Supporting Information. Magel, J.M.T., S.A. Dimoff, and J.K. Baum. 2020. Direct and indirect effects of climate change-amplified pulse heat stress events on coral reef fish communities. Ecological Applications.

Appendix S1

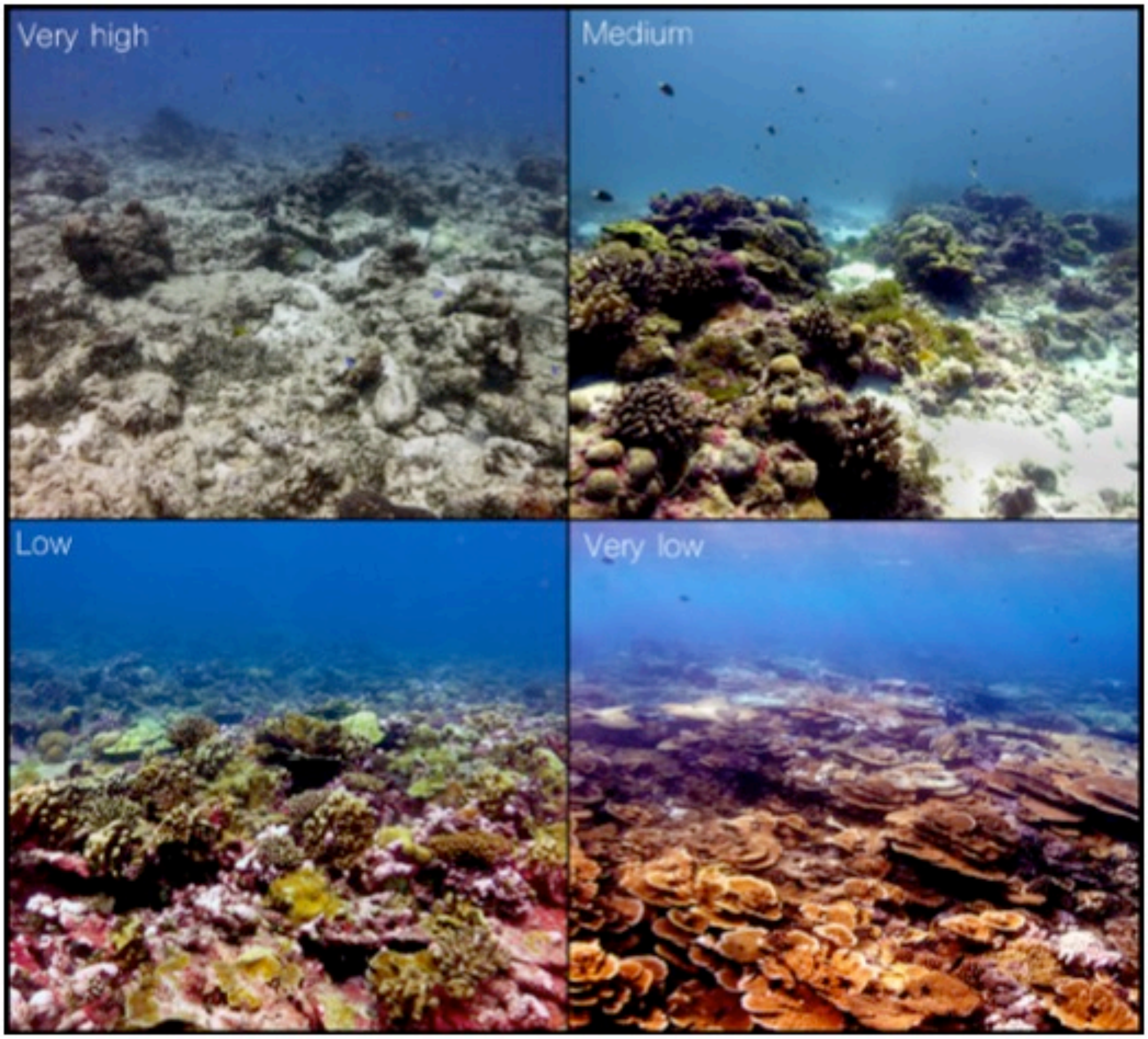

Figure S1. Representative photos of sites (showing average coral cover and benthic structural complexity) at each of the four local human disturbance levels included in this study, from Kiritimati (Christmas Island), prior to the 2015–2016 El Niño and mass coral mortality event.

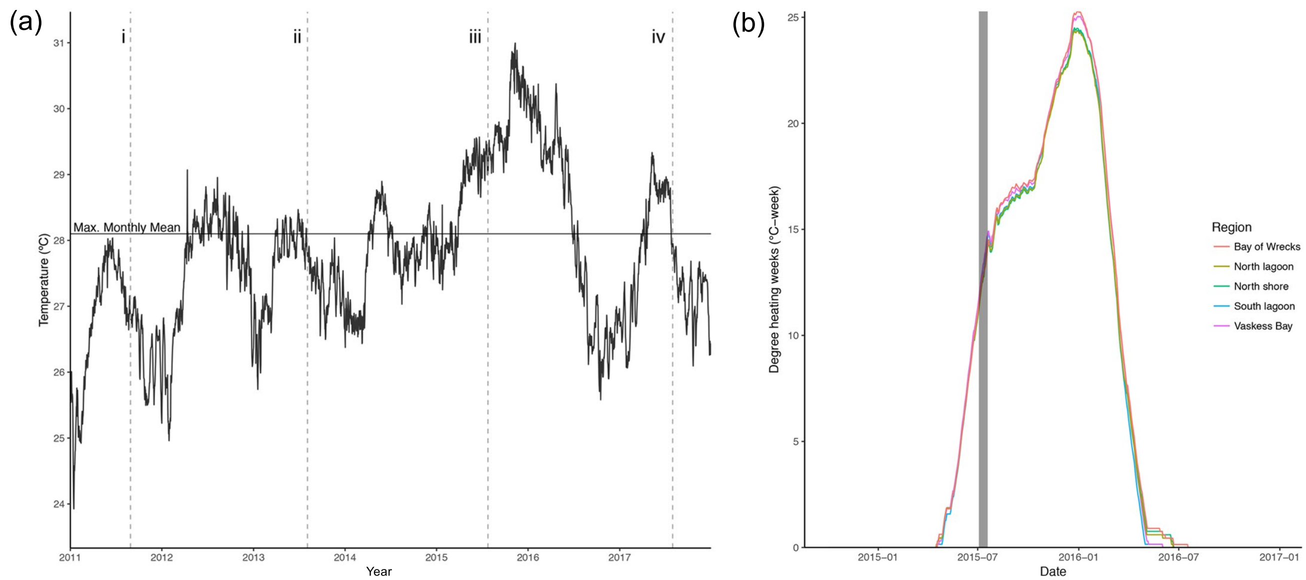

Figure S2. Thermal stress on Kiritimati during the 2015–2016 El Niño: a) In situ temperature on Kiritimati (black line), calculated from Seabird SBE56 temperature loggers deployed around the atoll, and maximum monthly mean temperature (horizontal black line). Dashed vertical lines indicate timing of expeditions. b) Degree heating weeks (°C-week; DHW), calculated from NOAA's DHW remote sensing data (https://coralreefwatch.noaa.gov/satellite/ bleaching5km/index.php); DHWs outside of this period never exceeded 2. DHW represents the accumulation of heat stress—when sea surface temperatures are higher than the long-term maximum monthly mean (MMM) in a region by 1°C—over the most recent twelve-week period. By the end of our 2015 expedition, Kiritimati's waters had experienced almost 15 DHWs. Grey vertical bar denotes the timing of our July 2015 expedition. To determine the number of DHWs experienced at Kiritimati, we first defined Kiritimati's maximum monthly mean (MMM) as 28.14°C, using NOAA's long-term data on the Northern Line Islands (NOAA Coral Reef Watch 2013). We then applied NOAA Coral Reef Watch's DHW equation to their remote sensing temperature data (5 km resolution; Liu et al. 2013). DHWs are plotted for the five regions on Kiritimati sampled in this study: Bay of Wrecks and Vaskess Bay, as denoted on Fig. 1; North lagoon (sites VH1, VH2, VH3), North shore (sites M5, L1, L2, L6), and South lagoon (sites M1, M2, M3, M4, M6). See Claar et al. 2019 for further details.

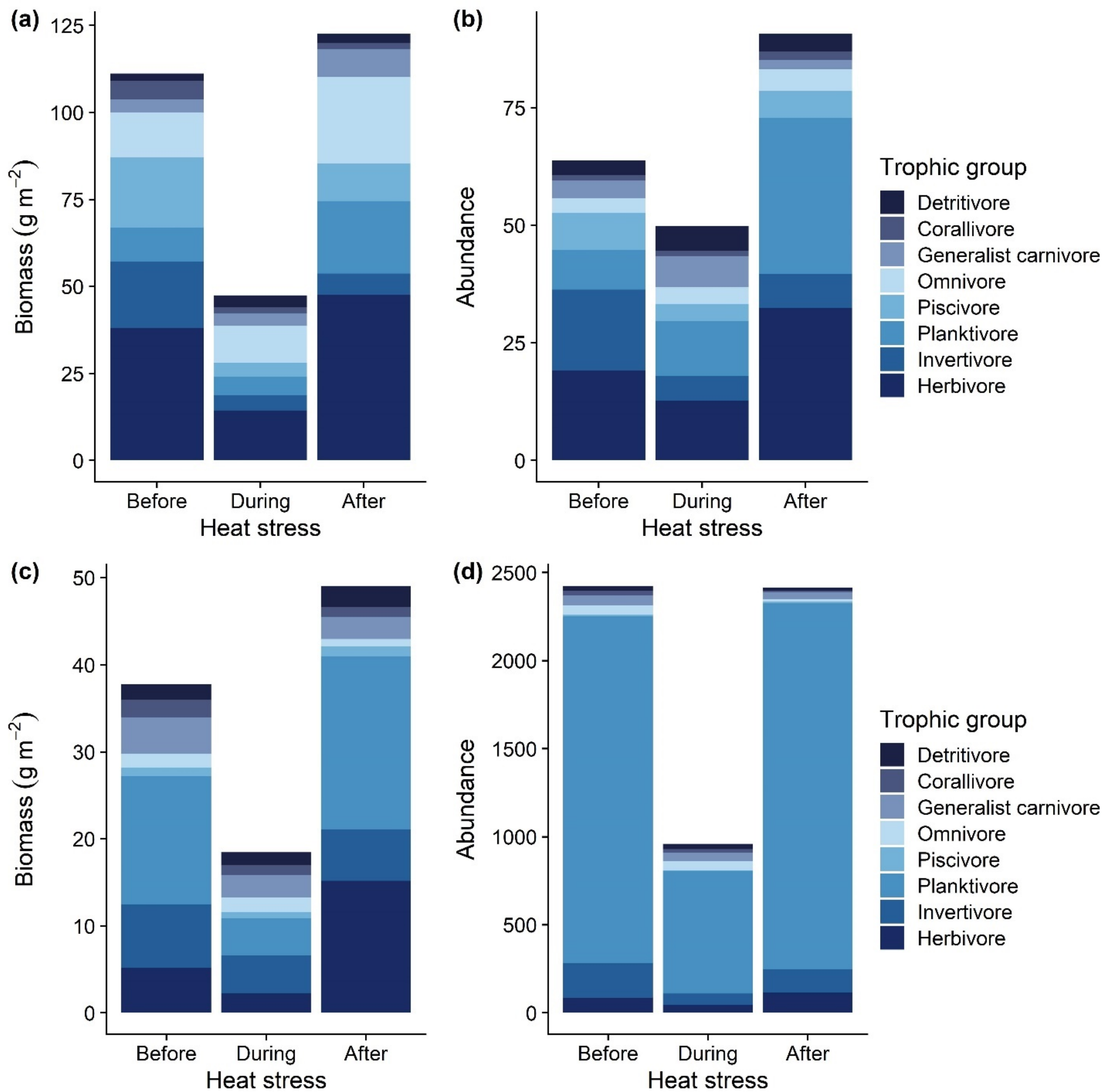

Figure S3. Relative contribution of individual trophic groups to the biomass (left) and abundance (right) of large (a,b) and small (c,d) fish at each heat stress time point. Y-axes represent mean site-level values for each metric combined across all sites and disturbance levels, with trophic groups ordered from most to least biomass, as in the legend (detritivores at the top of each bar and herbivores at the bottom).

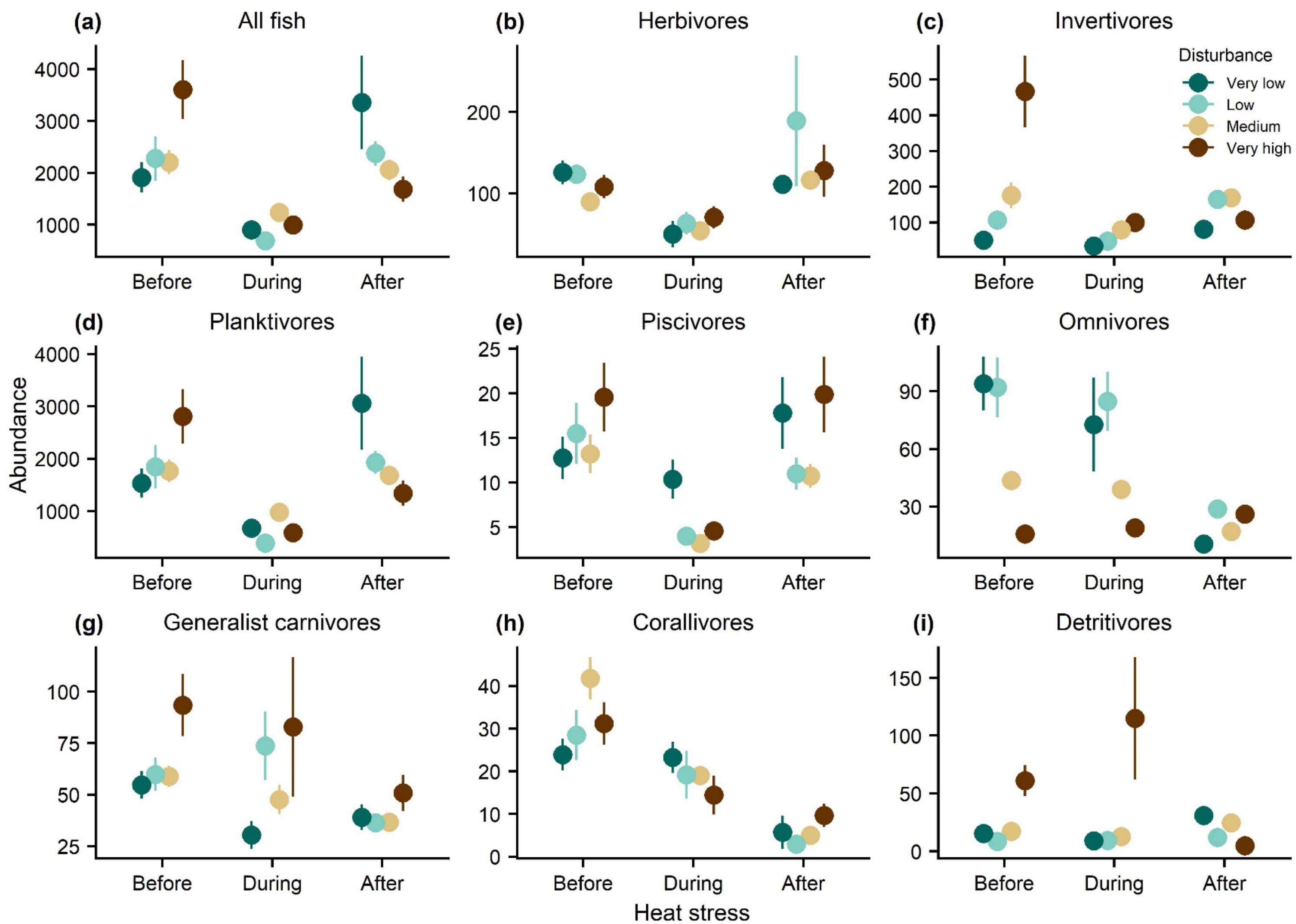

Figure S4. Mean site-level abundance of all fish (a) and individual trophic groups (b–i) at each of the four human disturbance levels on Kiritimati before, during, and after the heat stress event. Dots represent mean ± standard error of the mean [SEM], and are colored by the level of local human disturbance. Trophic groups are ordered from most to least biomass.

Table S1. Quantification of chronic local human disturbance for each monitoring site (included in this study) on Kiritimati. Population, which is the number of people residing within 2 km of each site, was calculated based on the Kiribati Population Census report (Kiribati National Statistics Office 2016). Fishing pressure is a kernel density function of fishing intensity with ten discrete levels (from Watson et al. 2016). Combined disturbance metric is the sum of the previous two columns. Based on these calculations, we categorized sites into four distinct 'local disturbance' categories for the purpose of plotting only (e.g., Fig. 1, 3, S1, S3). Local disturbance was treated as a continuous variable in analyses.

Site Name	Population	Fishing Pressure	Combined Local Disturbance Metric	Disturbance Category
VH1	4042	3234	7276	Very High
VH2	1223	3638	4861	Very High
VH3	3065	2021	5086	Very High
M1	0	1213	1213	Medium
M2	0	1213	1213	Medium
M3	0	1213	1213	Medium
M4	351	809	1160	Medium
M5	0	1617	1617	Medium
M6	351	1213	1564	Medium
L1	0	809	809	Low
L2	0	809	809	Low
L6	0	809	809	Low
VL1	0	0	0	Very Low
VL2	0	0	0	Very Low
VL3	0	0	0	Very Low
VL6	0	0	0	Very Low

Table S2. Mean percent hard coral cover (± SEM [standard error of the mean]) at each study site and local human disturbance level prior to the 2015–2016 El Niño and mass coral bleaching event on Kiritimati. Hard coral cover was calculated using data from 1 m^2 photoquadrats (n = 13–33 per site). Quadrats were randomly placed on either side of two 25 m transects running along the 10–12 m isobath, and the benthic composition under 100 random points per quadrat was identified using CoralNet (https://coralnet.ucsd.edu/). Site-level means represent the mean percent hard coral cover from all quadrats at a particular site, based on surveys conducted in 2013 (except for sites L2 and VL3, for which pre-heat stress benthic data was only available from August 2014 and May 2015, respectively). Disturbance-level means were calculated as the average of all site-level values at each disturbance level. Pre-heat stress benthic data was not available for sites VL6 and L6.

Human Disturbance	Disturbance-Level Mean	Site	Site-Level Mean
Very high	12.39 ± 9.52	VH1	2.12 ± 0.68
		VH2	3.64 ± 0.80
		VH3	31.41 ± 3.22
Medium	44.23 ± 3.67	M1	52.12 ± 3.71
		M2	41.38 ± 4.80
		M3	49.11 ± 2.14
		M4	34.80 ± 4.02
		M5	46.20 ± 4.03
		M6	41.64 ± 3.30
Low	43.18 ± 3.94	L1	47.12 ± 3.52
		L2	39.25 ± 2.50
		L6	- - -
Very low	59.66 ± 1.77	VL1	62.96 ± 3.37
		VL2	59.14 ± 4.82
		VL3	56.88 ± 3.67
		VL6	- - -

Table S3. Trophic group classifications for all fish taxa encountered (n = 245 species; n = 12 genus-level) during underwater visual censuses (UVCs) on Kiritimati in the current study. The number of species within each trophic group is listed in brackets after its name. References for diet classification are coded by number based on the reference list following the table.

Trophic group	Family	Species	Reference
Corallivore (20)	Chaetodontidae	*Chaetodon auriga*	1
		Chaetodon bennetti	1
		Chaetodon citrinellus	1
		Chaetodon ephippium	1
		Chaetodon kleinii	1
		Chaetodon lunula	2
		Chaetodon lunulatus	1
		Chaetodon meyeri	1
		Chaetodon ornatissimus	1
		Chaetodon quadrimaculatus	1
		Chaetodon trifascialis	1
		Chaetodon ulietensis	1
		Chaetodon unimaculatus	1
		Chaetodon vagabundus	1
		Heniochus chrysostomus	1
	Labridae	*Labrichthys unilineatus*	1
	Monacanthidae	*Amanses scopas*	1
		Cantherhines dumerilii	1
	Pomacentridae	*Plectroglyphidodon johnstonianus*	1
	Tetraodontidae	*Arothron meleagris*	1
Detritivore (6)	Acanthuridae	*Ctenochaetus binotatus*	1
		Ctenochaetus cyanocheilus	1
		Ctenochaetus flavicauda	1
		Ctenochaetus hawaiiensis	1
		Ctenochaetus marginatus	1
		Ctenochaetus striatus	1
Generalist carnivore (22)	Balistidae	*Sufflamen fraenatum*	1
	Caracanthidae	*Caracanthus maculatus*	1
	Cirrhitidae	*Cirrhitichthys oxycephalus*	3
		Cirrhitops hubbardi	3
		Paracirrhites arcatus	1
		Paracirrhites forsteri	1
		Paracirrhites xanthus	3*
	Gobiidae	*Eviota albolineata*	3
	Labridae	*Epibulus insidiator*	1
		Gomphosus varius	1
		Hologymnosus doliatus	1

		Iniistius auropunctatus	3
		Pseudocheilinus evanidus	1
	Lethrinidae	*Lethrinus olivaceus*	1
		Lethrinus xanthochilus	1
	Lutjanidae	*Lutjanus fulvus*	1
		Lutjanus gibbus	1
	Pinguipedidae	*Parapercis lata*	1**
	Scombridae	*Pterois antennata*	1
		Pterois volitans	1
		Sebastapistes cyanostigma	1
	Serranidae	*Cephalopholis urodeta*	1
Herbivore (40)	Acanthuridae	*Acanthurus achilles*	1
		Acanthurus blochii	1
		Acanthurus dussumieri	1
		Acanthurus guttatus	1
		Acanthurus leucocheilus	1
		Acanthurus lineatus	1
		Acanthurus maculiceps	1
		Acanthurus nigricans	1
		Acanthurus nigricauda	1
		Acanthurus nigrofuscus	1
		Acanthurus nigroris	1
		Acanthurus olivaceus	1
		Acanthurus pyroferus	1
		Acanthurus sp.	1
		Acanthurus triostegus	1
		Acanthurus xanthopterus	1
		Naso lituratus	1
		Zebrasoma rostratum	1
		Zebrasoma scopas	1
		Zebrasoma veliferum	1
	Blenniidae	Blenniidae sp.	1*
		Cirripectes sp.	1
		Cirripectes auritus	1**
		Cirripectes stigmaticus	1**
		Cirripectes variolosus	1
	Kyphosidae	*Kyphosus cinerascens*	1
	Pomacanthidae	*Centropyge loricula*	1
		Centropyge flavissima	1
	Pomacentridae	*Stegastes aureus*	1
		Stegastes fasciolatus	1
	Scaridae	*Calotomus carolinus*	1

		Chlorurus frontalis	1
		Chlorurus sordidus	1
		Chlorurus sp.	1**
		Hipposcarus longiceps	1
		Scarus festivus	1
		Scarus forsteni	1
		Scarus frenatus	1
		Scarus ghobban	1
		Scarus globiceps	1
		Scarus oviceps	1
		Scarus psittacus	1
		Scarus rubroviolaceus	1
		Scarus sp.	1
		Scarus tricolor	1
Invertivore (65)	Apogonidae	*Apogon kallopterus*	1
	Aulostomidae	*Pseudobalistes flavimarginatus*	1
		Sufflamen chrysopterum	1
	Balistidae	*Balistapus undulatus*	1
		Balistoides viridescens	1
	Chaetodontidae	*Forcipiger flavissimus*	1
		Forcipiger longirostris	1
	Callionymidae	*Neosynchiropus ocellatus*	3
	Diodontidae	*Diodon hystrix*	1
	Gobiidae	*Valenciennea helsdingenii*	3
		Valenciennea strigata	1
	Holocentridae	*Neoniphon samara*	1
		Sargocentron caudimaculatum	1
		Sargocentron spiniferum	1
		Sargocentron tiere	1
	Labridae	*Anampses caeruleopunctatus*	1
		Anampses melanurus	1
		Anampses meleagrides	1
		Anampses twistii	1
		Bodianus axillaris	1
		Bodianus loxozonus	1
		Cheilinus oxycephalus	1
		Cheilinus trilobatus	1
		Cheilinus undulatus	1
		Cheilio inermis	3
		Coris aygula	1
		Coris centralis	1
		Coris gaimard	1
		Halichoeres chrysus	1**

		Halichoeres hortulanus	1
		Halichoeres margaritaceus	1
		Halichoeres marginatus	1
		Halichoeres ornatissimus	1
		Halichoeres sp.	1
		Halichoeres trimaculatus	1
		Hemigymnus fasciatus	1
		Labroides bicolor	1
		Labroides dimidiatus	1
		Labroides pectoralis	1
		Labroides rubrolabiatus	1
		Macropharyngodon meleagris	1
		Novaculichthys taeniourus	1
		Pseudocheilinus hexataenia	1
		Pseudocheilinus octotaenia	1
		Pseudocheilinus tetrataenia	1
		Pseudojuloides cerasinus	1
		Stethojulis bandanensis	1
		Thalassoma lunare	1
		Thalassoma lutescens	1
		Thalassoma quinquevittatum	1
		Thalassoma trilobatum	1
	Lethrinidae	*Gnathodentex aureolineatus*	1
		Monotaxis grandoculis	1
	Lutjanidae	*Lutjanus kasmira*	1
	Malacanthidae	*Malacanthus latovittatus*	1
	Monacanthidae	*Cantherhines pardalis*	1
	Muraenidae	*Echidna nebulosa*	1
		Echidna unicolor	1**
	Mullidae	*Mulloidichthys flavolineatus*	1
		Mulloidichthys mimicus	1
		Mulloidichthys vanicolensis	1
		Parupeneus barberinus	1
		Parupeneus insularis	1
		Parupeneus multifasciatus	1
		Parupeneus pleurostigma	1
	Pomacanthidae	*Apolemichthys xanthopunctatus*	1
Omnivore (15)	Acanthuridae	*Paracanthurus hepatus*	3
	Balistidae	*Melichthys niger*	1
		Melichthys vidua	1
		Rhinecanthus rectangulus	1
		Sufflamen bursa	1
	Chaetodontidae	*Heniochus acuminatus*	3

	Chanidae	*Chanos chanos*	1
	Gobiidae	*Gnatholepis anjerensis*	3
	Labridae	*Pseudodax moluccanus*	1
	Monacanthidae	*Pervagor* sp.	1
	Ostraciidae	*Ostracion meleagris*	1
	Pomacanthidae	*Pomacanthus imperator*	1
	Pomacentridae	*Plectroglyphidodon dickii*	3
	Tetraodontidae	*Canthigaster amboinensis*	1
		Canthigaster solandri	1
	Zanclidae	*Zanclus cornutus*	1
Piscivore (37)	Blenniidae	*Plagiotremus rhinorhynchos*	1
		Plagiotremus tapeinosoma	1
		Plagiotremus sp.	1**
	Bothidae	*Bothus mancus*	1
		Bothus pantherinus	3
	Cirrhitidae	*Paracirrhites hemistictus*	1, 3*
	Fistulariidae	*Fistularia commersonii*	1
	Labridae	*Oxycheilinus digramma*	1
		Oxycheilinus unifasciatus	1
	Lutjanidae	*Aphareus furca*	1
		Lutjanus bohar	1
		Lutjanus monostigma	1
	Mullidae	*Parupeneus cyclostomus*	1
	Muraenidae	*Enchelycore pardalis*	1
		Gymnothorax breedeni	1
		Gymnothorax flavimarginatus	1
		Gymnothorax javanicus	1
		Gymnothorax meleagris	1
		Gymnothorax thyrsoideus	1, 3**
		Gymnothorax undulatus	1
		Gymnothorax sp.	1
	Serranidae	*Cephalopholis argus*	1
		Cephalopholis leopardus	1
		Cephalopholis miniata	1
		Epinephelus fasciatus	1
		Epinephelus hexagonatus	1
		Epinephelus howlandi	1
		Epinephelus macrospilos	1
		Epinephelus maculatus	1
		Epinephelus melanostigma	1
		Epinephelus merra	1
		Epinephelus polyphekadion	1
		Epinephelus spilotoceps	1

		Epinephelus tauvina	1
		Epinephelus sp.	1
		Gracila albomarginata	1
		Pogonoperca punctata	1
		Variola louti	1
	Synodontidae	*Synodus jaculum*	3
		Synodus variegatus	1
		Synodus sp.	3
Planktivore (40)	Acanthuridae	*Acanthurus albipectoralis*	1
		Acanthurus thompsoni	1
		Naso annulatus	1
		Naso brevirostris	1
		Naso hexacanthus	1
	Apogonidae	*Ostorhinchus angustatus*	4
		Ostorhinchus apogonoides	4
	Aulostomidae	*Odonus niger*	1
	Caesionidae	*Caesio teres*	1
		Pterocaesio lativittata	1**
		Pterocaesio tile	1
	Holocentridae	*Myripristis adusta*	1
		Myripristis amaena	1
		Myripristis berndti	1
		Myripristis earlei	1
		Myripristis kuntee	1
		Myripristis murdjan	1
	Labridae	*Cirrhilabrus exquisitus*	1
		Thalassoma amblycephalum	1
	Pempheridae	*Pempheris oualensis*	1
	Pomacentridae	*Chromis acares*	1
		Chromis atripes	1**
		Chromis margaritifer	1
		Chromis vanderbilti	1
		Chromis weberi	1
		Chromis xanthura	1
		Dascyllus auripinnis	1
		Dascyllus trimaculatus	1
		Plectroglyphidodon imparipennis	1
		Pomacentrus coelestis	1
	Priacanthidae	*Heteropriacanthus cruentatus*	1
		Priacanthus hamrur	3*
	Ptereleotridae	*Ptereleotris microlepis*	1
		Ptereleotris zebra	1
		Ptereleotris sp.	1**

Serranidae	*Luzonichthys whitleyi*	1
	Pseudanthias bartlettorum	1
	Pseudanthias cooperi	1
	Pseudanthias dispar	1
	Pseudanthias olivaceus	1
	Pseudanthias pascalus	1
	Pseudanthias sp.	1**

Reference Key (Note: * = inferred from Family; ** = inferred from genus):

1. Yeager, L. A., M. C. M. Deith, J. M. McPherson, I. D. Williams, and J. K. Baum. 2017. Scale dependence of environmental controls on the functional diversity of coral reef fish communities. Global Ecology and Biogeography 26:1177-1189.
2. Cole, A. J., M. S. Pratchett, and G. P. Jones. 2008. Diversity and functional importance of coral-feeding fishes on tropical coral reefs. Fish and Fisheries 9:286-307.
3. Randall, J. E. 2005. Reef and Shore Fishes of the South Pacific: New Caledonia to Tahiti and the Pitcairn Islands. Honolulu: University of Hawai'i Press.
4. Walsh, S. M. 2011. Ecosystem-scale effects of nutrients and fishing on coral reefs. Journal of Marine Biology 2011:187248.

Table S4. Disappearance of species[1] in each trophic group during and after the 2015–2016 El Niño. Values represent mean site-level biomass (g m^{-2}) of each species, with the total number of transects on which the species was observed shown in brackets. Trophic groups are ordered from most to least biomass.

Species	Before	During	After	Loss
Herbivores				
Acanthurus pyroferus	0.19 (17)	0.08 (2)	- - -	After
Invertivores				
Apogon kallopterus	0.27 (10)	- - -	- - -	During and After
Cheilinus undulatus	5.58 (8)	- - -	0.36 (1)	During
Mulloidichthys flavolineatus	0.04 (5)	- - -	- - -	During and After
Pseudocheilinus tetrataenia	0.04 (20)	<0.01 (3)	- - -	After
Thalassoma lunare	0.07 (13)	<0.01 (5)	- - -	After
Planktivores				
Pseudanthias pascalus	0.06 (9)	- - -	- - -	During and After
Piscivores				
Cephalopholis leopardus	0.04 (9)	<0.01 (1)	- - -	After
Corallivores				
Chaetodon trifascialis	0.04 (6)	0.03 (4)	- - -	After

[1]To avoid inferring losses for species that are merely rare or hard to detect, we only included those species that were observed on a minimum of five transects before the heat stress event.

Table S5. Results of permutational multivariate analysis of variance (PERMANOVA) tests examining the effects of heat stress, local disturbance, net primary productivity, time of day, and lunar day on reef fish community structure. Site x species matrices were calculated using fish biomass, and trophic groups are ordered from most to least biomass. Shaded boxes indicate non-significant results. Note that the F value reported in the table is a pseudo F statistic.

	Heat stress	**Local disturbance**	**NPP**	**Time of day**	**Lunar day**	**Heat stress x local disturbance**
All fish	F = 3.05 R^2 = 0.06 *p* = 0.001	F = 10.67 R^2 = 0.11 *p* = 0.001	F = 3.07 R^2 = 0.03 *p* = 0.004	F = 0.89 R^2 = 0.02 *p* = 0.773	F = 1.01 R^2 = 0.01 *p* = 0.230	F = 1.41 R^2 = 0.03 *p* = 0.001
Herbivores	F = 2.88 R^2 = 0.06 *p* = 0.001	F = 14.38 R^2 = 0.14 *p* = 0.001	F = 2.57 R^2 = 0.03 *p* = 0.001	F = 0.69 R^2 = 0.01 *p* = 0.943	F = 1.33 R^2 = 0.01 *p* = 0.050	F = 1.61 R^2 = 0.03 *p* = 0.001
Invertivores	F = 2.76 R^2 = 0.06 *p* = 0.001	F = 6.93 R^2 = 0.08 *p* = 0.001	F = 1.71 R^2 = 0.02 *p* = 0.001	F = 0.96 R^2 = 0.02 *p* = 0.468	F = 0.96 R^2 = 0.01 *p* = 0.314	F = 1.62 R^2 = 0.04 *p* = 0.002
Planktivores	F = 4.01 R^2 = 0.08 *p* = 0.001	F = 12.18 R^2 = 0.12 *p* = 0.001	F = 2.94 R^2 = 0.03 *p* = 0.005	F = 0.85 R^2 = 0.02 *p* = 0.734	F = 0.94 R^2 = 0.01 *p* = 0.567	F = 1.60 R^2 = 0.03 *p* = 0.002
Piscivores	F = 1.48 R^2 = 0.03 *p* = 0.024	F = 5.94 R^2 = 0.07 *p* = 0.133	F = 2.14 R^2 = 0.02 *p* = 0.103	F = 1.15 R^2 = 0.03 *p* = 0.257	F = 1.47 R^2 = 0.02 *p* = 0.127	F = 1.34 R^2 = 0.03 *p* = 0.069
Omnivores	F = 1.98 R^2 = 0.04 *p* = 0.013	F = 6.72 R^2 = 0.07 *p* = 0.001	F = 3.48 R^2 = 0.04 *p* = 0.065	F = 1.12 R^2 = 0.02 *p* = 0.267	F = 0.42 R^2 = <0.01 *p* = 0.864	F = 0.90 R^2 = 0.02 *p* = 0.353
Generalist carnivores	F = 2.21 R^2 = 0.04 *p* = 0.005	F = 7.73 R^2 = 0.08 *p* = 0.002	F = 6.52 R^2 = 0.07 *p* = 0.014	F = 1.15 R^2 = 0.02 *p* = 0.461	F = 1.14 R^2 = 0.01 *p* = 0.247	F = 2.08 R^2 = 0.04 *p* = 0.023
Corallivores	F = 3.72 R^2 = 0.08 *p* = 0.001	F = 5.36 R^2 = 0.06 *p* = 0.002	F = 1.06 R^2 = 0.01 *p* = 0.077	F = 0.96 R^2 = 0.02 *p* = 0.481	F = 0.85 R^2 = 0.01 *p* = 0.468	F = 0.75 R^2 = 0.02 *p* = 0.572
Detritivores	F = 2.26 R^2 = 0.05 *p* = 0.007	F = 7.35 R^2 = 0.08 *p* = 0.008	F = 0.96 R^2 = 0.01 *p* = 0.878	F = 1.65 R^2 = 0.04 *p* = 0.083	F = 0.56 R^2 = 0.01 *p* = 0.854	F = 1.49 R^2 = 0.03 *p* = 0.281

Table S6. Species contributing to 70% of the variation in reef fish community structure during the 2015–2016 El Niño (compared to pre-heat stress composition) for all fish (a) and individual trophic groups (b–i). Mean site-level biomass (g m^{-2}) for each heat stress point is given, as well as the cumulative contribution of each species to overall community dissimilarity. Trophic groups are ordered from most to least biomass.

Species	Change (+/-)	Before	During	Cumulative sum
a) All fish				
Acanthurus olivaceus [H]	+	7.08	11.93	0.054
Chanos chanos [Om]	+	7.21	8.92	0.105
Scarus frenatus [H]	-	10.54	3.29	0.153
Acanthurus nigricauda [H]	-	9.28	5.36	0.198
Lutjanus bohar [Pi]	-	13.05	0.77	0.236
Gnathodentex aureolineatus [In]	-	7.05	6.55	0.271
Scarus rubroviolaceus [H]	-	8.60	2.89	0.303
Chlorurus sordidus [H]	-	7.75	2.88	0.333
Pterocaesio tile [Pl]	-	9.84	1.78	0.361
Scarus ghobban [H]	-	9.27	2.00	0.389
Acanthurus nigricans [H]	-	6.37	3.27	0.413
Ctenochaetus marginatus [D]	+	3.08	5.30	0.435
Cheilinus undulatus [In]	-	5.58	0.00	0.457
Melichthys niger [Om]	-	4.28	2.42	0.479
Lutjanus gibbus [GC]	+	1.52	3.90	0.498
Parupeneus insularis [In]	-	4.82	0.91	0.518
Lutjanus kasmira [In]	-	9.66	0.08	0.537
Cephalopholis urodeta [GC]	-	5.59	3.57	0.555
Cephalopholis argus [Pi]	-	3.54	2.30	0.571
Arothron meleagris [C]	-	3.72	0.77	0.587
Parupeneus multifasciatus [In]	-	3.58	0.39	0.601
Acanthurus lineatus [H]	-	2.39	1.63	0.615
Scarus tricolor [H]	-	3.22	1.10	0.629
Balistoides viridescens [In]	-	2.62	0.00	0.642
Plectroglyphidodon dickii [Om]	+	1.90	2.23	0.654
Chromis margaritifer [Pl]	-	2.93	1.99	0.663
Chromis vanderbilti [Pl]	-	2.60	1.20	0.672
Odonus niger [Pl]	-	1.62	1.45	0.681
Myripristis earlei [Pl]	-	3.41	0.11	0.690
Ostorhinchus apogonoides [Pl]	-	3.57	0.03	0.698
Lutjanus fulvus [GC]	-	1.68	0.38	0.706
b) Herbivores [H]				
Scarus frenatus	-	10.54	3.29	0.157
Acanthurus olivaceus	+	7.08	11.93	0.274
Acanthurus nigricauda	-	9.28	5.36	0.385
Chlorurus sordidus	-	7.75	2.88	0.493
Scarus rubroviolaceus	-	8.60	2.89	0.592
Acanthurus nigricans	-	6.37	3.27	0.670
Scarus ghobban	-	9.27	2.00	0.730
c) Invertivores [In]				
Parupeneus insularis	-	4.82	0.91	0.132

Gnathodentex aureolineatus	-	7.05	6.55	0.256
Parupeneus multifasciatus	-	3.58	0.39	0.321
Cheilinus undulatus	-	5.58	0.00	0.384
Balistoides viridescens	-	2.61	0.00	0.444
Sargocentron tiere	-	0.86	0.37	0.494
Lutjanus kasmira	-	9.66	0.08	0.542
Coris aygula	-	1.04	0.31	0.582
Sufflamen chrysopterum	-	0.82	0.46	0.620
Balistapus undulatus	-	0.71	0.58	0.654
Pseudobalistes flavimarginatus	+	0.30	0.73	0.685
Sargocentron caudimaculatum	-	0.94	0.42	0.713
d) Planktivores [Pl]				
Pterocaesio tile	-	9.85	1.78	0.120
Chromis margaritifer	-	2.93	1.99	0.216
Chromis vanderbilti	-	2.60	1.20	0.310
Odonus niger	-	1.62	1.45	0.396
Thalassoma amblycephalus	-	1.73	0.36	0.461
Pseudanthias olivaceus	-	1.42	0.83	0.522
Myripristis earlei	-	3.41	0.11	0.581
Pseudanthias bartlettorum	-	1.24	0.37	0.636
Pseudanthias dispar	-	0.76	0.60	0.684
Myripristis berndti	-	1.29	0.63	0.732
e) Piscivores [Pi]				
Cephalopholis argus	-	3.54	2.30	0.184
Lutjanus bohar	-	13.05	0.77	0.345
Epinephelus spilotoceps	-	1.43	0.28	0.424
Variola louti	+	0.65	1.03	0.497
Paracirrhites hemistictus	-	1.13	0.78	0.564
Oxycheilinus unifasciatus	-	0.90	0.36	0.616
Aphares furca	-	0.81	0.67	0.667
Epinephelus fasciatus	-	0.58	0.26	0.712
f) Omnivores [Om]				
Melichthys niger	-	4.28	2.41	0.269
Chanos chanos	+	7.21	8.92	0.508
Plectroglyphidodon dickii	+	1.90	2.23	0.695
Melichthys vidua	-	1.99	0.95	0.851
g) Generalist carnivores [GC]				
Cephalopholis urodeta	-	5.59	3.57	0.358
Lutjanus gibbus	+	1.52	3.90	0.571
Lutjanus fulvus	-	1.68	0.38	0.702
h) Corallivores [C]				
Arothron meleagris	-	3.73	0.77	0.359
Chaetodon ornatissimus	+	0.41	0.54	0.469
Cantherhines dumerilii	+	0.20	0.37	0.552
Plectroglyphidodon johnstonianus	-	0.60	0.46	0.632
Chaetodon lunula	-	0.39	0.09	0.702
i) Detritivores [D]				
Ctenochaetus marginatus	+	3.08	5.55	0.626
Ctenochaetus striatus	+	0.97	1.40	0.852

Table S7. Species contributing to 70% of the variation in reef fish community structure after the 2015–2016 El Niño (compared to pre-heat stress composition) for all fish (a) and individual trophic groups (b–i). Mean site-level biomass (g m^{-2}) for each heat stress point is given, as well as the cumulative contribution of each species to overall community dissimilarity. Trophic groups are ordered from most to least biomass.

Species	Change (+/-)	Before	After	Cumulative sum
a) All fish				
Chanos chanos [Om]	+	7.21	31.41	0.076
Acanthurus olivaceus [H]	+	7.08	18.25	0.137
Pterocaesio tile [Pl]	+	9.85	16.56	0.177
Scarus frenatus [H]	+	10.54	10.64	0.214
Lutjanus bohar [Pi]	-	13.05	5.24	0.247
Acanthurus nigricauda [H]	-	9.28	4.11	0.276
Chlorurus sordidus [H]	+	7.75	8.89	0.301
Scarus rubroviolaceus [H]	-	8.60	5.64	0.325
Acanthurus lineatus [H]	+	2.39	7.73	0.349
Gnathodentex aureolineatus [In]	-	7.05	3.93	0.370
Scarus ghobban [H]	-	9.27	1.77	0.390
Chromis vanderbilti [Pl]	+	2.60	8.45	0.411
Acanthurus nigroris [H]	+	0.10	13.15	0.431
Lutjanus kasmira [In]	-	9.66	1.43	0.450
Acanthurus nigricans [H]	+	6.37	6.95	0.469
Cephalopholis argus [Pi]	+	3.54	6.80	0.487
Melichthys niger [Om]	-	4.28	3.97	0.506
Cheilinus undulatus [In]	-	5.58	3.65	0.522
Hipposcarus longiceps [H]	+	0.00	13.54	0.537
Ctenochaetus marginatus [D]	+	3.08	4.90	0.553
Pterocaesio lativittata [Pl]	+	2.58	4.80	0.567
Parupeneus insularis [In]	-	4.82	1.22	0.580
Caesio teres [Pl]	+	2.03	7.18	0.593
Cephalopholis urodeta [GC]	-	5.59	3.68	0.605
Chromis margaritifer [Pl]	+	2.93	4.25	0.616
Parupeneus multifasciatus [In]	-	3.58	1.33	0.626
Lethrinus xanthochilus [GC]	+	<0.01	4.10	0.637
Scarus tricolor [H]	-	3.22	2.19	0.647
Arothron meleagris [C]	-	3.73	0.46	0.657
Calotomus carolinus [H]	+	0.67	3.17	0.667
Pseudanthias dispar [Pl]	+	0.76	3.37	0.677
Balistoides viridescens [In]	-	2.61	0.89	0.687
Odonus niger [Pl]	+	1.62	2.18	0.695
Myripristis berndti [Pl]	+	1.29	2.48	0.704
b) Herbivores [H]				
Acanthurus olivaceus	+	7.08	18.25	0.137
Scarus frenatus	+	10.54	10.64	0.255
Acanthurus lineatus	+	2.39	7.73	0.344
Chlorurus sordidus	+	7.75	8.89	0.431
Scarus rubroviolaceus	-	8.60	5.64	0.505
Acanthurus nigricauda	-	9.28	4.11	0.576

Acanthurus nigricans	+	6.37	6.95	0.636
Scarus ghobban	-	9.27	1.77	0.683
Hipposcarus longiceps	+	0.00	13.54	0.728
c) Invertivores [In]				
Gnathodentex aureolineatus	-	7.05	3.93	0.134
Parupeneus insularis	-	4.82	1.22	0.237
Balistoides viridescens	-	2.61	0.89	0.304
Lutjanus kasmira	-	9.66	1.43	0.369
Cheilinus undulatus	-	5.58	0.36	0.432
Parupeneus multifasciatus	-	3.58	1.33	0.491
Sargocentron tiere	+	0.86	1.24	0.535
Sufflamen chrysopterum	-	0.82	0.69	0.572
Coris aygula	-	1.04	0.48	0.604
Halichoeres hortulanus	+	0.53	1.05	0.636
Sargocentron caudimaculatum	-	0.94	0.78	0.661
Monotaxis grandoculis	-	1.21	0.52	0.686
Balistapus undulatus	+	0.71	0.73	0.710
d) Planktivores [Pl]				
Chromis vanderbilti	+	2.60	8.45	0.143
Pterocaesio tile	+	9.85	16.56	0.276
Chromis margaritifer	+	2.93	4.25	0.350
Pseudanthias dispar	+	0.76	3.37	0.424
Odonus niger	+	1.62	2.18	0.486
Pseudanthias olivaceus	+	1.42	2.73	0.543
Pterocaesio lativittata	+	2.58	4.80	0.595
Myripristis berndti	+	1.29	2.48	0.636
Myripristis earlei	-	3.41	0.00	0.674
Caesio teres	+	2.03	7.18	0.711
e) Piscivores [Pi]				
Lutjanus bohar	-	13.05	5.24	0.220
Cephalopholis argus	+	3.54	6.80	0.429
Epinephelus spilotoceps	-	1.43	0.43	0.490
Paracirrhites hemistictus	-	1.13	0.89	0.548
Oxycheilinus unifasciatus	-	0.90	0.80	0.594
Variola louti	+	0.65	1.30	0.638
Cephalopholis miniata	-	1.22	0.70	0.680
Gracila albomarginata	+	0.46	1.05	0.718
f) Omnivores [Om]				
Chanos chanos	+	7.21	31.41	0.283
Melichthys niger	-	4.28	3.97	0.545
Melichthys vidua	+	1.99	3.25	0.726
g) Generalist carnivores [GC]				
Cephalopholis urodeta	-	5.59	3.68	0.332
Lutjanus gibbus	-	1.52	0.64	0.456
Lutjanus fulvus	-	1.68	0.10	0.568
Lethrinus xanthochilus	+	<0.01	4.10	0.675
Lethrinus olivaceus	+	0.55	1.50	0.755
h) Corallivores [C]				
Arothron meleagris	-	3.73	0.51	0.334

Plectroglyphidodon johnstonianus	-	0.60	0.03	0.442
Chaetodon ornatissimus	-	0.41	0.28	0.526
Chaetodon lunula	-	0.39	0.22	0.607
Chaetodon auriga	-	0.37	0.20	0.684
Chaetodon meyeri	-	0.30	0.18	0.754
i) Detritivores [D]				
Ctenochaetus marginatus	+	3.08	4.90	0.513
Ctenochaetus striatus	+	0.97	2.46	0.819

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