The following supplement accompanies the article

Why more comparative approaches are required in time-series analyses of coral reef ecosystems

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Physical and chemical setting

The physicochemical marine environment differs between the ETP and Mo'orea. Upwelling in the ETP leads to cooler seawater temperatures, lower pH, higher nutrients, and more variable salinity than is found in Mo'orea (Table S1). The intensity of upwelling varies regionally on a 100-km scale in the ETP, and strongly influences reef development (reviewed by Cortés 1997). Relative to the Indo-Pacific and Caribbean, ETP reefs are unconsolidated and uncemented accumulations of $CaCO_3$, small in areal extent (1–2 hectares), and generally limited to <10-m depth (Dana 1975, Glynn & Wellington 1983). In contrast, the reefs of Mo'orea form a heavily calcified barrier reef surrounding a high island (1,207 m elevation), which is ~ 1 km from the shore, and descends to a volcanic base ~ 100 m beneath (based on cores of the reef around Tahiti (Cabioch et al. 1999). The reef framework in Mo'orea is constructed from at least 67 nominal scleractinian species (Bosserelle et al. 2014), the hydrocoral *Millepora*, and a heavily calcified and diverse crustose coralline algal flora (Adjeroud et al. 2002, N'Yeurt & Payri 2010). ETP reefs are patchily distributed along the coast and islands of central America and the Galapagos Islands, ephemeral on geologic time scales, and constructed by a low diversity of coral species (Manzello et al. 2008). Moreover, they tend to experience relatively low seawater flow rates, and persist where wave exposure usually is minor. The focal reef of Uva Island in Panama occurs in a non-upwelling location, but shoaling of the shallow thermocline at 5–15-m depth creates a more heterogenous environment than occurs in Mo'orea (Dana 1975). The strongest upwelling occurs in the southern Galapagos Islands, where seawater temperatures are the lowest, and both pCO_2 and nutrients are highest (Table S1). Reefs in both locations are affected by ENSO events, but the thermal episodes are more extreme in the ETP versus Mo'orea (Table S1). In summary, ETP reefs occur in a marginal environment for coral survival and reef development, and have undergone more severe thermal stress than the reefs in Mo'orea.

Methods

Community structure

Mo'orea. Methods for analyses of benthic structure can be accessed from Trapon *et al.* (2011), Bramanti and Edmunds (2016), http://mcr.lternet.edu/data, and http://observatoire.criobe.pf/wiki/tiki-index.php.

Herbivorous fish data are from two sites on the north shore of Moorea (LTER 1 and LTER 2), which have been surveyed annually since 2005 (Brooks 2017). Briefly, at each site fish abundances are recorded by divers on four replicate 5 x 50 m permanent transects (data presented here are from three replicate transects at each site that have been surveyed by the same three observers each year). The total length (TL) of each fish observed is estimated to the nearest 1 cm and fish biomass is calculated using the formula $w = aL^b$, where L is length in cm and *a* and *b* are species-specific scaling parameters (Brooks 2011). Functional groups were defined according to Green and Bellwood (2009). A species list can be found in Han et al. (2016).

ETP. Methods for quantifying benthic structure can be found at https://www.bco-dmo.org/person/514244.

Methods for surveying fishes are presented in Smith (2005), but briefly described here. Herbivorous fishes were surveyed in 74 transects at the Uva Island study reef in 2002 – 2004. Surveys were apportioned in forereef (n = 21), crest (n = 15), flat (n = 23), and back reef (n = 15) areas around the living pocilloporid framework in depths of 1-5 m mean low water. Transects were placed by randomized fin kicks and consisted of 25 x 2 m belt transects to identify, size (TL), and count each individual herbivorous fish over 12-15 minutes. Herbivore biomass was calculated using species-specific parameters as above and defined in Smith (2005).

Table S1. Summary of select biological, physical, and chemical features of reefs in Mo’orea and the ETP.
Types of disturbances: A = COTs, B = bleaching, C = cyclones

	Mo’orea		ETP		References († = Mo’orea, § = ETP)
	Fringe	Forereef	Uva Reef, Panama	Southern Islands, Galapagos	
Framework-building coral genera*	~22	25	4	3	Bosserelle et al. (2014)[†]; Glynn et al. 2017[§]
Sea Urchin Density (no. m^{-2})	0-18.15	0.25-3.80	0-0.54	0.36-5.54	Smith 2005[§] knb-lter-mcr.7.28 (for 2015)[†]
Symbiodinium clades	A, B, C, D	A, C, D	C, D	C, D	Baker (1999)§; Darius et al. (1998, 2000); Putnam et al. (2012)[†]; Rouzé et al. (2017)[†]
Flow rate (m/s)	0-0.5	0-0.5	0.001–0.965	N/A	Leichter et al. (2013)[†]; knb-lter-mcr.30.31[†], T.B. Smith[§] (unpub. data)
Significant Wave Height (m)	0-2	0-8	0-0.9	N/A	knb-lter-mcr.30.31[†], T.B. Smith unpub. data[§]
Seawater temperature range (°C)	23.7-30.9	25.3-29.9	25.5-30.9	18.5-30.2	knb-lter-mcr.30.31[†]; Banzon et al. (2016)[a]
Salinity (psu)	No data	35.0-36.7	28.88-34.12	34.23-35.24	Manzello (2010)[§]; knb-lter-mcr.30.31[†]
Max Degree Heating week	No data	7.6	13.9	33.9	Hoegh-Guldberg 2002; Banzon et al. (2016)[b]
Aragonite Saturation State	3.52-4.30	3.96-4.08	1.60 - 5.07	1.54-3.70	Manzello (2010); knb-lter-mcr.1037.4[†]
Inorganic Nutrients (µmol/L)					
Phosphate	0.09-0.26	0.06-0.26	0.21-1.21	1.38-1.56	knb-lter-mcr.1034.7[†]; ETP: unpub data 2014[c]
Silicate	0.17-2.66	0.21-3.19	No data	2.8-3.5	knb-lter-mcr.1034.7[†]; ETP: unpub data 2014[c]
Nitrite	0.03-0.32	0.02-0.29	No data	0.32-0.39	knb-lter-mcr.1034.7[†]; ETP: unpub data 2014[c]
Nitrite plus Nitrate (µmol/L)	0.26-4.35	0.04-1.05	0.03-0.46	3.48-4.20	knb-lter-mcr.1034.7[†]; ETP: unpub data 2014[c]
Disturbance types	A,B,C	A,B,C	A,B	B	

a- ETP data are weekly averaged optimum interpolation sea surface temperatures (OISST) from 1981-2016.
b- Degree Heating Weeks for ETP calculated from OISST data according to Liu et al. (2006)
Nutrient data collected from 0-20m depth in August and October 2014 in Panama and Galapagos, respectively. Samples collected and analyzed at UC Davis analytical lab for Panama and according to Zhang et al. (2009) for Galapagos samples.

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