The following supplement accompanies the article

Herbivory strength is similar or even greater in algal- compared to coral-dominated habitats on a recovering coral reef

Sarah Joy Bittick*, Caitlin R. Fong, Rachel J. Clausing, Jay D. Harvey, Tarn M. Johnson, Tomas A. Frymann, Peggy Fong

*Corresponding author: sarah.bittick@lmu.edu

Marine Ecology Progress Series 634: 225–229 (2020)

Supplement.

1. Transect surveys of herbivorous fish abundance and size by family on the reef flat and slope.

Methods. To characterize fish abundance and size frequency distributions visual surveys were conducted on the reef flat and slope, hereafter referred to as reef zones. We laid out 30 m transects (n=6) at each zone and moved along the transect on snorkel at a constant speed, categorizing herbivorous fishes within 1 m of each side of the transect into Acanthuridae, Labridae (tribe Scarinae), Siganidae, and Kyphosidae and size class (<5 cm, 5-10 cm, 10-15 cm, 15-20 cm, >20 cm). Surveys included both algal and coral habitat, since they were close together and fish were observed to move between the different habitats. We conducted a MANOVA for each fish family to examine differences in abundance of fishes within size classes by zone.

Results. Only acanthurids and scarids were observed during our fish surveys. Acanthurids were more abundant by a factor of nearly ten (Figure S1A,B). There were differences in abundance of acanthurids within size classes between the two zones (Table S1, MANOVA). When size class abundances were analyzed separately by ANOVA for the two zones, there were significantly more 0-5cm acanthurids on reef flat than reef slope zone (Figure S1A, Table S1, ANOVA). None of the other acanthurid size classes varied by zone, but there was a trend toward more 5-10cm acanthurids in the flat than slope as well (Figure S1A, Table S1, ANOVA). There also appeared to be more acanthurids of the very smallest size class on the reef flat than slope, though this pattern was not strong enough to be supported by an interaction. In contrast, there was no effect of zone on the abundance of scarids in the 5 size classes (Figure S1B; MANOVA Table S1). Fish from the 5-10cm size class were the most abundant for both acanthurids and scarids, and at both zones.

Table S1. ANOVAs= analysis of variance; df = degrees of freedom; SS = sum of squares; MS = mean square; MANOVA = multivariate analysis of variance. Bold text indicates significant p-values.

Analysis	df	SS	MS	F-value	P-value
Acanthurid MANOVA					
Pillai's Trace	1			4.698	**0.021**
Acanthurid ANOVAs					
0-5cm	1	122.5	122.5	11.638	**0.005**
5-10cm	1	344.18	344.18	3.687	0.077
10-15cm	1	25.60	25.60	0.454	0.512
15-20cm	1	3.211	3.211	0.378	0.549
Scarid MANOVA					
Pillai's Trace	1			1.648	0.237

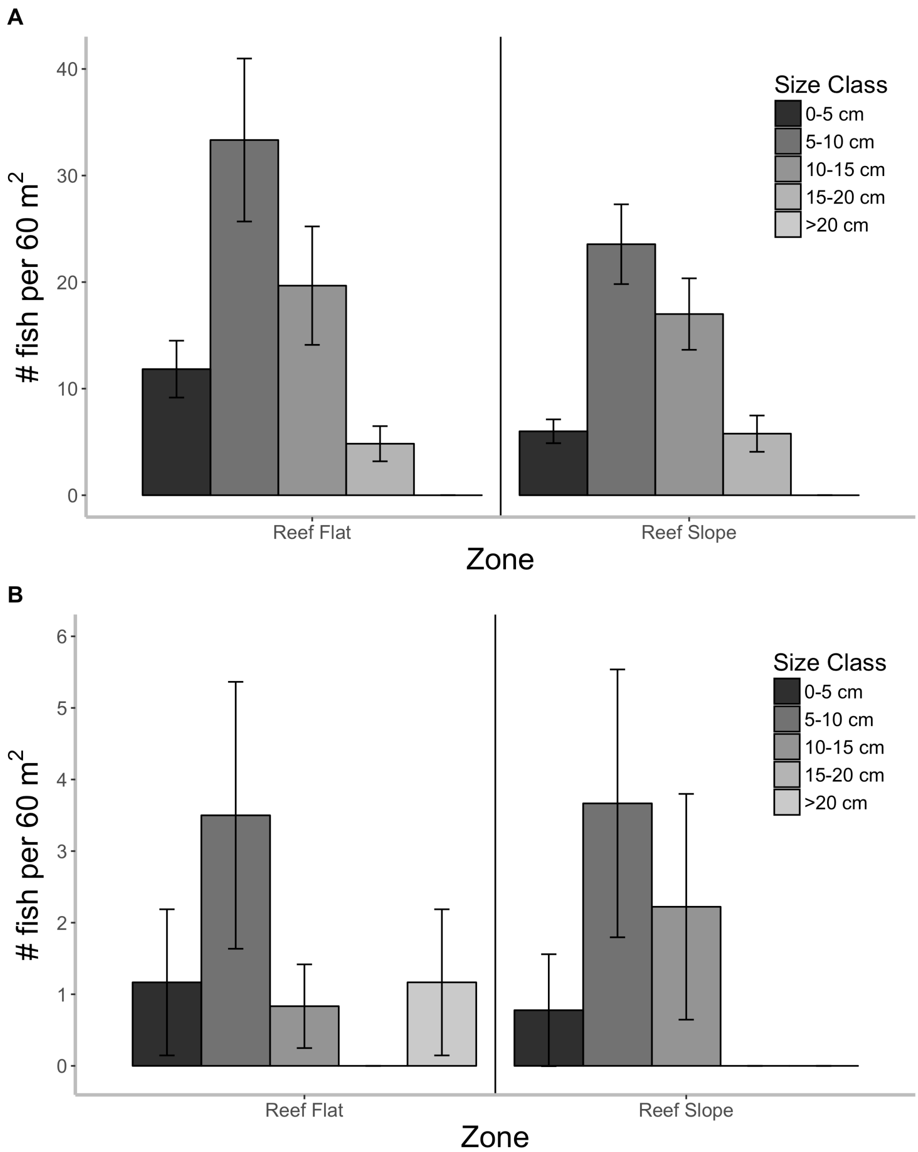

Figure S1. Fish surveys showing (A) density of acanthurids and (B) scarids by size class at the reef flat and slope zones.

2. MCR-LTER surveys on herbivorous fish community at site 2

Rationale and Methods. To estimate species composition of the herbivorous fish community, we used survey data collected by the Mo'orea Coral Reef-Long Term Ecological Research (http://mcr.lternet.edu/, Brooks 2018) from our north shore site, MCR-LTER site 2. Four surveys quantifying density of fish populations were conducted in August 2012 at the same fringing reef site as our study. Fish were identified to species and counted along a 50 x 5 m belt transect for a surveyed area of 250 m^2; for comparison with our surveys, we normalize these data to per 60 m^2. LTER data were collected on SCUBA at a depth of approximately 10m while ours were conducted on snorkel to a depth of 3 m. We only report species comprising $\geq$5% of the population by family. The average sizes of all observed acanthurids and scarids were 9.5 +/- 0.40 cm and 9.4 +/- 0.51 cm, respectively. This also falls within the most common size class we found in our habitat observations.

Results. The Acanthuridae community in our site was comprised largely of 3 species *Zebrasoma scopas* (44%), *Ctenochaetus striatus* (19%), *Acanthurus nigrofuscus* (17%), while the Labridae (tribe Scarinae) was comprised predominantly of *Chlorurus sordidus* (64%) and *Scarus psittacus* (27%) (Brooks 2018) (Figure S1).

Two of the three dominant acanthurids at this site, *Z. scopas* and *A. nigrofuscus* consume and remove algae (Marshell & Mumby 2015). *C. striatus* has been identified as a detritivore (Tebbett et al. 2017), but also is seen removing macroalgae, perhaps in the process of foraging for detritus (Marshell & Mumby 2015). The most abundant scarids, *C. sordidus* and *S. sordidus,* selectively feed on cyanobacteria and microscopic autotrophs that live on turf and macroalgae rather than the algal resource itself (Clements et al. 2016).

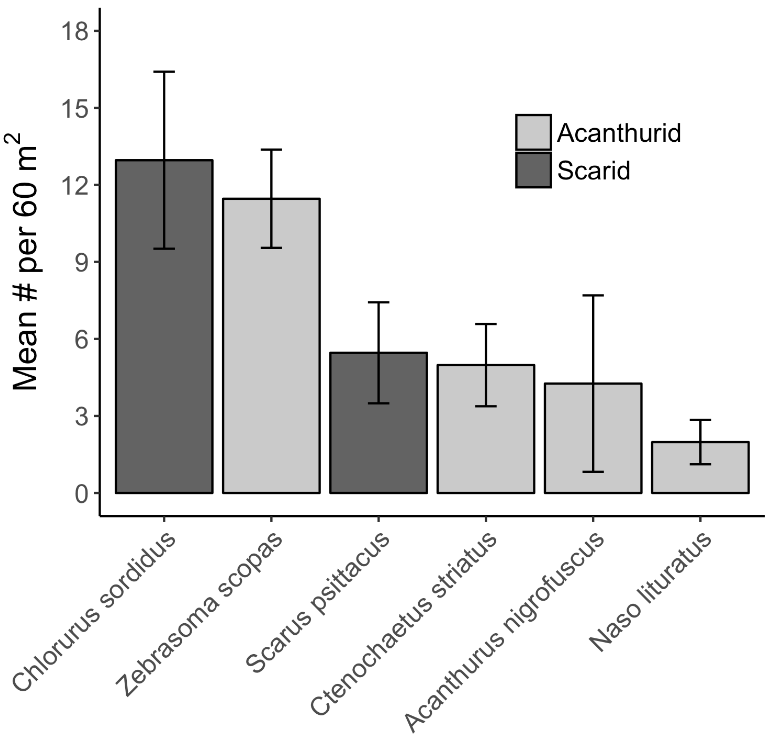

Figure S2. Mean density per 60 m^2 (±SE) of (A) Acanthuridae and Labridae (tribe Scarinae) documented by the MCR LTER in our study site in August 2012. Acanthuridae species include *Zebrasoma scopas* (44%), *Ctenochaetus striatus* (19%), *Acanthurus nigrofus-cus* (17%), *Naso lituratus* (8%); Labridae (tribe Scarinae) species include *Chlorurus sordidus* (64%), Scarus psittacus (27%).

REFERENCES

Brooks A (2018) MCR LTER: Coral Reef: Long-term Population and Community Dynamics: Fishes, ongoing since 2005.

Clements KD, German DP, Piché J, Tribollet A, Choat JH (2016) Integrating ecological roles and trophic diversification on coral reefs: multiple lines of evidence identify parrotfishes as microphages. Biol J Linn Soc 120:729–751

Marshell A, Mumby PJ (2015) The role of surgeonfish (Acanthuridae) in maintaining algal turf biomass on coral reefs. J Exp Mar Bio Ecol 473:152–160

Tebbett SB, Goatley CHR, Bellwood DR (2017) Clarifying functional roles: algal removal by the surgeonfishes Ctenochaetus striatus and Acanthurus nigrofuscus. Coral Reefs 36:803–813

3. Surveys of fish entering cages by family and size.

Methods. To quantify the size and abundance of fish that were entering and foraging in cages, we conducted a total of 7-hours of visual observation of each cage type on snorkel from at least 5 m away and categorized the family and size of fish that entered cages of each mesh opening size.

Results. Increasing cage opening size resulted in increased size and number of fishes entering, which meant that our experimental size restrictions were effective (Supplement Figure S3). As expected, no fish were observed to enter our 1x1cm control cages. Within the small (3x3cm), medium (5x5cm), and large (8x8cm) openings total number of fishes entering were 5, 49, and 102 in 7 hours, respectively. Average (+/- SE) and maximum fish lengths were 4.8 +/- 0.76 and 6 cm for small, 7.6 +/- 0.24 and 14 cm for medium, 9.5 +/- 0.21 and 16 cm for large openings.

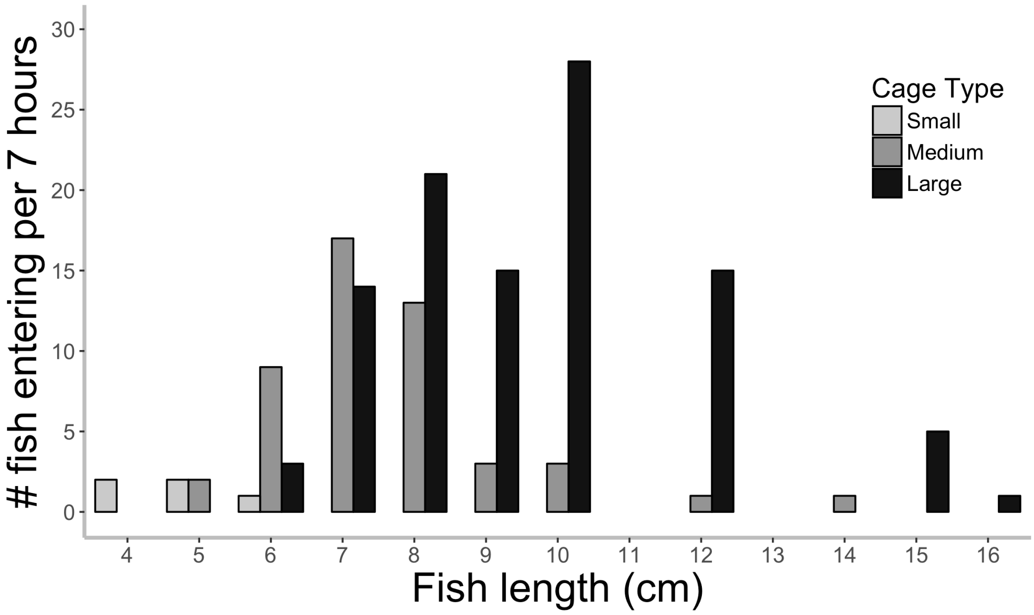

Figure S3. Visual surveys showing the frequency distribution of fish by size (cm) entering cages with mesh of sizes 3x3, 5x5, and 8x8 cm. No fish entered 1x1 cm cages.