Extended data

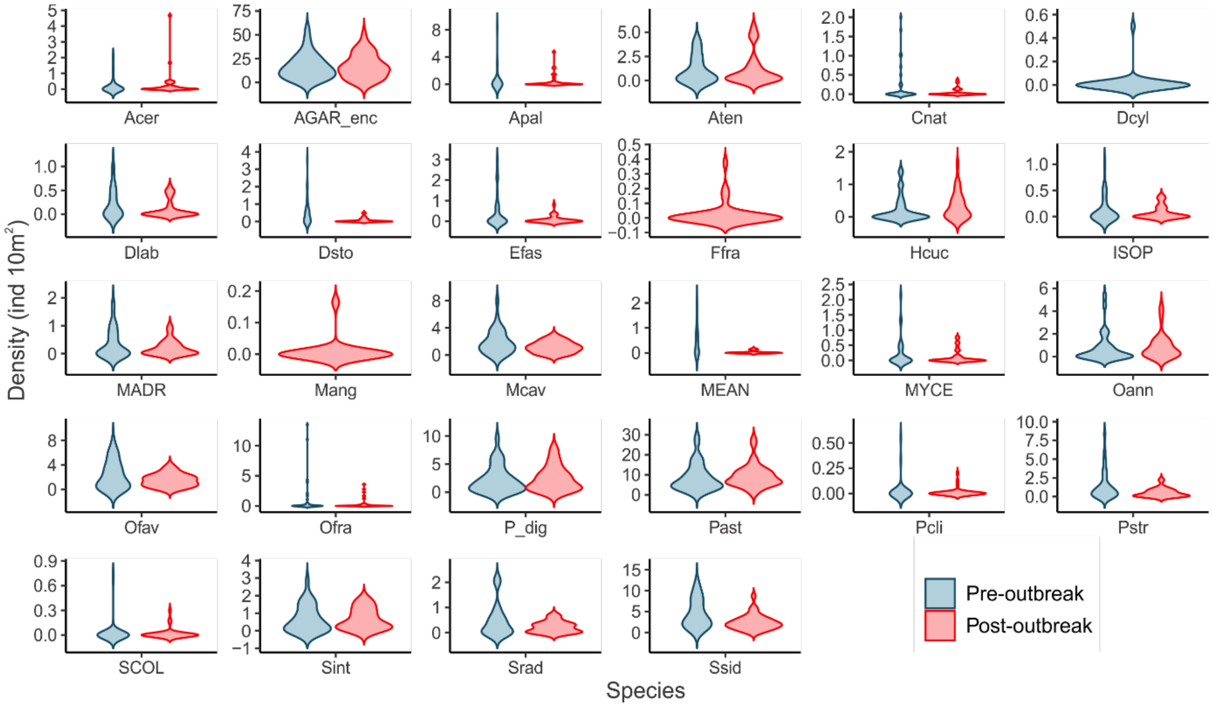

Figure S1. Changes in coral density before (blue) and after (red) the outbreak of the Stony Coral Tissue Loss Disease (SCTLD) in the 35 reef-sites along the Mexican Caribbean. Acer: *Acropora cervicornis*; AGAR_enc: *Agaricia* encrusting Apal: *Acropora palmata*; Aten*: Agaricia tenuifolia*; Cnat: *Colpophyllia natans*; Dcyl: *Dendrogyra cylindrus*; Dlab: *Diploria labyrinthiformis*; Dsto: Dichocoenia stokesii; Efas: *Eusmilia fastigiata;* Ffra: Favia fragum; Hcuc: Helioseris cucullata; ISOP: *Isophyllia spp*; MADR: Madracis spp; Mang: *Mussa angulosa*; Mcav: *Montastraea cavernosa*; MEAN: *Meandrina* spp; MYCE: *Mycetophyllia* spp; Oann: *Orbicella annularis*; Ofav: *Orbicella faveolata*; Ofra: *Orbicella franksi*; P_dig: Branching *Porites;* Past: *Porites astreoides*; Pcli: *Pseudodiploria clivosa*: Pstr: *Pseudodiploria strigosa*: SCOL: Scolymia spp; Sint*: Stephanocoenia intersepta*; Srad: Siderastrea radians; Ssid: *Siderastrea siderea*.

Table S1. Results from Generalized linear model (GLM) performed to test the relationship between the percentage of afflicted colonies by the SCTLD and multiple predictive variables: coastal development, MPA age, the density of coral colonies, its structural complexity, reef zonation, depth, and the site's exposition to dominant winds. All 101 sites included in this analysis.

Predictor	**Estimate**	**S.E.**	**t-value**	**P value**
(Intercept)	-2.97	8.16	-0.36	0.72
Coastal development threat				
Medium	27.60	6.25	4.42	**<0.01**
High	29.57	5.25	5.63	**<0.01**
MPA age	9.66	2.71	3.56	**<0.01**
Density of coral colonies	-0.89	2.35	0.38	0.71
Structural complexity	-2.41	2.29	-1.05	0.30
Reef zonation				
Fore reef	5.48	6.47	0.85	0.40
Depth	0.66	2.65	0.25	0.80
Sites exposition to dominant winds				
Windward	10.36	5.24	1.98	0.05

AIC = 882.4, df = 92

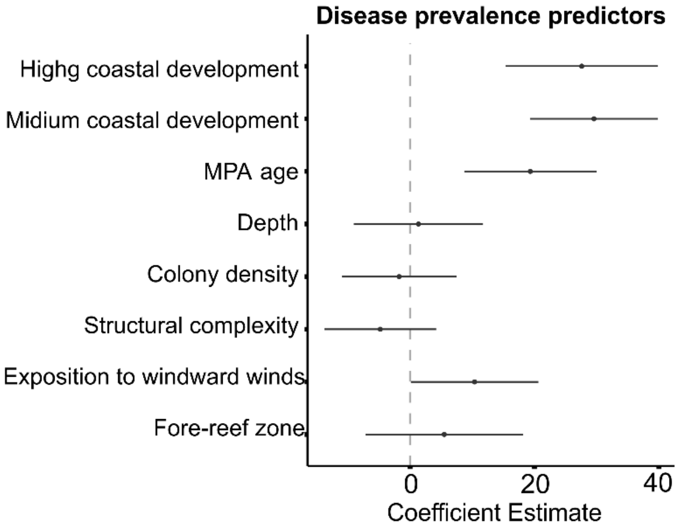

Figure S2. Disease prevalence predictors in coral reefs in the Mexican Caribbean. Standardized regression coefficients for predictive variables. Error bars represent 95% confidence intervals. There was a significant relationship between coastal development threat, MPA age, and the disease prevalence. However, this result was driven by reefs in Banco Chinchorro, the only region not afflicted by the disease outbreak.

Table S2. Results from Generalized linear model (GLM) performed without the sites in Banco Chinchorro to test the relationship between the percentage of afflicted colonies by the SCTLD and multiple predictive variables: Coastal development, MPA age, the density of coral colonies, its structural complexity, reef zonation, depth, and the site's exposition to dominant winds.

Predictor	**Estimate**	**S.E.**	**t-value**	**P value**
(Intercept)	21.06	13.40	1.57	0.12
Coastal development threat				
Medium	7.53	9.16	0.82	0.41
High	12.30	7.77	1.58	0.12
MPA age	5.78	3.23	1.79	0.08
Density of coral colonies	-2.98	2.58	-1.15	0.25
Structural complexity	-0.36	2.61	-0.14	0.89
Reef zonation				
Fore reef	4.85	7.28	0.67	0.51
Depth	0.80	2.96	0.27	0.79
Sites exposition to dominant winds				
Windward	2.67	7.62	0.35	0.73

AIC = 754.91, df = 77

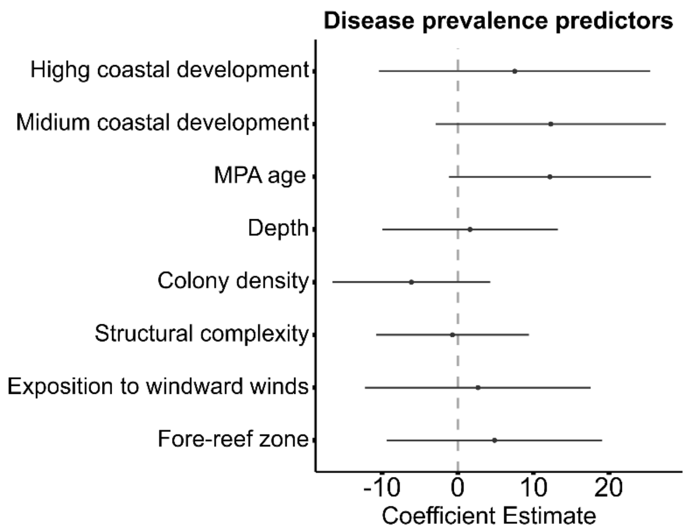

Figure S3. Disease prevalence predictors in coral reefs in the Mexican Caribbean without the sites from Banco Chinchorro. Standardized regression coefficients for predictive variables. Error bars represent 95% confidence intervals.

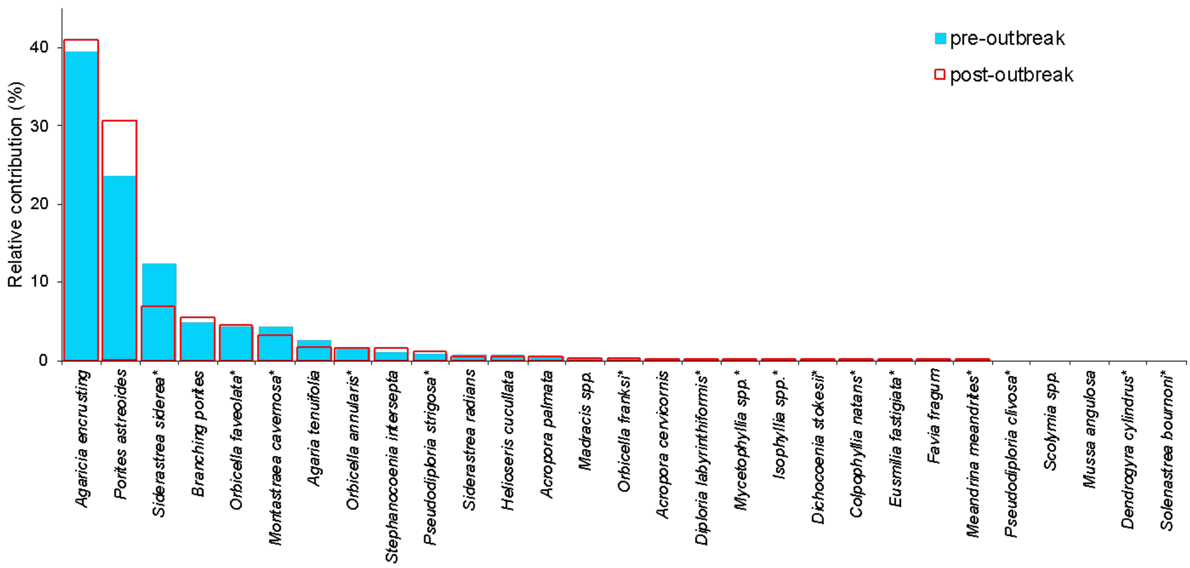

Figure S4. Abundance-based Similarity Percentage (SIMPER) analysis of species contributions to similarity within the pre-outbreak (blue bars) and post-outbreak (red lines) periods. The *Agaricia* encrusting groups five species: *A. agaricites, A. fragilis, A. grahamae, A. humilis* and *A. lamarcki*. The branching *Porites* correspond to those species with digitate form: *P. porites, P. divaricata* and *P. furcata. Madracis* spp., groups *M. decactis* and *M. aurentenra. Mycetophyllia* sp. correspond to four species: *M. aliciae, M. danaana, M. ferox* and *M. lamarckiana*. *Isophyllia* spp. groups *I. rigida and I. sinuosa. Scolymia* spp. correspond to S. *cubensis* and some colonies that were only identified at the genus level* indicates species with more than 10% of disease prevalence (which are considered as highly susceptible species, see Fig. 1 and Methods).

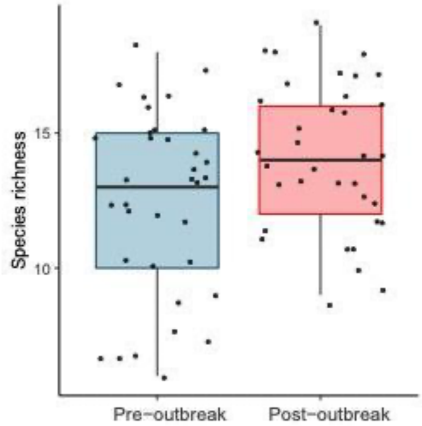

Figure S5. Box plot of coral species richness between the pre (blue) and post-outbreak (red) of the Stony Coral Tissue Loss Disease (SCTLD) in 35 reef sites along the Mexican Caribbean. The effort increased considerably for the post-outbreak period (mean number of transects = 8; SD=3.71) when compared with the pre-outbreak period (mean number of transects = 2.8; SD= 1.4).

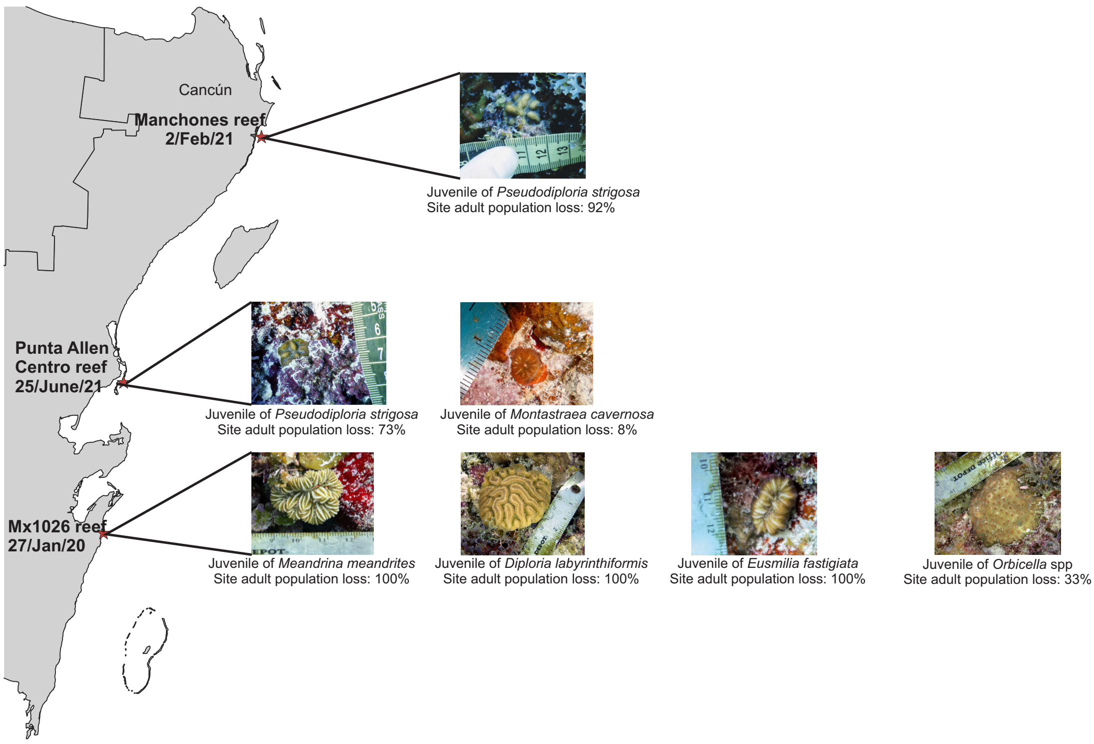

Figure S6. Example of juvenile corals of highly susceptible species to the Stony Coral Tissue Loss Disease observed in surveys after the outbreak (2020 and 2021). The estimate site loss for adult population of each species was calculated by comparing the surveys conducted before and after the SCTLD outbreak (see methods).

Table S3. Summary of Similarity Percentage analysis (SIMPER) results discriminating species in each period (pre-outbreak and post-outbreak). Species contribution (Contrib%) to the dissimilarity between groups, and cumulative total (Cum.%) of contributions. * indicates species with more than 10% of disease prevalence (which are considered as highly susceptible species, see Fig. 1 and Methods).

Species	Pre-outbreak mean Cover	Post-outbreak mean Cover	mean Dissimilarity	Diss/SD	Contrib%	Cum.%
Agaricia encrusting	16.44	17.07	16.51	1.4	33.17	33.17
Porites astreoides	8.71	9.53	8.59	1.03	17.25	50.42
*Siderastrea siderea**	4.49	2.44	3.91	1.16	7.87	58.29
Branching *porites*	2.23	2.41	3	1.1	6.03	64.31
*Orbicella faveolata**	2.32	1.53	2.49	1.14	5	69.31
*Montastraea cavernosa**	1.9	1.18	1.85	1.13	3.71	73.03
Agaria tenuifolia	1.09	1.16	1.82	1	3.66	76.69
*Pseudodiploria strigosa**	1.45	0.52	1.69	0.77	3.4	80.1
*Orbicella franksi**	1.11	0.38	1.51	0.46	3.04	83.14
*Orbicella annularis**	0.71	0.88	1.38	0.91	2.78	85.91
Acropora palmata	0.44	0.44	1.28	0.41	2.57	88.48
Stephanocoenia intersepta	0.66	0.66	0.9	1.21	1.81	90.29
*Dichocoenia stokesii**	0.52	0.07	0.62	0.72	1.24	91.53
Siderastrea radians	0.48	0.22	0.57	0.91	1.14	92.67
*Eusmilia fastigiata**	0.43	0.07	0.48	0.64	0.97	93.64
Helioseris cucullata	0.22	0.33	0.48	0.91	0.97	94.61
*Meandrina meandrites**	0.41	0.02	0.47	0.78	0.94	95.56
Madracis spp.	0.33	0.2	0.47	0.86	0.94	96.5
Acropora cervicornis	0.16	0.28	0.47	0.45	0.94	97.44
*Mycetophyllia spp.**	0.23	0.12	0.35	0.62	0.7	98.14
*Colpophyllia natans**	0.22	0.05	0.31	0.53	0.62	98.76
*Diploria labyrinthiformis**	0.21	0.11	0.3	0.83	0.6	99.36
*Isophyllia spp.**	0.11	0.07	0.18	0.75	0.36	99.71
*Pseudodiploria clivosa**	0.03	0.01	0.05	0.34	0.09	99.81
Scolymia spp.	0.02	0.02	0.04	0.3	0.08	99.88
Favia fragum	0	0.02	0.03	0.34	0.06	99.94
*Dendrogyra cylindrus**	0.01	0	0.02	0.17	0.04	99.98
Mussa angulosa	0	0.01	0.01	0.23	0.01	99.99
*Solenastrea bournoni**	0	0	0	0	0.01	100

Table S4. Functional traits and their contribution to reef functionality.

Trait group	Functional contribution	Functional traits	Categories
Growth patterns	Denotes how much accretion and regeneration has the reef[1], and how it influences in the reef carbonate balances[2].	Skeletal density	in $g\ cm^{-3}$: <1 (1), 1-1.4 (2), 1.4-1.7 (3), 1.7-2 (4), >2 (5)
		Growth rate	in $mm\ yr^{-1}$: 0-10 (1), 10-20 (2), 20-40 (3), 40-60 (4), >60 (5)
Structural complexity	Indicates the arrangement type of the reef carbonate structure, as well as the provision of habitat for associated species[3,4].	Rugosity index	1-1.29 (1), 1.3-1.59 (2), 1.6-1.99 (3), 2-2.5 (4), >2.5 (5)
		Colony height	in cm: 1-5 (1), 5-10 (2), 10-20 (3), 20-40 (4), >40 (5)
Reproduction strategies	Provides information about connectivity between reefs, and colonizing reefs which influences their recovery and resilience[5].	Reproductive mode	Brooders (1), Mixed (2), Spawners (3)
Feeding capacity	Capacity to capture nutrients which becomes fundamental due to the absence of symbionts[6].	Corallite width	in mm: 1-2 (1), 2-5 (2), 5-10 (3), 10-15 (4), >15 (5)

Table S5. Tested predictors for the effect of environmental and anthropogenic covariates on SCTLD prevalence. Type of variable, description, and justification for their inclusion in the models.

Predictor	Proxy for	Type	Description	Justification
Density of coral colonies (prior to the impact of the disease)	Habitat structure	Continuous	Percentage of afflicted colonies (%).	Transmission of a disease can be density-dependent[7].
Reef structural complexity	Habitat structure	Ordinal	Visually estimated by a single observer on a scale from 0 to 5 (Polunin & Roberts 1993).	Structural complexity is an important indicator of habitat perturbation. As reef building species have declined, architectural complexity has also decreased[8,9]. Since habitats' structural complexity is related to higher coral cover[10] and the SCTLD affects a higher number of species (>20 species[11]). This characteristic might influence susceptibility to disease.
Reef zonation	Habitat structure	Categorical	Back-reef, crest, fore-reef.	Reef zonation influences coral community structure, therefore, depending on the specific species composition and abundance can determine zones of higher vulnerability and mortality[12,13].
Depth	Light availability	Continuous	Bottom sites' depth (m).	Light is one of the main limiting factors for coral reefs growth due to the Symbionts light requirements for photosynthesis. Different light environments can influence corals' resistance and resilience against natural and anthropogenic perturbations[14].
Site's exposition to dominant winds	Wave energy	Categorical	Leeward, windward.	Exposure to different water column conditions (e.g., currents) might set a different level of vulnerability to infection. For instance, intense water motion favors coral reef development[15].
Coastal Development level (World Resources Institute database - Burke & Reytar 2011)	Influence from land-based human activities	Categorical	Low, Medium, High.	Coastal development can negatively influence coastal ecosystems such as coral reefs. This index is based on location and size of cities, ports, and airports, coastal population density, coastal population growth, and tourism growth since 2000[16].
MPA age	Management	Continuous	Time since MPA was formally established by Mexican legislation.	MPAs can mitigate the effects of natural and anthropogenic disturbances and increase resilience among coral reef communities against different perturbations. Benefits of MPAs increase with the time since MPA establishment [17,18,19].

Table S6. Data of coral traits used for the analysis of Functional Diversity.

Specie	Reproductive mode	Growth rate (mm yr-1)	Skeletal density (g cm-3)	Colony height (cm)	Colony rugosity	Corallite width (mm)
Acropora cervicornis	Spawner	106.6	1.96	21.56	2.27	1.7
Agaricia encrustant	Brooder	3.95	2.17	8.76	1.33	6.15
Acropora palmata	Spawner	66.82	1.83	52.59	3.66	1.6
Agaricia tenuifolia	Brooder	3.95	2.1	23.37	1.87	5.1
Colpophyllia natans	Spawner	6.35	0.78	37.62	1.6	12.9
Dendrogyra cylindrus	Spawner	12.67	1.46	96.1	2.8	4.2
Diploria labyrinthiformis	Mixed	4.08	1.43	22.54	1.61	5.8
Dichocoenia stokesi	Spawner	2.05	1.96	7.4	1.51	11.2
Eusmilia fastigiata	Spawner	7	1.3	9.74	1.45	20.9
Favia fragum	Mixed	5	1.14	3.97	1.25	5.8
Helioseris cucullata	Brooder	3.95	2.17	5.84	1.08	6
Isophyllia sp.	Brooder	2.75	1.14	4.73	1.24	14.7
Madracis sp.	Brooder	15.1	1.66	8.87	1.71	1.97
Montastraea cavernosa	Spawner	4.56	1.62	20.47	1.78	10
Meandrina sp.	Spawner	1.15	1.66	22.95	1.8	13.5
Mycetophyllia sp.	Brooder	2.75	1.14	7.18	1.19	15.83
Orbicella annularis	Spawner	6.84	1.67	53.38	1.89	3.8
Orbicella faveolata	Spawner	8.9	1.25	46.75	1.82	2.6
Orbicella franksi	Spawner	3.33	2.03	21.78	1.94	2.4
Branching *Porites*	Brooder	19.68	1.12	12.88	1.43	1.83
Porites astreoides	Mixed	3.68	1.49	6.23	1.52	1.6
Pseudodiploria clivosa	Spawner	4.79	1.2	17.61	1.59	5.8
Pseudodiploria strigosa	Mixed	4.91	1.2	24.01	1.85	10.1
Scolymia sp.	Brooder	2.75	1.14	3.23	1.25	56.5
Stephanocoenia intersepta	Spawner	2.87	1.66	5.32	1.09	2.7
Siderastrea radians	Mixed	2	1.51	2.88	1.03	3
Siderastrea siderea	Mixed	4.18	1.51	10.72	1.35	4.5
Mussa angulosa	Brooder	2.75	1.14	4.3	1.27	60

References for supporting material

1. Todd, P. A. Morphological plasticity in scleractinian corals. Biological Reviews 83, 315–337 (2008).
2. Perry, C. T. et al. Estimating rates of biologically driven coral reef framework production and erosion: A new census-based carbonate budget methodology and applications to the reefs of Bonaire. Coral Reefs 31, 853–868 (2012).
3. Gratwicke, B. & Speight, M. R. The relationship between fish species richness, abundance and habitat complexity in a range of shallow tropical marine habitats. Journal of Fish Biology 66, 650–667 (2005).
4. Alvarez-Filip, L., Gill, J. A. & Dulvy, N. K. Complex reef architecture supports more small-bodied fishes and longer food chains on Caribbean reefs. Ecosphere 2, art118 (2011).
5. Darling, E. S. & Côté, I. M. Seeking resilience in marine ecosystems. Science 359, 986–987 (2018).
6. Porter, J. W. Autotrophy , Heterotrophy, and Resource Partitioning in Caribbean Reef-Building Corals. The American Naturalist 110, 731–742 (1976).
7. Peters, E. C. Diseases of Coral Reef Organisms. in Coral Reefs in the Anthropocene (ed. Birkeland, C.) 147–178 (Springer Netherlands, 2015). doi:10.1007/978-94-017-7249-5_8
8. Alvarez-Filip, L., Dulvy, N. K., Gill, J. a, Côté, I. M. & Watkinson, A. R. Flattening of Caribbean coral reefs: region-wide declines in architectural complexity. Proceedings. Biological sciences / The Royal Society 276, 3019–25 (2009).
9. Alvarez-Filip, L. et al. Drivers of region-wide declines in architectural complexity on Caribbean reefs. Coral Reefs 30, 1051–1060 (2011).
10. Graham, N. A. J. & Nash, K. L. The importance of structural complexity in coral reef ecosystems. Coral Reefs 32, 315–326 (2013).
11. Alvarez-Filip, L., Estrada-Saldívar, N., Pérez-Cervantes, E., Molina-Hernández, A. & González-Barrios, F. J. A rapid spread of the Stony Coral Tissue Loss Disease outbreak in the Mexican Caribbean. PeerJ (2019). doi:10.7717/peerj.8069
12. Harvell, C. D. et al. Coral diseases, Environmental drivers and the balance between corals and microbial associates. Oceanography 20, 172–195 (2007).

13. Zawada, D. G. Reef topographic complexity. Encyclopedia of modern coral reefs: Structure, form, and process. Encyclopedia of Earth Sciences. Dordrecht: Springer 902–906 (2011).
14. López-Londoño, T. et al. Physiological and ecological consequences of the water optical properties degradation on reef corals. Coral Reefs (2021). doi:10.1007/s00338-021-02133-7
15. Jokiel, P. L. & Brown, E. K. Global warming, regional trends and inshore environmental conditions influence coral bleaching in Hawaii. Global Change Biology 10, 1627–1641 (2004).
16. Burke, L., Reytar, K., Spalding, M. & Perry, A. Reefs at risk. National Geographic (2011). doi:10.1016/0022-0981(79)90136-9
17. Selig, E. R. & Bruno, J. F. A Global Analysis of the Effectiveness of Marine Protected Areas in Preventing Coral Loss. 5, 1–7 (2010).
18. Mellin, C., Aaron Macneil, M., Cheal, A. J., Emslie, M. J. & Julian Caley, M. Marine protected areas increase resilience among coral reef communities. Ecology Letters 19, 629–637 (2016).
19. Suchley, A. & Alvarez-Filip, L. Local human activities limit marine protection efficacy on Caribbean coral reefs. Conservation Letters 11, 1–9 (2018).