Benthic characterization of mesophotic communities based on optical depths in the Southern Mexican Pacific coast (Oaxaca)

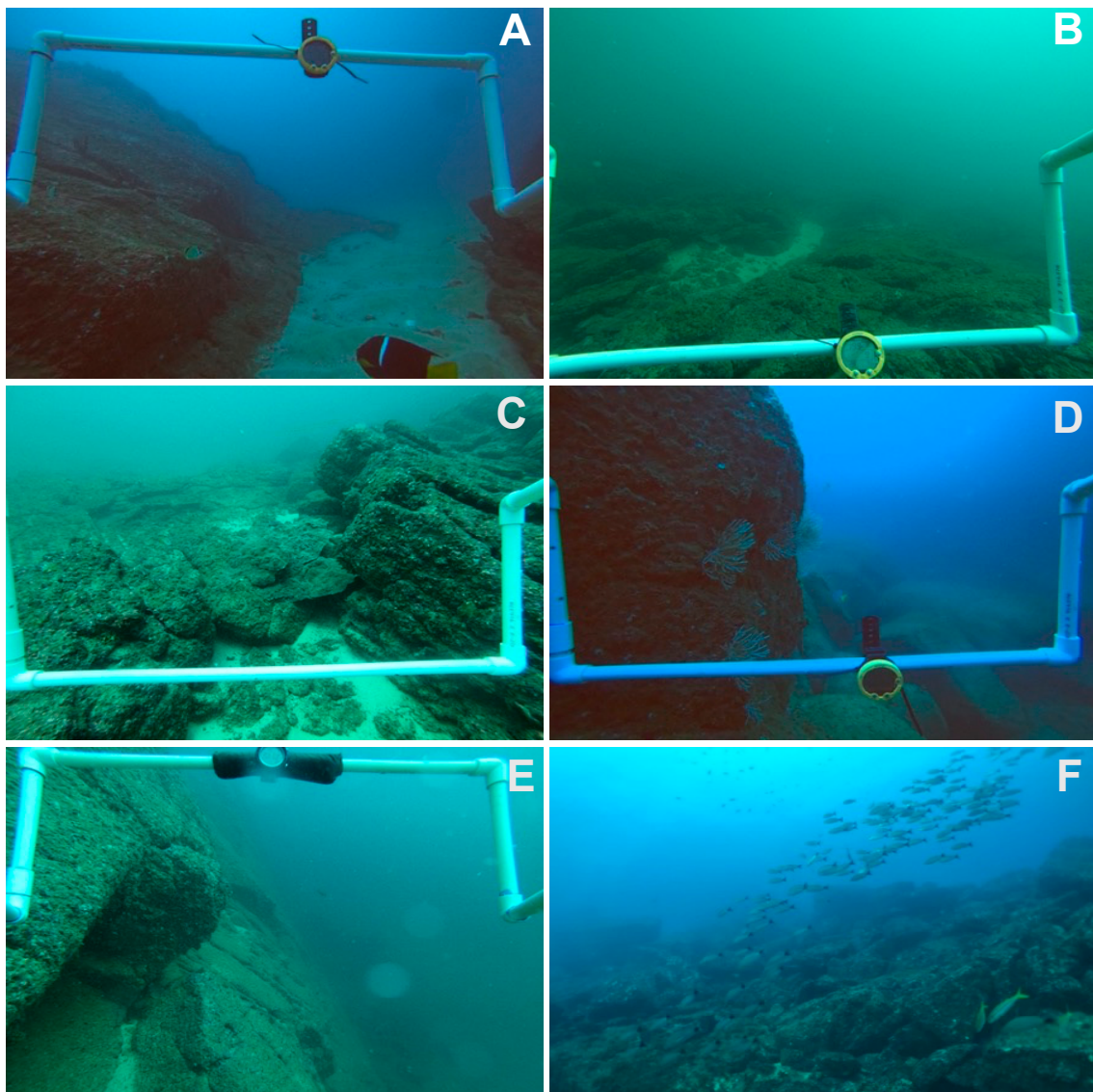**Miguel Ángel Pérez-Castro, Gal Eyal, Gerardo Esteban Leyte-Morales, Gustavo Hinojosa-Arango, Susana Enríquez**

Figure S1.Geofeatures and their slope grade : A) 'Ridge' at Tijera (20-50º), B) 'Ledge' at Estacahuite (0 < 20º), C) 'Ledge' at Tijera (0 < 20º , D) Slope at Salchi (20-50º), E) Slope at Riscalillo (> 50º), y F) 'Bajo' at Boquilla.
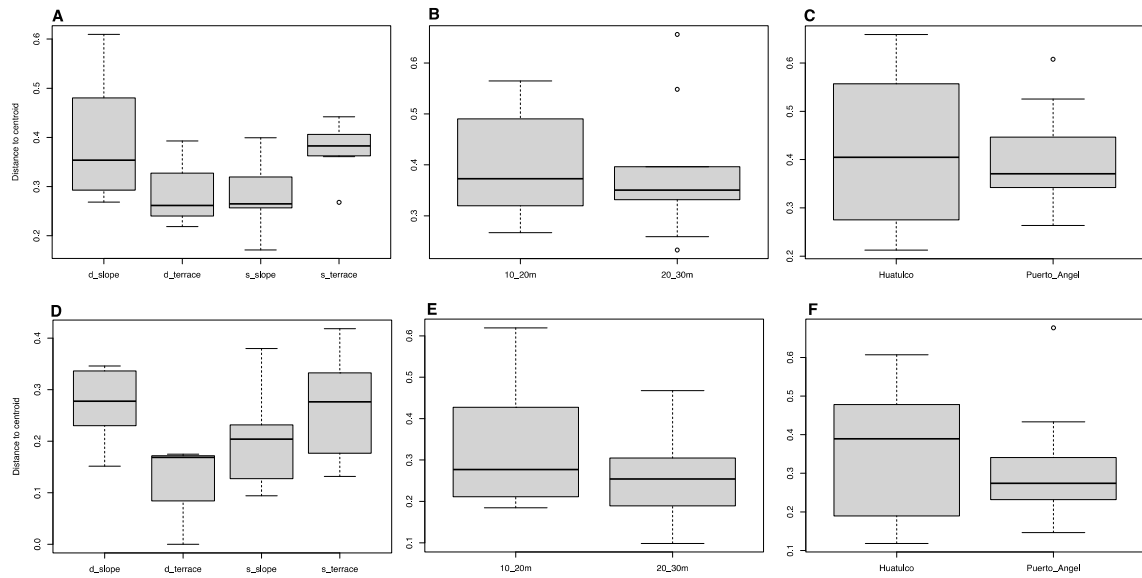
Figure. S2. Boxplots represent b-dispersion, a measure of within b-diversity that assesses the distance of the communities to the group centroid; (A-C)using Jaccard dissimilarities matrix; (D-F) using Bray-Curtis dissimilarities matrix which include relative coral abundance information. The p-value of all groups was not significant (p > 0.05).

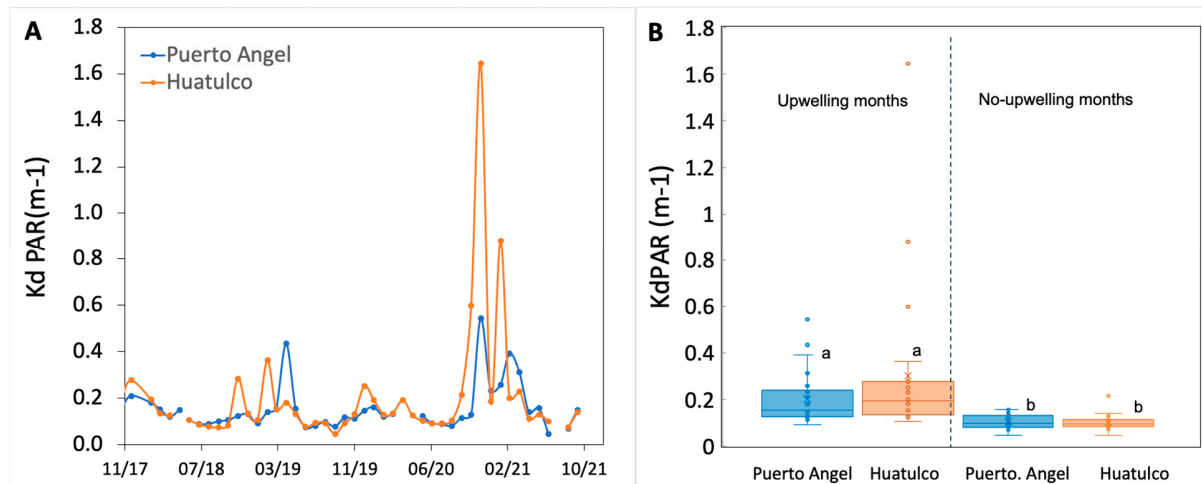
Figure. S3 Variability of Kd_{PAR} calculated from MODIS-Aqua satellite data (Kd_{490}) during four years A) time-series of Kd_{PAR} in Puerto Angel and Huatulco, Oaxaca, Mexico. B) Difference between upwelling and no upwelling months.

Table S1. Means and standard error of optical mesophotic depths bounderies during upwelling and non-upwelling months in different years.

Years	Optical depths (%)	Seasonal upwellings (Nov-Apr)		No Upwellings (May-Oct)	
		Puerto Angel (m)	Huatulco (m)	Puerto. Angel (m)	Huatulco (m)
2017-18	z10%	14.1	12.3	21.7	26.7
	z1%	28.1	24.6	43.4	53.4
	z0.1%	42.2	36.9	65.0	80.1
2018-19	z10%	17.9	11.1	22.9	25.9
	z1%	35.8	22.1	45.8	51.7
	z0.1%	53.7	33.2	68.7	77.6
2019-20	z10%	17.1	13.4	23.1	18.9
	z1%	34.2	26.7	46.2	37.8
	z0.1%	51.3	40.1	69.3	56.6
2020-21	z10%	7.4	3.7	20.4	20.6
	z1%	14.8	7.4	40.8	41.3
	z0.1%	22.2	11.1	61.2	61.9
Average 2017-2021	z10%	14.1 ± 2.8	10.1 ± 2.5	22.0 ± 0.7	23.0 ± 2.2
	z1%	28.2 ± 5.5	20.2 ± 5.1	44.0 ± 1.4	46.0 ± 4.4
	z0.1%	42.3 ± 8.3	30.3 ± 7.6	66.1 ± 2.2	69.1 ± 6.7

Table S2. List of benthic species in the study locations.

Phylum Polifera					
Class	**Order**	**Family**	**Species**	**Puerto Ángel**	**Huatulco**
Demospongiae	Haplosclerida	Niphatidae	*Amphimedon texotli*	X	X
		Chalinidae	*Haliclona caerulea*	X	X
	Verongiida	Aplysinidae	*Aplysina clathrata*	X	X
	Axinellida	Axinellidae	*Axinella nayaritensis*	X	
	Chondrosiida	Chondrosiidae	*Chondrosia sp.*	X	X
	Suberitida	Halichondriidae	*Ciocalypta sp*	X	X
	Poecilosclerida	Mycalidae	*Mycale cecilia*	X	X
Phylum Cnidaria					
Anthozoa	Scleractinia	Agariciidae	*Pavona cf. Clavus*	X	X
			Pavona duerdeni	X	X
			Pavona gigantea	X	X
			Pavona varians		X
		Poritidae	*Porites panamensis*	X	X
		Pocilloporidae	*Pocillopora cf. capitata*	X	X
			Pocillopora eydouxi	X	X
			Pocillopora cf. verrucosa	X	X
			Pocillopora damicornis	X	X
			Pocillopora cf. inflata		X
			Pocillopora cf woodjonesi		
		Dendrophylliidae	*Tubastraea coccinea*	X	X
	Antipatharia	Antipathidae	*Antipathes cf. galapagensis*	X	X
	Malacalcyonacea	Gorgoniidae	*Leptogorgia alba*	X	X
			Leptogorgia cuspidata	X	X
			Leptogorgia cf. ena	X	X
			Leptogorgia rigida	X	X
			Pacifigorgia cf. pulchra	X	
			Pacifigorgia rutila	X	X
			Pacifigorgia stenobrochis	X	X
		Plexauridae	*Muricea austera*		X
			Muricea fruticosa	X	X
			Muricea sp.		X
		Carijoidae	*Carijoa riisei*		X
Phylum Annelida					
Polychaeta	Sabellida	Serpulidae	*Serpula sp.*	X	X
Phylum Echinodermata					
Asteroidea	Valvatida	Oreasteridae	*Pentaceraster cumingi*	X	X
		Ophidiasteridae	*Pharia pyramidata*	X	X
			Phataria unifascialis	X	X
Echinoidea	Diadematoida	Diadematidae	*Astropyga pulvinata*	X	
			Diadema mexicanum	X	X
	Cidaroida	Cidaridae	*Eucidaris thouarsii*	X	X
	Camarodonta	Toxopneustidae	*Toxopneustes roseus*	X	X
			Tripneustes depressus	X	
Holothuroidea	Dendrochirotida	Cucumariidae	*Cucumaria flamma*	X	X
	Synallactida	Stichopodidae	*Isostichopus fuscus*	X	X
Ophiuroidea	Amphilepidida	Ophiotrichidae	*Ophiothela mirabilis*	X	X
			Ophiothrix spiculata		X
Phylum Mollusca					

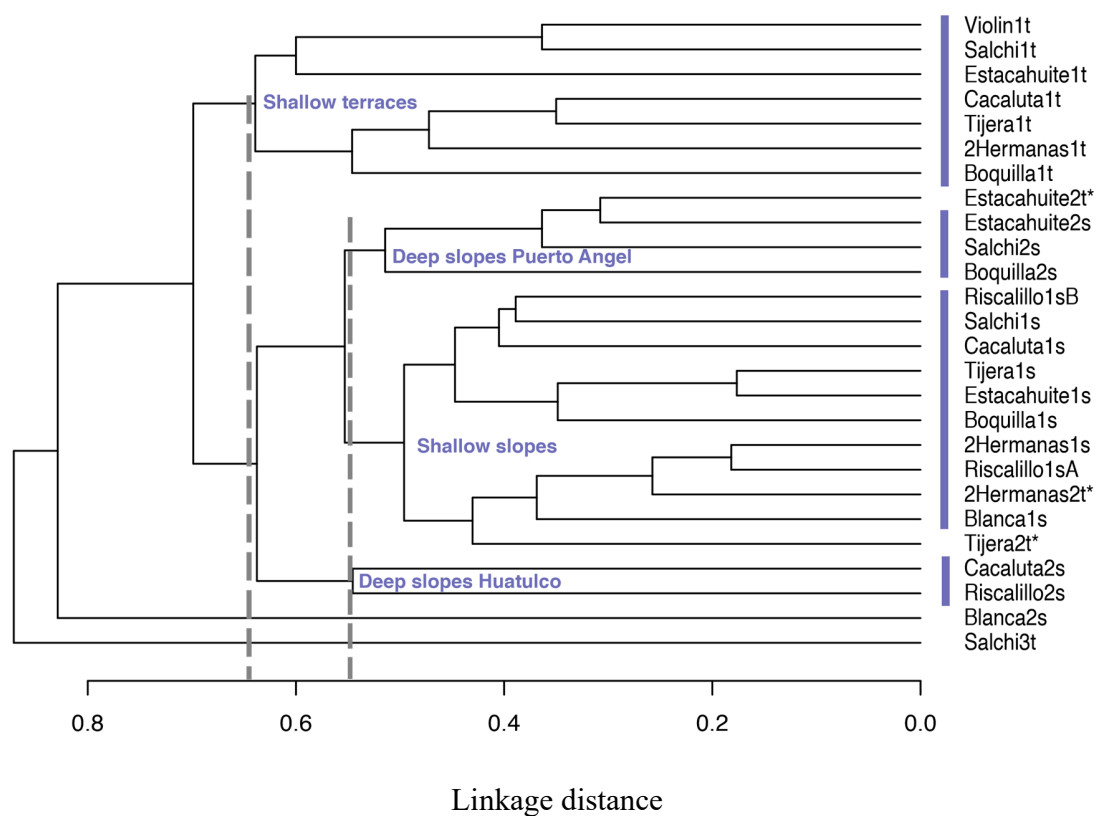|					
Bivalvia	Pectinida	Spondylidae	*Spondylus limbatus*	X	X
	Ostreida	Margaritidae	*Pinctada mazatlanica*	X	X
		Pinnidae	*Atrina maura*	X	
Gastropoda	Neogastropoda	Muricidae	*Hexaplex brassica*		X
		Conidae	*Conus purpurascens*	X	
		Fasciolariidae	*Leucozonia cerata*	X	X
Phylum Arthropoda					
Malacostraca	Decapoda	Mithracidae	*Mithraculus sp.*	X	X
		Palinuridae	*Panulirus inflatus*	X	X
Phylum Chordata					
Ascidiacea	Aplousobranchia	Diazonidae	*Rhopalaea birkelandi*	X	X
Elasmobranchii	Myliobatiformes	Urotrygonidae	*Urobatis concentricus*	X	X
Phylum Chlorophyta					
Ulvophyceae	Cladophorales	Cladophoraceae	*Cladophora sp.*	X	X
	Bryopsidales	Halimedaceae	*Halimeda discoidea*	X	
Phylum Ochrophyta					
Phaeophyceae	Dictyotales	Dictyotaceae	*Lobophora sp.*	X	
			Padina sp.	X	X
			Dictyota humifusa	X	X
Phylum Rhodophyta					
Florideophyceae	Gigartinales	Cystocloniaceae	*Hypnea pannosa*	X	
	Gracilariales	Gracilariaceae	*Gracilaria sp.*	X	X
	Peyssonneliales	Peyssonneliaceae	*Cf. Peyssonnelia sp*	X	X
	Corallinales	Lithophyllaceae	*Amphiroa misakiensis*	X	X
			Amphiroa sp.	X	X
		Corallinaceae	*Cf. Lithophyllum*	X	X
Unidentified	Unidentified	Unidentified	*Red blade*	X	
Unidentified	Unidentified	Unidentified	*Red filamentous*	X	X

Figure. S4. Dendrogram for hierarchical clustering of the 26sites, using group-average linking of Jaccard dissimilarities presence/absence data. The two main groups produced by an (arbitrary) threshold dissimilarity of 65% are shown (Shallow terrace and slopes). Three subgroups produced by an (arbitrary) threshold dissimilarity of 55% (deep slopes from Puerto Angel, shallow slopes, and deep slopes from Huatulco). The deep terraces (marked with an asterisk) was clustering with shallow slopes.
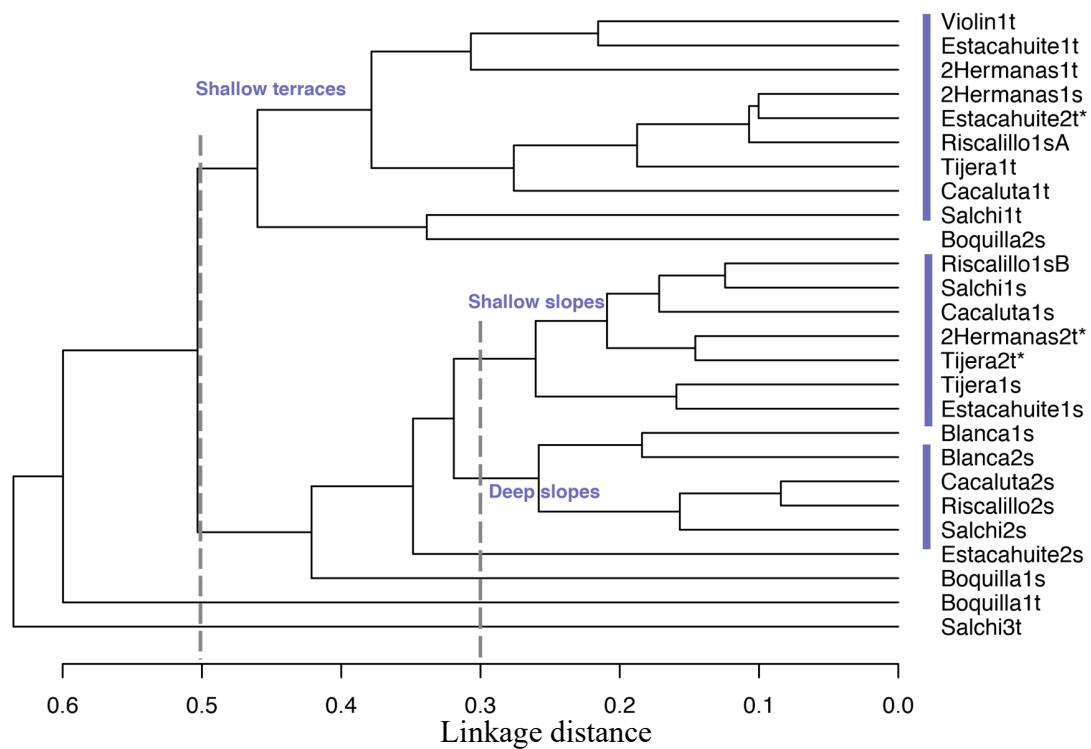
Figure. S5. Dendrogram for hierarchical clustering of the 26sites, using group-average linking of Bray-Curtis dissimilarities calculated on log (x+1) transformed abundance data. The two main groups produced by an (arbitrary) threshold dissimilarity of 50% are shown (Shallow terrace, and slopes). Two subgroups produced by an (arbitrary) threshold dissimilarity of 30% (shallow slopes and deep slopes). The deep terraces (marked with an asterisk) was clustering with shallow slopes.
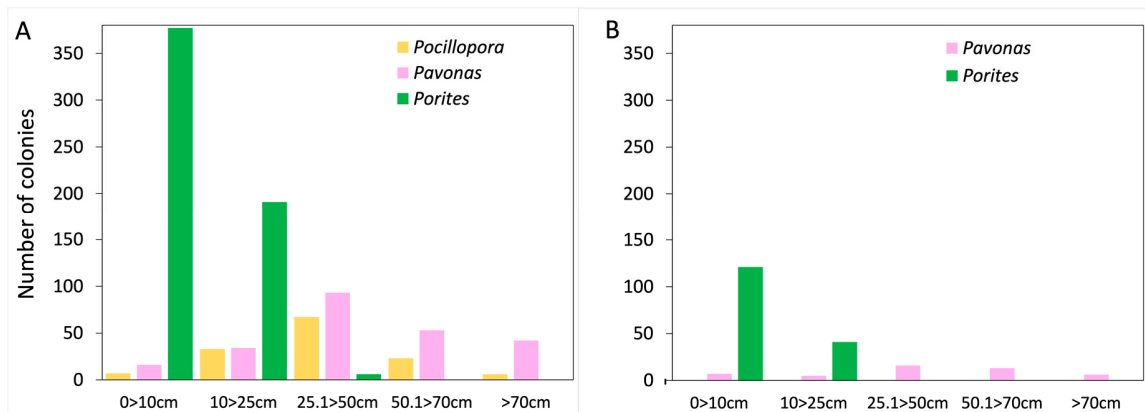

Figure. S6. Size frequency distributions of the three coral genera in the two depth strata, A) 10 > 20 m, B) 20 <30m.