

Supplementary material

Distinct species hidden in the widely distributed coral *Coelastrea aspera* (Cnidaria, Anthozoa, Scleractinia)

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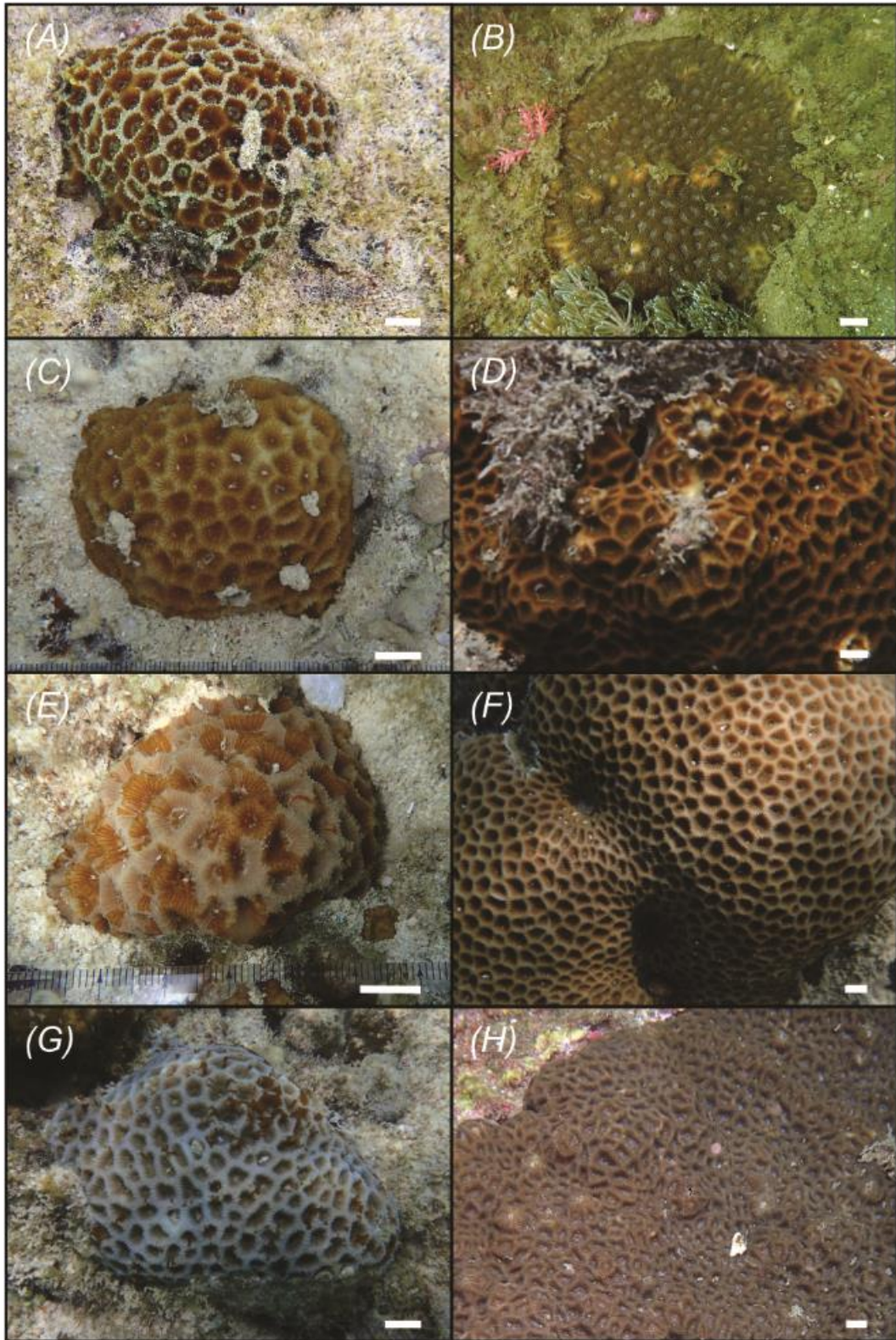


Fig. S1. *In situ* images of *Coelastrea aspera* (left column) and *C. incrustans* comb. nov. (right column); (A) SS150 (Okinawa, Japan); (B) MO297 (Miyazaki, Japan); (C) SS106 (Okinawa, Japan); (D) OT57 (Kochi, Japan); (E) SS111 (Okinawa, Japan); (F) SS152 (Okinawa, Japan); (G) SS153 (Okinawa, Japan); (H) TWN44 (Bi-Tou, Taiwan). Scale bars: 10 mm.

Table S1. List of specimens used in this study

Species	Sample number	Catalog number	Site	Spawning type	Clade	Morphological	Accession number	
						analysis	MtCR	ITS
<i>C. aspera</i>	AO99	MUFS C389	Amami Oshima		CladeA	○	LC634112	LC634178
<i>C. aspera</i>	SS106	MUFS C390	Sesoko, Okinawa		CladeA	○	LC634113	LC634179
<i>C. aspera</i>	SS107	MUFS C391	Sesoko, Okinawa		CladeA	○	LC634114	LC634180
<i>C. aspera</i>	SS108	MUFS C392	Sesoko, Okinawa		CladeA			
<i>C. aspera</i>	SS110	MUFS C393	Sesoko, Okinawa		CladeA		LC634115	LC634181
<i>C. aspera</i>	SS111	MUFS C394	Sesoko, Okinawa		CladeA	○	LC634116	LC634182
<i>C. aspera</i>	SS113	MUFS C395	Sesoko, Okinawa		CladeA		LC634117	
<i>C. aspera</i>	SS115	MUFS C396	Sesoko, Okinawa		CladeA	○	LC634118	LC634183
<i>C. aspera</i>	SS116	MUFS C397	Sesoko, Okinawa		CladeA	○	LC634119	LC634184
<i>C. aspera</i>	SS119	MUFS C398	Sesoko, Okinawa		CladeA		LC634120	LC634185
<i>C. aspera</i>	SS126	MUFS C399	Sesoko, Okinawa		CladeA	○	LC634121	LC634186
<i>C. aspera</i>	SS127	MUFS C400	Sesoko, Okinawa	non-bundle	CladeA	○	LC634122	LC634187
<i>C. aspera</i>	SS128	MUFS C401	Sesoko, Okinawa		CladeA		LC634123	LC634188
<i>C. aspera</i>	SS129	MUFS C402	Sesoko, Okinawa		CladeA		LC634124	LC634189
<i>C. aspera</i>	SS130	MUFS C403	Sesoko, Okinawa		CladeA		LC634125	LC634190
<i>C. aspera</i>	SS131	MUFS C404	Sesoko, Okinawa		CladeA		LC634126	LC634191
<i>C. aspera</i>	SS132	MUFS C405	Sesoko, Okinawa	non-bundle	-			
<i>C. aspera</i>	SS134	MUFS C406	Sesoko, Okinawa		CladeA	○		LC634192
<i>C. aspera</i>	SS135	MUFS C407	Sesoko, Okinawa		CladeA	○	LC634127	LC634193
<i>C. aspera</i>	SS136	MUFS C408	Sesoko, Okinawa		CladeA	○	LC634128	LC634194
<i>C. aspera</i>	SS137	MUFS C409	Sesoko, Okinawa	non-bundle	CladeA	○	LC634129	LC634195
<i>C. aspera</i>	SS138	MUFS C410	Sesoko, Okinawa		CladeA	○	LC634130	LC634196
<i>C. aspera</i>	SS145	MUFS C411	Sesoko, Okinawa	non-bundle	CladeA	○	LC634131	LC634197
<i>C. aspera</i>	SS146	MUFS C412	Sesoko, Okinawa		CladeA		LC634132	LC634198

Species	Sample number	Catalog number	Site	Spawning type	Clade	Morphological	Accession number	
						analysis	MtCR	ITS
<i>C. aspera</i>	SS147	MUFS C413	Sesoko, Okinawa	non-bundle	CladeA		LC634133	LC634199
<i>C. aspera</i>	SS149	MUFS C414	Sesoko, Okinawa		CladeA	○	LC634134	LC634200
<i>C. aspera</i>	SS150	MUFS C415	Sesoko, Okinawa	non-bundle	CladeA	○	LC634135	LC634201
<i>C. aspera</i>	SS153	MUFS C416	Sesoko, Okinawa	non-bundle	CladeA		LC634136	LC634202
<i>C. aspera</i>	SS157	MUFS C417	Sesoko, Okinawa		CladeA		LC634137	LC634203
<i>C. aspera</i>	SS158	MUFS C418	Sesoko, Okinawa		CladeA	○	LC634138	LC634204
<i>C. aspera</i>	SS159	MUFS C419	Sesoko, Okinawa	non-bundle	CladeA	○	LC634139	LC634205
<i>C. aspera</i>	SS160	MUFS C420	Sesoko, Okinawa	non-bundle	CladeA	○	LC634140	LC634206
<i>C. aspera</i>	SS163	MUFS C421	Sesoko, Okinawa		CladeA	○	LC634141	LC634207
<i>C. incrustans</i>	AO48	MUFS C422	Amami Oshima		CladeB			LC634208
<i>C. incrustans</i>	C250	MUFS C423	Kushimoto, Wakayama		CladeB			LC634209
<i>C. incrustans</i>	D13	MUFS C424	Shirahama, Wakayama	bundle	-			
<i>C. incrustans</i>	D15	MUFS C425	Shirahama, Wakayama	bundle	-			
<i>C. incrustans</i>	D17	MUFS C426	Shirahama, Wakayama	bundle	CladeB			LC634210
<i>C. incrustans</i>	KKI022	MUFS C427	Kikai island		CladeB	○	LC634142	LC634211
<i>C. incrustans</i>	KKI047	MUFS C428	Kikai island		CladeB	○		LC634212
<i>C. incrustans</i>	KKI067	MUFS C429	Kikai island		CladeB	○	LC634143	LC634213
<i>C. incrustans</i>	KKI068	MUFS C430	Kikai island		CladeB	○	LC634144	
<i>C. incrustans</i>	KKI069	MUFS C431	Kikai island		CladeB		LC634145	LC634214
<i>C. incrustans</i>	KKI081	MUFS C432	Kikai island		CladeB	○	LC634146	
<i>C. incrustans</i>	KKI149	MUFS C433	Kikai island		CladeB		LC634147	
<i>C. incrustans</i>	MO290	MUFS C434	Oshima, Miyazaki		CladeB			LC634215
<i>C. incrustans</i>	MO291	MUFS C435	Oshima, Miyazaki		CladeB		LC634148	LC634216
<i>C. incrustans</i>	MO292	MUFS C436	Oshima, Miyazaki		CladeB		LC634149	LC634217
<i>C. incrustans</i>	MO293	MUFS C437	Oshima, Miyazaki		CladeB			LC634218

Species	Sample number	Catalog number	Site	Spawning type	Clade	Morphological analysis	Accession number	
							MtCR	ITS
<i>C. incrustans</i>	MO294	MUFS C438	Oshima, Miyazaki		CladeB		LC634150	LC634219
<i>C. incrustans</i>	MO297	MUFS C439			CladeB		LC634151	LC634220
<i>C. incrustans</i>	MO302	MUFS C440	Oshima, Miyazaki		CladeB	○	LC634152	
<i>C. incrustans</i>	MO303	MUFS C441	Oshima, Miyazaki		CladeB	○	LC634153	LC634221
<i>C. incrustans</i>	MO305	MUFS C442	Oshima, Miyazaki		CladeB		LC634154	LC634222
<i>C. incrustans</i>	MO306	MUFS C443	Oshima, Miyazaki		CladeB		LC634155	LC634223
<i>C. incrustans</i>	MO318	MUFS C444	Oshima, Miyazaki		CladeB		LC634156	
<i>C. incrustans</i>	MO376	MUFS C445	Oshima, Miyazaki		CladeB			LC634224
<i>C. incrustans</i>	MO377	MUFS C446	Oshima, Miyazaki		CladeB			LC634225
<i>C. incrustans</i>	MO378	MUFS C447	Oshima, Miyazaki		CladeB	○		LC634226
<i>C. incrustans</i>	MO385	MUFS C448	Oshima, Miyazaki		CladeB	○		LC634227
<i>C. incrustans</i>	MO387	MUFS C449	Oshima, Miyazaki		CladeB			LC634228
<i>C. incrustans</i>	MO388	MUFS C450	Oshima, Miyazaki		CladeB			LC634229
<i>C. incrustans</i>	MO394	MUFS C451	Oshima, Miyazaki		CladeB			LC634230
<i>C. incrustans</i>	MO397	MUFS C452	Oshima, Miyazaki		CladeB			LC634231
<i>C. incrustans</i>	MO399	MUFS C453	Oshima, Miyazaki		CladeB			LC634232
<i>C. incrustans</i>	MO400	MUFS C454	Oshima, Miyazaki		CladeB			LC634233
<i>C. incrustans</i>	MO401	MUFS C455	Oshima, Miyazaki		CladeB	○	LC634157	
<i>C. incrustans</i>	MO454	MUFS C456	Oshima, Miyazaki		CladeB	○	LC634158	LC634234
<i>C. incrustans</i>	OT50	MUFS C457	Otsuki, Kochi		CladeB		LC634159	LC634235
<i>C. incrustans</i>	OT53	MUFS C458	Otsuki, Kochi		CladeB		LC634160	
<i>C. incrustans</i>	OT57	MUFS C459	Otsuki, Kochi		CladeB	○	LC634161	LC634236
<i>C. incrustans</i>	OT58	MUFS C460	Otsuki, Kochi		CladeB		LC634162	
<i>C. incrustans</i>	SS105	MUFS C461	Sesoko, Okinawa		CladeB			LC634237
<i>C. incrustans</i>	SS117	MUFS C462	Sesoko, Okinawa		CladeB		LC634163	LC634238

Species	Sample number	Catalog number	Site	Spawning type	Clade	Morphological analysis	Accession number	
							MtCR	ITS
<i>C. incrustans</i>	SS118	MUFS C463	Sesoko, Okinawa		CladeB	○	LC634164	LC634239
<i>C. incrustans</i>	SS139	MUFS C464	Sesoko, Okinawa	bundle	CladeB	○	LC634165	LC634240
<i>C. incrustans</i>	SS140	MUFS C465	Sesoko, Okinawa	bundle	CladeB	○	LC634166	LC634241
<i>C. incrustans</i>	SS141	MUFS C466	Sesoko, Okinawa	bundle	CladeB		LC634167	LC634242
<i>C. incrustans</i>	SS144	MUFS C467	Sesoko, Okinawa	bundle	CladeB	○	LC634168	LC634243
<i>C. incrustans</i>	SS152	MUFS C468	Sesoko, Okinawa	bundle	CladeB	○		LC634244
<i>C. incrustans</i>	SS154	MUFS C469	Sesoko, Okinawa		CladeB			LC634245
<i>C. incrustans</i>	SS155	MUFS C470	Sesoko, Okinawa	bundle	CladeB		LC634169	LC634246
<i>C. incrustans</i>	SS156	MUFS C471	Sesoko, Okinawa		CladeB	○	LC634170	LC634247
<i>C. incrustans</i>	SS161	MUFS C472	Sesoko, Okinawa		CladeB		LC634171	LC634248
<i>C. incrustans</i>	SS162	MUFS C473	Sesoko, Okinawa		Clade B			LC634249
<i>C. incrustans</i>	TK4	MUFS C474	Takashima, Nagasaki		CladeB	○	LC634172	
<i>C. incrustans</i>	TK28	MUFS C475	Takashima, Nagasaki		CladeB			LC634250
<i>C. incrustans</i>	TK29	MUFS C476	Takashima, Nagasaki		CladeB			LC634251
<i>C. incrustans</i>	TK40	MUFS C477	Takashima, Nagasaki		CladeB	○		LC634252
<i>C. incrustans</i>	TWN23	-	Taiwan, Bi-Tou		CladeB			LC634253
<i>C. incrustans</i>	TWN43	-	Taiwan, Bi-Tou		CladeB		LC634173	
<i>C. incrustans</i>	TWN44	-	Taiwan, Bi-Tou		CladeB		LC634174	
<i>C. incrustans</i>	TWN57	-	Taiwan, Bi-Tou		CladeB		LC634175	
<i>C. incrustans</i>	TWN58	-	Taiwan, Bi-Tou		CladeB		LC634176	
<i>C. cf. aspera</i>	MO321	MUFS C478	Oshima, Miyazaki		CladeC	○	LC634177	LC634254

Table S2. Skeletal morphological characters of specimens in clades A (a), B (b), and C (c) of ‘*Coelastrea aspera*’

	Calice (mm)		Septal number				Number of septal lobes	Number of septal teeth	Total septal number ÷ circumference
	Long diameter	Short diameter	Long septa	Middle septa	Short septa	Total			
a) clade A (<i>n</i> = 20)									
maximum	10.79	8.42	17	15	24	48	17	6	2.33
minimum	6.69	4.24	7	1	14	29	7	3.8	1.38
average	8.59	5.87	12.12	9.16	19.47	40.75	12.29	4.96	1.78
standard deviation	0.90	0.91	2.07	2.97	2.02	4.04	2.26	0.52	0.15
b) clade B (<i>n</i> = 20)									
maximum	10.08	8.31	20	23	30	65	20	10.2	2.82
minimum	6.83	4.03	11	3	8	35	10	6.2	1.52
average	8.42	5.94	14.57	11.23	20.65	46.45	14.82	7.67	2.05
standard deviation	0.75	0.89	1.83	3.28	4.27	5.17	1.94	0.76	0.22
c) clade C (<i>n</i> = 1)									
maximum	9.97	7.13	18	8	22	45	25	4	1.75
minimum	8.36	6.1	16	5	12	36	18	3.2	1.41
average	9.20	6.81	17.20	6.20	16.20	39.6	19.80	3.76	1.57
standard deviation	0.64	0.37	0.75	0.98	3.49	3.2	2.64	0.29	0.13

Table S3. Skeletal morphological characters of the type specimens of ‘*Coelastrea aspera*’ and type species of *Coelastrea*

Species	Checked specimen	Number of calices	Calice (s.d.) (mm)			Septal number (s.d.)			Number of septal lobes (s.d.)	Number of septal teeth (s.d.)	Total septal number ÷ circumference (s.d.)
			Long diameter	Short diameter	Long septa	Middle septa	Short septa	Total			
<i>Goniastrea aspera</i> Verrill, 1866	USNM 402	3	8.18 (0.43)	5.11 (1.11)	11 (0)	10 (0)	21.0 (2.0)	42.0 (1.7)	14.7 (3.1)	4.1 (0.2)	1.99 (0.13)
<i>Goniastrea aspera</i> Verrill, 1866	USNM 403	3	9.62 (1.56)	7.77 (1.37)	11.7 (1.5)	9.0 (1.7)	19.7 (1.2)	40.3 (3.5)	16.0 (3.0)	3.9 (0.3)	1.49 (0.23)
<i>Goniastrea mantonae</i> Crossland, 1952	NHMUK 1934.5.14.404	3	9.27 (0.11)	7.03 (0.81)	23.0 (1.7)	9.0 (4.0)	19.0 (2.0)	51.0 (1.0)	29.0 (1.0)	9.7 (0.6)	1.98 (0.07)
<i>Goniastrea incrustans</i> Duncan, 1889	Pl. I, fig. 20 in Duncan (1889)	1	7.95	5.95	9	16	0	46	22	8.6	2.1
<i>Coelastrea tenuis</i> Verrill, 1866	YPM 476	3	6.57 (0.69)	4.40 (0.35)	7.7 (1.5)	15.0 (2.6)	13.3 (1.2)	36.0 (1.7)	13.0 (2.6)	2.9 (0.4)	1.03 (1.35)

Reference

Duncan, P. M. (1886). On the Madreporaria of the Mergui Archipelago collected for the Trustees of the Indian Museum, Calcutta by Dr John Anderson, F.R.S., Superintendent of the Museum. *Zoological Journal of the Linnean Society* **21**, 1–25. doi:10.1111/j.1096-3642.1886.tb00967.x