Supplementary Materials for Lester et al., *Caribbean reefs of the Anthropocene: variance in ecosystem metrics indicate bright spots on coral depauperate reefs*.

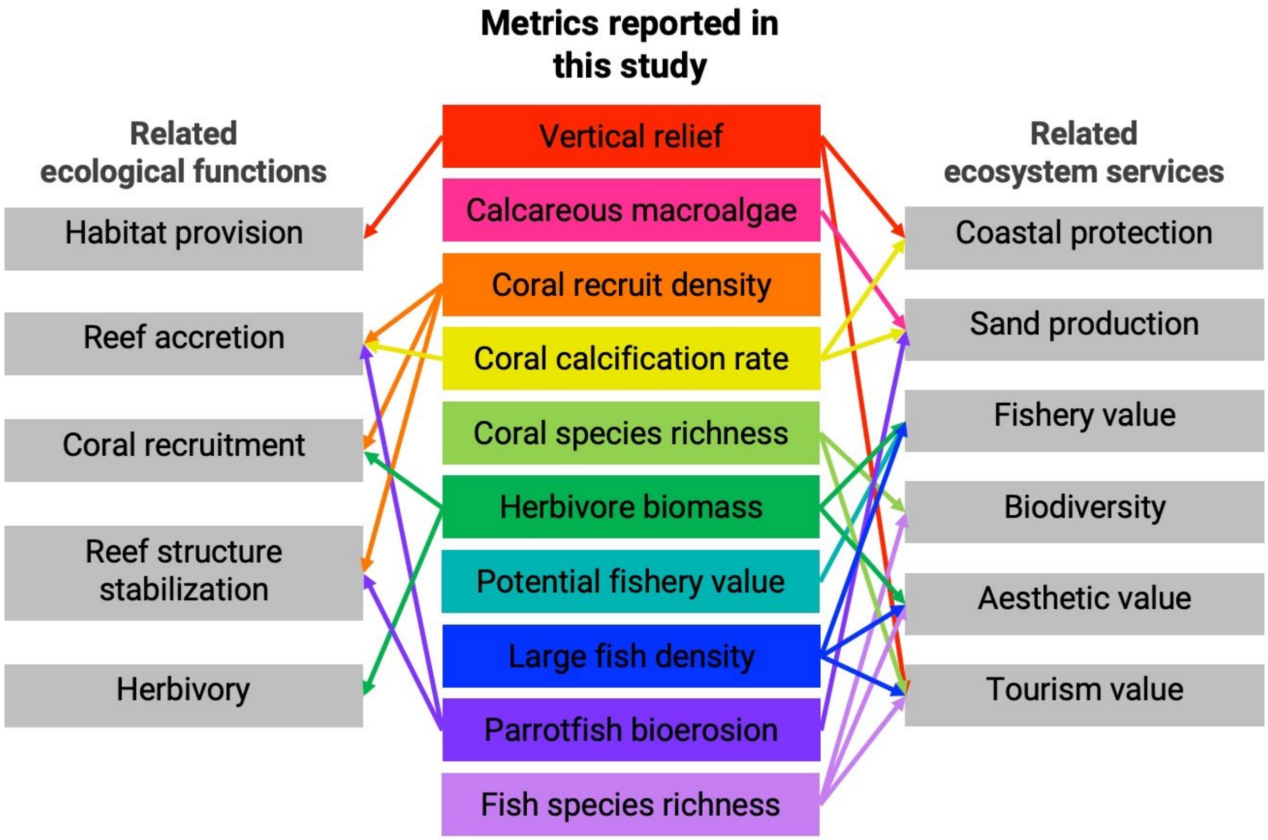


Fig. S1. Metrics reported in this study (center boxes) are related to (shown by arrows) various ecological functions (left boxes) and ecosystem services (right boxes). Note that this is not a comprehensive list of functions and services provided by coral reef ecosystems.

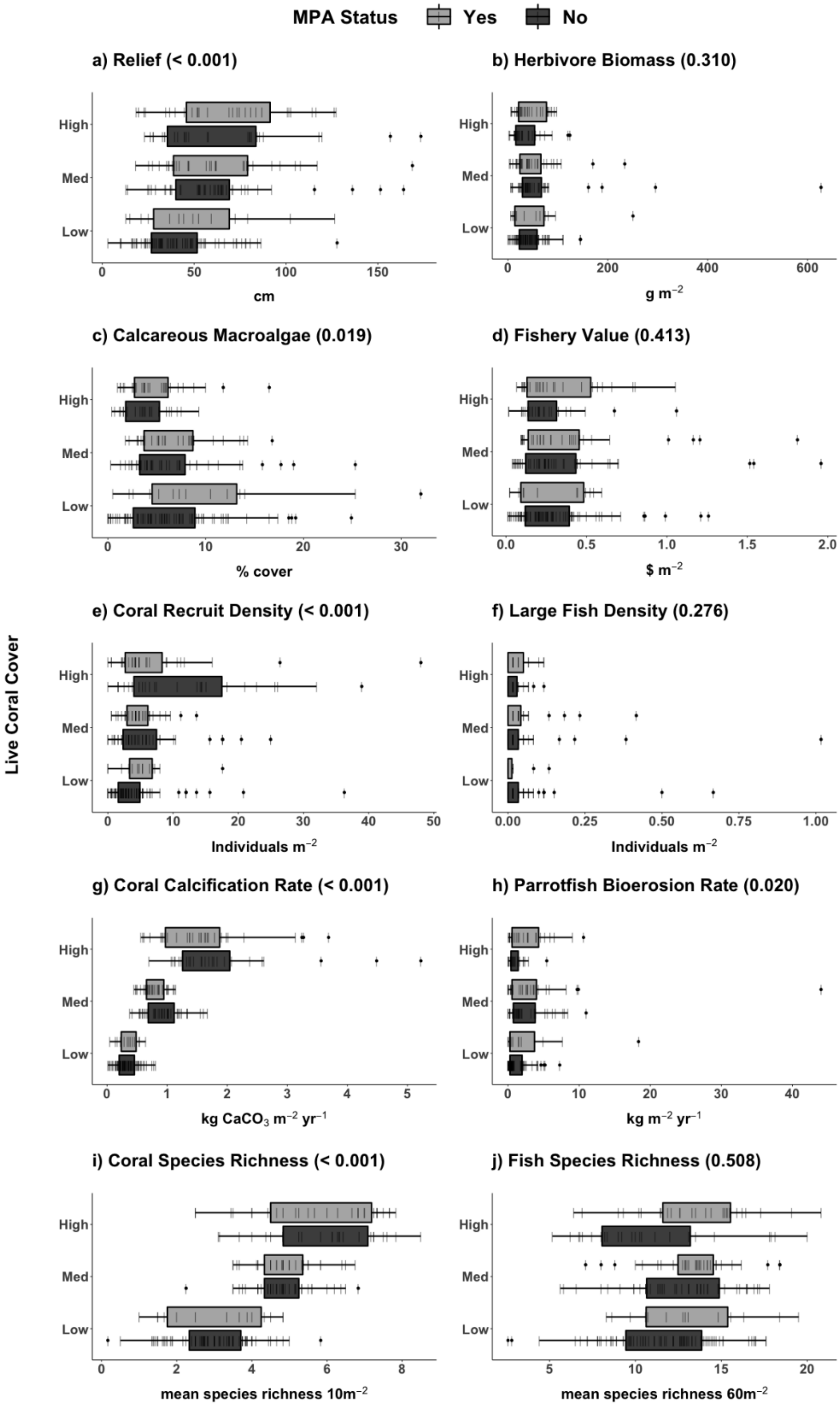


Fig. S2. Distribution of 10 metrics for sites with low (<10%), medium (10-20%), and high (>20%) live coral cover, by MPA status. Indicators like fish biomass and community composition are influenced by fishing pressure, which could potentially confound interpretation of associations between our indicators and coral cover. While there are few direct, Caribbean-wide measures of fishing pressure, several of our study sites fall within marine protected areas (MPAs) where fishing pressure could be lower compared to areas outside MPAs (although we note that most MPAs in the Caribbean may be poorly enforced). We do not find higher levels of herbivorous fish biomass, density of large fish, fishery value, or fish species density at higher versus lower coral cover sites inside or outside of MPAs, and therefore protection status does not appear to be obscuring a relationship between coral cover and these metrics. Data from AGRRA (2018), where “yes” and “no” indicate whether the survey was conducted inside an MPA (number of sites for yes, no: panels **A-G**, **I-J**, n=75, 144; panel **H**, n=63, 124). Data were filtered to exclude an MPA status of “unknown” (n=219 sites included). Lines represent individual data points. P-values are from LMERs including ecoregion, year, depth, and coral cover as effects; for the models for coral recruit density, parrotfish bioerosion, coral calcification, and fish species richness, we switched ecoregion to a fixed effect, and for the coral species richness model we switched year to a fixed effect, to avoid boundary errors.

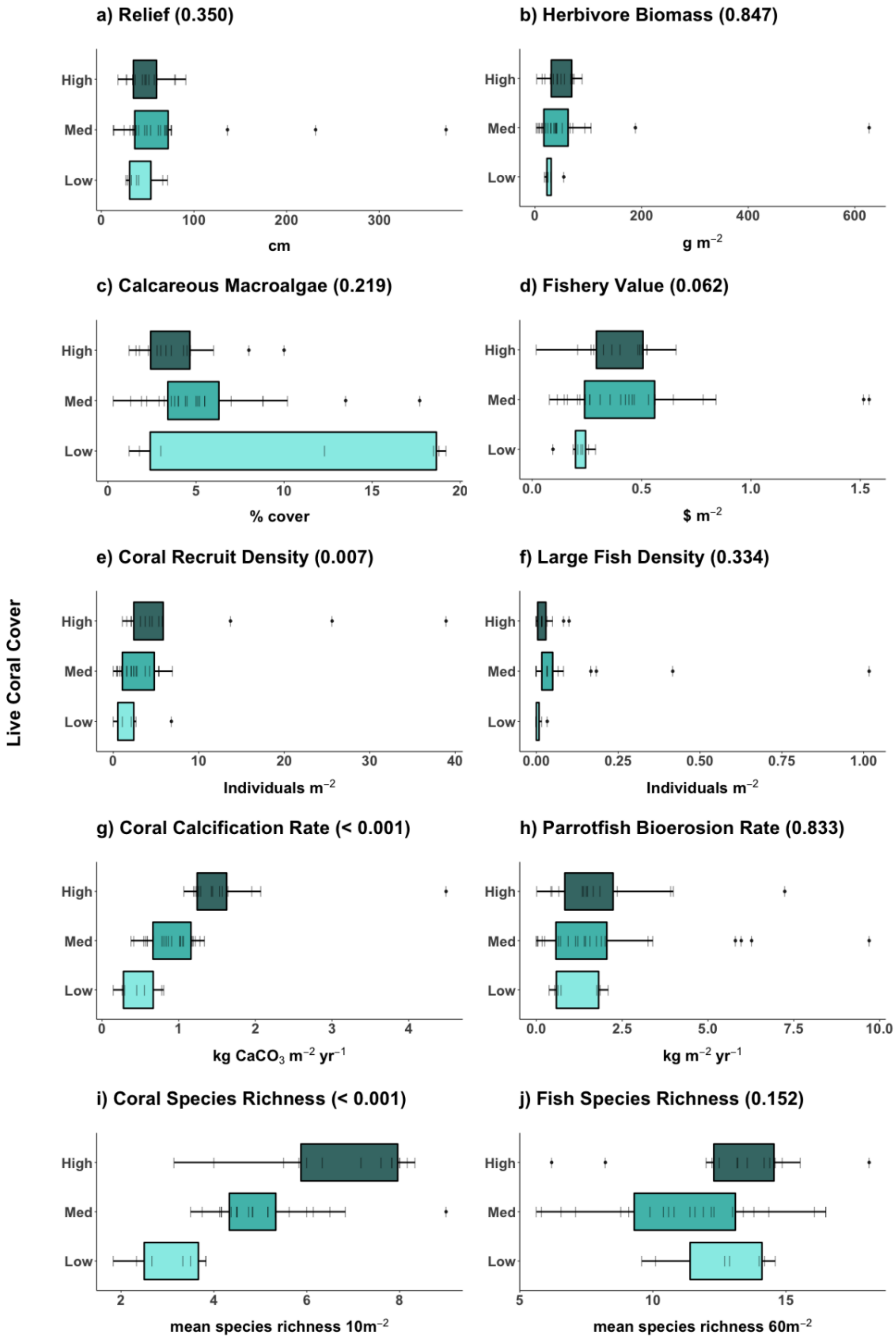


Fig. S3. Distribution of ten metrics, by three categories of mean percent live coral cover, plotted only for the Western Caribbean ecoregion surveyed in 2011. This is one of two ecoregion by year combinations for which we have the highest sample size, and the basic qualitative patterns are broadly consistent with those for the full dataset (Fig. 3). High coral cover is defined as >20%, medium is 10-20%, and low is <10%. Data from AGRRA 2018 (number of sites for high, medium, low coral cover: n=14, 25, 7). Lines represent individual data points. P-values are from LMERs including depth and coral cover as effects.

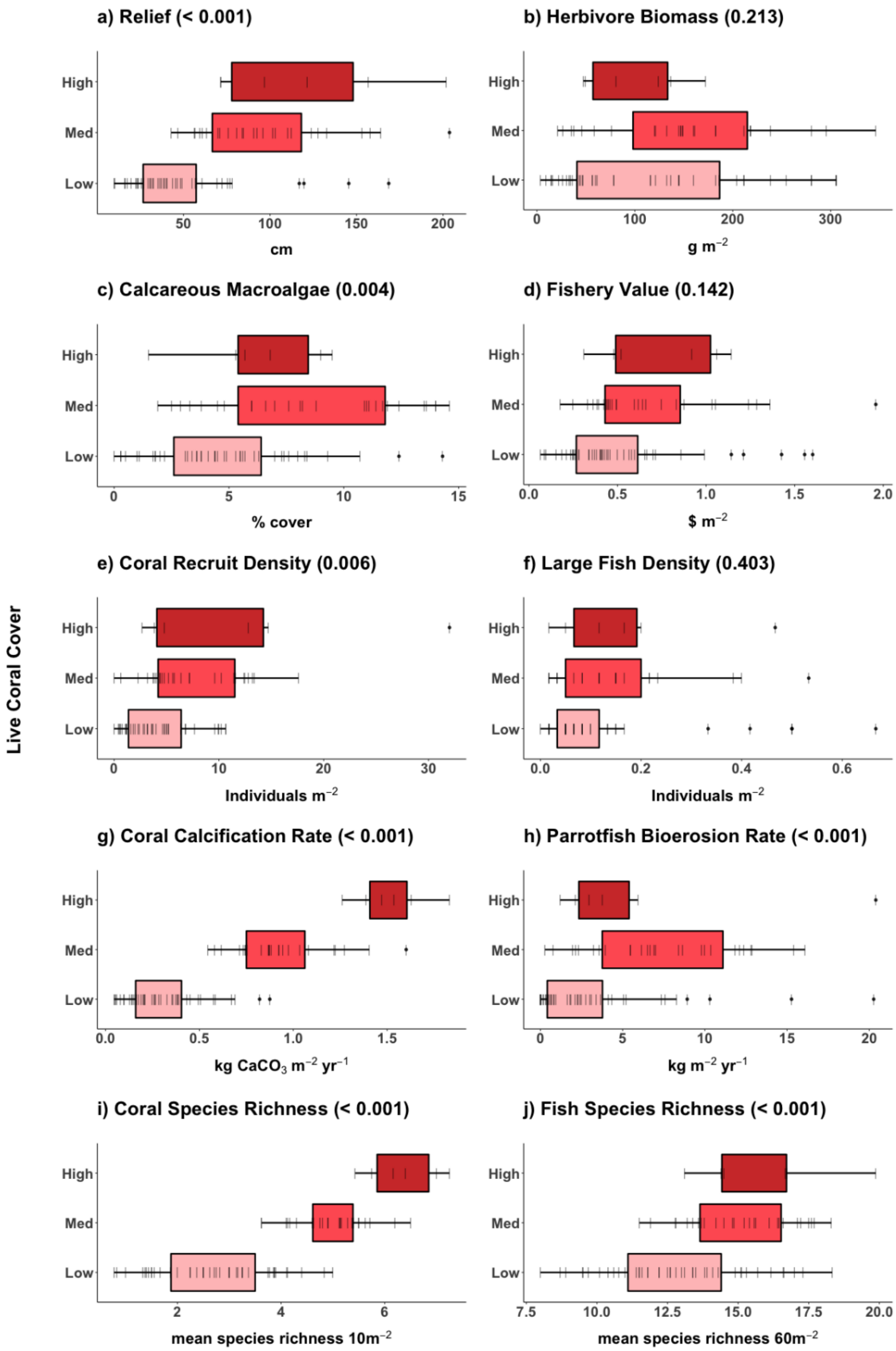


Fig. S4. Distribution of 10 metrics, by three categories of mean percent live coral cover, plotted only for the Bahamian ecoregion surveyed in 2011. This is one of two ecoregion by year combinations for which we have the highest sample size, and the basic qualitative patterns are broadly consistent with those for the full dataset (Fig. 3). The majority of the positive outliers (i.e., bright spots) in herbivore biomass at low-coral sites in this ecoregion are sites with medium or high relief, and similarly, most of the positive outliers for fishery value at low-coral sites have medium relief. High coral cover is defined as >20%, medium is 10-20%, and low is <10%. Data from AGRRA 2018 (number of sites for high, medium, low coral cover:

panels A-G, I-J, n=6, 27, 45; panel H, n=6, 27, 44). Lines represent individual data points. P-values are from LMERs including depth and coral cover as effects.

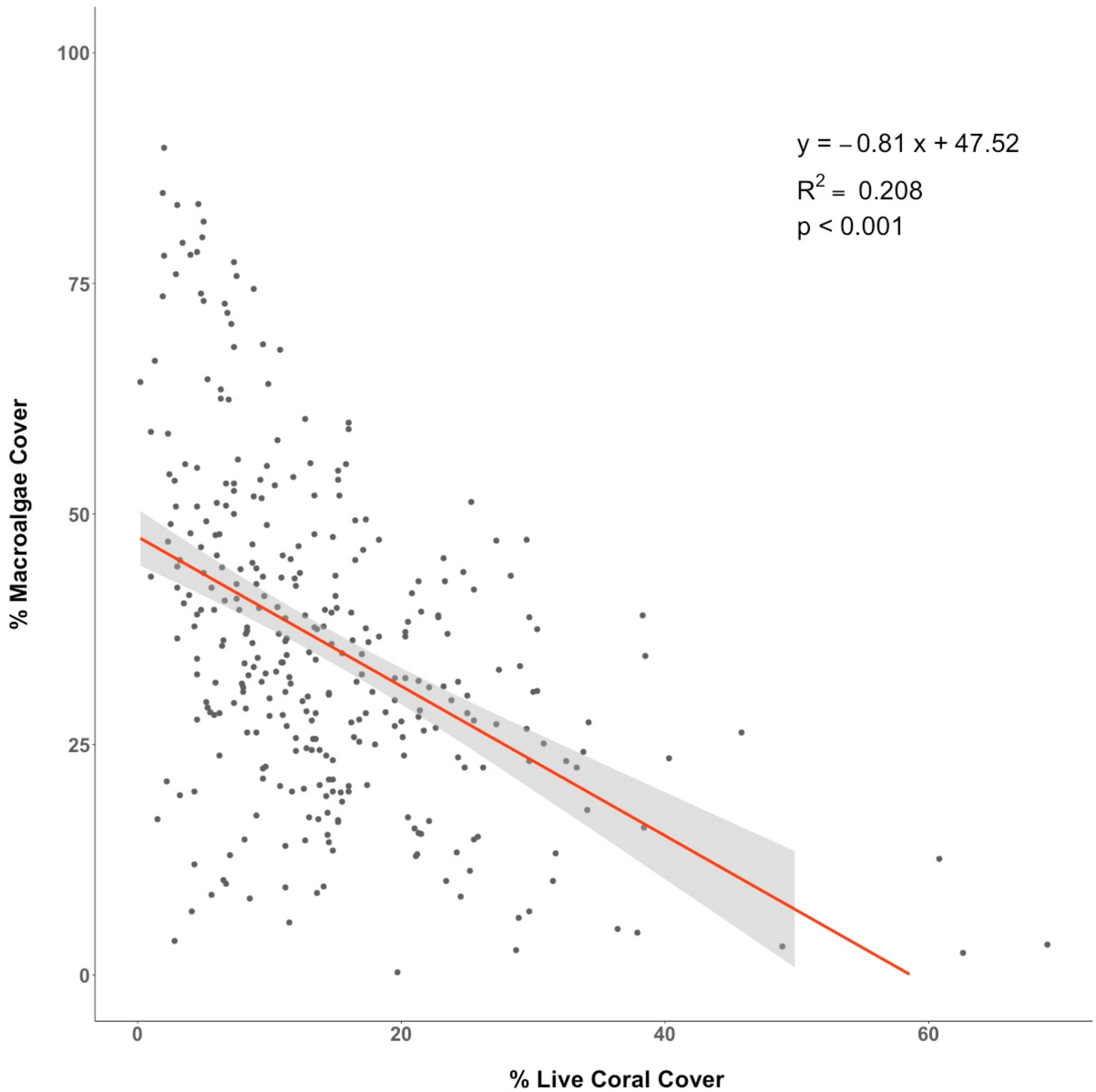


Fig. S5. Mean percent cover of macroalgae versus mean percent cover of live coral, across all AGRRA sites (n=328). Grey shading represents 95% confidence interval.

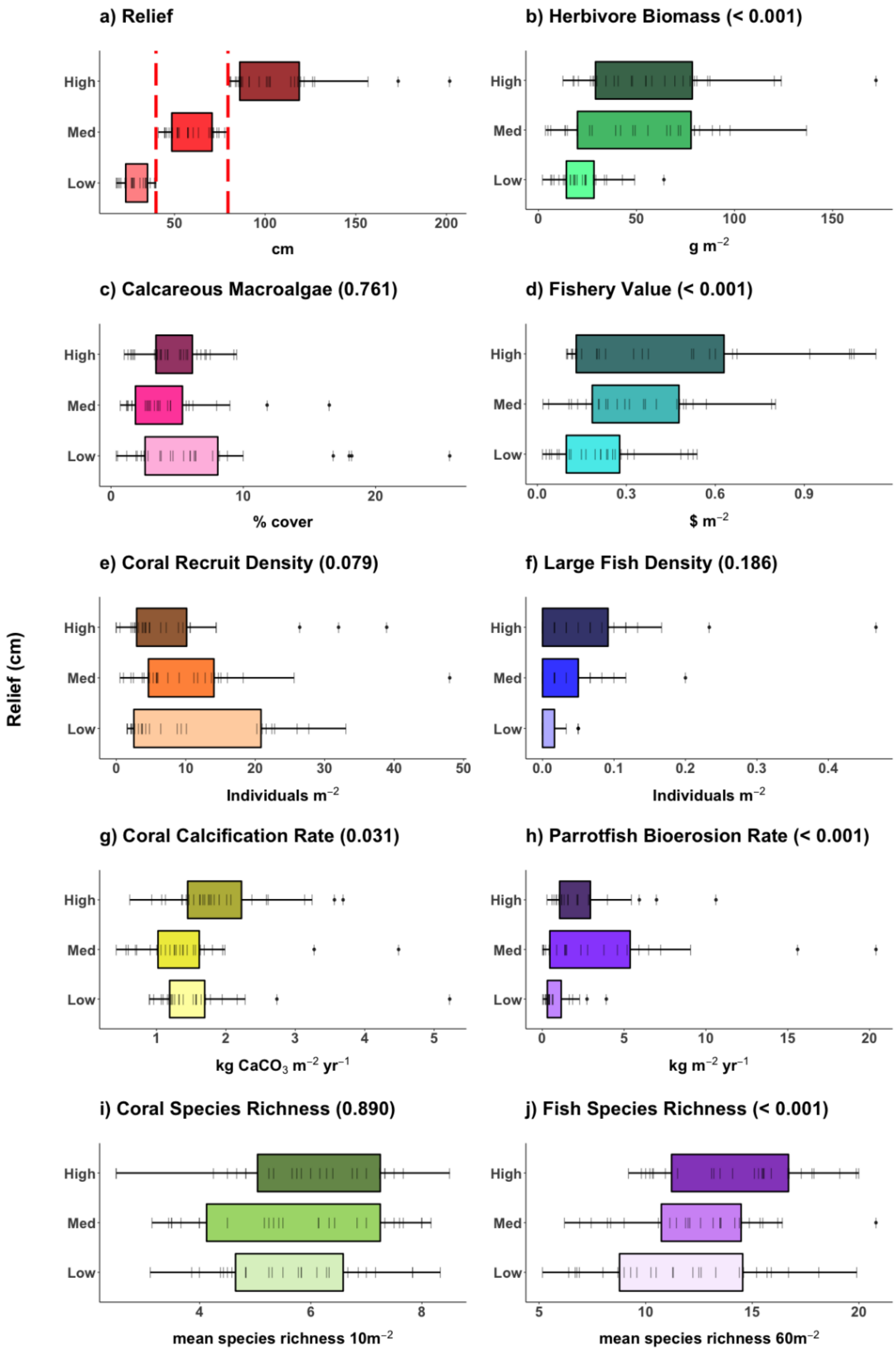


Fig. S6. Distribution of 10 metrics for high coral cover sites (>20% live coral cover) only (n=79), by three categories of reef relief. High relief is defined as >80 cm, medium is 40-80 cm, and low is <40 cm, as indicated by red lines in (A). Data for all plots from AGRRA 2018 (number of sites for high, medium, low coral cover: panels A-G, I-J, n=27, 26, 26; panel H, n=22, 24, 19). Lines represent individual data points. P-values are from LMERs including ecoregion, year, depth, and coral cover as effects.

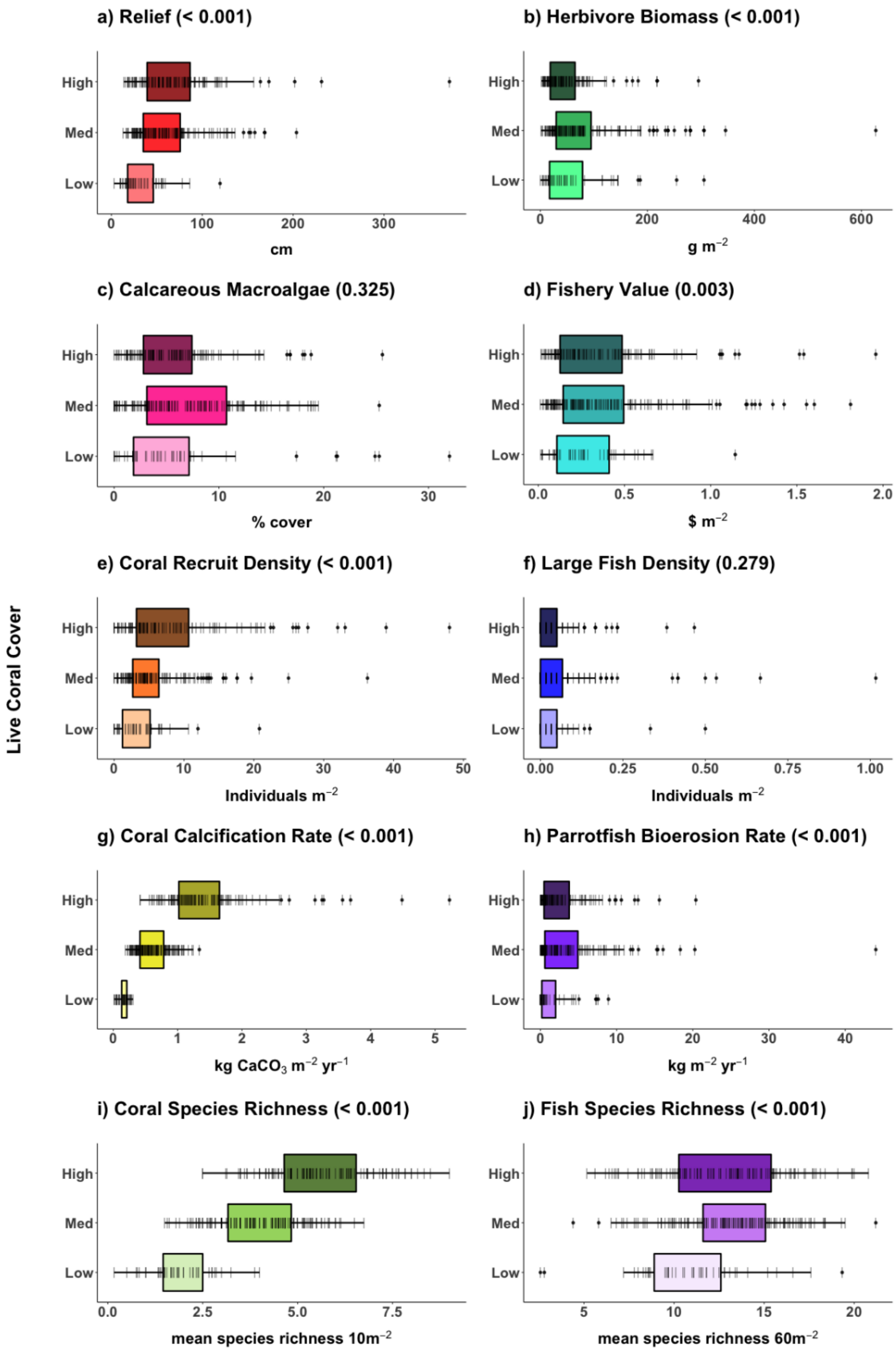


Fig. S7. Distribution of 10 metrics by three alternative categories of mean percent live coral cover. To test the sensitivity of our results to the coral cover thresholds used in the main paper, here high coral cover is defined as >15%, medium is 5-15%, and low is <5%. Data from AGRRA (2018). Number of sites for high, medium, low coral cover: panels A-G, I-J, n=120, 162, 46; panel H, n=101, 129, 42. Lines represent individual data points. P-values are from LMERs including ecoregion, year, depth, and coral cover as effects; for the model for coral calcification rate, we switched ecoregion to a fixed effect to avoid a boundary error.

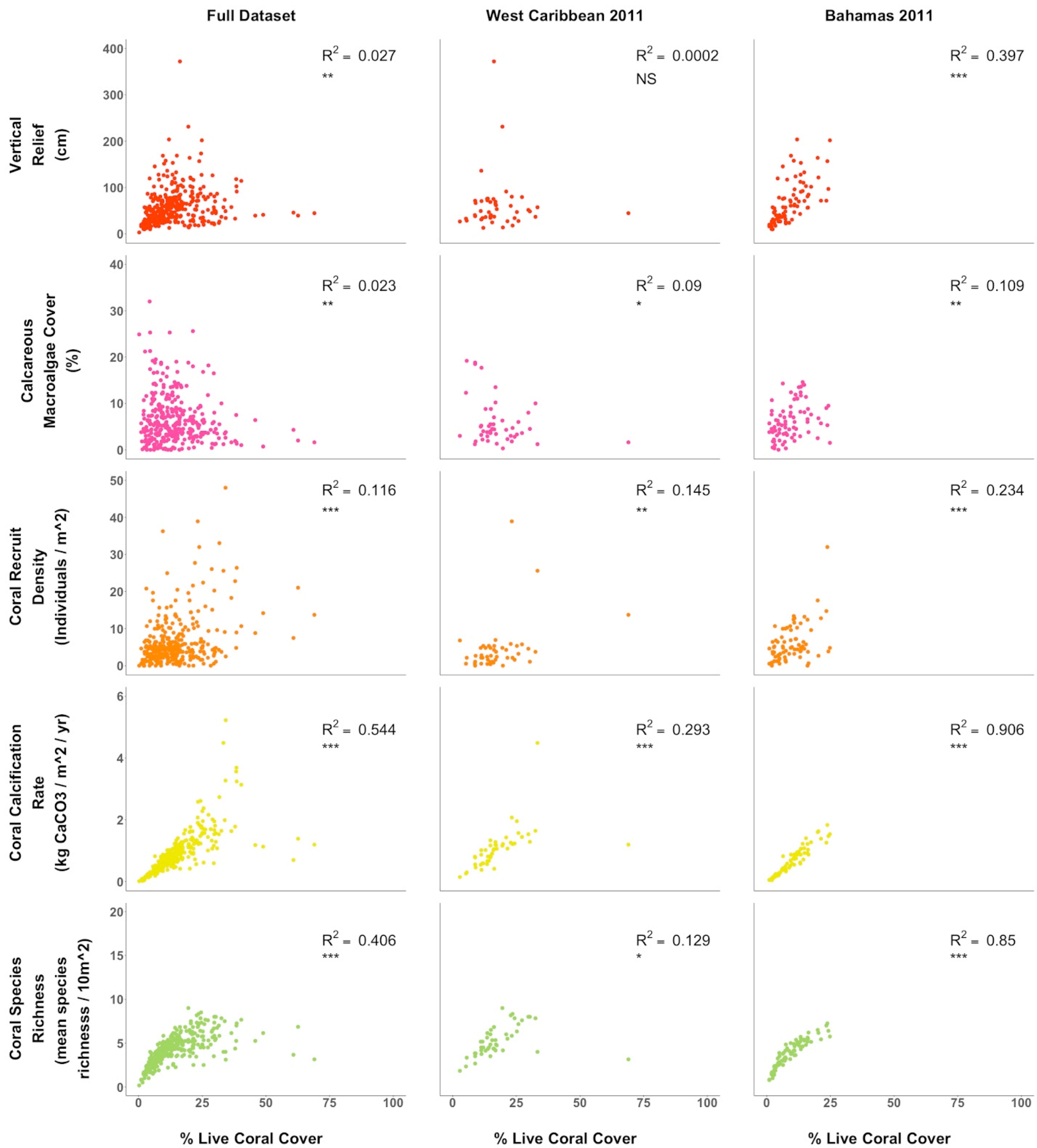


Fig. S8a. Metrics plotted against percent live coral cover. Data are plotted for all AGRRA sites (n=328 for all metrics), or for only the Western Caribbean ecoregion (n=46 for all metrics) or the Bahamian ecoregion (n=78 for all metrics) both surveyed in 2011.

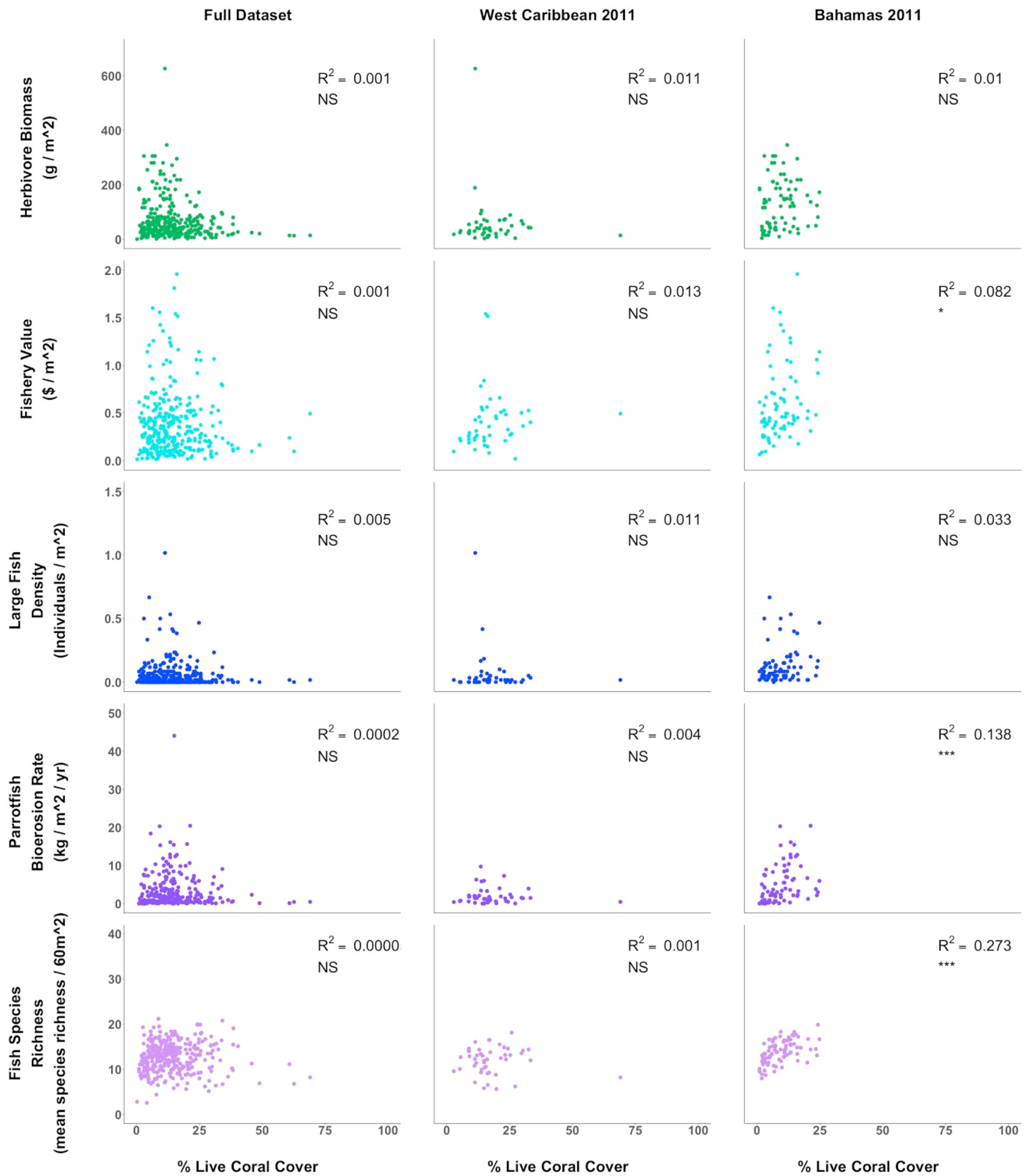


Fig. S8b. Metrics plotted against percent live coral cover. Data are plotted for all AGRRA sites (n=328 for all metrics except parrotfish bioerosion rate, n=272), or for only the Western Caribbean ecoregion (n=46) or the Bahamian ecoregion (n=78 for all metrics except parrotfish bioerosion rate, n=77) both surveyed in 2011.

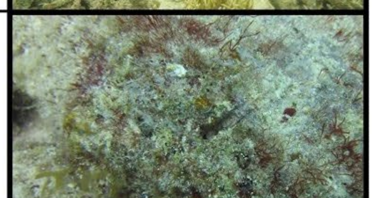
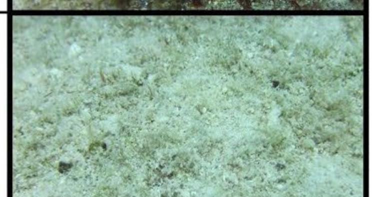
Table S1. Fish value, as price in USD per pound, for fishery value metric.

Scientific name	Value ($/lb)		Scientific name	Value ($/lb)
Acanthurus chirurgus	0		*Halichoeres garnoti*	0
Acanthurus coeruleus	0		*Halichoeres radiatus*	0
Acanthurus tractus	0		*Holacanthus bermudensis*	0
Aluterus scriptus	0		*Holacanthus ciliaris*	0
Anisotremus surinamensis	1.94		*Holacanthus tricolor*	0
Anisotremus virginicus	1.94		*Kyphosus spp.*	0
Balistes vetula	1.95		*Lachnolaimus maximus*	3.10
Bodianus rufus	0		*Lactophrys bicaudalis*	2.06
Calamus bajonado	2.07		*Lutjanus analis*	2.54
Calamus calamus	2.07		*Lutjanus apodus*	2.50
Calamus penna	2.07		*Lutjanus buccanella*	3.98
Calamus pennatula	2.07		*Lutjanus cyanopterus*	2.50
Cantherhines macrocerus	0		*Lutjanus griseus*	2.50
Cantherhines pullus	0		*Lutjanus jocu*	2.50
Canthidermis sufflamen	0		*Lutjanus mahogoni*	2.50
Caranx ruber	1.99		*Lutjanus synagris*	2.47
Centropyge argi	0		*Melichthys niger*	0
Cephalopholis cruentata	2.77		*Microspathodon chrysurus*	0
Cephalopholis fulva	2.83		*Monacanthus tuckeri*	0
Chaetodon capistratus	0		*Mycteroperca bonaci*	2.77
Chaetodon ocellatus	0		*Mycteroperca interstitialis*	2.77
Chaetodon sedentarius	0		*Mycteroperca tigris*	2.77
Chaetodon striatus	0		*Mycteroperca venenosa*	2.40
Cryptotomus roseus	0		*Ocyurus chrysurus*	2.41
Diodon holocanthus	0		*Pomacanthus arcuatus*	0
Diodon hystrix	0		*Pomacanthus paru*	0
Epinephelus adscensionis	2.77		*Prognathodes aculeatus*	0
Epinephelus guttatus	2.90		*Pterois volitans*	0
Epinephelus morio	2.77		*Scarus / Sparisoma*	0
Epinephelus striatus	2.51		*Scarus coelestinus*	1.88
Gymnothorax funebris	0		*Scarus coeruleus*	1.88
Gymnothorax miliaris	0		*Scarus guacamaia*	1.88
Gymnothorax moringa	0		*Scarus iseri*	1.88
Haemulon / Anisotremus	0		*Scarus taeniopterus*	1.88
Haemulon album	1.94		*Scarus vetula*	1.88
Haemulon aurolineatum	1.94		*Sparisoma atomarium*	1.88
Haemulon carbonarium	1.94		*Sparisoma aurofrenatum*	1.88
Haemulon chrysargyreum	1.94		*Sparisoma chrysopterum*	1.88
Haemulon flavolineatum	1.94		*Sparisoma radians*	1.88
Haemulon macrostomum	1.94		*Sparisoma rubripinne*	1.88
Haemulon melanurum	1.94		*Sparisoma viride*	1.88
Haemulon parra	1.94		*Sphoeroides spengleri*	0
Haemulon plumierii	2.22		*Sphyraena barracuda*	1.95
Haemulon sciurus	1.94		*Stegastes planifrons*	0
Haemulon steindachneri	1.94		*Trachinotus falcatus*	1.76
Haemulon striatum	1.94		*Xanthichthys ringens*	0
Halichoeres bivittatus	0			

Table S2. Details of GLMER models reported in Table 2 of the main paper.

Metric	GLMER model type	Distribution	Link	Ecoregion (random effect)	Year (random effect)	Depth (fixed effect)
Vertical Relief	GLM	Gamma	Log	No	No	Yes
Calcareous macroalgae cover	Hurdle	Zero-inflated Beta	Logit	Yes	Yes	Yes
Coral recruit density	Hurdle	Zero-inflated Gamma	Log	Yes	Yes	Yes
Coral calcification rate	GLMER	Gaussian	Log	No	Yes	Yes
Herbivore biomass	GLMER	Gamma	Log	Yes	Yes	Yes
Potential fishery value	GLMER	Gamma	Log	Yes	Yes	Yes
Density of large fish	Hurdle	Zero-inflated Gamma	Log	Yes	Yes	Yes
Parrotfish bioerosion rate	Hurdle	Zero-inflated Gamma (n=272)	Log	Yes	Yes	Yes

Table S3. Common reef ecosystem states possible at lower coral cover. Photo credits, top to bottom: Joshua Manning, Scott Miller, Kate Hill, Kate Hill, Margaret Miller, Margaret Miller, Joshua Manning.

Relief	Reef Ecosystem State	Dominant Taxa	Visual Example
High	High-relief soft structure	gorgonians, sponges	
High	Macroalgal beds	*Turbinaria, Sargassum* spp.	
Low	Low-relief soft structure	sponges, encrusting invertebrates	
Low	Macroalgal mats	*Dictyota, Halimeda, Laurencia,* short *Sargassum* spp.	
Low	Algal turf	filamentous red and green algae	
Low	Sediment-bound turf	filamentous red and green algae, diatoms	
Low	CCA	crustose coralline algae