8. SYNTHESIS OF RISK ASSESSMENTS: TAXONOMIC, REGIONAL, AND THREAT-BASED PATTERNS

Estimated likelihoods that the status for each of the 82 candidate coral species will fall below their Critical Risk Thresholds by the year 2100 are summarized in Figure 8.1 and Table 8.1. The candidate coral species are listed by ranked mean likelihood score while the range and relative distribution of points across risk likelihood categories reflect the varying uncertainties in demographic data and the individual Biological Review Team (BRT) members' perception of individual risks to each of the candidate species (Fig. 8.1 and Table 8.1). The relatively large spread of votes across risk categories for each candidate species primarily reflects the lack of adequate ecological and demographic information for most species. This resulted in uncertainties within votes by each of the BRT members in perception of that species' risk, as well as differences between BRT members' votes. On average, each BRT member spread their votes across three (mean 2.98, SD 0.66) risk likelihood categories per species or 53.75% (SD 12.73) likelihood points per species. The methods used to assess extinction risk, and the uncertainties that are reflected, do not allow for fine-scaled partitioning amongst mean likelihood scores for all of the 82 candidate coral species. However, characteristics of higher- and lower-ranked species can be discerned, and reflect somewhat greater confidence in the extinction risk status of the respective species. At one end species were clearly identified to have a relatively higher risk of extinction and at the other end a relatively lower risk of extinction, with a gradation of risk between these.

Species with high estimated likelihoods of their status falling below their Critical Risk Threshold by 2100 had at least some specific information available regarding small population size or declining population trends, combined with some specific or generic information indicating relatively high susceptibility to certain threats (e.g., bleaching or disease). Several of the highest-ranked (most at risk) species also had indications of very low to negligible recruitment potential. In contrast, species with lower estimated likelihoods of falling below their Critical Risk Thresholds by 2100 generally had wide geographic ranges, high abundances in at least some locations, and tended to display broad tolerances to environmental conditions, as evidenced by low known susceptibility to threats and/or known occurrence in diverse or marginal habitats. Many, if not most, species in the middle portion of the risk ranking have wide variances in likelihood points, or a relatively equal distribution of points across multiple categories. The resulting spread reflects some combination of uncertainties relative to taxonomic status, range, threat susceptibility, and population status and trends. For species in the middle and lower risk likelihood ranges, the evaluation was based primarily on projecting how high impact threats (i.e., ocean warming, disease, and ocean acidification) would affect the species, as there was little, if any, demographic information.

One other clear pattern in these assessments is that Caribbean species tend to have appreciably higher likelihood of falling below the Critical Risk Threshold by 2100. This reflects partly the relatively small geographic range size represented by the Caribbean basin (relative to the Indo-Pacific region). It is also clear that the Caribbean region has already been subject to dramatic, basin-wide declines in coral status, as reflected by the impacts of coral disease and general lack of coral recovery following disturbances. A similar high risk was given to the one species that likely is restricted to the eastern Pacific.

Ocean warming and coral disease were the threats that were deemed most important in driving Critical Risk Threshold likelihoods for the most at-risk species. However, the anticipated future impacts of ocean acidification were also deemed by the BRT to represent a substantial risk across almost all of the candidate species. While the BRT acknowledges the impacts of ocean acidification will vary among taxa, in the current state of knowledge, the BRT was unable to accurately separate taxa with greater or lesser risk from ocean acidification.

Figure 8.1. Summary of votes tallied across Critical Risk Threshold likelihood categories for all 82 candidate coral species ranked by mean likelihood. The x-axis indicates the percent likelihood of a species status falling below the Critical Risk Threshold. Darkness of color scales to the proportion of votes in each risk category for each species. Red text is used for Caribbean species names and black text is used for Indo-Pacific species names. See the Individual Species Accounts (Chapters 6 and 7) for the distribution of votes in each likelihood category.

Table 8.1. Summary of votes tallied in each risk likelihood category (colored columns), mean (and standard error, SE) likelihood of falling below the Critical Risk Threshold by 2100, and mean likelihood range for each of the 82 candidate coral species ranked by mean likelihood as determined by the BRT. The SE was calculated by taking the standard deviation of the seven mean voting scores of the BRT members. Mean likelihood range is the mean range of the likelihood estimates of the seven BRT voters. For example, an individual voter spreading votes in categories between "unlikely" and "more likely than not" would have an individual range of 56%. Three voters with a 33% range, one with a 56% range, and three with a 66% range would produce an average likelihood range of 50.4%. Red text is used for Caribbean species names and black text is used for Indo-Pacific species names. Species listed in parentheses were not petitioned per se, but were incorporated based on best available taxonomic information (see Sections 7.3.2, 7.8, 7.10.4 for discussions of taxonomic issues within Pocillopora, Montipora, and Porites respectively).

SPECIES	# OF VOTES IN EACH RISK LIKELIHOOD CATEGORY								MEAN LIKELI-HOOD (%)	SE OF BRT MEANS (%)	MEAN LIKELIHOOD RANGE (%)
	<1	1-10	10-33	33-50	50-66	66-90	90-99	>99			
Montastraea annularis	0	0	0	0	19	29	22	0	78	6.9	45.4
Montastraea faveolata	0	0	0	0	19	29	22	0	78	6.9	45.4
Acropora lokani	0	0	0	1	17	34	18	0	77	8.1	50.1
Acropora jacquelineae	0	0	0	1	17	37	15	0	76	7.3	50.1
Dendrogyra cylindrus	0	0	0	1	22	33	14	0	74	6.6	48.9
Montastraea franksi	0	0	0	3	25	24	18	0	74	9	47.9
Mycetophyllia ferox	0	0	0	5	26	30	9	0	70	8.2	50
Acropora rudis	0	0	0	9	19	34	8	0	70	11.2	49
Acropora dendrum	0	0	0	4	30	29	7	0	69	5.6	55
Pocillopora elegans (E Pacific)	0	0	3	7	25	26	9	0	67	13	53.4
Montipora patula (verrilli)	0	0	0	11	28	24	7	0	66	9.9	50.1
Acropora donei	0	0	0	13	28	26	3	0	64	8.2	52.6
Acropora pharaonis	0	0	0	15	27	23	5	0	64	8.9	55
Euphyllia paradivisa	0	0	0	15	28	22	5	0	63	9.6	50.3
Millepora foveolata	0	0	0	16	26	25	3	0	63	9.8	50.3
Millepora tuberosa	0	0	0	17	25	25	3	0	63	10.1	50.3
Euphyllia paraancora	0	0	0	17	27	21	5	0	63	10.4	50.3
Isopora cuneata	0	0	0	15	29	24	2	0	62	8.5	51.3
Euphyllia cristata	0	0	0	19	26	21	4	0	62	10.5	50.3
Montipora dilatata/flabellata (turgescens)	0	0	0	17	30	20	3	0	61	7.3	56.1
Agaricia lamarcki	0	0	0	17	29	23	1	0	61	6.3	54.9
Anacropora spinosa	0	0	0	22	27	19	2	0	59	7.5	54.9
Dichocoenia stokesi	0	0	0	19	33	17	1	0	59	5.1	58.3
Acropora microclados	0	0	3	19	27	19	2	0	58	11	60.3
Montipora lobulata	0	0	3	23	22	18	4	0	58	11.9	57.1
Acropora striata	0	0	2	21	27	19	1	0	58	8.4	58.1
Acropora listeri	0	0	3	18	31	17	1	0	58	6.7	64.9
Acropora globiceps	0	0	2	21	29	17	1	0	57	8.1	58.1
Pachyseris rugosa	0	0	3	23	24	18	2	0	57	10.8	57.1
Alveopora fenestrata	0	0	0	28	23	18	1	0	57	8.5	52.6
Alveopora allingi	0	0	0	27	25	17	1	0	57	8.7	52.6
Montipora australiensis	0	0	3	25	22	17	3	0	57	12	53.7
Anacropora puertogalerae	0	0	2	24	26	16	2	0	57	8.1	60.1
Acropora tenella	0	0	2	22	28	18	0	0	57	7.7	58.1
Montipora angulata	0	0	3	26	21	17	3	0	57	11.9	53.7
Isopora crateriformis	0	1	4	20	24	20	1	0	57	14.2	51.3
Montipora caliculata	0	0	3	25	23	16	3	0	57	11.6	53.7
Alveopora verrilliana	0	0	0	29	24	16	1	0	56	9	49.1
Montipora calcarea	0	0	3	26	23	15	3	0	56	11.6	53.7
Caulastrea echinulata	0	0	5	21	28	13	3	0	56	9.6	62.6
Seriatopora aculeata	0	0	4	25	25	15	1	0	55	10.3	59.1

SPECIES	# OF VOTES IN EACH RISK LIKELIHOOD CATEGORY								MEAN LIKELI-HOOD (%)	SE OF BRT MEANS (%)	MEAN LIKELIHOOD RANGE (%)
	<1	1-10	10-33	33-50	50-66	66-90	90-99	>99			
Acropora speciosa	0	0	4	25	25	16	0	0	55	10.1	54.4
Acropora verweyi	0	0	7	21	25	16	1	0	54	11.5	59.1
Acropora retusa	0	0	6	25	22	15	2	0	54	13.2	55.7
Pocillopora danae	0	0	8	20	28	11	3	0	54	13.7	52.3
Pavona diffluens	0	0	6	25	25	13	1	0	53	12	61.4
Acropora paniculata	0	0	5	26	26	12	1	0	53	9.4	49.9
Acropora polystoma	0	0	6	26	25	12	1	0	53	9.9	61.3
Acropora vaughani	0	0	8	24	24	13	1	0	52	11.2	61.3
Astreopora cucullata	0	0	8	25	24	11	2	0	52	9.2	59
Barabattoia laddi	0	0	4	28	29	8	1	0	52	12.6	51.1
Acropora palmerae	0	0	7	24	28	11	0	0	52	8.8	60
Acropora horrida	0	0	5	27	29	9	0	0	52	6.8	56.7
Physogyra lichtensteini	0	0	10	25	22	12	1	0	51	11.4	62.3
Porites horizontalata	0	0	10	25	22	12	1	0	51	11.7	62.3
Pocillopora elegans (W Pacific)	0	2	9	23	23	12	1	0	50	14.6	56.9
Porites napopora	0	0	8	27	27	8	0	0	50	9.1	57.7
Acanthastrea brevis	0	0	8	28	26	7	1	0	50	9.1	57.7
Acanthastrea hemprichii	0	0	8	28	26	7	1	0	50	9.1	57.7
Acanthastrea ishigakiensis	0	0	8	28	26	7	1	0	50	7	59.9
Porites nigrescens	0	0	8	29	25	7	1	0	50	8.9	57.7
Acropora acuminata	0	0	9	25	30	6	0	0	49	8.5	56.6
Acropora aculeus	0	0	11	22	30	7	0	0	49	11.8	51
Pectinia alcicornis	0	0	16	22	20	10	2	0	48	15.6	58.9
Acropora aspera	0	1	9	24	31	5	0	0	48	9.3	57.9
Pavona bipartita	0	0	10	28	26	6	0	0	48	10.9	47.4
Acanthastrea regularis	0	3	8	26	25	8	0	0	48	15	46.6
Pavona cactus	0	0	12	27	24	7	0	0	47	10.7	47.4
Pavona decussata	0	0	11	28	25	6	0	0	47	10.7	50.7
Pavona venosa	0	0	11	28	25	6	0	0	47	12	48.3
Cyphastrea agassizi	0	0	15	22	25	8	0	0	47	13.8	51.7
Cyphastrea ocellina	0	0	15	23	24	8	0	0	47	13.7	51.7
Turbinaria stellulata	0	0	8	33	29	0	0	0	46	5.9	40.6
Galaxea astreata	0	1	9	34	24	2	0	0	45	7.5	51.9
Psammacora stellata	0	2	18	30	18	2	0	0	41	9.2	58.4
Leptoseris incrustans	0	6	17	27	17	3	0	0	39	10.3	61.1
Leptoseris yabei	0	6	18	25	19	2	0	0	39	11.1	57.7
Turbinaria mesenterina	0	3	19	36	12	0	0	0	37	9.5	45.1
Turbinaria peltata	0	3	19	36	12	0	0	0	37	9.5	45.1
Turbinaria reniformis	0	3	19	36	12	0	0	0	37	9.5	45.1
Heliopora coerulea	0	4	24	28	11	3	0	0	37	11.1	54.1
Porites (Clade 1 forma *pukoensis**)	0	30	25	14	1	0	0	0	19	8.3	43.1
all votes summed	0	65	494	1750	1981	1209	241	0			
frequency of species per likelihood bin	0	13	57	80	82	77	57	0			
percentage of species per likelihood bin (%)	0	16	70	98	100	94	70	0			
mean likelihood score frequency	0	0	1	25	46	10	0	0			

* see species account *Porites pukoensis* for details

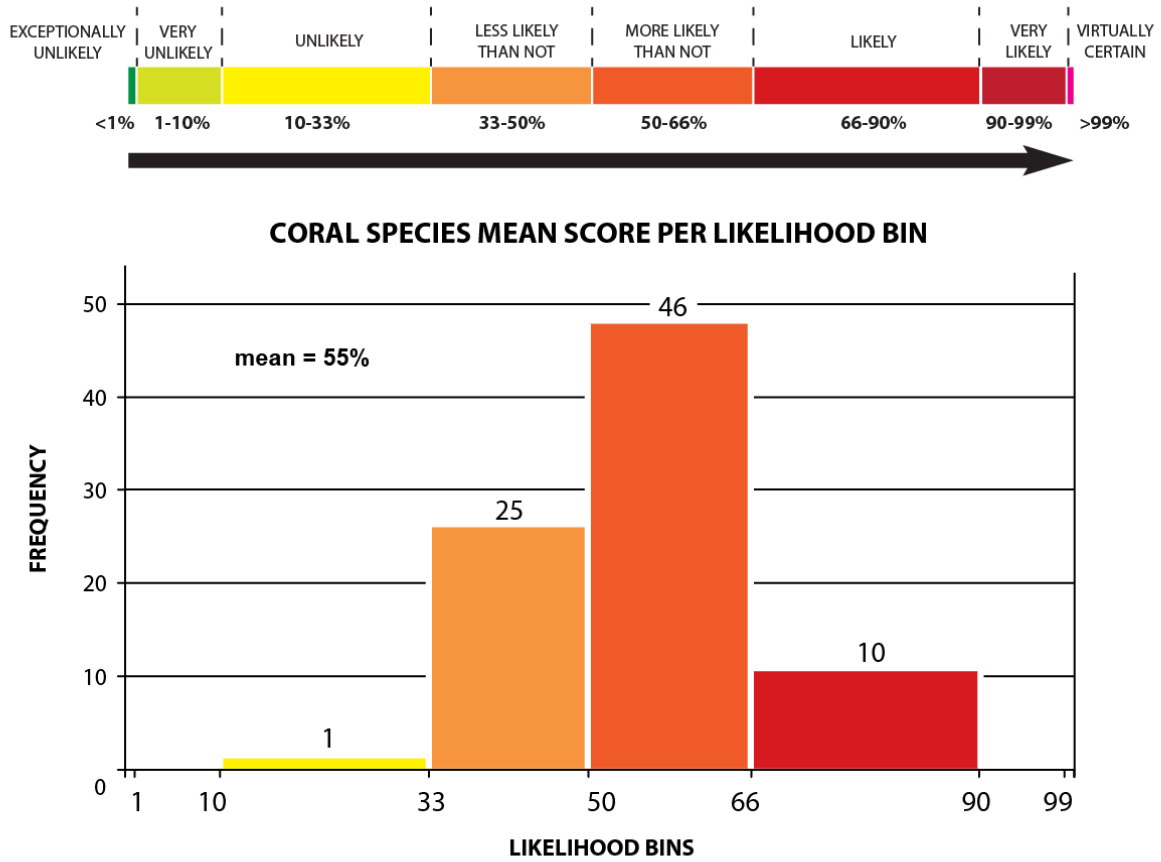

Figure 8.2. Number of coral species mean likelihood scores (total = 82 scores) that fall in each likelihood bin. The overall mean of the mean likelihood scores of all 82 species is 55%.