Multi-scale analysis of hermatypic coral assemblages at Mexican Central Pacific

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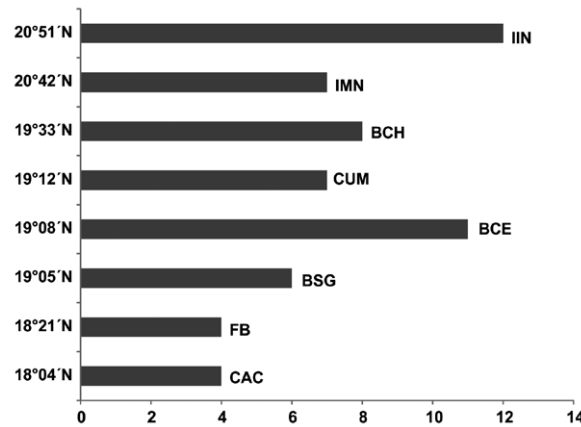
Supplementary material

Fig. S1. – Latitude of the different zones of the Mexican Central Pacific with their coral species richness. Codes by zones: IIN (Isla Isabel); IMN (Islas Marietas); BCH (Bahía Chamela); CUM (Bahía Cuastecomate-Punta Melaque); BCE (Bahía Ceníceros); FB (Faro de Bucerías) and CAC (Caleta de Campos).

Table S1. – Richness and coverages (%) of hermatypic corals species in the different sampling sites of the Mexican Central Pacific. Codes by states: NAY (Nayarit); JAL (Jalisco); COL (Colima) and MICH (Michoacán). Codes by Zones: IIN (Isla Isabel); IMN (Islas Marietas); BCH (Bahía Chamela); CUM (Bahía Cuastecomate-Punta Melaque); BCE (Bahía Ceníceros); FB (Faro de Bucerías) and CAC (Caleta de Campos). Codes by sites: PRO (Punta Rocosa); CSN (Caleta Sin Nombre); LMI (Las Monas Interno); LME (Las Monas Externo); CFS (Costa Fragata Somero); CFP (Costa Fragata Profundo); BRA (Bahía Rabijuncos); EPE (Ensenada de Pescadores); POC (Pocitas); PA (Playa del Amor); PP (Plataforma *Pavonas*); TAM (Túnel Amarradero); ZR (Zona de Restauración); ZRS (Zona de Restauración Sur); CDM (Cueva del Muerto); P (Pelícanos); Lpj (La Pajarera); Lpa (La Palma); EEL (El Elefante); EC (Ensenada Cocinas); IC (Isla Cocinas); TE (Tenacatita); LV (La Virgencita); CU (Cuastecomatito); LMO (Las Monjas 1); LMT (Las Monjas 2); CRZ (Carrizales); PM (Paraíso Montemar); LR (L´Recif); EE (Elefante); PB (Punto B); LB (La Boquita); IPE (Isla Pájaros Este); BH (Barco Hundido), IPO (Isla Pájaro Oeste); IP (Isla Protegida); ER (El Relis); EF (El Faro); LE (La Ensenada); ET (El Teolan) and MC (Manto Carrizo). Codes by coral species: *Pc*, *P.capitata*; *Pd*, *P. damicornis*; *Pef*, *P. effusus*; *Pey*, *P. eydouxi*; Pi, *P. inflata*; *Pm*, *P. meandrina*; *Pv*, *P. verrucosa*; *Pl*, *P. lobata*; *Pp*, *P. panamensis*; *Pcl*, *P. clavus*; *Pdu*, *P. duerdeni*; *Pg*, *P. gigantea*; *Pva*, *P. varians*; *Pst*, *P.stellata* and *Psu*, *P. superficialis*. S, Richness of coral species.

ST	ZN	SI	Pc	Pd	Pef	Pey	Pi	Pm	Pv	Pl	Pp	Pcl	Pdu	Pg	Pva	Pst	Psu	S
NAY	IIN	PRO	0.5		0.6				3.2	3.9		2.6				0.8	0.3	7
		CSN		0.4					5.0	6.1								2
		LMI	1.7	0.5	0.1				4.8	1.0				0.2			0.1	7
		LME		0.2					2.3	0.2								3
		CFS	9.0	6.1					5.4	1.4								4
		CFP							0.2	0.1								2
		BRA		0.1				0.1	3.2	8.0	0.1			0.1		0.2		7
		EPE	4.1	2.4		0.2			12.3	4.0						0.1	0.5	7
		POC							0.9	2.8						0.1	0.4	4
	IMN	PA						0.1	4.6		2.8							3
		PP							2.0		1.8			12.3				3
		TAM							1.4		1.2			3.1				3
		ZR	0.2	0.1		0.5		0.3	6.1		3.0							6
		ZRS	3.4	3.4				0.1	15.7		3.2			0.5				6
		CDM	0.2	1.4					8.9		2.9							4
JAL	BCH	P	1.5	8.5		1.7			12.5									4
		LPj	0.7	0.4		1.3			4.4		1.7							5
		Lpa	21.6	6.4				0.2	20.7	0.2	0.7							6
		EEL							1.6	0.7	1.1							3
		EC		0.3				0.2	0.9	0.4	0.8							5
		IC	1.2						0.1		1.7			0.9				4
	CUM	TE	16.9	40.8				8.6	1.2	0.3	0.2							6
		LV	1.5	9.9				0.6	9.7	0.9	0.2							6
		CU	5.4	36.5				1.3	2.5	0.6	0.9	0.5						7
		LMO	7.4	41.2				1.9	2.6	0.1	0.1	0.1						7
		LMT	0.3	1.4						0.5	0.7							4
COL	BCE	CRZ	12.5	19.1		0.2	0.4	0.3	19.3	0.3	0.2		0.3	0.3	0.1			11
		PM		0.1				0.2		1.1	1.5							4
		LR								3.0	1.0							2
	BSG	EE		0.1					0.1	0.1	0.4							4
		PB	0.1	7.5					3.2	0.3	0.2			0.3				6
		LB	0.2	9.0					1.3	4.8	0.3			0.1				5
MICH	FB	IPE	2.5	0.5					0.2		9.3							4
		BH									3.3							1
		IPO									8.5							1
		IP									0.8							1
	CAC	ER									1.2							1
		EF									3.9							1
		LE		0.3					0.1		2.5			0.8				4
		ET							1.0		0.2							2
		MC									1.3							1

Table S2. − Results of the ANOVA and PERMANOVA pairwise test. Codes by the states: NAY (Nayarit); JAL (Jalisco); COL (Colima) and MICH (Michoacán). Codes by zones: IIN (Isla Isabel); IMN (Islas Marietas); BCH (Bahía Chamela); CUM (Bahía Cuastecomate-Punta Melaque); BCE (Bahía Ceníceros); FB (Faro de Bucerías) and CAC (Caleta de Campos). Bold numbers correspond to a statistical significance $p<0.05$.

	Group	t	P(perm)		Group	t	P(perm)
ANOVA							
Species	MICH *vs.* COL	2.7209	**0.025**	Shannon	MICH *vs.* COL	8.4951	**0.0002**
richness (S)	MICH *vs.* JAL	6.5742	**0.0001**	diversity (H′)	MICH *vs.* JAL	15.238	**0.0001**
	MICH *vs.* NAY	2.6789	**0.0154**		MICH *vs.* NAY	6.0826	**0.0001**
	COL *vs.* JAL	1.4477	0.1761		COL *vs.* JAL	1.3134	0.2351
	COL *vs.* NAY	0.3879	0.7139		COL *vs.* NAY	0.5467	0.6015
	JAL *vs.* NAY	1.9694	0.062		JAL *vs.* NAY	1.601	0.1281
Live coral	MICH *vs.* COL	1.3428	**0.0207**				
cover (LCC)	MICH *vs.* JAL	3.4174	**0.0036**				
	MICH *vs.* NAY	2.3125	**0.0335**				
	COL *vs.* JAL	1.1252	0.2823				
	COL *vs.* NAY	0.0642	0.9505				
	JAL *vs.* NAY	1.8369	0.0789				
Coral	MICH *vs.* COL	3.1900	**0.0009**	Coral	IIN *vs.* IMN	3.8892	**0.0003**
assemblages	MICH *vs.* JAL	4.4237	**0.0003**	assemblages	BCH *vs.* CUM	1.7266	0.0630
by state	MICH *vs.* NAY	5.1706	**0.0001**	by zone	BCE *vs.* SGO	0.7083	0.6822
	COL *vs.* JAL	1.3824	0.1461		FB *vs.* CAC	1.0539	0.3550
	COL *vs.* NAY	2.1246	**0.0052**				
	JAL *vs.* NAY	2.2036	**0.0053**				
Benthonic	MICH *vs.* COL	1.5571	0.0670	Benthonic	IIN *vs.* IMN	1.1832	0.2462
habitat	MICH *vs.* JAL	1.6078	0.0537	habitat	BCH *vs.* CUM	1.7558	**0.0034**
structure	MICH *vs.* NAY	2.5896	**0.0001**	structure	BCE *vs.* SGO	0.7347	0.6972
by state	COL *vs.* JAL	1.1812	0.2477	by zone	FB *vs.* CAC	1.4774	0.1547
	COL *vs.* NAY	2.5816	**0.0007**				
	JAL *vs.* NAY	2.3814	**0.0011**				

Table S3. − Results of the similarity percentage analysis (SIMPER) and coverages (%) of coral species by state. For SIMPER, only those species contributing 90% of the average dissimilarity (Ave. Dis.) of coral species between states of the Mexican Central Pacific are presented. AC, specie cover per state; C, percentage of contribution to the average dissimilarity; CC, percentage of accumulated contribution to the average dissimilarity. Codes: NAY (Nayarit); JAL (Jalisco); COL (Colima); and MICH (Michoacán).

	AC	AC	C	CC		AC	AC	C	CC
Ave. Dis. = 76.83%	MICH	NAY			Ave. Dis. = 57.20%	COL	JAL		
P. verrucosa	0.11	1.23	31.53	31.53	*P. damicornis*	1.23	1.18	22.04	22.04
P. panamensis	1.21	0.51	25.74	57.27	*P. verrucosa*	0.86	1.09	19.05	41.09
P. lobata	0	0.54	14.21	71.49	*P. capitata*	0.54	0.85	15.88	56.98
P. capitata	0.07	0.37	7.74	79.23	*P. lobata*	0.83	0.34	15.32	72.3
P. damicornis	0.08	0.33	7.62	86.85	*P. panamensis*	0.59	0.7	10.53	82.83
P. gigantea	0.05	0.16	5.25	92.1	*P. meandrina*	0.12	0.43	7.97	90.81

Table S4. − Results of the similarity percentage analysis (SIMPER) and coverages (%) of coral species per zone. For SIMPER, only those species contributing 90% of the average dissimilarity (Ave. Dis.) of coral species between zones of the Mexican Central Pacific are presented. AC, percentage of average cover per zone; C, percentage of contribution to the average dissimilarity; CC, percentage of accumulated contribution to the average dissimilarity. Codes: IIN (Isla Isabel); IMN (Islas Marietas); CAC (Caleta de Campos) and FB (Faro de Bucerías).

	AC	AC	C	CC		AC	AC	C	CC
Ave. Dis. = 71.03%	IMN	IIN			Ave. Dis. = 29.52%	CAC	FB		
P. panamensis	1.18	0.01	26.41	26.41	*P. panamensis*	1.04	1.43	60.04	60.04
P. lobata	0	0.94	19.17	45.58	*P. verrucosa*	0.14	0.08	17.38	77.42
P. verrucosa	1.28	1.2	15.88	61.45	*P. damicornis*	0.07	0.1	8.98	86.4
P. capitata	0.27	0.44	9.61	71.06	*P. capitata*	0	0.15	8.46	94.87
P. damicornis	0.28	0.37	9.16	80.22					
P. gigantea	0.33	0.04	7.74	87.96					
P. stellata	0	0.18	3.19	91.15					

Table S5. – Results of the similarity percentage analysis (SIMPER) and coverages (%) of coral species per site. For SIMPER, only those species contributing 90% of the average dissimilarity (Ave. Dis.) of coral species between sampling sites of the Mexican Central Pacific are presented. AC, percentage of average cover per site; C, percentage of contribution to the average dissimilarity; CC, percentage of accumulated contribution to the average dissimilarity. Codes: CFS (Costa Fragata Somero); CFP (Costa Fragata Profundo); CSN (Caleta Sin Nombre); POC (Pocitas); ZRS (Zona de Restauración Sur); TAM (Túnel Amarradero); ZR (Zona de Restauración); PA (Playa del Amor); P (Pelícanos); IC (Isla Cocinas); EEL (El Elefante); EC (Ensenada Cocinas); LMT (Las Monjas 2); TE (Tenacatita); CU (Cuastecomatito); LMO (Las Monjas 1); CRZ (Carrizales); LR (L´Recif); PM (Paraíso Montemar); EE (Elefante); LB (La Boquita); PB (Punto B); ET (El Teolan); LE (La Ensenada); ER (El Relis); MC (Manto Carrizo); IPO (Isla Pájaro Oeste); IP (Isla Protegida); and BH (Barco Hundido).

	AC	AC	C	CC		AC	AC	C	CC
Isla Isabel									
Ave. Dis. = 77.49%	CFS	CFP			Ave. Dis. = 33.29%	CSN	POC		
P. capitata	1.69	0	38.32	38.32	*P. verrucosa*	1.44	0.77	39.63	39.63
P. damicornis	1.41	0	32.53	70.85	*P. lobata*	1.54	1.26	23.49	63.12
P. verrucosa	1.26	0.53	16.1	86.94	*P. superficialis*	0	0.29	12.94	76.06
P. lobata	0.54	0.3	13.06	100	*P. damicornis*	0.3	0	12.79	88.85
					P. stellata	0	0.23	11.15	100
Islas Marietas									
Ave. Dis= 60.61%	ZRS	TEMB			Ave. Dis=25.92%	ZR	PA		
P. verrucosa	1.98	0.46	34.83	34.83	*P. panamensis*	1.28	1.13	22.88	22.88
P. capitata	1.12	0	24.69	59.52	*P. eydouxi*	0.41	0	21.56	44.44
P. damicornis	0.83	0	16.23	75.74	*P. verrucosa*	1.55	1.36	20.24	64.68
P. gigantea	0.25	0.53	13.14	88.89	*P. meandrina*	0.22	0.13	15.94	80.62
P. panamensis	1.3	0.97	7.98	96.86	*P. damicornis*	0.16	0	9.85	90.47
Bahía Chamela									
Ave. Dis= 88.55%	P	IC			Ave. Dis= 23.81%	EEL	EC		
P. damicornis	1.47	0	24.7	24.7	*P. lobata*	0.89	0.59	27.49	27.49
P. verrucosa	1.72	0.22	24.36	49.06	*P. meandrina*	0	0.29	21.91	49.41
P. panamensis	0	1.11	18.99	68.05	*P. damicornis*	0	0.33	21.3	70.7
P. gigantea	0	0.72	13.24	81.29	*P. verrucosa*	1	0.97	18.15	88.86
P. capitata	0.74	0.46	11.27	92.56	*P. panamensis*	1	0.94	11.14	100
Bahía Cuastecomate- Punta Melaque									
Ave. Dis= 71.43%	LMT	TE			Ave. Dis= 20.52%	CU	LMO		
P. damicornis	0.78	2.45	25.27	25.27	*P. panamensis*	0.96	0.22	24.46	24.46
P. capitata	0.33	1.95	23.95	49.22	*P. meandrina*	0.75	1.12	19.17	43.62
P. meandrina	0	1.65	23.43	72.66	*P. damicornis*	2.44	2.36	17	60.63
P. verrucosa	0	0.75	10.37	83.02	*P. lobata*	0.39	0.22	14.53	75.15
P. panamensis	0.88	0.29	9.69	92.72	*P. duerdeni*	0.36	0.22	13.83	88.98
					P. capitata	1.52	1.59	7.61	96.59
Bahía Ceníceros									
Ave. Dis. = 87.72%	CRZ	LR			Ave. Dis. = 30.48%	PM	LR		
P. verrucosa	2.05	0	24.2	24.2	*P. panamensis*	1.07	0.74	33.63	33.63
P. damicornis	2.02	0	23.82	48.02	*P. damicornis*	0.45	0	29.3	62.93
P. capitata	1.75	0	20.11	68.12	*P. lobata*	1.01	1.24	19.57	82.5
P. lobata	0.44	1.24	9.73	77.86	*P. meandrina*	0.29	0	17.5	100
P. panamensis	0.3	0.74	7.55	85.41					
P. meandrina	0.33	0	3.85	89.26					
P. inflata	0.34	0	3.44	92.7					
Bahía Santiago									
Ave. Dis. = 57.88%	EE	LB			Ave. Dis. =38.48%	LB	PB		
P. damicornis	0.33	1.57	35.51	35.51	*P. lobata*	1.26	0.52	26.86	26.86
P. lobata	0.33	1.26	27.06	62.57	*P. verrucosa*	0.56	0.94	24.41	51.26
P. verrucosa	0.67	0.56	16.06	78.64	*P. damicornis*	1.57	1.63	14.07	65.33
P. panamensis	0.87	0.42	13.69	92.33	*P. panamensis*	0.42	0.67	13.33	78.67
					P. gigantea	0.11	0.33	10.76	89.43
					P. capitata	0.18	0.27	10.57	100
Faro de Bucerías									
Ave. Dis. = 61.70%	ET	LE			Ave. Dis. = 13.87%	ER	MC		
P. panamensis	0.44	1.25	42.56	42.56	*P. panamensis*	0.98	0.99	100	100
P. verrucosa	0.66	0.22	35.22	77.78					
P. gigantea	0	0.41	12.63	90.41					
Caleta de Campos									
Ave. Dis. = 35.92%	IPO	IP			Ave. Dis. = 11.16%	BH	IP		
P. panamensis	1.53	1.04	42.26	42.26	*P. panamensis*	1.32	1.04	100	100
P. capitata	0.55	0	26.43	68.68					
P. damicornis	0.36	0	17.31	85.99					
P. verrucosa	0.29	0	14.01	100					

Table S6. – Coverages (%) of the morphofunctional groups per site. Codes by sites: PRO (Punta Rocosa); CSN (Caleta Sin Nombre); LMI (Las Monas Interno); LME (Las Monas Externo); CFS (Costa Fragata Somero); CFP (Costa Fragata Profundo); BRA (Bahía Rabijuncos); EPE (Ensenada de Pescadores); POC (Pocitas); PA (Playa del Amor); PP (Plataforma *Pavonas*); TAM (Túnel Amarradero); ZR (Zona de Restauración); ZRS (Zona de Restauración Sur); CDM (Cueva del Muerto); P (Pelícanos); Lpj (La Pajarera); Lpa (La Palma); EEL (El Elefante); EC (Ensenada Cocinas); IC (Isla Cocinas); TE (Tenacatita); LV (La Virgencita); CU (Cuastecomatito); LMO (Las Monjas 1); LMT (Las Monjas 2); CRZ (Carrizales); PM (Paraíso Montemar); LR (L´Recif); EE (Elefante); PB (Punto B); LB (La Boquita); IPE (Isla Pájaros Este); BH (Barco Hundido), IPO (Isla Pájaro Oeste); IP (Isla Protegida); ER (El Relis); EF (El Faro); LE (La Ensenada); ET (El Teolan); and MC (Manto Carrizo). Codes by morphofunctional groups: LCC, Live coral cover; DSC, Soft coral; HC, Hydrocoral; RSC, Sponge; TUC, Turf; ACA, Articulate algae; CCA, Crustose calcareus algae; FMA, Fleshy macroalgae; RU, Rubble; DCC, Death coral; RO, Rock; SS, Sand; BAC, Barnacles.

	LCC	DSC	HC	RSC	TUC	ACA	CCA	FMA	RU	DCC	RO	SS	BAC
PRO	11.9	0.6	1.4	1.0	50.9		7.1	0.5	0.8	0.1	16.9	8.8	
CSN	11.5		0.7	0.1	48.4		6.3	4.3	0.6		9.5	18.7	
LMI	8.4	0.4	2.5	1.7	48.7		1.8	0.3	0.2	0.3	30.4	5.2	
LME	2.7	0.1	3.1	1.7	44.3		2.4	0.3	0.6		29.9	14.9	
CFS	21.9		0.7	0.2	52.7		6.9	14.9	2.0	0.1		0.6	
CFP	0.3			0.5	58.3		0.1	2.5			25.0	13.2	
BRA	11.6	0.1	0.2	0.5	60.9	0.1	5.4	14.1	0.1		3.5	3.5	
EPE	23.5			0.1	39.5		0.6	0.4	2.5	0.5	19.1	13.8	
POC	4.2		0.4	0.7	59.4		1.3	0.3	0.1	0.1	16.2	17.2	
PA	7.5		0.7	0.5	18.8	0.4	6.4	0.1	0.4	0.3	61.0	3.9	
PP	16.0	0.5	3.2	4.6	50.6		5.9		3.0	0.8	3.9	11.5	
TAM	5.8	0.5	0.8	0.6	45.5		3.7	0.4	2.4	1.1	16.2	23.0	
ZR	10.2		0.4	0.2	18.6		7.7	7.0	1.2	0.4	48.4	5.7	
ZRS	26.4				20.1		3.5	8.0	4.7	0.2	35.2	2.0	
CDM	13.3		0.6	0.4	55.6		7.8	3.6	3.2	0.9	6.6	8.1	
P	24.2					0.1	0.2	0.8	23.6	11.5	33.4	6.2	
LPj	8.5	0.3				1.2	0.7	12.8		0.1	74.1	2.5	
Lpa	49.9		0.1	0.7	14.3	2.1	2.7	15.6	4.7		7.3	2.5	
EEL	3.5	0.5	0.6	1.4	33.7	4.8	16.0	9.3	2.5		13.5	14.3	
EC	2.7	0.7	2.2	1.9	46.9	0.7	17.7	4.1	0.9		2.8	0.7	18.9
IC	3.9	0.7				0.1		0.4	0.0		76.8	18.1	
TE	67.9				7.1	0.9	0.7	7.5	10.9		0.0	4.9	
LV	22.9				24.3	3.0	10.8	33.1	2.0		0.8	3.1	
CU	47.7				35.2	2.8	3.1	7.0	2.2		0.5	1.3	
LMO	53.3			0.1	19.3	1.8	8.0	13.9	1.5		1.2	0.9	
LMT	2.9	0.1	1.3	1.7	59.4		17.2	2.6	1.4		7.1	6.3	
CRZ	53.0			0.2	10.4	2.1	3.3	25.3	1.6		0.1	3.9	
PM	2.9	0.1	0.8	2.7	59.1	10.9	11.0	1.9	1.7		4.3	4.7	
LR	4.0	0.3	1.6	1.3	57.9	0.4	26.2				3.6	4.7	
EE	0.7	0.1	2.0	1.1	18.3	7.6	1.4	57.0	2.9		3.6	5.5	
PB	11.6		0.3	4.3	39.9	9.1	7.7	14.2	7.5		2.1	3.3	
LB	15.7			1.6	9.4	1.1	0.4	61.7	1.4		1.4	7.3	
IPE	12.5				50.1	0.7	12.6	6.6	3.3		4.6	9.7	
BH	3.3	0.3			66.3		21.3	1.3			0.7	6.9	
IPO	8.5	0.1	0.5		23.0	2.4	14.5	9.3	2.5		25.6	13.6	
IP	0.8	1.5	0.1	1.5	62.2		7.3	3.0			3.3	20.2	
ER	1.2	4.4	1.1	0.4	19.0	0.2	3.0	14.0	0.3		41.5	14.9	
EF	3.9				34.7	0.9	15.5	35.4	0.1		5.1	4.4	
LE	3.7	0.1		0.1		3.5	1.5	61.7			24.7	4.7	
ET	1.2	3.9	0.5	1.9	56.3		12.0	6.3			8.5	9.3	
MC	1.3			0.5	21.9	3.2	10.5	38.1			1.2	23.3	