

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Appendix 1

Table of species included in the supertree with corresponding observed state (AZ: Azooxanthellate, Z: Zooxanthellate, F: Facultative) and estimated probability of being in each rate category.

Species	State	Azoox Stable	Zoox Stable	Azoox Labile	Zoox Labile	Azoox Volatile	Zoox Volatile
Acanthastrea brevis	Z	0	0.8098	0	0.1902	0	0.0001
Acanthastrea echinata	Z	0	0.8098	0	0.1902	0	0.0001
Acanthastrea hemprichi	Z	0	0.8098	0	0.1901	0	0.0001
Acanthastrea minuta	Z	0	0.8093	0	0.1903	0	0.0004
Acanthastrea pachysepta	Z	0	0.8099	0	0.1901	0	0
Acanthastrea rotundoflora	Z	0	0.8098	0	0.1902	0	0.0001
Acanthastrea subechinata	Z	0	0.8098	0	0.1901	0	0.0001
Acropora abrolhosensis	Z	0	0.8089	0	0.1908	0	0.0002
Acropora abrotanoides	Z	0	0.8094	0	0.1906	0	0
Acropora aculeus	Z	0	0.8091	0	0.1908	0	0.0001
Acropora acuminata	Z	0	0.8095	0	0.1905	0	0
Acropora anthocercis	Z	0	0.8094	0	0.1905	0	0
Acropora arabensis	Z	0	0.8095	0	0.1905	0	0
Acropora aspera	Z	0	0.8096	0	0.1903	0	0.0001
Acropora austera	Z	0	0.8085	0	0.1913	0	0.0002
Acropora awi	Z	0	0.8094	0	0.1906	0	0
Acropora batunai	Z	0	0.8094	0	0.1906	0	0
Acropora branchi	Z	0	0.8096	0	0.1904	0	0.0001
Acropora bushyensis	Z	0	0.8094	0	0.1906	0	0
Acropora cardenae	Z	0	0.8095	0	0.1905	0	0
Acropora carduus	Z	0	0.8094	0	0.1906	0	0
Acropora caroliniana	Z	0	0.8094	0	0.1905	0	0
Acropora cerealis	Z	0	0.8095	0	0.1905	0	0
Acropora cervicornis	Z	0	0.8091	0	0.1907	0	0.0002
Acropora chesterfieldensis	Z	0	0.8095	0	0.1905	0	0
Acropora clathrata	Z	0	0.8094	0	0.1905	0	0
Acropora cytherea	Z	0	0.8094	0	0.1905	0	0
Acropora dendrum	Z	0	0.8095	0	0.1905	0	0
Acropora derawanensis	Z	0	0.8093	0	0.1906	0	0
Acropora desalwii	Z	0	0.8094	0	0.1905	0	0
Acropora digitifera	Z	0	0.8096	0	0.1904	0	0
Acropora divaricata	Z	0	0.8094	0	0.1905	0	0
Acropora donei	Z	0	0.8087	0	0.191	0	0.0003
Acropora downingi	Z	0	0.8093	0	0.1906	0	0

Acropora echinata	Z	0	0.8088	0	0.1909	0	0.0002
Acropora elegans	Z	0	0.8095	0	0.1905	0	0
Acropora elseyi	Z	0	0.8089	0	0.1908	0	0.0002
Acropora eurystoma	Z	0	0.8095	0	0.1904	0	0.0001
Acropora fastigata	Z	0	0.8096	0	0.1903	0	0
Acropora fenneri	Z	0	0.8095	0	0.1905	0	0
Acropora filiformis	Z	0	0.8093	0	0.1906	0	0
Acropora florida	Z	0	0.8094	0	0.1905	0	0
Acropora gemmifera	Z	0	0.8096	0	0.1904	0	0.0001
Acropora glauca	Z	0	0.8094	0	0.1906	0	0
Acropora globiceps	Z	0	0.8096	0	0.1904	0	0.0001
Acropora gomezi	Z	0	0.8094	0	0.1906	0	0
Acropora grandis	Z	0	0.8094	0	0.1905	0	0
Acropora granulosa	Z	0	0.8094	0	0.1906	0	0
Acropora halmaherae	Z	0	0.8093	0	0.1906	0	0
Acropora hemprichii	Z	0	0.8094	0	0.1906	0	0
Acropora hoeksemai	Z	0	0.8094	0	0.1905	0	0
Acropora horrida	Z	0	0.8093	0	0.1906	0	0
Acropora humilis	Z	0	0.8096	0	0.1904	0	0.0001
Acropora hyacinthus	Z	0	0.8094	0	0.1905	0	0
Acropora indonesia	Z	0	0.8094	0	0.1905	0	0
Acropora intermedia	Z	0	0.8087	0	0.191	0	0.0002
Acropora jacquelineae	Z	0	0.8095	0	0.1905	0	0
Acropora japonica	Z	0	0.8096	0	0.1904	0	0
Acropora kimbeensis	Z	0	0.8095	0	0.1905	0	0
Acropora kirstyae	Z	0	0.8093	0	0.1906	0	0
Acropora kosurini	Z	0	0.8094	0	0.1905	0	0
Acropora lamarcki	Z	0	0.8094	0	0.1906	0	0
Acropora latistella	Z	0	0.8091	0	0.1908	0	0.0001
Acropora listeri	Z	0	0.8093	0	0.1906	0	0
Acropora loisetteae	Z	0	0.8095	0	0.1904	0	0.0001
Acropora lokani	Z	0	0.8095	0	0.1905	0	0
Acropora longicyathus	Z	0	0.8094	0	0.1906	0	0
Acropora loripes	Z	0	0.8095	0	0.1905	0	0
Acropora loveli	Z	0	0.8094	0	0.1906	0	0
Acropora lutkeni	Z	0	0.8095	0	0.1905	0	0
Acropora maryae	Z	0	0.8095	0	0.1905	0	0
Acropora microclados	Z	0	0.8094	0	0.1905	0	0
Acropora microphthalma	Z	0	0.8095	0	0.1905	0	0
Acropora millepora	Z	0	0.8095	0	0.1904	0	0
Acropora minuta	Z	0	0.8095	0	0.1905	0	0
Acropora monticulosa	Z	0	0.8096	0	0.1904	0	0
Acropora multiacuta	Z	0	0.8096	0	0.1904	0	0
Acropora muricata	Z	0	0.8095	0	0.1904	0	0.0001
Acropora nana	Z	0	0.8091	0	0.1908	0	0.0001
Acropora nasuta	Z	0	0.8095	0	0.1905	0	0

Acropora natalensis	Z	0	0.8095	0	0.1905	0	0
Acropora navini	Z	0	0.8094	0	0.1906	0	0
Acropora palmata	Z	0	0.8091	0	0.1907	0	0.0002
Acropora palmerae	Z	0	0.8094	0	0.1906	0	0
Acropora paniculata	Z	0	0.8094	0	0.1905	0	0
Acropora papillare	Z	0	0.8094	0	0.1905	0	0
Acropora parahemprichii	Z	0	0.8085	0	0.1913	0	0.0002
Acropora parapharaonis	Z	0	0.8095	0	0.1905	0	0
Acropora pectinata	Z	0	0.8093	0	0.1906	0	0
Acropora pharaonis	Z	0	0.8095	0	0.1905	0	0
Acropora pichoni	Z	0	0.8095	0	0.1905	0	0
Acropora plumosa	Z	0	0.8096	0	0.1904	0	0
Acropora polystoma	Z	0	0.8093	0	0.1906	0	0
Acropora proximalis	Z	0	0.8093	0	0.1906	0	0
Acropora pulchra	Z	0	0.8096	0	0.1903	0	0.0001
Acropora retusa	Z	0	0.8096	0	0.1904	0	0
Acropora ridzwani	Z	0	0.8096	0	0.1904	0	0
Acropora robusta	Z	0	0.8094	0	0.1906	0	0
Acropora rongelapensis	Z	0	0.8095	0	0.1905	0	0
Acropora roseni	Z	0	0.8095	0	0.1905	0	0
Acropora rudis	Z	0	0.8085	0	0.1913	0	0.0002
Acropora rufa	Z	0	0.8093	0	0.1906	0	0
Acropora russelli	Z	0	0.8095	0	0.1905	0	0
Acropora samoensis	Z	0	0.8096	0	0.1903	0	0
Acropora sarmentosa	Z	0	0.8094	0	0.1905	0	0
Acropora secale	Z	0	0.8095	0	0.1905	0	0
Acropora selago	Z	0	0.8095	0	0.1904	0	0
Acropora seriata	Z	0	0.8095	0	0.1905	0	0
Acropora simplex	Z	0	0.8095	0	0.1905	0	0
Acropora sirikitiae	Z	0	0.8094	0	0.1905	0	0
Acropora solitaryensis	Z	0	0.8095	0	0.1905	0	0
Acropora spathulata	Z	0	0.8094	0	0.1906	0	0
Acropora speciosa	Z	0	0.8094	0	0.1905	0	0
Acropora spicifera	Z	0	0.8095	0	0.1905	0	0
Acropora squarrosa	Z	0	0.8095	0	0.1905	0	0
Acropora striata	Z	0	0.8095	0	0.1904	0	0
Acropora subglabra	Z	0	0.8088	0	0.1909	0	0.0002
Acropora subulata	Z	0	0.8091	0	0.1908	0	0.0001
Acropora suharsonoi	Z	0	0.8094	0	0.1905	0	0
Acropora sukarnoi	Z	0	0.8093	0	0.1906	0	0
Acropora tanegashimensis	Z	0	0.8094	0	0.1905	0	0
Acropora tenella	Z	0	0.8095	0	0.1905	0	0
Acropora tenuis	Z	0	0.8087	0	0.191	0	0.0002
Acropora torihalimeda	Z	0	0.8095	0	0.1905	0	0
Acropora torresiana	Z	0	0.8096	0	0.1904	0	0
Acropora tortuosa	Z	0	0.8094	0	0.1905	0	0
Acropora turaki	Z	0	0.8094	0	0.1906	0	0

Acropora valenciennesi	Z	0	0.8095	0	0.1905	0	0
Acropora valida	Z	0	0.8095	0	0.1905	0	0
Acropora variolosa	Z	0	0.8085	0	0.1913	0	0.0002
Acropora vaughani	Z	0	0.8095	0	0.1904	0	0.0001
Acropora verweyi	Z	0	0.8094	0	0.1906	0	0
Acropora walindii	Z	0	0.8095	0	0.1905	0	0
Acropora willisae	Z	0	0.8094	0	0.1905	0	0
Acropora yongei	Z	0	0.8095	0	0.1905	0	0
Agaricia agaricites	Z	0	0.7405	0	0.2223	0	0.0372
Agaricia fragilis	Z	0	0.7412	0	0.2226	0	0.0362
Agaricia grahamae	Z	0	0.7412	0	0.2226	0	0.0361
Agaricia humilis	Z	0	0.7339	0	0.2211	0	0.045
Agaricia lamarcki	Z	0	0.7412	0	0.2226	0	0.0362
Agaricia tenuifolia	Z	0	0.7405	0	0.2223	0	0.0372
Agaricia undata	Z	0	0.7412	0	0.2226	0	0.0361
Alatotrochus rubescens	AZ	0.9771	0	0.0226	0	0.0003	0
Alveopora allingi	Z	0	0.807	0	0.1918	0	0.0012
Alveopora catalai	Z	0	0.807	0	0.1918	0	0.0012
Alveopora daedalea	Z	0	0.8073	0	0.1915	0	0.0012
Alveopora excelsa	Z	0	0.807	0	0.1917	0	0.0013
Alveopora fenestrata	Z	0	0.8072	0	0.1913	0	0.0016
Alveopora gigas	Z	0	0.807	0	0.1918	0	0.0012
Alveopora japonica	Z	0	0.807	0	0.1918	0	0.0012
Alveopora marionensis	Z	0	0.8072	0	0.1913	0	0.0016
Alveopora minuta	Z	0	0.8074	0	0.1915	0	0.0011
Alveopora ocellata	Z	0	0.8069	0	0.1919	0	0.0012
Alveopora spongiosa	Z	0	0.8073	0	0.1915	0	0.0012
Alveopora tizardi	Z	0	0.807	0	0.1918	0	0.0012
Alveopora verrilliana	Z	0	0.8072	0	0.1913	0	0.0016
Alveopora viridis	Z	0	0.8074	0	0.1915	0	0.0011
Anacropora forbesi	Z	0	0.8092	0	0.1907	0	0.0001
Anacropora matthai	Z	0	0.8093	0	0.1907	0	0
Anacropora pillai	Z	0	0.8093	0	0.1907	0	0
Anacropora puertogalerae	Z	0	0.8093	0	0.1907	0	0
Anacropora reticulata	Z	0	0.8093	0	0.1907	0	0
Anacropora spinosa	Z	0	0.8093	0	0.1907	0	0
Anacropora spumosa	Z	0	0.8093	0	0.1907	0	0
Anomastraea irregularis	Z	0	0.8039	0	0.1875	0	0.0086
Anomocora carinata	AZ	0.9757	0	0.0242	0	0.0001	0
Anomocora fecunda	AZ	0.9756	0	0.0242	0	0.0001	0
Anomocora gigas	AZ	0.9757	0	0.0242	0	0.0001	0
Anomocora marchadi	AZ	0.9757	0	0.0242	0	0.0001	0
Anomocora prolifera	AZ	0.9756	0	0.0242	0	0.0001	0
Anthemiphyllia dentata	AZ	0.964	0	0.0357	0	0.0002	0

Anthemiphyllia frustum	AZ	0.9641	0	0.0358	0	0.0002	0
Anthemiphyllia macrolobata	AZ	0.964	0	0.0357	0	0.0002	0
Anthemiphyllia multidentata	AZ	0.964	0	0.0357	0	0.0003	0
Anthemiphyllia pacifica	AZ	0.9641	0	0.0358	0	0.0002	0
Anthemiphyllia patera	AZ	0.881	0	0.1098	0	0.0092	0
Anthemiphyllia spinifera	AZ	0.8911	0	0.1008	0	0.0082	0
Astrangia atrata	AZ	0.0046	0	0.981	0	0.0143	0
Astrangia browni	AZ	0.0048	0	0.9823	0	0.013	0
Astrangia californica	AZ	0.0039	0	0.9594	0	0.0367	0
Astrangia conferta	AZ	0.0031	0	0.9393	0	0.0576	0
Astrangia costata	AZ	0.0046	0	0.9611	0	0.0343	0
Astrangia dentata	AZ	0.004	0	0.9718	0	0.0242	0
Astrangia equatorialis	AZ	0.0049	0	0.9729	0	0.0222	0
Astrangia haimei	AZ	0.0044	0	0.9651	0	0.0305	0
Astrangia howardi	AZ	0.005	0	0.9856	0	0.0094	0
Astrangia macrodentata	AZ	0.0045	0	0.9807	0	0.0147	0
Astrangia mercatoris	AZ	0.0044	0	0.9679	0	0.0277	0
Astrangia poculata	F	0	0.2513	0	0.0023	0	0.7464
Astrangia rathbuni	AZ	0.0041	0	0.9804	0	0.0155	0
Astrangia solitaria	AZ	0.0045	0	0.9667	0	0.0288	0
Astrangia woodsi	AZ	0.004	0	0.9548	0	0.0412	0
Astrea annuligera	Z	0	0.8099	0	0.1901	0	0
Astrea curta	Z	0	0.8097	0	0.1903	0	0.0001
Astrea devantieri	Z	0	0.8097	0	0.1902	0	0.0001
Astreopora cucullata	Z	0	0.807	0	0.1922	0	0.0008
Astreopora expansa	Z	0	0.8075	0	0.192	0	0.0005
Astreopora gracilis	Z	0	0.8075	0	0.192	0	0.0005
Astreopora incrustans	Z	0	0.8072	0	0.1921	0	0.0007
Astreopora listeri	Z	0	0.8075	0	0.192	0	0.0005
Astreopora macrostoma	Z	0	0.8072	0	0.1919	0	0.0009
Astreopora moretonensis	Z	0	0.8072	0	0.1921	0	0.0007
Astreopora myriophthalma	Z	0	0.8075	0	0.192	0	0.0005
Astreopora ocellata	Z	0	0.8072	0	0.1919	0	0.0009
Astreopora randalli	Z	0	0.8075	0	0.192	0	0.0005
Astreopora scabra	Z	0	0.807	0	0.1922	0	0.0008
Astreopora suggesta	Z	0	0.8075	0	0.192	0	0.0005
Astroides calycularis	AZ	0.0126	0	0.9565	0	0.0309	0
Aulocyathus atlanticus	AZ	0.9647	0	0.0351	0	0.0001	0
Aulocyathus juvenescens	AZ	0.9647	0	0.0352	0	0.0001	0

Aulocyathus matricidus	AZ	0.9647	0	0.0351	0	0.0001	0
Aulocyathus recidivus	AZ	0.9647	0	0.0351	0	0.0001	0
Australocyathus vincentinus	AZ	0.9711	0	0.0279	0	0.001	0
Australogyra zelli	Z	0	0.8099	0	0.19	0	0.0001
Australophyllia wilsoni	Z	0	0.8099	0	0.1901	0	0
Balanophyllia (Balanophyllia) bairdiana	AZ	0.0772	0	0.9125	0	0.0102	0
Balanophyllia (Balanophyllia) bayeri	AZ	0.0719	0	0.9044	0	0.0237	0
Balanophyllia (Balanophyllia) bonaespei	AZ	0.0834	0	0.9046	0	0.012	0
Balanophyllia (Balanophyllia) capensis	AZ	0.0675	0	0.8952	0	0.0374	0
Balanophyllia (Balanophyllia) cedrosensis	AZ	0.0787	0	0.9045	0	0.0167	0
Balanophyllia (Balanophyllia) cellulosa	AZ	0.0809	0	0.9115	0	0.0076	0
Balanophyllia (Balanophyllia) chnous	AZ	0.0684	0	0.9212	0	0.0104	0
Balanophyllia (Balanophyllia) corniculans	AZ	0.0838	0	0.9015	0	0.0147	0
Balanophyllia (Balanophyllia) cornu	AZ	0.0768	0	0.9165	0	0.0067	0
Balanophyllia (Balanophyllia) crassiseptum	AZ	0.073	0	0.8923	0	0.0347	0
Balanophyllia (Balanophyllia) crassitheca	AZ	0.0781	0	0.9118	0	0.01	0
Balanophyllia (Balanophyllia) cumingii	AZ	0.0816	0	0.9109	0	0.0075	0
Balanophyllia (Balanophyllia) cyathoides	AZ	0.0777	0	0.9141	0	0.0082	0
Balanophyllia (Balanophyllia) dentata	AZ	0.07	0	0.9204	0	0.0096	0
Balanophyllia (Balanophyllia) desmophyllioides	AZ	0.0812	0	0.9075	0	0.0113	0
Balanophyllia (Balanophyllia) diademata	AZ	0.09	0	0.8984	0	0.0116	0

Balanophyllia (Balanophyllia) diffusa	AZ	0.0791	0	0.9102	0	0.0107	0
Balanophyllia (Balanophyllia) dilatata	AZ	0.0836	0	0.908	0	0.0084	0
Balanophyllia (Balanophyllia) dineta	AZ	0.0747	0	0.9112	0	0.0141	0
Balanophyllia (Balanophyllia) diomedeae	AZ	0.0819	0	0.9072	0	0.0109	0
Balanophyllia (Balanophyllia) dubia	AZ	0.0761	0	0.891	0	0.0329	0
Balanophyllia (Balanophyllia) elegans	AZ	0.0768	0	0.9165	0	0.0067	0
Balanophyllia (Balanophyllia) europaea	Z	0	0.2607	0	0.0122	0	0.7271
Balanophyllia (Balanophyllia) floridana	AZ	0.0803	0	0.8894	0	0.0303	0
Balanophyllia (Balanophyllia) galapagensis	AZ	0.0647	0	0.9002	0	0.0352	0
Balanophyllia (Balanophyllia) gemma	AZ	0.0737	0	0.9128	0	0.0136	0
Balanophyllia (Balanophyllia) gemmifera	AZ	0.0821	0	0.909	0	0.0089	0
Balanophyllia (Balanophyllia) generatrix	AZ	0.08	0	0.8882	0	0.0318	0
Balanophyllia (Balanophyllia) gigas	AZ	0.0672	0	0.9193	0	0.0136	0
Balanophyllia (Balanophyllia) hadros	AZ	0.0786	0	0.9008	0	0.0206	0
Balanophyllia (Balanophyllia) helenae	AZ	0.0717	0	0.9181	0	0.0102	0
Balanophyllia (Balanophyllia) iwayamaensis	AZ	0.0786	0	0.9145	0	0.0069	0
Balanophyllia (Balanophyllia) japonica	AZ	0.0755	0	0.9152	0	0.0093	0
Balanophyllia (Balanophyllia) kalakauai	AZ	0.0831	0	0.9042	0	0.0127	0
Balanophyllia (Balanophyllia) laysanensis	AZ	0.0723	0	0.9157	0	0.012	0

Balanophyllia (Balanophyllia) malouinensis	AZ	0.0845	0	0.902	0	0.0135	0
Balanophyllia (Balanophyllia) merguiensis	AZ	0.0628	0	0.9181	0	0.0191	0
Balanophyllia (Balanophyllia) palifera	AZ	0.0728	0	0.9209	0	0.0063	0
Balanophyllia (Balanophyllia) parallela	AZ	0.0779	0	0.904	0	0.018	0
Balanophyllia (Balanophyllia) parvula	AZ	0.073	0	0.9054	0	0.0216	0
Balanophyllia (Balanophyllia) profundicella	AZ	0.0823	0	0.9107	0	0.007	0
Balanophyllia (Balanophyllia) rediviva	AZ	0.0787	0	0.9111	0	0.0102	0
Balanophyllia (Balanophyllia) regia	AZ	0.07	0	0.9204	0	0.0096	0
Balanophyllia (Balanophyllia) scabra	AZ	0.0837	0	0.9077	0	0.0086	0
Balanophyllia (Balanophyllia) scabrosa	AZ	0.0796	0	0.9096	0	0.0108	0
Balanophyllia (Balanophyllia) serrata	AZ	0.0792	0	0.902	0	0.0188	0
Balanophyllia (Balanophyllia) spongiosa	AZ	0.0857	0	0.9062	0	0.0081	0
Balanophyllia (Balanophyllia) striata	AZ	0.0779	0	0.9136	0	0.0085	0
Balanophyllia (Balanophyllia) taprobanae	AZ	0.0641	0	0.9215	0	0.0144	0
Balanophyllia (Balanophyllia) tenuis	AZ	0.0793	0	0.9116	0	0.009	0
Balanophyllia (Balanophyllia) thalassae	AZ	0.0738	0	0.9174	0	0.0088	0
Balanophyllia (Balanophyllia) vanderhorsti	AZ	0.0799	0	0.9121	0	0.0081	0
Balanophyllia (Balanophyllia) wellsi	AZ	0.076	0	0.9135	0	0.0105	0
Balanophyllia (Balanophyllia) yongei	AZ	0.0788	0	0.9059	0	0.0154	0

Balanophyllia (Eupsammia) caribbeana	AZ	0.029	0	0.9606	0	0.0104	0
Balanophyllia (Eupsammia) carinata	AZ	0.0289	0	0.9584	0	0.0128	0
Balanophyllia (Eupsammia) imperialis	AZ	0.029	0	0.9601	0	0.0109	0
Balanophyllia (Eupsammia) pittieri	AZ	0.0287	0	0.9578	0	0.0135	0
Balanophyllia (Eupsammia) regalis	AZ	0.0288	0	0.9581	0	0.0131	0
Balanophyllia (Eupsammia) stimpsonii	AZ	0.0291	0	0.9608	0	0.0102	0
Bathelia candida	AZ	0.0006	0	0.2589	0	0.7405	0
Bathycyathus chilensis	AZ	0.9768	0	0.0231	0	0.0002	0
Bathypsammia fallosocialis	AZ	0.0384	0	0.9565	0	0.0051	0
Bathypsammia tintinnabulum	AZ	0.0384	0	0.9565	0	0.0051	0
Bernardpora stutchburyi	Z	0	0.809	0	0.1904	0	0.0006
Blastomussa loyae	Z	0	0.7837	0	0.1675	0	0.0489
Blastomussa merleti	Z	0	0.7837	0	0.1675	0	0.0489
Blastomussa wellsi	Z	0	0.7826	0	0.1673	0	0.05
Blastotrochus nutrix	AZ	0.9787	0	0.0211	0	0.0002	0
Boninastrea boninensis	Z	0	0.8098	0	0.1902	0	0
Bourneotrochus stellulatus	AZ	0.0274	0	0.9524	0	0.0202	0
Cantharellus doederleini	Z	0	0.8042	0	0.1873	0	0.0086
Cantharellus jebbi	Z	0	0.8042	0	0.1873	0	0.0085
Cantharellus noumeae	Z	0	0.8042	0	0.1873	0	0.0086
Caryophyllia (Acanthocyathus) decamera	AZ	0.977	0	0.0228	0	0.0002	0
Caryophyllia (Acanthocyathus) dentata	AZ	0.9748	0	0.025	0	0.0003	0
Caryophyllia (Acanthocyathus) grayi	AZ	0.9735	0	0.0263	0	0.0003	0
Caryophyllia (Acanthocyathus) karubarica	AZ	0.975	0	0.0247	0	0.0003	0
Caryophyllia (Acanthocyathus) quangdongensis	AZ	0.9743	0	0.0256	0	0.0002	0
Caryophyllia (Acanthocyathus) spinicarens	AZ	0.9762	0	0.0236	0	0.0002	0

Caryophyllia (Acanthocyathus) spinigera	AZ	0.9731	0	0.0267	0	0.0003	0
Caryophyllia (Acanthocyathus) unicristata	AZ	0.9768	0	0.023	0	0.0002	0
Caryophyllia (Caryophyllia) abrupta	AZ	0.9748	0	0.0251	0	0.0002	0
Caryophyllia (Caryophyllia) abyssorum	AZ	0.9754	0	0.0244	0	0.0002	0
Caryophyllia (Caryophyllia) alaskensis	AZ	0.9742	0	0.0256	0	0.0002	0
Caryophyllia (Caryophyllia) alberti	AZ	0.9743	0	0.0255	0	0.0002	0
Caryophyllia (Caryophyllia) ambrosia	AZ	0.9758	0	0.024	0	0.0002	0
Caryophyllia (Caryophyllia) antarctica	AZ	0.9752	0	0.0246	0	0.0002	0
Caryophyllia (Caryophyllia) antillarum	AZ	0.9749	0	0.0249	0	0.0002	0
Caryophyllia (Caryophyllia) arnoldi	AZ	0.9763	0	0.0236	0	0.0002	0
Caryophyllia (Caryophyllia) aspera	AZ	0.974	0	0.0257	0	0.0003	0
Caryophyllia (Caryophyllia) atlantica	AZ	0.9758	0	0.024	0	0.0002	0
Caryophyllia (Caryophyllia) balanacea	AZ	0.9753	0	0.0246	0	0.0002	0
Caryophyllia (Caryophyllia) barbadensis	AZ	0.9734	0	0.0263	0	0.0002	0
Caryophyllia (Caryophyllia) berteriana	AZ	0.9765	0	0.0233	0	0.0002	0
Caryophyllia (Caryophyllia) calveri	AZ	0.9758	0	0.024	0	0.0002	0
Caryophyllia (Caryophyllia) cintinculata	AZ	0.9752	0	0.0246	0	0.0002	0
Caryophyllia (Caryophyllia) concreta	AZ	0.9734	0	0.0263	0	0.0002	0
Caryophyllia (Caryophyllia) cornulum	AZ	0.9749	0	0.0249	0	0.0002	0

Caryophyllia (Caryophyllia) corona	AZ	0.9761	0	0.0237	0	0.0002	0
Caryophyllia (Caryophyllia) corrugata	AZ	0.9747	0	0.0251	0	0.0002	0
Caryophyllia (Caryophyllia) crosnieri	AZ	0.9754	0	0.0244	0	0.0002	0
Caryophyllia (Caryophyllia) crypta	AZ	0.9753	0	0.0245	0	0.0002	0
Caryophyllia (Caryophyllia) cyathus	AZ	0.9743	0	0.0254	0	0.0002	0
Caryophyllia (Caryophyllia) diomedeae	AZ	0.9736	0	0.0262	0	0.0002	0
Caryophyllia (Caryophyllia) eltaninae	AZ	0.9738	0	0.0259	0	0.0002	0
Caryophyllia (Caryophyllia) ephyala	AZ	0.973	0	0.0268	0	0.0002	0
Caryophyllia (Caryophyllia) foresti	AZ	0.9763	0	0.0235	0	0.0002	0
Caryophyllia (Caryophyllia) grandis	AZ	0.9768	0	0.023	0	0.0001	0
Caryophyllia (Caryophyllia) hawaiiensis	AZ	0.9742	0	0.0256	0	0.0002	0
Caryophyllia (Caryophyllia) horologium	AZ	0.9732	0	0.0265	0	0.0003	0
Caryophyllia (Caryophyllia) huinayensis	AZ	0.9728	0	0.0269	0	0.0003	0
Caryophyllia (Caryophyllia) inornata	AZ	0.9625	0	0.0359	0	0.0016	0
Caryophyllia (Caryophyllia) japonica	AZ	0.9749	0	0.0249	0	0.0002	0
Caryophyllia (Caryophyllia) jogashimaensis	AZ	0.9749	0	0.0249	0	0.0002	0
Caryophyllia (Caryophyllia) laevigata	AZ	0.9733	0	0.0265	0	0.0002	0
Caryophyllia (Caryophyllia) lamellifera	AZ	0.9731	0	0.0264	0	0.0005	0
Caryophyllia (Caryophyllia) mabahithi	AZ	0.9765	0	0.0234	0	0.0002	0

Caryophyllia (Caryophyllia) marmorea	AZ	0.9753	0	0.0245	0	0.0002	0
Caryophyllia (Caryophyllia) oblonga	AZ	0.9738	0	0.0259	0	0.0003	0
Caryophyllia (Caryophyllia) octonaria	AZ	0.9756	0	0.0242	0	0.0002	0
Caryophyllia (Caryophyllia) octopali	AZ	0.9752	0	0.0246	0	0.0002	0
Caryophyllia (Caryophyllia) paradoxus	AZ	0.9753	0	0.0245	0	0.0002	0
Caryophyllia (Caryophyllia) paucipalata	AZ	0.9745	0	0.0252	0	0.0003	0
Caryophyllia (Caryophyllia) perculta	AZ	0.9737	0	0.026	0	0.0003	0
Caryophyllia (Caryophyllia) planilamellata	AZ	0.9726	0	0.0266	0	0.0008	0
Caryophyllia (Caryophyllia) polygona	AZ	0.9741	0	0.0257	0	0.0002	0
Caryophyllia (Caryophyllia) profunda	AZ	0.9749	0	0.0249	0	0.0002	0
Caryophyllia (Caryophyllia) protei	AZ	0.9748	0	0.025	0	0.0002	0
Caryophyllia (Caryophyllia) quadragenaria	AZ	0.9758	0	0.0239	0	0.0003	0
Caryophyllia (Caryophyllia) ralphae	AZ	0.9741	0	0.0258	0	0.0002	0
Caryophyllia (Caryophyllia) rugosa	AZ	0.9721	0	0.0271	0	0.0007	0
Caryophyllia (Caryophyllia) sarsiae	AZ	0.9751	0	0.0247	0	0.0003	0
Caryophyllia (Caryophyllia) scobinosa	AZ	0.9767	0	0.023	0	0.0003	0
Caryophyllia (Caryophyllia) secta	AZ	0.9749	0	0.0248	0	0.0002	0
Caryophyllia (Caryophyllia) seguenzae	AZ	0.9747	0	0.0252	0	0.0002	0
Caryophyllia (Caryophyllia) sewelli	AZ	0.9742	0	0.0256	0	0.0002	0

Caryophyllia (Caryophyllia) smithii	AZ	0.9755	0	0.0243	0	0.0002	0
Caryophyllia (Caryophyllia) solida	AZ	0.9748	0	0.025	0	0.0002	0
Caryophyllia (Caryophyllia) squiresi	AZ	0.9752	0	0.0246	0	0.0002	0
Caryophyllia (Caryophyllia) stellula	AZ	0.9723	0	0.0275	0	0.0003	0
Caryophyllia (Caryophyllia) tangaroae	AZ	0.9755	0	0.0243	0	0.0002	0
Caryophyllia (Caryophyllia) transversalis	AZ	0.9768	0	0.023	0	0.0001	0
Caryophyllia (Caryophyllia) valdiviae	AZ	0.9764	0	0.0234	0	0.0002	0
Caryophyllia (Caryophyllia) versicolorata	AZ	0.9777	0	0.0218	0	0.0004	0
Caryophyllia (Caryophyllia) zopyros	AZ	0.9767	0	0.0231	0	0.0002	0
Catalaphyllia jardinei	Z	0	0.8096	0	0.1903	0	0.0002
Caulastraea connata	Z	0	0.8097	0	0.1902	0	0
Caulastraea curvata	Z	0	0.8097	0	0.1902	0	0
Caulastraea echinulata	Z	0	0.8097	0	0.1902	0	0
Caulastraea furcata	Z	0	0.8097	0	0.1902	0	0
Caulastraea tumida	Z	0	0.8097	0	0.1902	0	0
Ceratotrochus franciscana	AZ	0.9647	0	0.0352	0	0.0002	0
Ceratotrochus laxus	AZ	0.9647	0	0.0351	0	0.0002	0
Ceratotrochus magnaghii	AZ	0.9647	0	0.0352	0	0.0002	0
Cladangia exusta	AZ	0.0077	0	0.9816	0	0.0107	0
Cladocora arbuscula	Z	0	0.3127	0	0.0078	0	0.6795
Cladocora caespitosa	Z	0	0.3127	0	0.0078	0	0.6795
Cladocora debilis	AZ	0.0041	0	0.8268	0	0.1691	0
Cladocora pacifica	AZ	0.0041	0	0.8268	0	0.1691	0
Cladopsammia echinata	AZ	0.013	0	0.981	0	0.006	0
Cladopsammia eguchii	AZ	0.0129	0	0.9809	0	0.0061	0
Cladopsammia gracilis	AZ	0.013	0	0.9813	0	0.0057	0
Cladopsammia manuelensis	AZ	0.013	0	0.9813	0	0.0058	0
Cladopsammia rolandi	AZ	0.0129	0	0.9809	0	0.0061	0

Cladopsammia willeyi	AZ	0.013	0	0.9816	0	0.0055	0
Coelastrea aspera	Z	0	0.81	0	0.19	0	0.0001
Coelastrea palauensis	Z	0	0.8097	0	0.1902	0	0.0001
Coeloseris mayeri	Z	0	0.7603	0	0.2366	0	0.0031
Coenocyathus anthophyllites	AZ	0.9747	0	0.0252	0	0.0001	0
Coenocyathus bowersi	AZ	0.9747	0	0.0252	0	0.0001	0
Coenocyathus brooki	AZ	0.9747	0	0.0252	0	0.0001	0
Coenocyathus caribbeana	AZ	0.9746	0	0.0252	0	0.0001	0
Coenocyathus cylindricus	AZ	0.9747	0	0.0252	0	0.0001	0
Coenocyathus goreaui	AZ	0.9746	0	0.0252	0	0.0001	0
Coenocyathus humanni	AZ	0.9747	0	0.0252	0	0.0002	0
Coenocyathus parvulus	AZ	0.9747	0	0.0252	0	0.0001	0
Coenosmilia arbuscula	AZ	0.9757	0	0.0241	0	0.0002	0
Coenosmilia inordinata	AZ	0.9757	0	0.0241	0	0.0002	0
Colangia immersa	AZ	0.0107	0	0.9668	0	0.0224	0
Colangia jamaicaensis	AZ	0.0107	0	0.9668	0	0.0224	0
Colangia moseleyi	AZ	0.0107	0	0.9668	0	0.0225	0
Colangia multipalifera	AZ	0.0107	0	0.9668	0	0.0225	0
Colpophyllia natans	Z	0	0.8098	0	0.1901	0	0
Concentrotheca laevigata	AZ	0.9765	0	0.0234	0	0.0002	0
Concentrotheca vaughani	AZ	0.9765	0	0.0234	0	0.0002	0
Confluphyllia juncta	AZ	0.9744	0	0.0254	0	0.0002	0
Conocyathus formosus	AZ	0.9848	0	0.0151	0	0.0001	0
Conocyathus gracilis	AZ	0.9848	0	0.0151	0	0.0001	0
Conocyathus zelandiae	AZ	0.9848	0	0.0151	0	0.0001	0
Conotrochus asymmetros	AZ	0.9647	0	0.0352	0	0.0001	0
Conotrochus brunneus	AZ	0.9647	0	0.0352	0	0.0001	0
Conotrochus funicolumna	AZ	0.9647	0	0.0352	0	0.0001	0
Coscinaraea columna	Z	0	0.8099	0	0.1887	0	0.0014
Coscinaraea crassa	Z	0	0.81	0	0.1887	0	0.0013
Coscinaraea exesa	Z	0	0.8099	0	0.1887	0	0.0014
Coscinaraea hahazimaensis	Z	0	0.8099	0	0.1887	0	0.0014
Coscinaraea marshae	Z	0	0.81	0	0.1887	0	0.0013

Coscinaraea mcneilli	Z	0	0.81	0	0.1887	0	0.0013
Coscinaraea monile	Z	0	0.81	0	0.1887	0	0.0013
Craterastrea levis	Z	0	0.8094	0	0.1887	0	0.0019
Crispatotrochus cornu	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus curvatus	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus foxi	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus galapagensis	AZ	0.9794	0	0.0206	0	0.0001	0
Crispatotrochus gregarius	AZ	0.9793	0	0.0206	0	0.0001	0
Crispatotrochus inornatus	AZ	0.9793	0	0.0206	0	0.0001	0
Crispatotrochus irregularis	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus niinoi	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus rubescens	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus rugosus	AZ	0.9793	0	0.0206	0	0.0001	0
Crispatotrochus septumdentatus	AZ	0.9794	0	0.0205	0	0.0001	0
Crispatotrochus squiresi	AZ	0.9794	0	0.0206	0	0.0001	0
Crispatotrochus woodsi	AZ	0.9793	0	0.0206	0	0.0001	0
Cryptotrochus brevipalus	AZ	0.9748	0	0.0251	0	0.0001	0
Cryptotrochus carolinensis	AZ	0.9748	0	0.0251	0	0.0001	0
Cryptotrochus javanus	AZ	0.9748	0	0.0251	0	0.0001	0
Ctenactis albitentaculata	Z	0	0.8096	0	0.1899	0	0.0005
Ctenactis crassa	Z	0	0.8095	0	0.1899	0	0.0005
Ctenactis echinata	Z	0	0.8095	0	0.1899	0	0.0005
Ctenella chagius	Z	0	0.8084	0	0.1911	0	0.0006
Culicia australiensis	AZ	0.0089	0	0.9869	0	0.0042	0
Culicia cuticulata	AZ	0.0089	0	0.9873	0	0.0039	0
Culicia excavata	AZ	0.0089	0	0.987	0	0.0041	0
Culicia fragilis	AZ	0.0089	0	0.9875	0	0.0036	0
Culicia hoffmeisteri	AZ	0.0088	0	0.9868	0	0.0043	0
Culicia quinaria	AZ	0.0088	0	0.9871	0	0.0041	0
Culicia rachelfitzhardingeae	AZ	0.0089	0	0.9872	0	0.0039	0
Culicia rubeola	AZ	0.0089	0	0.9869	0	0.0043	0
Culicia smithii	AZ	0.0089	0	0.9871	0	0.0041	0
Culicia stellata	AZ	0.0089	0	0.9874	0	0.0037	0
Culicia subaustraliensis	AZ	0.0089	0	0.9871	0	0.004	0
Culicia tenella	AZ	0.0089	0	0.9867	0	0.0044	0
Culicia tenuisepes	AZ	0.0088	0	0.9871	0	0.0041	0
Cyathelia axillaris	AZ	0.0258	0	0.9472	0	0.027	0
Cyathotrochus nascornatus	AZ	0.9724	0	0.0275	0	0.0001	0

Cyathotrochus pileus	AZ	0.9724	0	0.0275	0	0.0001	0
Cycloseris costulata	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris curvata	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris cyclolites	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris distorta	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris explanulata	Z	0	0.8097	0	0.19	0	0.0003
Cycloseris fragilis	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris mokai	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris sinensis	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris somervillei	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris tenuis	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris vaughani	Z	0	0.8098	0	0.19	0	0.0002
Cycloseris wellsi	Z	0	0.8097	0	0.19	0	0.0003
Cylicia inflata	AZ	0.0084	0	0.9791	0	0.0125	0
Cynarina lacrymalis	Z	0	0.8097	0	0.1902	0	0.0001
Cynarina macassarensis	Z	0	0.8097	0	0.1902	0	0.0001
Cyphastrea agassizi	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea chalcidicum	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea decadia	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea hexasepta	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea japonica	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea microphthalma	Z	0	0.8094	0	0.1904	0	0.0002
Cyphastrea ocellina	Z	0	0.8093	0	0.1903	0	0.0003
Cyphastrea serailia	Z	0	0.8094	0	0.1904	0	0.0002
Dactylotrochus cervicornis	AZ	0.1038	0	0.7554	0	0.1409	0
Danafungia horrida	Z	0	0.8099	0	0.19	0	0.0001
Danafungia scruposa	Z	0	0.8099	0	0.19	0	0.0001
Dasmosmilia lymani	AZ	0.9766	0	0.0232	0	0.0002	0
Dasmosmilia variegata	AZ	0.9766	0	0.0232	0	0.0002	0
Deltocyathoides orientalis	AZ	0.9724	0	0.0275	0	0.0001	0
Deltocyathoides stimpsonii	AZ	0.9724	0	0.0275	0	0.0001	0
Deltocyathus agassizi	AZ	0.9579	0	0.0417	0	0.0004	0
Deltocyathus andamanicus	AZ	0.9596	0	0.0401	0	0.0004	0
Deltocyathus calcar	AZ	0.9584	0	0.0412	0	0.0004	0
Deltocyathus cameratus	AZ	0.9588	0	0.0408	0	0.0004	0
Deltocyathus corrugatus	AZ	0.9607	0	0.039	0	0.0003	0
Deltocyathus crassiseptum	AZ	0.9589	0	0.0407	0	0.0004	0
Deltocyathus eccentricus	AZ	0.9577	0	0.0418	0	0.0005	0

Deltocyathus halianthus	AZ	0.9571	0	0.0424	0	0.0004	0
Deltocyathus heteroclitus	AZ	0.9589	0	0.0408	0	0.0003	0
Deltocyathus inusitiatus	AZ	0.9583	0	0.0415	0	0.0002	0
Deltocyathus italicus	AZ	0.9735	0	0.0263	0	0.0002	0
Deltocyathus magnificus	AZ	0.9715	0	0.0279	0	0.0006	0
Deltocyathus moseleyi	AZ	0.9599	0	0.0397	0	0.0003	0
Deltocyathus murrayi	AZ	0.9581	0	0.0415	0	0.0004	0
Deltocyathus nascornatus	AZ	0.9587	0	0.0409	0	0.0004	0
Deltocyathus ornatus	AZ	0.958	0	0.0414	0	0.0006	0
Deltocyathus parvulus	AZ	0.9588	0	0.0408	0	0.0004	0
Deltocyathus philippinensis	AZ	0.9574	0	0.0423	0	0.0003	0
Deltocyathus pourtalesi	AZ	0.9586	0	0.041	0	0.0004	0
Deltocyathus rotulus	AZ	0.9583	0	0.0415	0	0.0002	0
Deltocyathus sarsi	AZ	0.9583	0	0.0415	0	0.0002	0
Deltocyathus stella	AZ	0.9578	0	0.0418	0	0.0004	0
Deltocyathus suluensis	AZ	0.9582	0	0.0414	0	0.0004	0
Deltocyathus taiwanicus	AZ	0.9597	0	0.04	0	0.0003	0
Deltocyathus varians	AZ	0.9597	0	0.0399	0	0.0004	0
Deltocyathus vaughani	AZ	0.9587	0	0.0409	0	0.0004	0
Dendrogyra cylindrus	Z	0	0.2183	0	0.0208	0	0.7609
Dendrophyllia aculeata	AZ	0.0146	0	0.9802	0	0.0053	0
Dendrophyllia alcocki	AZ	0.0144	0	0.9808	0	0.0048	0
Dendrophyllia alternata	AZ	0.0144	0	0.9811	0	0.0045	0
Dendrophyllia arbuscula	AZ	0.0146	0	0.9809	0	0.0045	0
Dendrophyllia boschmai	AZ	0.0144	0	0.9805	0	0.0051	0
Dendrophyllia californica	AZ	0.0144	0	0.9805	0	0.0051	0
Dendrophyllia carleenae	AZ	0.0145	0	0.9807	0	0.0048	0
Dendrophyllia cecilliana	AZ	0.0141	0	0.9713	0	0.0146	0
Dendrophyllia cladonia	AZ	0.0146	0	0.9811	0	0.0043	0
Dendrophyllia cornigera	AZ	0.0146	0	0.981	0	0.0044	0

Dendrophyllia cribrosa	AZ	0.0145	0	0.981	0	0.0045	0
Dendrophyllia dilatata	AZ	0.0144	0	0.9805	0	0.005	0
Dendrophyllia florulenta	AZ	0.0144	0	0.9807	0	0.0049	0
Dendrophyllia futojiku	AZ	0.0146	0	0.9809	0	0.0044	0
Dendrophyllia granosa	AZ	0.0145	0	0.98	0	0.0056	0
Dendrophyllia ijimai	AZ	0.0145	0	0.9813	0	0.0042	0
Dendrophyllia incisa	AZ	0.0146	0	0.981	0	0.0043	0
Dendrophyllia indica	AZ	0.0145	0	0.981	0	0.0045	0
Dendrophyllia johnsoni	AZ	0.0144	0	0.9811	0	0.0044	0
Dendrophyllia laboreli	AZ	0.0146	0	0.9807	0	0.0047	0
Dendrophyllia minima	AZ	0.0146	0	0.9807	0	0.0047	0
Dendrophyllia minuscula	AZ	0.0145	0	0.9805	0	0.005	0
Dendrophyllia oldroydae	AZ	0.0145	0	0.9809	0	0.0047	0
Dendrophyllia paragracilis	AZ	0.0146	0	0.981	0	0.0044	0
Dendrophyllia radians	AZ	0.0146	0	0.9809	0	0.0045	0
Dendrophyllia ramea	AZ	0.0145	0	0.9809	0	0.0046	0
Dendrophyllia robusta	AZ	0.0146	0	0.9807	0	0.0047	0
Dendrophyllia suprarbuscula	AZ	0.0146	0	0.9809	0	0.0045	0
Dendrophyllia velata	AZ	0.0145	0	0.9801	0	0.0054	0
Desmophyllum dianthus	AZ	0.9737	0	0.0262	0	0.0001	0
Desmophyllum quinarium	AZ	0.9737	0	0.0262	0	0.0001	0
Desmophyllum striatum	AZ	0.9737	0	0.0262	0	0.0001	0
Dichocoenia stokesii	Z	0	0.2558	0	0.0376	0	0.7066
Dichopsammia granulosa	F	0	0.3447	0	0.014	0	0.6413
Diploastrea heliopora	Z	0	0.714	0	0.1608	0	0.1252
Diploria labyrinthiformis	Z	0	0.8098	0	0.1901	0	0.0001
Dipsastraea albida	Z	0	0.8099	0	0.1901	0	0
Dipsastraea amicorum	Z	0	0.8099	0	0.1901	0	0
Dipsastraea danai	Z	0	0.8099	0	0.1901	0	0
Dipsastraea faviaformis	Z	0	0.8097	0	0.1902	0	0.0001

Dipsastraea favus	Z	0	0.8099	0	0.1901	0	0
Dipsastraea helianthoides	Z	0	0.8099	0	0.1901	0	0
Dipsastraea lacuna	Z	0	0.8097	0	0.1902	0	0.0001
Dipsastraea laddi	Z	0	0.8099	0	0.1901	0	0
Dipsastraea laxa	Z	0	0.8099	0	0.1901	0	0
Dipsastraea lizardensis	Z	0	0.8099	0	0.1901	0	0
Dipsastraea maritima	Z	0	0.8098	0	0.1901	0	0.0001
Dipsastraea marshae	Z	0	0.81	0	0.1899	0	0
Dipsastraea matthaii	Z	0	0.8099	0	0.1901	0	0
Dipsastraea maxima	Z	0	0.8099	0	0.1901	0	0.0001
Dipsastraea pallida	Z	0	0.8099	0	0.1901	0	0
Dipsastraea rosaria	Z	0	0.8099	0	0.1901	0	0.0001
Dipsastraea rotumana	Z	0	0.8097	0	0.1902	0	0.0001
Dipsastraea speciosa	Z	0	0.8099	0	0.1901	0	0
Dipsastraea truncata	Z	0	0.8098	0	0.1901	0	0.0001
Dipsastraea veroni	Z	0	0.8099	0	0.1901	0	0.0001
Dipsastraea vietnamensis	Z	0	0.8097	0	0.1902	0	0.0001
Duncanopsammia axifuga	Z	0	0.3077	0	0.0067	0	0.6856
Dunocyathus parasiticus	AZ	0.9837	0	0.0162	0	0.0001	0
Dunocyathus wallaceae	AZ	0.9837	0	0.0162	0	0.0001	0
Echinomorpha nishihirai	Z	0	0.8098	0	0.1901	0	0.0001
Echinophyllia aspera	Z	0	0.8099	0	0.1901	0	0
Echinophyllia costata	Z	0	0.8099	0	0.1901	0	0
Echinophyllia echinata	Z	0	0.8098	0	0.1901	0	0.0001
Echinophyllia echinoporoides	Z	0	0.8098	0	0.1901	0	0
Echinophyllia orpheensis	Z	0	0.8099	0	0.1901	0	0
Echinophyllia patula	Z	0	0.8099	0	0.1901	0	0
Echinophyllia pectinata	Z	0	0.8099	0	0.1901	0	0
Echinopora ashmorensis	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora forskaliana	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora fruticulosa	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora gemmacea	Z	0	0.8098	0	0.1902	0	0.0001
Echinopora hirsutissima	Z	0	0.8098	0	0.1901	0	0.0001

Echinopora horrida	Z	0	0.8098	0	0.1902	0	0.0001
Echinopora irregularis	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora lamellosa	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora mammiformis	Z	0	0.8097	0	0.1902	0	0.0001
Echinopora pacificus	Z	0	0.8098	0	0.1902	0	0.0001
Echinopora robusta	Z	0	0.8098	0	0.1901	0	0.0001
Echinopora taylorae	Z	0	0.8098	0	0.1902	0	0.0001
Echinopora tiranensis	Z	0	0.8098	0	0.1901	0	0.0001
Eguchipsammia cornucopia	AZ	0.0283	0	0.9644	0	0.0073	0
Eguchipsammia fistula	AZ	0.0286	0	0.9638	0	0.0076	0
Eguchipsammia gaditana	AZ	0.0286	0	0.9646	0	0.0068	0
Eguchipsammia japonica	AZ	0.0286	0	0.9641	0	0.0073	0
Eguchipsammia serpentina	AZ	0.0287	0	0.9643	0	0.007	0
Eguchipsammia strigosa	AZ	0.0286	0	0.9639	0	0.0075	0
Eguchipsammia wellsi	AZ	0.0287	0	0.9633	0	0.008	0
Enallopsammia profunda	AZ	0.0054	0	0.9512	0	0.0434	0
Enallopsammia pusilla	AZ	0.0054	0	0.9497	0	0.045	0
Enallopsammia rostrata	AZ	0.0054	0	0.9505	0	0.0441	0
Endocyathopora laticostata	AZ	0.9843	0	0.0155	0	0.0001	0
Endopachys bulbosa	AZ	0.0814	0	0.914	0	0.0046	0
Endopachys grayi	AZ	0.0814	0	0.914	0	0.0046	0
Endopsammia philippensis	AZ	0.0384	0	0.9556	0	0.006	0
Endopsammia pourtalesi	AZ	0.0384	0	0.9555	0	0.0061	0
Endopsammia regularis	AZ	0.0384	0	0.9551	0	0.0066	0
Enigmopora darveliensis	Z	0	0.8071	0	0.1921	0	0.0008
Ericiocyathus echinatus	AZ	0.9673	0	0.0318	0	0.0009	0
Erythrastrea flabellata	Z	0	0.8097	0	0.1902	0	0
Euphyllia ancora	Z	0	0.8073	0	0.1911	0	0.0016
Euphyllia cristata	Z	0	0.8084	0	0.191	0	0.0006
Euphyllia divisa	Z	0	0.8074	0	0.1911	0	0.0016
Euphyllia glabrescens	Z	0	0.8084	0	0.191	0	0.0006
Euphyllia paraancora	Z	0	0.8074	0	0.1911	0	0.0016
Euphyllia paradivisa	Z	0	0.8084	0	0.191	0	0.0006

Euphyllia paraglabrescens	Z	0	0.8084	0	0.191	0	0.0006
Euphyllia yaeyamaensis	Z	0	0.8074	0	0.1911	0	0.0016
Eusmilia fastigiata	Z	0	0.2621	0	0.0382	0	0.6997
Falcatoflabellum raoulensis	AZ	0.9636	0	0.0359	0	0.0004	0
Favia fragum	Z	0	0.8098	0	0.1901	0	0.0001
Favia gravida	Z	0	0.8098	0	0.1901	0	0.0001
Favia leptophylla	Z	0	0.8098	0	0.1901	0	0.0001
Favites abdita	Z	0	0.81	0	0.1899	0	0
Favites acuticollis	Z	0	0.81	0	0.1899	0	0
Favites chinensis	Z	0	0.81	0	0.1899	0	0
Favites colemani	Z	0	0.81	0	0.1899	0	0
Favites complanata	Z	0	0.81	0	0.1899	0	0
Favites flexuosa	Z	0	0.81	0	0.1899	0	0
Favites halicora	Z	0	0.81	0	0.1899	0	0
Favites magnistellata	Z	0	0.81	0	0.1899	0	0.0001
Favites melicerum	Z	0	0.81	0	0.1899	0	0
Favites micropentagonus	Z	0	0.8096	0	0.1903	0	0.0001
Favites paraflexuosus	Z	0	0.81	0	0.19	0	0.0001
Favites pentagona	Z	0	0.8096	0	0.1903	0	0.0001
Favites rotundata	Z	0	0.81	0	0.1899	0	0
Favites spinosa	Z	0	0.81	0	0.1899	0	0
Favites stylifera	Z	0	0.81	0	0.1899	0	0
Favites valenciennesi	Z	0	0.81	0	0.1899	0	0
Favites vasta	Z	0	0.81	0	0.1899	0	0
Flabellum (Flabellum) angustum	AZ	0.9783	0	0.0215	0	0.0002	0
Flabellum (Flabellum) arcuatile	AZ	0.9804	0	0.0195	0	0.0002	0
Flabellum (Flabellum) areum	AZ	0.9786	0	0.0212	0	0.0002	0
Flabellum (Flabellum) atlanticum	AZ	0.9782	0	0.0216	0	0.0002	0
Flabellum (Flabellum) australe	AZ	0.9773	0	0.0226	0	0.0002	0
Flabellum (Flabellum) campanulatum	AZ	0.9783	0	0.0216	0	0.0002	0
Flabellum (Flabellum) chunii	AZ	0.9778	0	0.0221	0	0.0002	0
Flabellum (Flabellum) curvatum	AZ	0.9786	0	0.0212	0	0.0001	0
Flabellum (Flabellum) flexuosum	AZ	0.9789	0	0.0209	0	0.0002	0
Flabellum (Flabellum) floridanum	AZ	0.978	0	0.0217	0	0.0002	0

Flabellum (Flabellum) folkesoni	AZ	0.9806	0	0.0192	0	0.0002	0
Flabellum (Flabellum) gardineri	AZ	0.9769	0	0.023	0	0.0002	0
Flabellum (Flabellum) impensum	AZ	0.9793	0	0.0205	0	0.0002	0
Flabellum (Flabellum) knoxi	AZ	0.9767	0	0.0231	0	0.0002	0
Flabellum (Flabellum) lamellulosum	AZ	0.9807	0	0.0192	0	0.0001	0
Flabellum (Flabellum) magnificum	AZ	0.9802	0	0.0195	0	0.0003	0
Flabellum (Flabellum) ongulense	AZ	0.9783	0	0.0215	0	0.0002	0
Flabellum (Flabellum) patens	AZ	0.9782	0	0.0216	0	0.0002	0
Flabellum (Flabellum) pavoninum	AZ	0.9804	0	0.0195	0	0.0001	0
Flabellum (Flabellum) politum	AZ	0.9785	0	0.0213	0	0.0001	0
Flabellum (Flabellum) thouarsii	AZ	0.9788	0	0.021	0	0.0001	0
Flabellum (Flabellum) transversale	AZ	0.9783	0	0.0215	0	0.0002	0
Flabellum (Flabellum) vaughani	AZ	0.9807	0	0.0192	0	0.0001	0
Flabellum (Ulocyathus) alabastrum	AZ	0.9783	0	0.0215	0	0.0002	0
Flabellum (Ulocyathus) angulare	AZ	0.9784	0	0.0212	0	0.0004	0
Flabellum (Ulocyathus) aotearoa	AZ	0.9784	0	0.0214	0	0.0002	0
Flabellum (Ulocyathus) apertum	AZ	0.9775	0	0.022	0	0.0005	0
Flabellum (Ulocyathus) conuis	AZ	0.9787	0	0.0212	0	0.0002	0
Flabellum (Ulocyathus) daphnense	AZ	0.977	0	0.0228	0	0.0002	0
Flabellum (Ulocyathus) deludens	AZ	0.9794	0	0.0205	0	0.0001	0

Flabellum (Ulocyathus) hoffmeisteri	AZ	0.9779	0	0.022	0	0.0002	0
Flabellum (Ulocyathus) japonicum	AZ	0.9794	0	0.0205	0	0.0001	0
Flabellum (Ulocyathus) lowekeyesi	AZ	0.9789	0	0.0208	0	0.0003	0
Flabellum (Ulocyathus) macandrewi	AZ	0.9781	0	0.0217	0	0.0002	0
Flabellum (Ulocyathus) marcus	AZ	0.9791	0	0.0208	0	0.0002	0
Flabellum (Ulocyathus) marenzelleri	AZ	0.9789	0	0.0209	0	0.0001	0
Flabellum (Ulocyathus) messum	AZ	0.978	0	0.0219	0	0.0002	0
Flabellum (Ulocyathus) moseleyi	AZ	0.9786	0	0.0212	0	0.0002	0
Flabellum (Ulocyathus) sexcostatum	AZ	0.9788	0	0.0211	0	0.0002	0
Flabellum (Ulocyathus) tuthilli	AZ	0.9794	0	0.0205	0	0.0001	0
Foveolocyathus alternans	AZ	0.9844	0	0.0155	0	0.0001	0
Foveolocyathus kitsoni	AZ	0.9844	0	0.0155	0	0.0001	0
Foveolocyathus parkeri	AZ	0.9844	0	0.0155	0	0.0001	0
Foveolocyathus verconis	AZ	0.9844	0	0.0155	0	0.0001	0
Fungia fungites	Z	0	0.8099	0	0.19	0	0.0001
Fungiacyathus (Bathyactis) crispus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) dennanti	AZ	0.9733	0	0.0266	0	0.0001	0
Fungiacyathus (Bathyactis) fissidiscus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) fissilis	AZ	0.9733	0	0.0265	0	0.0002	0
Fungiacyathus (Bathyactis) granulosus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) hydra	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) marenzelleri	AZ	0.9704	0	0.0289	0	0.0007	0

Fungiacyathus (Bathyactis) margaretae	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) pliciseptus	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) pseudostephanus	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) sibogae	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) symmetricus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Bathyactis) turbinolioides	AZ	0.972	0	0.0275	0	0.0005	0
Fungiacyathus (Bathyactis) variegatus	AZ	0.9734	0	0.0264	0	0.0001	0
Fungiacyathus (Fungiacyathus) fragilis	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Fungiacyathus) multicarinatus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Fungiacyathus) paliferus	AZ	0.9733	0	0.0265	0	0.0001	0
Fungiacyathus (Fungiacyathus) pusillus	AZ	0.9656	0	0.0332	0	0.0012	0
Fungiacyathus (Fungiacyathus) sandoi	AZ	0.9734	0	0.0265	0	0.0001	0
Fungiacyathus (Fungiacyathus) stephanus	AZ	0.9734	0	0.0265	0	0.0001	0
Galaxea acrhelia	Z	0	0.8085	0	0.1911	0	0.0004
Galaxea astreata	Z	0	0.8085	0	0.1911	0	0.0004
Galaxea cryptoramosa	Z	0	0.8085	0	0.1911	0	0.0004
Galaxea fascicularis	Z	0	0.8084	0	0.1911	0	0.0005
Galaxea horrescens	Z	0	0.8085	0	0.1911	0	0.0004
Galaxea longisepta	Z	0	0.8085	0	0.1911	0	0.0004
Galaxea paucisepta	Z	0	0.8085	0	0.1911	0	0.0004
Gardineria hawaiiensis	AZ	0.9457	0	0.054	0	0.0003	0
Gardineria minor	AZ	0.9457	0	0.0539	0	0.0003	0
Gardineria paradoxa	AZ	0.9457	0	0.054	0	0.0003	0
Gardineria philippinensis	AZ	0.9457	0	0.0539	0	0.0003	0
Gardineria simplex	AZ	0.9457	0	0.0539	0	0.0004	0
Gardineroseris planulata	Z	0	0.7607	0	0.2348	0	0.0045
Goniastrea columella	Z	0	0.8098	0	0.1902	0	0

Goniastrea edwardsi	Z	0	0.8098	0	0.1902	0	0
Goniastrea favulus	Z	0	0.8098	0	0.1902	0	0
Goniastrea minuta	Z	0	0.8098	0	0.1902	0	0
Goniastrea pectinata	Z	0	0.8098	0	0.1902	0	0
Goniastrea ramosa	Z	0	0.8097	0	0.1902	0	0
Goniastrea retiformis	Z	0	0.8098	0	0.1902	0	0
Goniastrea stelligera	Z	0	0.8097	0	0.1902	0	0
Goniastrea thecata	Z	0	0.81	0	0.19	0	0.0001
Goniocorella dumosa	AZ	0.9744	0	0.0254	0	0.0002	0
Goniopora albiconus	Z	0	0.8093	0	0.1904	0	0.0003
Goniopora burgosi	Z	0	0.8091	0	0.1904	0	0.0005
Goniopora cellulosa	Z	0	0.8094	0	0.1903	0	0.0003
Goniopora ciliatus	Z	0	0.8095	0	0.1903	0	0.0002
Goniopora columna	Z	0	0.8093	0	0.1903	0	0.0004
Goniopora diminuta	Z	0	0.8093	0	0.1903	0	0.0004
Goniopora djiboutiensis	Z	0	0.8092	0	0.1904	0	0.0004
Goniopora eclipsensis	Z	0	0.8093	0	0.1903	0	0.0004
Goniopora fruticosa	Z	0	0.8094	0	0.1903	0	0.0003
Goniopora lobata	Z	0	0.8093	0	0.1904	0	0.0004
Goniopora norfolkensis	Z	0	0.8094	0	0.1903	0	0.0003
Goniopora paliformis	Z	0	0.7511	0	0.1748	0	0.0741
Goniopora palmensis	Z	0	0.8093	0	0.1904	0	0.0003
Goniopora pandoraensis	Z	0	0.8093	0	0.1903	0	0.0004
Goniopora pearsoni	Z	0	0.8093	0	0.1903	0	0.0003
Goniopora pedunculata	Z	0	0.8093	0	0.1904	0	0.0003
Goniopora pendulus	Z	0	0.8093	0	0.1904	0	0.0003
Goniopora planulata	Z	0	0.8093	0	0.1903	0	0.0004
Goniopora polyformis	Z	0	0.8093	0	0.1905	0	0.0003
Goniopora savignyi	Z	0	0.8092	0	0.1904	0	0.0004
Goniopora somaliensis	Z	0	0.8092	0	0.1904	0	0.0004
Goniopora stokesi	Z	0	0.8094	0	0.1903	0	0.0003
Goniopora sultani	Z	0	0.8094	0	0.1904	0	0.0003
Goniopora tenella	Z	0	0.8093	0	0.1903	0	0.0003
Goniopora tenuidens	Z	0	0.8093	0	0.1904	0	0.0003
Guynia annulata	AZ	0.822	0	0.1627	0	0.0153	0
Gyrosmilia interrupta	Z	0	0.8084	0	0.1911	0	0.0006
Halomitra clavator	Z	0	0.8099	0	0.19	0	0.0001
Halomitra pileus	Z	0	0.8099	0	0.19	0	0.0001
Heliofungia actiniformis	Z	0	0.8098	0	0.19	0	0.0002

Heliofungia fralinae	Z	0	0.8098	0	0.19	0	0.0003
Helioseris cucullata	Z	0	0.2885	0	0.1072	0	0.6043
Herpolitha limax	Z	0	0.8096	0	0.1899	0	0.0005
Heterocyathus aequicostatus	F	0	0.0793	0	0.0093	0	0.9115
Heterocyathus alternatus	F	0	0.0867	0	0.0094	0	0.9039
Heterocyathus antoniae	AZ	0.006	0	0.146	0	0.848	0
Heterocyathus hemisphaericus	AZ	0.0062	0	0.1544	0	0.8394	0
Heterocyathus sulcatus	F	0	0.0815	0	0.0123	0	0.9062
Heteropsammia cochlea	F	0	0.1426	0	0.008	0	0.8494
Heteropsammia eupsammides	F	0	0.1523	0	0.0105	0	0.8372
Heteropsammia moretonensis	AZ	0.0016	0	0.2477	0	0.7507	0
Holcotrochus crenulatus	AZ	0.984	0	0.0158	0	0.0001	0
Holcotrochus scriptus	AZ	0.984	0	0.0158	0	0.0001	0
Homophyllia australis	Z	0	0.8097	0	0.1902	0	0.0001
Homophyllia bowerbanki	Z	0	0.8092	0	0.1903	0	0.0004
Hoplangia durotrix	AZ	0.0195	0	0.3514	0	0.6291	0
Horastrea indica	Z	0	0.8039	0	0.1875	0	0.0086
Hydnophora bonsai	Z	0	0.8098	0	0.1901	0	0.0001
Hydnophora exesa	Z	0	0.8098	0	0.1901	0	0.0001
Hydnophora grandis	Z	0	0.8098	0	0.1901	0	0.0001
Hydnophora microconos	Z	0	0.8098	0	0.1901	0	0.0001
Hydnophora pilosa	Z	0	0.8098	0	0.1901	0	0.0001
Hydnophora rigida	Z	0	0.8098	0	0.1901	0	0.0001
Idiotrochus alatus	AZ	0.9837	0	0.0162	0	0.0001	0
Idiotrochus emarciatus	AZ	0.9837	0	0.0162	0	0.0001	0
Idiotrochus kikutii	AZ	0.9837	0	0.0162	0	0.0001	0
Isophyllia rigida	Z	0	0.8095	0	0.1902	0	0.0003
Isophyllia sinuosa	Z	0	0.8098	0	0.1902	0	0.0001
Isopora brueggemanni	Z	0	0.8084	0	0.1914	0	0.0002
Isopora crateriformis	Z	0	0.8085	0	0.1914	0	0.0002
Isopora cuneata	Z	0	0.8085	0	0.1914	0	0.0002
Isopora elizabethensis	Z	0	0.8084	0	0.1914	0	0.0002
Isopora palifera	Z	0	0.8085	0	0.1914	0	0.0002
Isopora togianensis	Z	0	0.8084	0	0.1914	0	0.0003
Javania antarctica	AZ	0.9777	0	0.0221	0	0.0002	0
Javania borealis	AZ	0.9782	0	0.0217	0	0.0002	0
Javania cailleti	AZ	0.9782	0	0.0216	0	0.0002	0
Javania californica	AZ	0.9782	0	0.0216	0	0.0001	0
Javania erhardti	AZ	0.9786	0	0.0212	0	0.0002	0
Javania exserta	AZ	0.9784	0	0.0211	0	0.0005	0

Javania fusca	AZ	0.9638	0	0.0351	0	0.001	0
Javania insignis	AZ	0.9631	0	0.0361	0	0.0008	0
Javania lamprotichum	AZ	0.9792	0	0.0206	0	0.0003	0
Javania pseudoalabastra	AZ	0.9776	0	0.0222	0	0.0002	0
Kionotrochus suteri	AZ	0.9843	0	0.0155	0	0.0001	0
Labyrinthocyathus delicatus	AZ	0.9789	0	0.021	0	0.0001	0
Labyrinthocyathus facetus	AZ	0.9789	0	0.021	0	0.0001	0
Labyrinthocyathus langae	AZ	0.9789	0	0.021	0	0.0001	0
Labyrinthocyathus limatulus	AZ	0.9789	0	0.021	0	0.0001	0
Labyrinthocyathus quaylei	AZ	0.9789	0	0.021	0	0.0001	0
Leptastrea aequalis	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea bewickensis	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea bottae	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea inaequalis	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea pruinosa	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea purpurea	Z	0	0.8099	0	0.19	0	0.0001
Leptastrea transversa	Z	0	0.8099	0	0.19	0	0.0001
Leptopenus antarcticus	AZ	0.9466	0	0.0529	0	0.0005	0
Leptopenus discus	AZ	0.9466	0	0.0529	0	0.0004	0
Leptopenus hypocoelus	AZ	0.9466	0	0.0529	0	0.0005	0
Leptopenus solidus	AZ	0.9466	0	0.0529	0	0.0005	0
Leptopsammia britannica	AZ	0.0394	0	0.9541	0	0.0065	0
Leptopsammia chevalieri	AZ	0.0395	0	0.9546	0	0.0059	0
Leptopsammia columna	AZ	0.0394	0	0.9537	0	0.0068	0
Leptopsammia crassa	AZ	0.0394	0	0.9541	0	0.0065	0
Leptopsammia formosa	AZ	0.0394	0	0.9543	0	0.0063	0
Leptopsammia poculum	AZ	0.0394	0	0.9544	0	0.0062	0
Leptopsammia pruvoti	AZ	0.0395	0	0.9542	0	0.0063	0
Leptopsammia queenslandiae	AZ	0.0395	0	0.9553	0	0.0052	0
Leptopsammia stokesiana	AZ	0.0393	0	0.9545	0	0.0062	0
Leptopsammia trinitatis	AZ	0.0395	0	0.9546	0	0.0059	0
Leptoria irregularis	Z	0	0.8098	0	0.1902	0	0.0001
Leptoria phrygia	Z	0	0.8099	0	0.19	0	0.0001
Leptoseris amitoriensis	Z	0	0.7613	0	0.2359	0	0.0028
Leptoseris cailleti	Z	0	0.7613	0	0.2359	0	0.0028

Leptoseris explanata	Z	0	0.7609	0	0.236	0	0.0031
Leptoseris foliosa	Z	0	0.7609	0	0.2359	0	0.0032
Leptoseris gardineri	Z	0	0.7612	0	0.2359	0	0.0029
Leptoseris hawaiiensis	Z	0	0.761	0	0.2361	0	0.0029
Leptoseris incrustans	Z	0	0.7611	0	0.236	0	0.0029
Leptoseris mycetoseroides	Z	0	0.7609	0	0.2359	0	0.0032
Leptoseris papyracea	Z	0	0.7612	0	0.2359	0	0.0029
Leptoseris scabra	Z	0	0.761	0	0.2361	0	0.0029
Leptoseris solida	Z	0	0.761	0	0.2361	0	0.0028
Leptoseris striata	Z	0	0.761	0	0.2361	0	0.0029
Leptoseris tubulifera	Z	0	0.7613	0	0.2356	0	0.0031
Leptoseris yabei	Z	0	0.7609	0	0.2359	0	0.0032
Letepsammia fissilis	AZ	0.9477	0	0.052	0	0.0003	0
Letepsammia formosissima	AZ	0.9477	0	0.052	0	0.0003	0
Letepsammia franki	AZ	0.9477	0	0.052	0	0.0003	0
Letepsammia superstes	AZ	0.9477	0	0.052	0	0.0003	0
Lissotrochus curvatus	AZ	0.9748	0	0.0251	0	0.0001	0
Lithophyllon concinna	Z	0	0.8097	0	0.1901	0	0.0002
Lithophyllon ranjithi	Z	0	0.8098	0	0.1901	0	0.0002
Lithophyllon repanda	Z	0	0.8097	0	0.1901	0	0.0002
Lithophyllon scabra	Z	0	0.8098	0	0.1901	0	0.0002
Lithophyllon spinifer	Z	0	0.8097	0	0.1901	0	0.0002
Lithophyllon undulatum	Z	0	0.8098	0	0.1901	0	0.0002
Lobactis scutaria	Z	0	0.8098	0	0.19	0	0.0001
Lobophyllia agaricia	Z	0	0.8099	0	0.1901	0	0
Lobophyllia corymbosa	Z	0	0.8099	0	0.1901	0	0.0001
Lobophyllia dentata	Z	0	0.8099	0	0.1901	0	0
Lobophyllia diminuta	Z	0	0.8099	0	0.1901	0	0
Lobophyllia erythraea	Z	0	0.8099	0	0.1901	0	0
Lobophyllia flabelliformis	Z	0	0.8099	0	0.1901	0	0
Lobophyllia hassi	Z	0	0.8099	0	0.1901	0	0
Lobophyllia hataii	Z	0	0.8099	0	0.1901	0	0
Lobophyllia hemprichii	Z	0	0.8099	0	0.1901	0	0
Lobophyllia ishigakiensis	Z	0	0.8097	0	0.1901	0	0.0002
Lobophyllia radians	Z	0	0.8099	0	0.1901	0	0
Lobophyllia recta	Z	0	0.8099	0	0.1901	0	0
Lobophyllia robusta	Z	0	0.8099	0	0.1901	0	0

Lobophyllia rowleyensis	Z	0	0.8098	0	0.1901	0	0.0001
Lobophyllia serrata	Z	0	0.8099	0	0.1901	0	0
Lobophyllia valenciennesii	Z	0	0.8099	0	0.1901	0	0
Lobophyllia vitiensis	Z	0	0.8097	0	0.1902	0	0.0001
Lochmaeotrochus gardineri	AZ	0.9647	0	0.0352	0	0.0002	0
Lochmaeotrochus oculeus	AZ	0.9647	0	0.0352	0	0.0002	0
Lophelia pertusa	AZ	0.9726	0	0.0268	0	0.0006	0
Machadoporites tantillus	Z	0	0.8029	0	0.1889	0	0.0082
Madracis asanoi	F	0	0.0922	0	0.0047	0	0.9031
Madracis asperula	AZ	0.0014	0	0.106	0	0.8926	0
Madracis auretenra	Z	0	0.1067	0	0.0063	0	0.887
Madracis brueggemanni	AZ	0.016	0	0.9325	0	0.0515	0
Madracis carmabi	Z	0	0.1404	0	0.013	0	0.8466
Madracis decactis	Z	0	0.1419	0	0.0113	0	0.8469
Madracis formosa	Z	0	0.1636	0	0.0156	0	0.8208
Madracis fragilis	AZ	0.0159	0	0.9323	0	0.0518	0
Madracis hellana	AZ	0.0158	0	0.9304	0	0.0538	0
Madracis kauaiensis	AZ	0.0155	0	0.9249	0	0.0595	0
Madracis kirbyi	Z	0	0.1419	0	0.0113	0	0.8469
Madracis myriaster	AZ	0.0156	0	0.9373	0	0.0471	0
Madracis pharensis	F	0	0.1384	0	0.0111	0	0.8505
Madracis profunda	AZ	0.0155	0	0.9157	0	0.0688	0
Madracis senaria	Z	0	0.1962	0	0.0211	0	0.7827
Madrepora arbuscula	AZ	0.7649	0	0.2333	0	0.0018	0
Madrepora carolina	AZ	0.7649	0	0.2335	0	0.0016	0
Madrepora minutiseptum	AZ	0.7649	0	0.2335	0	0.0016	0
Madrepora oculata	AZ	0.7649	0	0.2335	0	0.0017	0
Madrepora porcellana	AZ	0.7649	0	0.2335	0	0.0016	0
Manicina areolata	Z	0	0.8098	0	0.1901	0	0
Meandrina brasiliensis	Z	0	0.3072	0	0.0552	0	0.6376
Meandrina danae	Z	0	0.3072	0	0.0552	0	0.6376
Meandrina meandrites	Z	0	0.2621	0	0.0382	0	0.6997
Merulina ampliata	Z	0	0.8098	0	0.1902	0	0
Merulina scabricula	Z	0	0.8098	0	0.1902	0	0
Merulina scheeri	Z	0	0.8098	0	0.1902	0	0
Merulina triangularis	Z	0	0.8098	0	0.1902	0	0
Micromussa amakusensis	Z	0	0.8093	0	0.1903	0	0.0004
Micromussa lordhowensis	Z	0	0.8098	0	0.1901	0	0.0001
Micromussa multipunctata	Z	0	0.8093	0	0.1903	0	0.0004
Micromussa regularis	Z	0	0.8097	0	0.1902	0	0.0001

Monohedotrochus capitolii	AZ	0.0605	0	0.9308	0	0.0087	0
Monohedotrochus circularis	AZ	0.0605	0	0.9313	0	0.0082	0
Monohedotrochus epithecatus	AZ	0.0605	0	0.9316	0	0.0079	0
Monomyces pygmaea	AZ	0.9808	0	0.0191	0	0.0001	0
Monomyces rubrum	AZ	0.9808	0	0.0191	0	0.0001	0
Montastraea cavernosa	Z	0	0.7764	0	0.1789	0	0.0447
Montigyra kenti	Z	0	0.8084	0	0.1911	0	0.0006
Montipora aequituberculata	Z	0	0.8093	0	0.1907	0	0.0001
Montipora altasepta	Z	0	0.8093	0	0.1907	0	0.0001
Montipora angulata	Z	0	0.8093	0	0.1907	0	0
Montipora aspergillus	Z	0	0.8087	0	0.1912	0	0.0001
Montipora australiensis	Z	0	0.8089	0	0.1909	0	0.0002
Montipora cactus	Z	0	0.8092	0	0.1907	0	0.0001
Montipora calcarea	Z	0	0.8088	0	0.1911	0	0.0001
Montipora caliculata	Z	0	0.8087	0	0.1912	0	0.0001
Montipora capitata	Z	0	0.8093	0	0.1907	0	0
Montipora capricornis	Z	0	0.8092	0	0.1907	0	0.0001
Montipora cebuensis	Z	0	0.8089	0	0.191	0	0.0001
Montipora circumvallata	Z	0	0.8091	0	0.1908	0	0.0001
Montipora cocosensis	Z	0	0.8085	0	0.1914	0	0.0001
Montipora confusa	Z	0	0.8093	0	0.1907	0	0
Montipora corbettensis	Z	0	0.8087	0	0.1912	0	0.0001
Montipora crassituberculata	Z	0	0.8088	0	0.1911	0	0.0001
Montipora cryptus	Z	0	0.8092	0	0.1908	0	0.0001
Montipora danae	Z	0	0.8093	0	0.1907	0	0
Montipora delicatula	Z	0	0.8093	0	0.1907	0	0.0001
Montipora digitata	Z	0	0.8088	0	0.1911	0	0.0001
Montipora dilatata	Z	0	0.8093	0	0.1907	0	0
Montipora echinata	Z	0	0.8088	0	0.1912	0	0.0001
Montipora efflorescens	Z	0	0.8093	0	0.1907	0	0.0001
Montipora effusa	Z	0	0.8087	0	0.1912	0	0.0001
Montipora flabellata	Z	0	0.8093	0	0.1907	0	0
Montipora florida	Z	0	0.8092	0	0.1907	0	0.0001
Montipora floweri	Z	0	0.8087	0	0.1912	0	0.0001
Montipora foliosa	Z	0	0.8093	0	0.1907	0	0.0001
Montipora foveolata	Z	0	0.8087	0	0.1912	0	0.0001
Montipora friabilis	Z	0	0.8086	0	0.1913	0	0.0001
Montipora gaimardi	Z	0	0.8093	0	0.1907	0	0
Montipora grisea	Z	0	0.809	0	0.1909	0	0.0001

Montipora hemispherica	Z	0	0.809	0	0.1909	0	0.0001
Montipora hispida	Z	0	0.8093	0	0.1907	0	0.0001
Montipora hodgsoni	Z	0	0.8089	0	0.191	0	0.0001
Montipora hoffmeisteri	Z	0	0.8088	0	0.1911	0	0.0001
Montipora incrassata	Z	0	0.8091	0	0.1908	0	0.0001
Montipora informis	Z	0	0.8088	0	0.1911	0	0.0001
Montipora kellyi	Z	0	0.8088	0	0.1911	0	0.0001
Montipora mactanensis	Z	0	0.8084	0	0.1915	0	0.0001
Montipora malampaya	Z	0	0.809	0	0.191	0	0.0001
Montipora meandrina	Z	0	0.8091	0	0.1909	0	0.0001
Montipora millepora	Z	0	0.8089	0	0.1911	0	0.0001
Montipora mollis	Z	0	0.8088	0	0.1911	0	0.0001
Montipora monasteriata	Z	0	0.8089	0	0.191	0	0.0001
Montipora niugini	Z	0	0.8088	0	0.1911	0	0.0001
Montipora nodosa	Z	0	0.8087	0	0.1912	0	0.0001
Montipora orientalis	Z	0	0.8087	0	0.1912	0	0.0001
Montipora pachytuberculata	Z	0	0.809	0	0.1909	0	0.0001
Montipora palawanensis	Z	0	0.8089	0	0.191	0	0.0001
Montipora patula	Z	0	0.8093	0	0.1907	0	0
Montipora peltiformis	Z	0	0.8093	0	0.1907	0	0.0001
Montipora porites	Z	0	0.8091	0	0.1908	0	0.0001
Montipora samarensis	Z	0	0.8092	0	0.1907	0	0.0001
Montipora saudii	Z	0	0.8087	0	0.1912	0	0.0001
Montipora setosa	Z	0	0.8086	0	0.1913	0	0.0001
Montipora spongiosa	Z	0	0.8089	0	0.1911	0	0.0001
Montipora spongodes	Z	0	0.8088	0	0.1911	0	0.0001
Montipora spumosa	Z	0	0.8087	0	0.1912	0	0.0001
Montipora stellata	Z	0	0.8093	0	0.1907	0	0.0001
Montipora stilosa	Z	0	0.8089	0	0.191	0	0.0001
Montipora taiwanensis	Z	0	0.8088	0	0.1911	0	0.0001
Montipora tuberculosa	Z	0	0.8087	0	0.1911	0	0.0002
Montipora turgescens	Z	0	0.8093	0	0.1907	0	0
Montipora turtlensis	Z	0	0.8093	0	0.1907	0	0
Montipora undata	Z	0	0.8093	0	0.1907	0	0
Montipora venosa	Z	0	0.8088	0	0.1911	0	0.0001
Montipora verrilli	Z	0	0.8093	0	0.1907	0	0
Montipora verrucosa	Z	0	0.8093	0	0.1907	0	0
Montipora verruculosa	Z	0	0.8089	0	0.191	0	0.0001

Montipora vietnamensis	Z	0	0.8087	0	0.1912	0	0.0001
Moseleya latistellata	Z	0	0.8093	0	0.1903	0	0.0004
Mussa angulosa	Z	0	0.8094	0	0.1902	0	0.0004
Mussismilia braziliensis	Z	0	0.8098	0	0.1901	0	0.0001
Mussismilia harttii	Z	0	0.8098	0	0.1901	0	0.0001
Mussismilia hispida	Z	0	0.8098	0	0.1901	0	0.0001
Mycedium elephantotus	Z	0	0.8098	0	0.1902	0	0
Mycedium mancaoi	Z	0	0.8098	0	0.1902	0	0
Mycedium robokaki	Z	0	0.8098	0	0.1902	0	0
Mycedium spina	Z	0	0.8098	0	0.1902	0	0
Mycedium steeni	Z	0	0.8098	0	0.1902	0	0
Mycedium umbra	Z	0	0.8098	0	0.1902	0	0
Mycetophyllia aliciae	Z	0	0.8098	0	0.1901	0	0.0001
Mycetophyllia danaana	Z	0	0.8098	0	0.1901	0	0.0001
Mycetophyllia ferox	Z	0	0.8098	0	0.1901	0	0.0001
Mycetophyllia lamarckiana	Z	0	0.8098	0	0.1901	0	0.0001
Mycetophyllia reesi	Z	0	0.8098	0	0.1901	0	0.0001
Nemenzophyllia turbida	Z	0	0.802	0	0.1703	0	0.0277
Nomlandia californica	AZ	0.9749	0	0.0249	0	0.0002	0
Notocyathus conicus	AZ	0.9747	0	0.0251	0	0.0002	0
Notocyathus venustus	AZ	0.9747	0	0.0251	0	0.0002	0
Notophyllia etheridgi	AZ	0.0815	0	0.9151	0	0.0034	0
Notophyllia hecki	AZ	0.0815	0	0.915	0	0.0035	0
Notophyllia piscacauda	AZ	0.0815	0	0.915	0	0.0035	0
Notophyllia recta	AZ	0.0815	0	0.9153	0	0.0033	0
Oculina diffusa	F	0	0.0734	0	0.0052	0	0.9214
Oculina patagonica	Z	0	0.0786	0	0.0051	0	0.9163
Oculina profunda	AZ	0.0001	0	0.1039	0	0.896	0
Oculina robusta	Z	0	0.0858	0	0.0056	0	0.9087
Oculina tenella	F	0	0.0707	0	0.0032	0	0.9261
Oculina valenciennesi	Z	0	0.0773	0	0.0047	0	0.9179
Oculina varicosa	F	0	0.0858	0	0.0056	0	0.9087
Oculina virgosa	AZ	0.0001	0	0.1026	0	0.8973	0
Orbicella annularis	Z	0	0.8092	0	0.1904	0	0.0004
Orbicella faveolata	Z	0	0.8092	0	0.1904	0	0.0004
Orbicella franksi	Z	0	0.8092	0	0.1904	0	0.0004
Oulangia bradleyi	AZ	0.0078	0	0.9862	0	0.006	0
Oulangia cyathiformis	AZ	0.0078	0	0.9868	0	0.0054	0
Oulangia stokesiana	AZ	0.0078	0	0.9867	0	0.0055	0
Oulastrea crispata	Z	0	0.1326	0	0.0195	0	0.848
Oulophyllia bennettae	Z	0	0.8097	0	0.1902	0	0
Oulophyllia crispa	Z	0	0.8097	0	0.1902	0	0
Oulophyllia levis	Z	0	0.8097	0	0.1902	0	0

Oxypora convoluta	Z	0	0.8098	0	0.1901	0	0.0001
Oxypora crassispinosa	Z	0	0.8098	0	0.1901	0	0.0001
Oxypora egyptensis	Z	0	0.8098	0	0.1901	0	0.0001
Oxypora glabra	Z	0	0.8098	0	0.1901	0	0.0001
Oxypora lacera	Z	0	0.8098	0	0.1901	0	0.0001
Oxysmilia corrugata	AZ	0.0618	0	0.927	0	0.0111	0
Oxysmilia rotundifolia	AZ	0.0618	0	0.927	0	0.0111	0
Pachyseris foliosa	Z	0	0.8026	0	0.1906	0	0.0067
Pachyseris gemmae	Z	0	0.8029	0	0.1906	0	0.0064
Pachyseris involuta	Z	0	0.8026	0	0.1906	0	0.0067
Pachyseris rugosa	Z	0	0.803	0	0.1906	0	0.0064
Pachyseris speciosa	Z	0	0.8029	0	0.1907	0	0.0064
Palauastrea ramosa	Z	0	0.3718	0	0.0649	0	0.5633
Paraconotrochus antarcticus	AZ	0.9647	0	0.0352	0	0.0001	0
Paraconotrochus capense	AZ	0.9647	0	0.0352	0	0.0001	0
Paraconotrochus zeidleri	AZ	0.9647	0	0.0352	0	0.0001	0
Paracyathus andersoni	AZ	0.0167	0	0.9774	0	0.0059	0
Paracyathus arcuatus	AZ	0.0167	0	0.9784	0	0.0049	0
Paracyathus cavatus	AZ	0.0168	0	0.9783	0	0.0049	0
Paracyathus conceptus	AZ	0.0168	0	0.9784	0	0.0048	0
Paracyathus coronatus	AZ	0.0167	0	0.978	0	0.0052	0
Paracyathus darwinensis	AZ	0.0166	0	0.9775	0	0.0059	0
Paracyathus ebonensis	AZ	0.0166	0	0.9778	0	0.0056	0
Paracyathus fulvus	AZ	0.0165	0	0.9774	0	0.0061	0
Paracyathus indicus	AZ	0.0169	0	0.9781	0	0.005	0
Paracyathus lifuensis	AZ	0.0166	0	0.9778	0	0.0056	0
Paracyathus molokensis	AZ	0.0167	0	0.9778	0	0.0054	0
Paracyathus montereyensis	AZ	0.0166	0	0.9777	0	0.0057	0
Paracyathus parvulus	AZ	0.0168	0	0.9778	0	0.0054	0
Paracyathus persicus	AZ	0.0167	0	0.9774	0	0.0059	0
Paracyathus porcellanus	AZ	0.0168	0	0.9779	0	0.0053	0
Paracyathus profundus	AZ	0.0166	0	0.9785	0	0.0049	0
Paracyathus pruinosus	AZ	0.0167	0	0.9779	0	0.0055	0
Paracyathus pulchellus	AZ	0.0168	0	0.9779	0	0.0053	0
Paracyathus rotundatus	AZ	0.0167	0	0.9781	0	0.0052	0

Paracyathus stearnsii	AZ	0.0167	0	0.9781	0	0.0052	0
Paracyathus stokesii	AZ	0.0168	0	0.9777	0	0.0055	0
Paracyathus vittatus	AZ	0.0167	0	0.9773	0	0.0061	0
Paragoniastrea australensis	Z	0	0.81	0	0.19	0	0.0001
Paragoniastrea deformis	Z	0	0.81	0	0.19	0	0.0001
Paragoniastrea russelli	Z	0	0.81	0	0.19	0	0.0001
Paramontastraea peresi	Z	0	0.81	0	0.19	0	0.0001
Paramontastraea salebrosa	Z	0	0.8096	0	0.1902	0	0.0002
Paramontastraea serageldini	Z	0	0.8097	0	0.1903	0	0.0001
Pavona bipartita	Z	0	0.7607	0	0.238	0	0.0013
Pavona cactus	Z	0	0.7608	0	0.238	0	0.0012
Pavona chiriquiensis	Z	0	0.7607	0	0.238	0	0.0012
Pavona clavus	Z	0	0.7605	0	0.2375	0	0.002
Pavona danai	Z	0	0.7608	0	0.238	0	0.0012
Pavona decussata	Z	0	0.7608	0	0.2381	0	0.0012
Pavona diffluens	Z	0	0.7608	0	0.238	0	0.0012
Pavona duerdeni	Z	0	0.7607	0	0.238	0	0.0012
Pavona explanulata	Z	0	0.7608	0	0.238	0	0.0011
Pavona frondifera	Z	0	0.7608	0	0.238	0	0.0012
Pavona gigantea	Z	0	0.7607	0	0.238	0	0.0012
Pavona maldivensis	Z	0	0.7606	0	0.238	0	0.0014
Pavona minuta	Z	0	0.7609	0	0.238	0	0.0012
Pavona varians	Z	0	0.7604	0	0.2373	0	0.0024
Pavona venosa	Z	0	0.7608	0	0.238	0	0.0012
Pavona xarifae	Z	0	0.7608	0	0.2381	0	0.0011
Pectinia africana	Z	0	0.8098	0	0.1902	0	0
Pectinia alcicornis	Z	0	0.8098	0	0.1902	0	0
Pectinia crassa	Z	0	0.8098	0	0.1902	0	0
Pectinia elongata	Z	0	0.8097	0	0.1902	0	0.0001
Pectinia lactuca	Z	0	0.8098	0	0.1902	0	0
Pectinia maxima	Z	0	0.8098	0	0.1902	0	0
Pectinia paeonia	Z	0	0.8098	0	0.1902	0	0
Pectinia pygmaea	Z	0	0.8097	0	0.1902	0	0.0001
Pectinia teres	Z	0	0.8097	0	0.1902	0	0.0001
Pedicellocyathus keyesi	AZ	0.9735	0	0.0263	0	0.0001	0
Peponocyathus dawsoni	AZ	0.9846	0	0.0153	0	0.0001	0
Peponocyathus folliculus	AZ	0.9846	0	0.0153	0	0.0001	0
Peponocyathus minimus	AZ	0.9846	0	0.0153	0	0.0001	0
Petrophyllia rediviva	AZ	0.0006	0	0.2572	0	0.7421	0
Phacelocyathus flos	AZ	0.0107	0	0.9645	0	0.0247	0
Phyllangia americana	AZ	0.0107	0	0.9572	0	0.0321	0
Phyllangia consagensis	AZ	0.0545	0	0.9394	0	0.0061	0
Phyllangia dispersa	AZ	0.0545	0	0.9387	0	0.0068	0

Phyllangia echinosepes	AZ	0.0545	0	0.9389	0	0.0066	0
Phyllangia granulata	AZ	0.0107	0	0.9573	0	0.032	0
Phyllangia hayamaensis	AZ	0.0545	0	0.9399	0	0.0056	0
Phyllangia papuensis	AZ	0.0545	0	0.9393	0	0.0062	0
Phyllangia pequegnatae	AZ	0.0107	0	0.9571	0	0.0322	0
Physogyra lichtensteini	Z	0	0.8005	0	0.1701	0	0.0294
Physophyllia ayleni	Z	0	0.8098	0	0.1902	0	0
Placotrochides cylindrica	AZ	0.9638	0	0.036	0	0.0002	0
Placotrochides frustum	AZ	0.9638	0	0.036	0	0.0002	0
Placotrochides minuta	AZ	0.9638	0	0.036	0	0.0002	0
Placotrochides scaphula	AZ	0.9638	0	0.036	0	0.0002	0
Placotrochus laevis	AZ	0.9656	0	0.0337	0	0.0007	0
Platygyra acuta	Z	0	0.81	0	0.1899	0	0
Platygyra carnosa	Z	0	0.81	0	0.1899	0	0
Platygyra contorta	Z	0	0.81	0	0.1899	0	0
Platygyra crosslandi	Z	0	0.81	0	0.1899	0	0
Platygyra daedalea	Z	0	0.81	0	0.1899	0	0.0001
Platygyra lamellina	Z	0	0.81	0	0.1899	0	0
Platygyra pini	Z	0	0.81	0	0.1899	0	0
Platygyra ryukyuensis	Z	0	0.81	0	0.1899	0	0
Platygyra sinensis	Z	0	0.81	0	0.19	0	0.0001
Platygyra verweyi	Z	0	0.81	0	0.1899	0	0
Platygyra yaeyamaensis	Z	0	0.81	0	0.1899	0	0
Platytrochus compressus	AZ	0.9846	0	0.0153	0	0.0001	0
Platytrochus hastatus	AZ	0.9846	0	0.0153	0	0.0001	0
Platytrochus laevigatus	AZ	0.9846	0	0.0153	0	0.0001	0
Platytrochus parisepta	AZ	0.9846	0	0.0153	0	0.0001	0
Pleotrochus venustus	AZ	0.9772	0	0.0226	0	0.0002	0
Pleotrochus zibrowii	AZ	0.9772	0	0.0226	0	0.0002	0
Plerogyra cauliformis	Z	0	0.8029	0	0.1704	0	0.0266
Plerogyra diabolotus	Z	0	0.803	0	0.1704	0	0.0266
Plerogyra discus	Z	0	0.803	0	0.1704	0	0.0266
Plerogyra multilobata	Z	0	0.803	0	0.1704	0	0.0266
Plerogyra simplex	Z	0	0.8029	0	0.1704	0	0.0266
Plerogyra sinuosa	Z	0	0.803	0	0.1704	0	0.0266

Plesiastrea versipora	Z	0	0.3491	0	0.0279	0	0.623
Pleuractis granulosa	Z	0	0.8097	0	0.19	0	0.0003
Pleuractis gravis	Z	0	0.8097	0	0.19	0	0.0003
Pleuractis moluccensis	Z	0	0.8097	0	0.19	0	0.0003
Pleuractis paumotensis	Z	0	0.8097	0	0.19	0	0.0003
Pleuractis seychellensis	Z	0	0.8097	0	0.19	0	0.0003
Pleuractis taiwanensis	Z	0	0.8097	0	0.19	0	0.0003
Pocillopora ankeli	Z	0	0.82	0	0.1747	0	0.0053
Pocillopora brevicornis	Z	0	0.8184	0	0.1748	0	0.0068
Pocillopora capitata	Z	0	0.8194	0	0.1739	0	0.0067
Pocillopora damicornis	Z	0	0.8197	0	0.175	0	0.0053
Pocillopora effusa	Z	0	0.8201	0	0.1742	0	0.0057
Pocillopora elegans	Z	0	0.8203	0	0.1745	0	0.0052
Pocillopora fungiformis	Z	0	0.8199	0	0.1739	0	0.0062
Pocillopora grandis	Z	0	0.8197	0	0.175	0	0.0053
Pocillopora indiania	Z	0	0.8195	0	0.1749	0	0.0056
Pocillopora inflata	Z	0	0.8194	0	0.1742	0	0.0064
Pocillopora kelleheri	Z	0	0.8206	0	0.174	0	0.0054
Pocillopora ligulata	Z	0	0.8206	0	0.174	0	0.0054
Pocillopora meandrina	Z	0	0.8196	0	0.175	0	0.0055
Pocillopora molokensis	Z	0	0.8196	0	0.1746	0	0.0058
Pocillopora verrucosa	Z	0	0.8197	0	0.175	0	0.0053
Pocillopora woodjonesi	Z	0	0.8196	0	0.1747	0	0.0057
Pocillopora zelli	Z	0	0.8195	0	0.1748	0	0.0056
Podabacia crustacea	Z	0	0.8099	0	0.19	0	0.0001
Podabacia kunzmanni	Z	0	0.8099	0	0.19	0	0.0001
Podabacia motuporensis	Z	0	0.8099	0	0.19	0	0.0001
Podabacia sinai	Z	0	0.8099	0	0.19	0	0.0001
Polycyathus andamanensis	AZ	0.022	0	0.972	0	0.0059	0
Polycyathus atlanticus	AZ	0.0219	0	0.9713	0	0.0068	0
Polycyathus difficilis	AZ	0.022	0	0.972	0	0.006	0
Polycyathus fulvus	AZ	0.0219	0	0.9714	0	0.0067	0
Polycyathus furanaensis	AZ	0.0221	0	0.9725	0	0.0054	0
Polycyathus fuscomarginatus	AZ	0.0219	0	0.9707	0	0.0074	0

Polycyathus hodgsoni	AZ	0.0221	0	0.9719	0	0.0061	0
Polycyathus hondaensis	AZ	0.0222	0	0.9707	0	0.0071	0
Polycyathus isabela	AZ	0.022	0	0.9718	0	0.0062	0
Polycyathus marigondoni	AZ	0.0221	0	0.9714	0	0.0064	0
Polycyathus mayae	AZ	0.0222	0	0.9716	0	0.0062	0
Polycyathus muellerae	AZ	0.022	0	0.9718	0	0.0062	0
Polycyathus norfolkensis	AZ	0.0221	0	0.9717	0	0.0062	0
Polycyathus octuplus	AZ	0.0221	0	0.9717	0	0.0062	0
Polycyathus palifera	AZ	0.0223	0	0.9709	0	0.0068	0
Polycyathus persicus	AZ	0.0221	0	0.9721	0	0.0058	0
Polycyathus senegalensis	AZ	0.022	0	0.9706	0	0.0074	0
Polycyathus verrilli	AZ	0.022	0	0.9714	0	0.0066	0
Polymyces fragilis	AZ	0.9808	0	0.0191	0	0.0001	0
Polymyces montereyensis	AZ	0.9809	0	0.019	0	0.0001	0
Polymyces wellsi	AZ	0.9808	0	0.019	0	0.0001	0
Polyphyllia novaehiberniae	Z	0	0.8096	0	0.1899	0	0.0005
Polyphyllia talpina	Z	0	0.8096	0	0.1899	0	0.0005
Porites annae	Z	0	0.8096	0	0.1903	0	0.0001
Porites aranetai	Z	0	0.8095	0	0.1904	0	0.0001
Porites arnaudi	Z	0	0.8093	0	0.1906	0	0.0001
Porites astreoides	Z	0	0.8095	0	0.1903	0	0.0002
Porites attenuata	Z	0	0.8094	0	0.1905	0	0.0001
Porites australiensis	Z	0	0.8096	0	0.1904	0	0.0001
Porites baueri	Z	0	0.8091	0	0.1908	0	0.0001
Porites branneri	Z	0	0.8095	0	0.1905	0	0.0001
Porites brighami	Z	0	0.8095	0	0.1904	0	0.0001
Porites cocosensis	Z	0	0.8095	0	0.1904	0	0.0001
Porites colonensis	Z	0	0.8094	0	0.1905	0	0.0001
Porites columnaris	Z	0	0.8095	0	0.1904	0	0.0001
Porites compressa	Z	0	0.8096	0	0.1903	0	0.0001
Porites cylindrica	Z	0	0.8096	0	0.1903	0	0.0001
Porites decasepta	Z	0	0.8094	0	0.1905	0	0.0001
Porites deformis	Z	0	0.8094	0	0.1905	0	0.0001
Porites densa	Z	0	0.8093	0	0.1906	0	0.0001
Porites desilveri	Z	0	0.8095	0	0.1904	0	0.0001
Porites divaricata	Z	0	0.8095	0	0.1905	0	0.0001
Porites duerdeni	Z	0	0.8096	0	0.1903	0	0.0001
Porites echinulata	Z	0	0.8095	0	0.1904	0	0.0001
Porites evermanni	Z	0	0.8096	0	0.1903	0	0.0001
Porites flavus	Z	0	0.8095	0	0.1904	0	0.0001
Porites furcata	Z	0	0.8095	0	0.1905	0	0.0001
Porites harrisoni	Z	0	0.8093	0	0.1906	0	0.0001
Porites heronensis	Z	0	0.8095	0	0.1903	0	0.0002
Porites horizontalata	Z	0	0.8095	0	0.1904	0	0.0001
Porites latistellata	Z	0	0.8095	0	0.1903	0	0.0001
Porites lichen	Z	0	0.8096	0	0.1903	0	0.0001
Porites lobata	Z	0	0.8096	0	0.1903	0	0.0001

Porites lutea	Z	0	0.8097	0	0.1903	0	0.0001
Porites mayeri	Z	0	0.8094	0	0.1905	0	0.0001
Porites monticulosa	Z	0	0.8094	0	0.1905	0	0.0001
Porites murrayensis	Z	0	0.8094	0	0.1905	0	0.0001
Porites myrmidonensis	Z	0	0.8094	0	0.1905	0	0.0001
Porites napopora	Z	0	0.8093	0	0.1906	0	0.0001
Porites negrosensis	Z	0	0.8093	0	0.1906	0	0.0001
Porites nigrescens	Z	0	0.8093	0	0.1906	0	0.0001
Porites nodifera	Z	0	0.8093	0	0.1907	0	0.0001
Porites okinawensis	Z	0	0.8097	0	0.1903	0	0.0001
Porites ornata	Z	0	0.8096	0	0.1903	0	0.0001
Porites panamensis	Z	0	0.8094	0	0.1905	0	0.0001
Porites porites	Z	0	0.8095	0	0.1905	0	0.0001
Porites profundus	Z	0	0.8093	0	0.1906	0	0.0001
Porites pukoensis	Z	0	0.8094	0	0.1905	0	0.0001
Porites randalli	Z	0	0.8096	0	0.1903	0	0.0001
Porites rugosus	Z	0	0.8094	0	0.1905	0	0.0001
Porites rus	Z	0	0.8096	0	0.1903	0	0.0001
Porites sillimaniani	Z	0	0.8095	0	0.1904	0	0.0001
Porites solida	Z	0	0.8097	0	0.1903	0	0.0001
Porites somaliensis	Z	0	0.8093	0	0.1906	0	0.0001
Porites stephensoni	Z	0	0.8095	0	0.1904	0	0.0001
Porites sverdrupi	Z	0	0.8095	0	0.1904	0	0.0002
Porites vaughani	Z	0	0.8095	0	0.1904	0	0.0001
Pourtalocyathus hispidus	AZ	0.9435	0	0.0558	0	0.0007	0
Pourtalopsammia togata	AZ	0.0384	0	0.9564	0	0.0052	0
Pourtalosmilia anthophyllites	AZ	0.9761	0	0.0237	0	0.0002	0
Pourtalosmilia conferta	AZ	0.9761	0	0.0237	0	0.0002	0
Premocyathus cornuformis	AZ	0.9733	0	0.0265	0	0.0002	0
Premocyathus dentiformis	AZ	0.9733	0	0.0265	0	0.0002	0
Psammocora albopicta	Z	0	0.8098	0	0.1888	0	0.0014
Psammocora contigua	Z	0	0.8097	0	0.1888	0	0.0015
Psammocora digitata	Z	0	0.8097	0	0.1888	0	0.0015
Psammocora haimiana	Z	0	0.8098	0	0.1888	0	0.0014
Psammocora nierstraszi	Z	0	0.8098	0	0.1888	0	0.0014
Psammocora profundacella	Z	0	0.8098	0	0.1888	0	0.0014
Psammocora stellata	Z	0	0.8097	0	0.1888	0	0.0015
Psammocora verrilli	Z	0	0.8097	0	0.1888	0	0.0015
Pseudocyathoceras avis	AZ	0.9789	0	0.0205	0	0.0005	0
Pseudodiploria clivosa	Z	0	0.8098	0	0.1901	0	0
Pseudodiploria strigosa	Z	0	0.8098	0	0.1901	0	0

Pseudosiderastrea formosa	Z	0	0.7846	0	0.1793	0	0.0361
Pseudosiderastrea tayamai	Z	0	0.7846	0	0.1793	0	0.0361
Rhizopsammia annae	AZ	0.0136	0	0.9812	0	0.0053	0
Rhizopsammia bermudensis	AZ	0.0136	0	0.9807	0	0.0058	0
Rhizopsammia compacta	AZ	0.0136	0	0.9807	0	0.0057	0
Rhizopsammia goesi	AZ	0.0136	0	0.9813	0	0.0051	0
Rhizopsammia minuta	AZ	0.0136	0	0.9815	0	0.005	0
Rhizopsammia nuda	AZ	0.0136	0	0.9814	0	0.005	0
Rhizopsammia pulchra	AZ	0.0136	0	0.9812	0	0.0052	0
Rhizopsammia verrilli	AZ	0.0136	0	0.9815	0	0.0049	0
Rhizopsammia wellingtoni	AZ	0.0135	0	0.9807	0	0.0058	0
Rhizopsammia wettsteini	AZ	0.0135	0	0.9818	0	0.0047	0
Rhizosmilia elata	AZ	0.0541	0	0.9332	0	0.0127	0
Rhizosmilia gerdae	AZ	0.0107	0	0.966	0	0.0233	0
Rhizosmilia maculata	AZ	0.0107	0	0.966	0	0.0233	0
Rhizosmilia multipalifera	AZ	0.0542	0	0.9377	0	0.0081	0
Rhizosmilia robusta	AZ	0.9741	0	0.0258	0	0.0002	0
Rhizosmilia sagamiensis	AZ	0.0542	0	0.9377	0	0.0081	0
Rhizosmilia valida	AZ	0.9766	0	0.0232	0	0.0002	0
Rhizotrochus flabelliformis	AZ	0.9664	0	0.0335	0	0.0001	0
Rhizotrochus levidensis	AZ	0.9664	0	0.0335	0	0.0001	0
Rhizotrochus tuberculatus	AZ	0.9664	0	0.0335	0	0.0001	0
Rhizotrochus typus	AZ	0.9664	0	0.0335	0	0.0001	0
Rhombopsammia niphada	AZ	0.9478	0	0.0519	0	0.0003	0
Rhombopsammia squiresi	AZ	0.9478	0	0.0519	0	0.0003	0
Sandalolitha dentata	Z	0	0.8099	0	0.19	0	0.0001
Sandalolitha robusta	Z	0	0.8099	0	0.19	0	0.0001
Scapophyllia cylindrica	Z	0	0.8098	0	0.1902	0	0.0001
Schizoculina africana	Z	0	0.0833	0	0.0065	0	0.9102
Schizoculina fissipara	Z	0	0.0833	0	0.0065	0	0.9102
Schizocyathus fissilis	AZ	0.9436	0	0.0558	0	0.0006	0
Sclerhelia hirtella	AZ	0.9734	0	0.026	0	0.0006	0
Sclerophyllia maxima	Z	0	0.8098	0	0.1902	0	0.0001

Scolymia cubensis	Z	0	0.8097	0	0.1902	0	0.0001
Scolymia lacera	Z	0	0.8097	0	0.1902	0	0.0001
Scolymia wellsii	Z	0	0.8097	0	0.1902	0	0.0001
Seriatopora aculeata	Z	0	0.8179	0	0.1717	0	0.0104
Seriatopora caliendrum	Z	0	0.8176	0	0.1717	0	0.0107
Seriatopora dentritica	Z	0	0.818	0	0.1717	0	0.0103
Seriatopora guttata	Z	0	0.818	0	0.1717	0	0.0103
Seriatopora hystrix	Z	0	0.818	0	0.1717	0	0.0103
Seriatopora stellata	Z	0	0.8179	0	0.1717	0	0.0104
Siderastrea glynni	Z	0	0.7957	0	0.183	0	0.0213
Siderastrea radians	Z	0	0.7956	0	0.183	0	0.0214
Siderastrea savignyana	Z	0	0.7926	0	0.1825	0	0.025
Siderastrea siderea	Z	0	0.795	0	0.1829	0	0.022
Siderastrea stellata	Z	0	0.7957	0	0.183	0	0.0213
Simplastrea vesicularis	Z	0	0.8083	0	0.1911	0	0.0006
Sinuorota hexagonalis	Z	0	0.8098	0	0.19	0	0.0002
Solenastrea bournoni	Z	0	0.3862	0	0.0447	0	0.5692
Solenastrea hyades	Z	0	0.1377	0	0.0101	0	0.8522
Solenosmilia variabilis	AZ	0.9735	0	0.0262	0	0.0003	0
Sphenotrochus (Eusthenotrochus) auritus	AZ	0.9854	0	0.0145	0	0.0001	0
Sphenotrochus (Eusthenotrochus) gilchristi	AZ	0.9854	0	0.0145	0	0.0001	0
Sphenotrochus (Sphenotrochus) andrewianus	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) aurantiacus	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) cuneolus	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) evexicostatus	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) excavatus	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) gardineri	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) hancocki	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) imbricaticostatus	AZ	0.9856	0	0.0143	0	0.0001	0

Sphenotrochus (Sphenotrochus) lindstroemi	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) ralphae	AZ	0.9856	0	0.0143	0	0.0001	0
Sphenotrochus (Sphenotrochus) squiresi	AZ	0.9856	0	0.0143	0	0.0001	0
Stenocyathus vermiformis	AZ	0.9735	0	0.0263	0	0.0001	0
Stephanocoenia intersepta	Z	0	0.1595	0	0.025	0	0.8155
Stephanocyathus (Acinocyathus) explanans	AZ	0.9702	0	0.0296	0	0.0003	0
Stephanocyathus (Acinocyathus) spiniger	AZ	0.9705	0	0.0294	0	0.0001	0
Stephanocyathus (Odontocyathus) campaniformis	AZ	0.9704	0	0.0294	0	0.0002	0
Stephanocyathus (Odontocyathus) coronatus	AZ	0.9705	0	0.0294	0	0.0001	0
Stephanocyathus (Odontocyathus) nobilis	AZ	0.9703	0	0.0295	0	0.0002	0
Stephanocyathus (Odontocyathus) weberianus	AZ	0.9704	0	0.0293	0	0.0003	0
Stephanocyathus (Stephanocyathus) crassus	AZ	0.9702	0	0.0296	0	0.0002	0
Stephanocyathus (Stephanocyathus) diadema	AZ	0.9703	0	0.0295	0	0.0002	0
Stephanocyathus (Stephanocyathus) imperialis	AZ	0.9704	0	0.0294	0	0.0002	0
Stephanocyathus (Stephanocyathus) laevifundus	AZ	0.9703	0	0.0295	0	0.0002	0
Stephanocyathus (Stephanocyathus) moseleyanus	AZ	0.9702	0	0.0296	0	0.0002	0
Stephanocyathus (Stephanocyathus) paliferus	AZ	0.9704	0	0.0294	0	0.0002	0
Stephanocyathus (Stephanocyathus) platypus	AZ	0.9704	0	0.0294	0	0.0002	0
Stephanocyathus (Stephanocyathus) regius	AZ	0.9703	0	0.0295	0	0.0002	0
Stephanophyllia complicata	AZ	0.9478	0	0.0519	0	0.0002	0

Stephanophyllia fungulus	AZ	0.9478	0	0.0519	0	0.0002	0
Stephanophyllia neglecta	AZ	0.9478	0	0.0519	0	0.0002	0
Stolarskicyathus pocilliformis	AZ	0.9448	0	0.0541	0	0.0011	0
Stylaraea punctata	Z	0	0.8064	0	0.1899	0	0.0036
Stylocoeniella armata	Z	0	0.0909	0	0.0073	0	0.9017
Stylocoeniella cocosensis	Z	0	0.2189	0	0.0303	0	0.7508
Stylocoeniella guentheri	Z	0	0.0618	0	0.0028	0	0.9355
Stylocoeniella nikei	AZ	0.0011	0	0.0882	0	0.9106	0
Stylophora danae	Z	0	0.8185	0	0.1722	0	0.0092
Stylophora kuehlmanni	Z	0	0.8187	0	0.1722	0	0.0091
Stylophora madagascarensis	Z	0	0.8187	0	0.1722	0	0.0091
Stylophora mamillata	Z	0	0.8171	0	0.1718	0	0.0111
Stylophora pistillata	Z	0	0.8185	0	0.1722	0	0.0092
Stylophora subseriata	Z	0	0.8187	0	0.1722	0	0.0091
Stylophora wellsi	Z	0	0.8184	0	0.1722	0	0.0094
Sympodangia albatrossi	AZ	0.7615	0	0.2292	0	0.0093	0
Temnotrochus kermadecensis	AZ	0.9436	0	0.0558	0	0.0006	0
Tethocyathus cylindraceus	AZ	0.0628	0	0.9307	0	0.0065	0
Tethocyathus endesa	AZ	0.0631	0	0.9303	0	0.0066	0
Tethocyathus minor	AZ	0.0629	0	0.9308	0	0.0064	0
Tethocyathus prahli	AZ	0.063	0	0.931	0	0.0059	0
Tethocyathus recurvatus	AZ	0.0629	0	0.93	0	0.0071	0
Tethocyathus variabilis	AZ	0.0631	0	0.93	0	0.007	0
Tethocyathus virgatus	AZ	0.0631	0	0.9307	0	0.0062	0
Thalamophyllia gasti	AZ	0.0934	0	0.8668	0	0.0398	0
Thalamophyllia gombergi	AZ	0.0934	0	0.8684	0	0.0382	0
Thalamophyllia riisei	AZ	0.0934	0	0.8679	0	0.0387	0
Thalamophyllia tenuescens	AZ	0.0934	0	0.8667	0	0.0399	0
Thecopsammia elongata	AZ	0.0847	0	0.9092	0	0.0061	0
Thecopsammia socialis	AZ	0.0847	0	0.9092	0	0.0061	0
Thrypticotrochus petterdi	AZ	0.9748	0	0.0251	0	0.0002	0
Trachyphyllia geoffroyi	Z	0	0.8097	0	0.1902	0	0.0001

Trematotrochus corbicula	AZ	0.9844	0	0.0155	0	0.0001	0
Trematotrochus hedleyi	AZ	0.9844	0	0.0155	0	0.0001	0
Trochocyathus (Aplocyathus) brevispina	AZ	0.0287	0	0.9642	0	0.0071	0
Trochocyathus (Aplocyathus) hastatus	AZ	0.0287	0	0.9642	0	0.0071	0
Trochocyathus (Aplocyathus) longispina	AZ	0.0287	0	0.9642	0	0.0071	0
Trochocyathus (Trochocyathus) aithoseptatus	AZ	0.0299	0	0.9653	0	0.0047	0
Trochocyathus (Trochocyathus) apertus	AZ	0.0298	0	0.9655	0	0.0047	0
Trochocyathus (Trochocyathus) burchae	AZ	0.0299	0	0.9653	0	0.0047	0
Trochocyathus (Trochocyathus) caryophylloides	AZ	0.0299	0	0.9658	0	0.0043	0
Trochocyathus (Trochocyathus) cepulla	AZ	0.0299	0	0.9653	0	0.0047	0
Trochocyathus (Trochocyathus) cooperi	AZ	0.0299	0	0.9653	0	0.0048	0
Trochocyathus (Trochocyathus) decamera	AZ	0.03	0	0.966	0	0.0041	0
Trochocyathus (Trochocyathus) discus	AZ	0.0299	0	0.9655	0	0.0046	0
Trochocyathus (Trochocyathus) efateensis	AZ	0.0299	0	0.9652	0	0.0049	0
Trochocyathus (Trochocyathus) fasciatus	AZ	0.0299	0	0.9653	0	0.0048	0
Trochocyathus (Trochocyathus) fossulus	AZ	0.0299	0	0.9661	0	0.004	0
Trochocyathus (Trochocyathus) gardineri	AZ	0.0299	0	0.9657	0	0.0044	0
Trochocyathus (Trochocyathus) gordoni	AZ	0.0299	0	0.9662	0	0.004	0
Trochocyathus (Trochocyathus) japonicus	AZ	0.0299	0	0.9656	0	0.0045	0
Trochocyathus (Trochocyathus) laboreli	AZ	0.0299	0	0.9655	0	0.0046	0

Trochocyathus (Trochocyathus) maculatus	AZ	0.0299	0	0.9657	0	0.0044	0
Trochocyathus (Trochocyathus) mauiensis	AZ	0.0299	0	0.9658	0	0.0043	0
Trochocyathus (Trochocyathus) oahensis	AZ	0.0299	0	0.9651	0	0.0049	0
Trochocyathus (Trochocyathus) patelliformis	AZ	0.03	0	0.9655	0	0.0045	0
Trochocyathus (Trochocyathus) philippinensis	AZ	0.0299	0	0.9655	0	0.0047	0
Trochocyathus (Trochocyathus) porphyreus	AZ	0.0299	0	0.9658	0	0.0043	0
Trochocyathus (Trochocyathus) rawsonii	AZ	0.0299	0	0.9657	0	0.0044	0
Trochocyathus (Trochocyathus) rhombocolumna	AZ	0.9735	0	0.026	0	0.0006	0
Trochocyathus (Trochocyathus) semperi	AZ	0.03	0	0.965	0	0.0051	0
Trochocyathus (Trochocyathus) spinosocostatus	AZ	0.0299	0	0.965	0	0.005	0
Trochocyathus (Trochocyathus) vasiformis	AZ	0.0299	0	0.9657	0	0.0044	0
Trochopsammia infundibulum	AZ	0.0384	0	0.9564	0	0.0052	0
Tropidocyathus labidus	AZ	0.9743	0	0.0253	0	0.0004	0
Tropidocyathus lessonii	AZ	0.9722	0	0.0275	0	0.0003	0
Truncatoflabellum aculeatum	AZ	0.9786	0	0.0212	0	0.0002	0
Truncatoflabellum angiostomum	AZ	0.9783	0	0.0215	0	0.0002	0
Truncatoflabellum angustum	AZ	0.9785	0	0.0213	0	0.0002	0
Truncatoflabellum arcuatum	AZ	0.9785	0	0.0213	0	0.0002	0
Truncatoflabellum australiensis	AZ	0.9662	0	0.0335	0	0.0002	0
Truncatoflabellum candeanum	AZ	0.9662	0	0.0335	0	0.0002	0
Truncatoflabellum carinatum	AZ	0.9787	0	0.0211	0	0.0002	0
Truncatoflabellum crassum	AZ	0.9786	0	0.0212	0	0.0002	0
Truncatoflabellum cumingii	AZ	0.9787	0	0.0211	0	0.0002	0

Truncatoflabellum dens	AZ	0.9773	0	0.0225	0	0.0002	0
Truncatoflabellum formosum	AZ	0.9804	0	0.0195	0	0.0001	0
Truncatoflabellum gardineri	AZ	0.9779	0	0.0219	0	0.0002	0
Truncatoflabellum inconstans	AZ	0.9787	0	0.0212	0	0.0002	0
Truncatoflabellum incrustatum	AZ	0.9787	0	0.0211	0	0.0002	0
Truncatoflabellum irregulare	AZ	0.9779	0	0.0219	0	0.0002	0
Truncatoflabellum macroeschara	AZ	0.9759	0	0.0235	0	0.0007	0
Truncatoflabellum martensii	AZ	0.9783	0	0.0215	0	0.0002	0
Truncatoflabellum mortenseni	AZ	0.9785	0	0.0213	0	0.0002	0
Truncatoflabellum multispinosum	AZ	0.9784	0	0.0214	0	0.0002	0
Truncatoflabellum paripavoninum	AZ	0.978	0	0.0219	0	0.0002	0
Truncatoflabellum phoenix	AZ	0.9779	0	0.0219	0	0.0002	0
Truncatoflabellum pusillum	AZ	0.9781	0	0.0218	0	0.0002	0
Truncatoflabellum spheniscus	AZ	0.9663	0	0.0334	0	0.0003	0
Truncatoflabellum stabile	AZ	0.9797	0	0.0201	0	0.0001	0
Truncatoflabellum stokesii	AZ	0.9774	0	0.0224	0	0.0002	0
Truncatoflabellum trapezoideum	AZ	0.9783	0	0.0214	0	0.0002	0
Truncatoflabellum truncum	AZ	0.9781	0	0.0217	0	0.0002	0
Truncatoflabellum vanuatu	AZ	0.9792	0	0.0207	0	0.0001	0
Truncatoflabellum veroni	AZ	0.9779	0	0.022	0	0.0002	0
Truncatoflabellum vigintifarium	AZ	0.9786	0	0.0212	0	0.0002	0
Truncatoflabellum zuluense	AZ	0.9783	0	0.0216	0	0.0002	0
Truncatoguynia irregularis	AZ	0.9735	0	0.0263	0	0.0001	0
Tubastraea coccinea	AZ	0.0148	0	0.9791	0	0.0061	0
Tubastraea diaphana	AZ	0.0148	0	0.98	0	0.0052	0
Tubastraea faulkneri	AZ	0.0148	0	0.9796	0	0.0056	0
Tubastraea floreana	AZ	0.0148	0	0.979	0	0.0062	0
Tubastraea micranthus	AZ	0.0148	0	0.9799	0	0.0053	0
Tubastraea tagusensis	AZ	0.0147	0	0.9788	0	0.0065	0
Turbinaria bifrons	Z	0	0.7617	0	0.0417	0	0.1966

Turbinaria conspicua	Z	0	0.7636	0	0.0416	0	0.1948
Turbinaria frondens	Z	0	0.7682	0	0.0424	0	0.1894
Turbinaria heronensis	Z	0	0.7659	0	0.0417	0	0.1924
Turbinaria irregularis	Z	0	0.7703	0	0.0423	0	0.1874
Turbinaria mesenterina	Z	0	0.7646	0	0.0429	0	0.1925
Turbinaria patula	Z	0	0.7667	0	0.0416	0	0.1917
Turbinaria peltata	Z	0	0.766	0	0.0427	0	0.1912
Turbinaria radicalis	Z	0	0.7674	0	0.0414	0	0.1912
Turbinaria reniformis	Z	0	0.7617	0	0.0415	0	0.1968
Turbinaria stellulata	Z	0	0.7684	0	0.0416	0	0.19
Turbinolia stephensoni	AZ	0.985	0	0.0148	0	0.0002	0
Vaughanella concinna	AZ	0.9655	0	0.0341	0	0.0003	0
Vaughanella margaritata	AZ	0.9655	0	0.0342	0	0.0003	0
Vaughanella multipalifera	AZ	0.9655	0	0.0342	0	0.0003	0
Vaughanella oreophila	AZ	0.9655	0	0.0342	0	0.0003	0
Zoopilus echinatus	Z	0	0.8099	0	0.19	0	0.0001

Appendix 2

Table of species included in the molecular with corresponding observed state (AZ: Azooxanthellate, Z: Zooxanthellate, F: Facultative) and estimated probability of being in each rate category.

Species	State	Azoox Stable	Zoox Stable	Azoox Labile	Zoox Labile
Acanthastrea echinata	Z	0	0.9751	0	0.0249
Acanthastrea hemprichi	Z	0	0.9752	0	0.0248
Acanthastrea hillae	Z	0	0.9742	0	0.0258
Acanthastrea pachysepta	Z	0	0.9788	0	0.0212
Acanthastrea rotundoflora	Z	0	0.9751	0	0.0249
Acanthastrea subechinata	Z	0	0.9752	0	0.0248
Acropora abrolhosensis	Z	0	0.9772	0	0.0228
Acropora abrotanoides	Z	0	0.9773	0	0.0227
Acropora acuminata	Z	0	0.9785	0	0.0215
Acropora anthocercis	Z	0	0.9787	0	0.0213
Acropora aspera	Z	0	0.9786	0	0.0214
Acropora austera	Z	0	0.9764	0	0.0236
Acropora batunai	Z	0	0.9787	0	0.0213
Acropora bushyensis	Z	0	0.9788	0	0.0212
Acropora carduus	Z	0	0.9788	0	0.0212
Acropora caroliniana	Z	0	0.9787	0	0.0213
Acropora cerealis	Z	0	0.9778	0	0.0222
Acropora cervicornis	Z	0	0.9768	0	0.0232
Acropora chesterfieldensis	Z	0	0.9784	0	0.0216
Acropora cytherea	Z	0	0.9783	0	0.0217
Acropora dendrum	Z	0	0.9786	0	0.0214
Acropora derawanensis	Z	0	0.9789	0	0.0211
Acropora digitifera	Z	0	0.9787	0	0.0213
Acropora divaricata	Z	0	0.9782	0	0.0218
Acropora donei	Z	0	0.9776	0	0.0224
Acropora echinata	Z	0	0.9766	0	0.0234
Acropora elegans	Z	0	0.9788	0	0.0212
Acropora elseyi	Z	0	0.9782	0	0.0218

Acropora florida	Z	0	0.9787	0	0.0213
Acropora gemmifera	Z	0	0.9785	0	0.0215
Acropora globiceps	Z	0	0.9786	0	0.0214
Acropora grandis	Z	0	0.9789	0	0.0211
Acropora granulosa	Z	0	0.9787	0	0.0213
Acropora hemprichii	Z	0	0.9783	0	0.0217
Acropora horrida	Z	0	0.9779	0	0.0221
Acropora humilis	Z	0	0.9783	0	0.0217
Acropora hyacinthus	Z	0	0.9781	0	0.0219
Acropora indonesia	Z	0	0.979	0	0.021
Acropora intermedia	Z	0	0.9777	0	0.0223
Acropora jacquelineae	Z	0	0.979	0	0.021
Acropora kimbeensis	Z	0	0.9785	0	0.0215
Acropora kirstyae	Z	0	0.9786	0	0.0214
Acropora latistella	Z	0	0.9751	0	0.0249
Acropora listeri	Z	0	0.9785	0	0.0215
Acropora loisetteae	Z	0	0.9788	0	0.0212
Acropora lokani	Z	0	0.9785	0	0.0215
Acropora longicyathus	Z	0	0.9767	0	0.0233
Acropora loripes	Z	0	0.9788	0	0.0212
Acropora lutkeni	Z	0	0.9788	0	0.0212
Acropora microclados	Z	0	0.9788	0	0.0212
Acropora microphthalma	Z	0	0.979	0	0.021
Acropora millepora	Z	0	0.978	0	0.022
Acropora monticulosa	Z	0	0.9778	0	0.0222
Acropora multiacuta	Z	0	0.9761	0	0.0239
Acropora muricata	Z	0	0.9783	0	0.0217
Acropora nana	Z	0	0.977	0	0.023
Acropora nasuta	Z	0	0.9773	0	0.0227
Acropora palmata	Z	0	0.9769	0	0.0231
Acropora papillare	Z	0	0.9789	0	0.0211
Acropora pichoni	Z	0	0.9789	0	0.0211
Acropora polystoma	Z	0	0.9788	0	0.0212
Acropora prolifera	Z	0	0.9769	0	0.0231
Acropora pulchra	Z	0	0.9785	0	0.0215
Acropora retusa	Z	0	0.9765	0	0.0235
Acropora robusta	Z	0	0.9773	0	0.0227

Acropora rongelapensis	Z	0	0.9784	0	0.0216
Acropora samoensis	Z	0	0.9787	0	0.0213
Acropora sarmentosa	Z	0	0.9787	0	0.0213
Acropora selago	Z	0	0.9788	0	0.0212
Acropora solitaryensis	Z	0	0.9786	0	0.0214
Acropora spathulata	Z	0	0.9782	0	0.0218
Acropora speciosa	Z	0	0.9787	0	0.0213
Acropora spicifera	Z	0	0.9783	0	0.0217
Acropora subglabra	Z	0	0.9769	0	0.0231
Acropora tenella	Z	0	0.9789	0	0.0211
Acropora tenuis	Z	0	0.9777	0	0.0223
Acropora tortuosa	Z	0	0.9788	0	0.0212
Acropora valida	Z	0	0.9787	0	0.0213
Acropora vaughani	Z	0	0.979	0	0.021
Acropora walindii	Z	0	0.9787	0	0.0213
Acropora yongei	Z	0	0.9777	0	0.0223
Agaricia agaricites	Z	0	0.7615	0	0.2385
Agaricia fragilis	Z	0	0.7661	0	0.2339
Agaricia grahamae	Z	0	0.7664	0	0.2336
Agaricia humilis	Z	0	0.7593	0	0.2407
Agaricia lamarcki	Z	0	0.7652	0	0.2348
Agaricia tenuifolia	Z	0	0.7615	0	0.2385
Agaricia undata	Z	0	0.7664	0	0.2336
Alveopora allingi	Z	0	0.97	0	0.03
Alveopora catalai	Z	0	0.97	0	0.03
Alveopora excelsa	Z	0	0.9701	0	0.0299
Alveopora japonica	Z	0	0.97	0	0.03
Alveopora spongiosa	Z	0	0.97	0	0.03
Alveopora tizardi	Z	0	0.9698	0	0.0302
Alveopora verrilliana	Z	0	0.9701	0	0.0299
Anacropora forbesi	Z	0	0.978	0	0.022
Anacropora matthai	Z	0	0.9782	0	0.0218
Anomastraea irregularis	Z	0	0.9743	0	0.0257
Anthemiphyllia dentata	AZ	0.9558	0	0.0442	0
Anthemiphyllia patera	AZ	0.8673	0	0.1327	0
Anthemiphyllia spinifera	AZ	0.9341	0	0.0659	0

Astrangia poculata	F	0	0.2721	0	0.7279
Astrea curta	Z	0	0.9749	0	0.0251
Astrea devantieri	Z	0	0.9747	0	0.0253
Astreopora expansa	Z	0	0.9651	0	0.0349
Astreopora explanata	Z	0	0.9655	0	0.0345
Astreopora gracilis	Z	0	0.9635	0	0.0365
Astreopora listeri	Z	0	0.9627	0	0.0373
Astreopora myriophthalma	Z	0	0.9655	0	0.0345
Astroides calycularis	AZ	0.4317	0	0.5683	0
Balanophyllia (Balanophyllia) cornu	AZ	0.4789	0	0.5211	0
Balanophyllia (Balanophyllia) dentata	AZ	0.4406	0	0.5594	0
Balanophyllia (Balanophyllia) desmophyllioides	AZ	0.2835	0	0.7165	0
Balanophyllia (Balanophyllia) elegans	AZ	0.4795	0	0.5205	0
Balanophyllia (Balanophyllia) europaea	Z	0	0.1832	0	0.8168
Balanophyllia (Balanophyllia) gigas	AZ	0.4775	0	0.5225	0
Balanophyllia (Balanophyllia) regia	AZ	0.308	0	0.692	0
Balanophyllia (Eupsammia) imperialis	AZ	0.4672	0	0.5328	0
Bernardpora stutchburyi	Z	0	0.9392	0	0.0608
Blastomussa loyae	Z	0	0.9212	0	0.0788
Blastomussa merleti	Z	0	0.9212	0	0.0788
Blastomussa omanensis	Z	0	0.921	0	0.079
Blastomussa vivida	Z	0	0.924	0	0.076
Blastomussa wellsi	Z	0	0.924	0	0.076
Caryophyllia (Acanthocyathus) grayi	AZ	0.9802	0	0.0198	0
Caryophyllia (Acanthocyathus) unicristata	AZ	0.9848	0	0.0152	0

Caryophyllia (Caryophyllia) ambrosia	AZ	0.9826	0	0.0174	0
Caryophyllia (Caryophyllia) atlantica	AZ	0.9826	0	0.0174	0
Caryophyllia (Caryophyllia) calveri	AZ	0.9717	0	0.0283	0
Caryophyllia (Caryophyllia) diomedeae	AZ	0.979	0	0.021	0
Caryophyllia (Caryophyllia) grandis	AZ	0.9845	0	0.0155	0
Caryophyllia (Caryophyllia) inornata	AZ	0.9842	0	0.0158	0
Caryophyllia (Caryophyllia) lamellifera	AZ	0.9837	0	0.0163	0
Caryophyllia (Caryophyllia) planilamellata	AZ	0.9823	0	0.0177	0
Caryophyllia (Caryophyllia) quadragenaria	AZ	0.9802	0	0.0198	0
Caryophyllia (Caryophyllia) ralphae	AZ	0.9376	0	0.0624	0
Caryophyllia (Caryophyllia) rugosa	AZ	0.9837	0	0.0163	0
Caryophyllia (Caryophyllia) scobinosa	AZ	0.9852	0	0.0148	0
Caryophyllia (Caryophyllia) smithii	AZ	0.9631	0	0.0369	0
Caryophyllia (Caryophyllia) transversalis	AZ	0.9845	0	0.0155	0
Caryophyllia (Caryophyllia) versicolorata	AZ	0.9823	0	0.0177	0
Catalaphyllia jardinei	Z	0	0.977	0	0.023
Caulastraea echinulata	Z	0	0.9767	0	0.0233
Caulastraea furcata	Z	0	0.9767	0	0.0233
Caulastraea tumida	Z	0	0.9764	0	0.0236
Ceratotrochus magnaghii	AZ	0.9601	0	0.0399	0
Cladocora arbuscula	Z	0	0.2895	0	0.7105

Cladocora caespitosa	Z	0	0.1238	0	0.8762
Cladopsammia eguchii	AZ	0.3436	0	0.6564	0
Cladopsammia gracilis	AZ	0.4739	0	0.5261	0
Coelastrea aspera	Z	0	0.9776	0	0.0224
Coelastrea palauensis	Z	0	0.9776	0	0.0224
Colpophyllia natans	Z	0	0.974	0	0.026
Conotrochus funicolumna	AZ	0.9601	0	0.0399	0
Coscinaraea columna	Z	0	0.9737	0	0.0263
Coscinaraea monile	Z	0	0.9739	0	0.0261
Craterastrea levis	Z	0	0.9741	0	0.0259
Crispatotrochus rugosus	AZ	0.9823	0	0.0177	0
Ctenactis albitentaculata	Z	0	0.9768	0	0.0232
Ctenactis crassa	Z	0	0.976	0	0.024
Ctenactis echinata	Z	0	0.9768	0	0.0232
Ctenella chagius	Z	0	0.96	0	0.04
Cyathelia axillaris	AZ	0.2299	0	0.7701	0
Cyathotrochus pileus	AZ	0.973	0	0.027	0
Cycloseris costulata	Z	0	0.9778	0	0.0222
Cycloseris cyclolites	Z	0	0.9779	0	0.0221
Cycloseris explanulata	Z	0	0.9779	0	0.0221
Cycloseris fragilis	Z	0	0.9779	0	0.0221
Cycloseris mokai	Z	0	0.9779	0	0.0221
Cycloseris sinensis	Z	0	0.9778	0	0.0222
Cycloseris tenuis	Z	0	0.9778	0	0.0222
Cycloseris vaughani	Z	0	0.9779	0	0.0221
Cycloseris wellsi	Z	0	0.9779	0	0.0221
Cynarina lacrymalis	Z	0	0.9745	0	0.0255
Cyphastrea chalcidicum	Z	0	0.9756	0	0.0244
Cyphastrea japonica	Z	0	0.9756	0	0.0244
Cyphastrea microphthalma	Z	0	0.9751	0	0.0249
Cyphastrea ocellina	Z	0	0.9744	0	0.0256
Cyphastrea serailia	Z	0	0.9754	0	0.0246
Dactylotrochus cervicornis	AZ	0.2409	0	0.7591	0

Danafungia horrida	Z	0	0.9766	0	0.0234
Danafungia scruposa	Z	0	0.9773	0	0.0227
Dasmosmilia lymani	AZ	0.9852	0	0.0148	0
Deltocyathus corrugatus	AZ	0.9551	0	0.0449	0
Deltocyathus inusitiatus	AZ	0.9588	0	0.0412	0
Deltocyathus magnificus	AZ	0.9712	0	0.0288	0
Deltocyathus ornatus	AZ	0.9565	0	0.0435	0
Deltocyathus rotulus	AZ	0.9584	0	0.0416	0
Deltocyathus sarsi	AZ	0.9588	0	0.0412	0
Deltocyathus suluensis	AZ	0.9585	0	0.0415	0
Deltocyathus vaughani	AZ	0.9577	0	0.0423	0
Dendrogyra cylindrus	Z	0	0.3352	0	0.6648
Dendrophyllia alternata	AZ	0.4526	0	0.5474	0
Dendrophyllia arbuscula	AZ	0.4732	0	0.5268	0
Dendrophyllia cornigera	AZ	0.4408	0	0.5592	0
Desmophyllum dianthus	AZ	0.9814	0	0.0186	0
Dichocoenia stokesii	Z	0	0.3537	0	0.6463
Diploastrea heliopora	Z	0	0.8938	0	0.1062
Diploria labyrinthiformis	Z	0	0.9762	0	0.0238
Dipsastraea amicorum	Z	0	0.9789	0	0.0211
Dipsastraea danai	Z	0	0.9789	0	0.0211
Dipsastraea faviaformis	Z	0	0.9789	0	0.0211
Dipsastraea favus	Z	0	0.9788	0	0.0212
Dipsastraea laxa	Z	0	0.9786	0	0.0214
Dipsastraea lizardensis	Z	0	0.9788	0	0.0212
Dipsastraea maritima	Z	0	0.9788	0	0.0212
Dipsastraea matthaii	Z	0	0.9789	0	0.0211
Dipsastraea maxima	Z	0	0.9779	0	0.0221
Dipsastraea pallida	Z	0	0.9788	0	0.0212
Dipsastraea rosaria	Z	0	0.9775	0	0.0225

Dipsastraea rotumana	Z	0	0.9779	0	0.0221
Dipsastraea speciosa	Z	0	0.9789	0	0.0211
Dipsastraea truncata	Z	0	0.9771	0	0.0229
Duncanopsammia axifuga	Z	0	0.5676	0	0.4324
Echinophyllia aspera	Z	0	0.9773	0	0.0227
Echinophyllia echinata	Z	0	0.9767	0	0.0233
Echinophyllia echinoporoides	Z	0	0.977	0	0.023
Echinophyllia orpheensis	Z	0	0.9773	0	0.0227
Echinopora gemmacea	Z	0	0.9761	0	0.0239
Echinopora horrida	Z	0	0.9761	0	0.0239
Echinopora lamellosa	Z	0	0.9761	0	0.0239
Echinopora mammiformis	Z	0	0.9743	0	0.0257
Echinopora pacificus	Z	0	0.9761	0	0.0239
Eguchipsammia fistula	AZ	0.4735	0	0.5265	0
Eguchipsammia serpentina	AZ	0.3436	0	0.6564	0
Enallopsammia rostrata	AZ	0.3547	0	0.6453	0
Endopachys grayi	AZ	0.2728	0	0.7272	0
Euphyllia ancora	Z	0	0.9577	0	0.0423
Euphyllia divisa	Z	0	0.9577	0	0.0423
Euphyllia glabrescens	Z	0	0.96	0	0.04
Eusmilia fastigiata	Z	0	0.3574	0	0.6426
Favia fragum	Z	0	0.9753	0	0.0247
Favia gravida	Z	0	0.9757	0	0.0243
Favia leptophylla	Z	0	0.975	0	0.025
Favites abdita	Z	0	0.9759	0	0.0241
Favites chinensis	Z	0	0.9751	0	0.0249
Favites colemani	Z	0	0.9776	0	0.0224
Favites complanata	Z	0	0.9759	0	0.0241
Favites flexuosa	Z	0	0.9774	0	0.0226
Favites halicora	Z	0	0.9776	0	0.0224
Favites magnistellata	Z	0	0.9742	0	0.0258
Favites paraflexuosus	Z	0	0.9774	0	0.0226
Favites pentagona	Z	0	0.9749	0	0.0251
Favites rotundata	Z	0	0.9763	0	0.0237
Favites valenciennesi	Z	0	0.9776	0	0.0224

Flabellum (Flabellum) arcuatile	AZ	0.9857	0	0.0143	0
Flabellum (Flabellum) folkesoni	AZ	0.9839	0	0.0161	0
Flabellum (Flabellum) impensum	AZ	0.9764	0	0.0236	0
Flabellum (Flabellum) lamellulosum	AZ	0.9825	0	0.0175	0
Flabellum (Flabellum) magnificum	AZ	0.9857	0	0.0143	0
Flabellum (Flabellum) pavoninum	AZ	0.9862	0	0.0138	0
Flabellum (Flabellum) vaughani	AZ	0.9825	0	0.0175	0
Flabellum (Ulocyathus) angulare	AZ	0.9783	0	0.0217	0
Flabellum (Ulocyathus) apertum	AZ	0.9778	0	0.0222	0
Flabellum (Ulocyathus) deludens	AZ	0.9786	0	0.0214	0
Flabellum (Ulocyathus) japonicum	AZ	0.9786	0	0.0214	0
Flabellum (Ulocyathus) lowekeyesi	AZ	0.9781	0	0.0219	0
Flabellum (Ulocyathus) tuthilli	AZ	0.9771	0	0.0229	0
Fungia fungites	Z	0	0.9771	0	0.0229
Fungiacyathus (Bathyactis) marenzelleri	AZ	0.9686	0	0.0314	0
Fungiacyathus (Bathyactis) turbinolioides	AZ	0.9697	0	0.0303	0
Fungiacyathus (Fungiacyathus) fragilis	AZ	0.9722	0	0.0278	0
Fungiacyathus (Fungiacyathus) pusillus	AZ	0.9678	0	0.0322	0
Fungiacyathus (Fungiacyathus) stephanus	AZ	0.9722	0	0.0278	0
Galaxea astreata	Z	0	0.9618	0	0.0382
Galaxea fascicularis	Z	0	0.9611	0	0.0389

Galaxea horrescens	Z	0	0.9618	0	0.0382
Gardineria hawaiiensis	AZ	0.9327	0	0.0673	0
Gardineria paradoxa	AZ	0.9327	0	0.0673	0
Gardineroseris planulata	Z	0	0.8062	0	0.1938
Goniastrea edwardsi	Z	0	0.9774	0	0.0226
Goniastrea favulus	Z	0	0.9781	0	0.0219
Goniastrea minuta	Z	0	0.977	0	0.023
Goniastrea pectinata	Z	0	0.9782	0	0.0218
Goniastrea retiformis	Z	0	0.977	0	0.023
Goniastrea stelligera	Z	0	0.9766	0	0.0234
Goniopora albiconus	Z	0	0.9655	0	0.0345
Goniopora burgosi	Z	0	0.9653	0	0.0347
Goniopora cellulosa	Z	0	0.9654	0	0.0346
Goniopora ciliatus	Z	0	0.9651	0	0.0349
Goniopora columna	Z	0	0.9653	0	0.0347
Goniopora djiboutiensis	Z	0	0.9651	0	0.0349
Goniopora fruticosa	Z	0	0.9655	0	0.0345
Goniopora lobata	Z	0	0.9653	0	0.0347
Goniopora norfolkensis	Z	0	0.9655	0	0.0345
Goniopora paliformis	Z	0	0.9559	0	0.0441
Goniopora pedunculata	Z	0	0.9559	0	0.0441
Goniopora pendulus	Z	0	0.9653	0	0.0347
Goniopora planulata	Z	0	0.9654	0	0.0346
Goniopora somaliensis	Z	0	0.9655	0	0.0345
Goniopora stokesi	Z	0	0.965	0	0.035
Goniopora tantillus	Z	0	0.9608	0	0.0392
Goniopora tenuidens	Z	0	0.9653	0	0.0347
Guynia annulata	AZ	0.5966	0	0.4034	0
Halomitra clavator	Z	0	0.9774	0	0.0226
Halomitra pileus	Z	0	0.9774	0	0.0226
Heliofungia actiniformis	Z	0	0.9765	0	0.0235

Heliofungia fralinae	Z	0	0.9766	0	0.0234
Helioseris cucullata	Z	0	0.0857	0	0.9143
Herpolitha limax	Z	0	0.9766	0	0.0234
Heterocyathus sulcatus	F	0	0.9043	0	0.0957
Heteropsammia cochlea	F	0	0.153	0	0.847
Homophyllia bowerbanki	Z	0	0.9742	0	0.0258
Hoplangia durotrix	AZ	0.5844	0	0.4156	0
Horastrea indica	Z	0	0.9743	0	0.0257
Hydnophora exesa	Z	0	0.9768	0	0.0232
Hydnophora grandis	Z	0	0.9771	0	0.0229
Hydnophora microconos	Z	0	0.9771	0	0.0229
Hydnophora pilosa	Z	0	0.9771	0	0.0229
Hydnophora rigida	Z	0	0.9768	0	0.0232
Isophyllia sinuosa	Z	0	0.9761	0	0.0239
Isopora brueggemanni	Z	0	0.9733	0	0.0267
Isopora cuneata	Z	0	0.9738	0	0.0262
Isopora palifera	Z	0	0.9738	0	0.0262
Isopora togianensis	Z	0	0.9735	0	0.0265
Javania cailleti	AZ	0.9788	0	0.0212	0
Javania exserta	AZ	0.9807	0	0.0193	0
Javania fusca	AZ	0.9739	0	0.0261	0
Javania insignis	AZ	0.9634	0	0.0366	0
Javania lamprotichum	AZ	0.9781	0	0.0219	0
Leptastrea bottae	Z	0	0.9773	0	0.0227
Leptastrea pruinosa	Z	0	0.9773	0	0.0227
Leptastrea purpurea	Z	0	0.9773	0	0.0227
Leptastrea transversa	Z	0	0.9772	0	0.0228
Leptopsammia pruvoti	AZ	0.4407	0	0.5593	0
Leptoria irregularis	Z	0	0.9775	0	0.0225
Leptoria phrygia	Z	0	0.9775	0	0.0225
Leptoseris foliosa	Z	0	0.8061	0	0.1939
Leptoseris incrustans	Z	0	0.8051	0	0.1949
Leptoseris yabei	Z	0	0.8057	0	0.1943
Letepsammia formosissima	AZ	0.9385	0	0.0615	0
Lithophyllon concinna	Z	0	0.9772	0	0.0228

Lithophyllon repanda	Z	0	0.9772	0	0.0228
Lithophyllon scabra	Z	0	0.9776	0	0.0224
Lithophyllon spinifer	Z	0	0.9776	0	0.0224
Lithophyllon undulatum	Z	0	0.9776	0	0.0224
Lobactis scutaria	Z	0	0.9767	0	0.0233
Lobophyllia agaricia	Z	0	0.9786	0	0.0214
Lobophyllia corymbosa	Z	0	0.9782	0	0.0218
Lobophyllia costata	Z	0	0.9785	0	0.0215
Lobophyllia diminuta	Z	0	0.9785	0	0.0215
Lobophyllia erythraea	Z	0	0.9784	0	0.0216
Lobophyllia flabelliformis	Z	0	0.9782	0	0.0218
Lobophyllia hemprichii	Z	0	0.9787	0	0.0213
Lobophyllia ishigakiensis	Z	0	0.9786	0	0.0214
Lobophyllia radians	Z	0	0.9787	0	0.0213
Lobophyllia recta	Z	0	0.9787	0	0.0213
Lobophyllia robusta	Z	0	0.978	0	0.022
Lobophyllia valenciennesii	Z	0	0.9786	0	0.0214
Lobophyllia vitiensis	Z	0	0.9784	0	0.0216
Lophelia pertusa	AZ	0.9826	0	0.0174	0
Madracis asanoi	F	0	0.1541	0	0.8459
Madracis auretenra	Z	0	0.1334	0	0.8666
Madracis carmabi	Z	0	0.1416	0	0.8584
Madracis decactis	Z	0	0.1475	0	0.8525
Madracis formosa	Z	0	0.142	0	0.858
Madracis myriaster	AZ	0.0308	0	0.9692	0
Madracis pharensis	F	0	0.1428	0	0.8572
Madracis senaria	Z	0	0.1958	0	0.8042
Madrepora oculata	AZ	0.6288	0	0.3712	0
Manicina areolata	Z	0	0.9762	0	0.0238
Meandrina brasiliensis	Z	0	0.1545	0	0.8455
Meandrina meandrites	Z	0	0.3574	0	0.6426
Merulina ampliata	Z	0	0.9781	0	0.0219
Merulina scabricula	Z	0	0.9784	0	0.0216

Merulina scheeri	Z	0	0.9783	0	0.0217
Merulina triangularis	Z	0	0.9784	0	0.0216
Micromussa amakusensis	Z	0	0.9742	0	0.0258
Micromussa multipunctata	Z	0	0.9742	0	0.0258
Monomyces pygmaea	AZ	0.9812	0	0.0188	0
Montastraea cavernosa	Z	0	0.8938	0	0.1062
Montipora aequituberculata	Z	0	0.9781	0	0.0219
Montipora altasepta	Z	0	0.9782	0	0.0218
Montipora angulata	Z	0	0.978	0	0.022
Montipora cactus	Z	0	0.978	0	0.022
Montipora capitata	Z	0	0.9781	0	0.0219
Montipora capricornis	Z	0	0.978	0	0.022
Montipora circumvallata	Z	0	0.9757	0	0.0243
Montipora confusa	Z	0	0.9779	0	0.0221
Montipora danae	Z	0	0.9781	0	0.0219
Montipora delicatula	Z	0	0.9782	0	0.0218
Montipora digitata	Z	0	0.9766	0	0.0234
Montipora dilatata	Z	0	0.9782	0	0.0218
Montipora efflorescens	Z	0	0.9782	0	0.0218
Montipora flabellata	Z	0	0.9783	0	0.0217
Montipora florida	Z	0	0.978	0	0.022
Montipora foliosa	Z	0	0.9782	0	0.0218
Montipora gaimardi	Z	0	0.9781	0	0.0219
Montipora grisea	Z	0	0.9782	0	0.0218
Montipora hispida	Z	0	0.9782	0	0.0218
Montipora hoffmeisteri	Z	0	0.9779	0	0.0221
Montipora incrassata	Z	0	0.9779	0	0.0221
Montipora mollis	Z	0	0.9767	0	0.0233
Montipora patula	Z	0	0.9781	0	0.0219
Montipora peltiformis	Z	0	0.9783	0	0.0217
Montipora spongodes	Z	0	0.9767	0	0.0233
Montipora stellata	Z	0	0.9778	0	0.0222
Montipora taiwanensis	Z	0	0.9778	0	0.0222

Montipora tuberculosa	Z	0	0.9778	0	0.0222
Montipora turgescens	Z	0	0.9783	0	0.0217
Montipora turtlensis	Z	0	0.9783	0	0.0217
Montipora undata	Z	0	0.9781	0	0.0219
Montipora venosa	Z	0	0.978	0	0.022
Montipora verrilli	Z	0	0.9782	0	0.0218
Montipora verrucosa	Z	0	0.9781	0	0.0219
Moseleya latistellata	Z	0	0.9748	0	0.0252
Mussa angulosa	Z	0	0.9758	0	0.0242
Mussismilia braziliensis	Z	0	0.9757	0	0.0243
Mussismilia harttii	Z	0	0.9756	0	0.0244
Mussismilia hispida	Z	0	0.9757	0	0.0243
Mycedium elephantotus	Z	0	0.9781	0	0.0219
Mycedium robokaki	Z	0	0.9781	0	0.0219
Mycetophyllia aliciae	Z	0	0.9763	0	0.0237
Mycetophyllia danaana	Z	0	0.9763	0	0.0237
Mycetophyllia lamarckiana	Z	0	0.9762	0	0.0238
Nemenzophyllia turbida	Z	0	0.9189	0	0.0811
Notocyathus conicus	AZ	0.9719	0	0.0281	0
Oculina diffusa	F	0	0.2818	0	0.7182
Oculina patagonica	Z	0	0.2896	0	0.7104
Oculina robusta	Z	0	0.1251	0	0.8749
Oculina varicosa	F	0	0.1242	0	0.8758
Orbicella annularis	Z	0	0.9753	0	0.0247
Orbicella faveolata	Z	0	0.9753	0	0.0247
Orbicella franksi	Z	0	0.9751	0	0.0249
Oulastrea crispata	Z	0	0.9043	0	0.0957
Oulophyllia bennettae	Z	0	0.9764	0	0.0236
Oulophyllia crispa	Z	0	0.9764	0	0.0236
Oxypora glabra	Z	0	0.9773	0	0.0227
Oxypora lacera	Z	0	0.9767	0	0.0233
Pachyseris speciosa	Z	0	0.9299	0	0.0701
Paracyathus pulchellus	AZ	0.0565	0	0.9435	0
Paragoniastrea australensis	Z	0	0.9756	0	0.0244

Paragoniastrea deformis	Z	0	0.9758	0	0.0242
Paragoniastrea russelli	Z	0	0.9758	0	0.0242
Paramontastraea peresi	Z	0	0.974	0	0.026
Paramontastraea salebrosa	Z	0	0.9739	0	0.0261
Pavona cactus	Z	0	0.7504	0	0.2496
Pavona clavus	Z	0	0.7964	0	0.2036
Pavona decussata	Z	0	0.8036	0	0.1964
Pavona frondifera	Z	0	0.8036	0	0.1964
Pavona varians	Z	0	0.8013	0	0.1987
Pectinia alcicornis	Z	0	0.9771	0	0.0229
Pectinia crassa	Z	0	0.978	0	0.022
Pectinia lactuca	Z	0	0.978	0	0.022
Pectinia paeonia	Z	0	0.9777	0	0.0223
Phyllangia americana	AZ	0.1266	0	0.8734	0
Phyllangia papuensis	AZ	0.3756	0	0.6244	0
Physogyra lichtensteini	Z	0	0.8884	0	0.1116
Placotrochides scaphula	AZ	0.9784	0	0.0216	0
Placotrochus laevis	AZ	0.9804	0	0.0196	0
Platygyra acuta	Z	0	0.9788	0	0.0212
Platygyra carnosa	Z	0	0.9764	0	0.0236
Platygyra contorta	Z	0	0.9788	0	0.0212
Platygyra daedalea	Z	0	0.9788	0	0.0212
Platygyra lamellina	Z	0	0.9785	0	0.0215
Platygyra pini	Z	0	0.9788	0	0.0212
Platygyra ryukyuensis	Z	0	0.9785	0	0.0215
Platygyra sinensis	Z	0	0.9788	0	0.0212
Platygyra verweyi	Z	0	0.9788	0	0.0212
Plerogyra sinuosa	Z	0	0.8884	0	0.1116
Plesiastrea versipora	Z	0	0.1651	0	0.8349
Pleuractis granulosa	Z	0	0.9771	0	0.0229
Pleuractis gravis	Z	0	0.9776	0	0.0224
Pleuractis moluccensis	Z	0	0.9769	0	0.0231
Pleuractis paumotensis	Z	0	0.977	0	0.023
Pleuractis taiwanensis	Z	0	0.977	0	0.023
Pocillopora damicornis	Z	0	0.8543	0	0.1457
Pocillopora effusa	Z	0	0.8547	0	0.1453
Pocillopora elegans	Z	0	0.8547	0	0.1453

Pocillopora grandis	Z	0	0.8547	0	0.1453
Pocillopora inflata	Z	0	0.8547	0	0.1453
Pocillopora meandrina	Z	0	0.8534	0	0.1466
Pocillopora molokensis	Z	0	0.8542	0	0.1458
Pocillopora verrucosa	Z	0	0.8504	0	0.1496
Pocillopora woodjonesi	Z	0	0.8531	0	0.1469
Podabacia crustacea	Z	0	0.9779	0	0.0221
Podabacia kunzmanni	Z	0	0.9777	0	0.0223
Podabacia motuporensis	Z	0	0.9779	0	0.0221
Podabacia sinai	Z	0	0.9778	0	0.0222
Polycyathus muellerae	AZ	0.0701	0	0.9299	0
Polyphyllia talpina	Z	0	0.9763	0	0.0237
Porites annae	Z	0	0.9707	0	0.0293
Porites astreoides	Z	0	0.9667	0	0.0333
Porites australiensis	Z	0	0.969	0	0.031
Porites branneri	Z	0	0.9656	0	0.0344
Porites brighami	Z	0	0.9696	0	0.0304
Porites colonensis	Z	0	0.9612	0	0.0388
Porites compressa	Z	0	0.9715	0	0.0285
Porites cylindrica	Z	0	0.9717	0	0.0283
Porites divaricata	Z	0	0.9656	0	0.0344
Porites evermanni	Z	0	0.9707	0	0.0293
Porites furcata	Z	0	0.9655	0	0.0345
Porites lichen	Z	0	0.9682	0	0.0318
Porites lobata	Z	0	0.9712	0	0.0288
Porites lutea	Z	0	0.9717	0	0.0283
Porites monticulosa	Z	0	0.9707	0	0.0293
Porites nigrescens	Z	0	0.9712	0	0.0288
Porites okinawensis	Z	0	0.9707	0	0.0293
Porites panamensis	Z	0	0.9645	0	0.0355
Porites porites	Z	0	0.9652	0	0.0348
Porites pukoensis	Z	0	0.9714	0	0.0286
Porites randalli	Z	0	0.9682	0	0.0318
Porites rus	Z	0	0.9708	0	0.0292
Porites solida	Z	0	0.9713	0	0.0287
Porites sverdrupi	Z	0	0.9645	0	0.0355
Pourtalosmilia anthophyllites	AZ	0.9842	0	0.0158	0
Psammocora albopicta	Z	0	0.9753	0	0.0247
Psammocora contigua	Z	0	0.9751	0	0.0249

Psammocora digitata	Z	0	0.9753	0	0.0247
Psammocora haimiana	Z	0	0.9752	0	0.0248
Psammocora nierstraszi	Z	0	0.9751	0	0.0249
Psammocora profundacella	Z	0	0.9751	0	0.0249
Psammocora stellata	Z	0	0.9752	0	0.0248
Pseudodiploria clivosa	Z	0	0.9761	0	0.0239
Pseudodiploria strigosa	Z	0	0.9761	0	0.0239
Pseudosiderastrea formosa	Z	0	0.9205	0	0.0795
Pseudosiderastrea tayamai	Z	0	0.9205	0	0.0795
Rhizopsammia verrilli	AZ	0.4739	0	0.5261	0
Rhizopsammia wettsteini	AZ	0.4732	0	0.5268	0
Rhizosmilia maculata	AZ	0.1261	0	0.8739	0
Rhizosmilia robusta	AZ	0.9376	0	0.0624	0
Rhizosmilia sagamiensis	AZ	0.3756	0	0.6244	0
Rhizotrochus flabelliformis	AZ	0.9862	0	0.0138	0
Rhizotrochus typus	AZ	0.9807	0	0.0193	0
Rhombopsammia niphada	AZ	0.9386	0	0.0614	0
Sandalolitha dentata	Z	0	0.9779	0	0.0221
Sandalolitha robusta	Z	0	0.9779	0	0.0221
Scapophyllia cylindrica	Z	0	0.9781	0	0.0219
Sclerophyllia maxima	Z	0	0.9712	0	0.0288
Scolymia cubensis	Z	0	0.9761	0	0.0239
Seriatopora caliendrum	Z	0	0.8364	0	0.1636
Seriatopora hystrix	Z	0	0.8364	0	0.1636
Siderastrea glynni	Z	0	0.9421	0	0.0579
Siderastrea radians	Z	0	0.941	0	0.059
Siderastrea savignyana	Z	0	0.9324	0	0.0676
Siderastrea siderea	Z	0	0.9421	0	0.0579
Siderastrea stellata	Z	0	0.9417	0	0.0583
Solenastrea bournoni	Z	0	0.4762	0	0.5238

Solenastrea hyades	Z	0	0.1628	0	0.8372
Solenosmilia variabilis	AZ	0.9826	0	0.0174	0
Stenocyathus vermiformis	AZ	0.9784	0	0.0216	0
Stephanocoenia intersepta	Z	0	0.5559	0	0.4441
Stephanocyathus (Acinocyathus) spiniger	AZ	0.9141	0	0.0859	0
Stephanocyathus (Odontocyathus) coronatus	AZ	0.9615	0	0.0385	0
Stephanocyathus (Odontocyathus) weberianus	AZ	0.9615	0	0.0385	0
Stephanocyathus (Stephanocyathus) platypus	AZ	0.9612	0	0.0388	0
Stephanophyllia complicata	AZ	0.9381	0	0.0619	0
Stylaraea punctata	Z	0	0.9392	0	0.0608
Stylocoeniella guentheri	Z	0	0.6142	0	0.3858
Stylophora madagascarensis	Z	0	0.8353	0	0.1647
Stylophora pistillata	Z	0	0.8353	0	0.1647
Tethocyathus virgatus	AZ	0.349	0	0.651	0
Thalamophyllia gasti	AZ	0.1085	0	0.8915	0
Thalamophyllia riisei	AZ	0.1152	0	0.8848	0
Trachyphyllia geoffroyi	Z	0	0.977	0	0.023
Trochocyathus (Trochocyathus) efateensis	AZ	0.2303	0	0.7697	0
Trochocyathus (Trochocyathus) rhombocolumna	AZ	0.9567	0	0.0433	0
Tropidocyathus labidus	AZ	0.9719	0	0.0281	0
Tropidocyathus lessonii	AZ	0.973	0	0.027	0
Truncatoflabellum australiensis	AZ	0.982	0	0.018	0
Truncatoflabellum candeanum	AZ	0.982	0	0.018	0
Truncatoflabellum formosum	AZ	0.9862	0	0.0138	0
Truncatoflabellum macroeschara	AZ	0.9809	0	0.0191	0
Truncatoflabellum spheniscus	AZ	0.9808	0	0.0192	0

Tubastraea coccinea	AZ	0.4738	0	0.5262	0
Tubastraea diaphana	AZ	0.4726	0	0.5274	0
Tubastraea micranthus	AZ	0.474	0	0.526	0
Turbinaria heronensis	Z	0	0.7222	0	0.2778
Turbinaria irregularis	Z	0	0.5641	0	0.4359
Turbinaria mesenterina	Z	0	0.715	0	0.285
Turbinaria patula	Z	0	0.7222	0	0.2778
Turbinaria peltata	Z	0	0.5637	0	0.4363
Turbinaria reniformis	Z	0	0.715	0	0.285
Vaughanella concinna	AZ	0.9605	0	0.0395	0
Zoopilus echinatus	Z	0	0.9778	0	0.0222