

**Table S1:** Primers used for each gene, targeted base pair (bp) length, annealing temperatures, and the attempted primer order based on amplification success rate.

Gene	Attempted Primer Order	Primer	Sequence (5' - 3')	bp target	Primer Pair	Annealing ° C / sec	Reference
COI mtDNA	1	COI1490 (FWD)	GGTCAACAAATCATAAAGATATTGG	1400	COI1490 COXR1	45/80	Folmer et al. 1994
		COXR1 (REV)	GCGACTACATAATAAGTRTCRTG				Cheng et al. 2013
	2	jpgLCO1490 (FWD)	TITCIACIA AYCAYAARG AYATTG	648	jpgLCO1490 jpgHC02198	45/45	Geller et al. 2013
		jpgHCO2198 (REV)	TAIACYTCIGGRTGICCRAARAACA				Geller et al. 2013
	3	mlCOlint (FWD)	GGWACWGGWTGAACWTWTAYCCYCC	313	mlCOlint jpgHC02198	45/45	Leray et al. 2013
28S rRNA	1	28F63mod (FWD)	ACCCGCTGAAYTTAAGCATATHANTMA	1050	28F63mod 28R1072	45/80	Medina et al. 2001
		28R1072 (REV)	GCTATCCTGAGGGAAACTTCGG				Medina et al. 2001
	2	28S-C2-fwd (FWD)	GAAAAGAAGCTTGRARAGAGAGT	450	28S-C2-fwd 28S-D2-rev	48/20	Chombard et al. 1998
		28S-D2-rev (REV)	TCCGTGTTTCAAGACGGG				Chombard et al. 1998
	3	28SMycF (FWD)	GAAGTGGGAAGAGCTCGAGCC	950	28SMycF 28R1072	45/70	In-house primer design

**Table S2:** Classification of the unique sponge barcoded morphologies (BM) identified based on taxonomy and 28S rRNA barcoding.

BM	COI	28S	Class	Order	Family	Species
BM_42	X	X	Demospongiae	Tetractinellida	Ancorinidae	Ancorinidae sp. 1
BM_44	X	X	Demospongiae	Tetractinellida	Ancorinidae	Ancorinidae sp. 3
BM_49*	X	X	Demospongiae	Dendroceratida	Darwinellidae	<i>Aplysilla rosea</i>
BM_25	X	X	Demospongiae	Haplosclerida	Chalinidae	Chalinidae sp. 1
BM_56	X	X	Demospongiae	Dendroceratida	Darwinellidae	<i>Chelonaplysilla</i> sp. 1
BM_58	X	X	Demospongiae	Chondrillida		Chondrillida sp. 1
BM_97	X	X	Demospongiae	Haplosclerida	Chalinidae	<i>Cladocroce burapha</i>
BM_50	X	X	Demospongiae	Dictyoceratida		Dictyoceratida sp. 1
BM_90	X	X	Demospongiae	Dictyoceratida	Dysideidae	<i>Dysidea</i> sp. 3
BM_78	X	X	Demospongiae	Suberitida	Halichondriidae	<i>Halichondria</i> sp. 1
BM_27	X	X	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i> sp. 1
BM_26	X	X	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i> sp. 24
BM_32	X	X	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i> sp. 4
BM_29	X	X	Demospongiae	Haplosclerida		Haplosclerida sp. 1
BM_30	X	X	Demospongiae	Haplosclerida		Haplosclerida sp. 2
BM_37	X	X	Demospongiae	Haplosclerida		Haplosclerida sp. 7
BM_38	X	X	Demospongiae	Haplosclerida		Haplosclerida sp. 8
BM_73	X	X	Demospongiae	Suberitida	Halichondriidae	<i>Hymeniacidon chloris</i>
BM_74	X	X	Demospongiae	Suberitida	Halichondriidae	<i>Hymeniacidon</i> sp. 2
BM_94	X	X	Demospongiae	Dictyoceratida	Irciniidae	<i>Ircinia</i> sp. 2
BM_109	X	X	Demospongiae	Poecilosclerida	Coelosphaeridae	<i>Lissodendoryx</i> sp. 2
BM_84	X	X	Homoscleromorpha	Homosclerophorida	Oscarellidae	<i>Oscarella</i> sp. 3
BM_86	X	X	Homoscleromorpha	Homosclerophorida	Oscarellidae	<i>Oscarella</i> sp. 5
BM_104	X	X	Homoscleromorpha	Homosclerophorida	Oscarellidae	<i>Oscarella</i> sp. 6
BM_87*	X	X	Homoscleromorpha	Homosclerophorida	Plakinidae	<i>Plakina</i> sp. 1
BM_88*	X	X	Homoscleromorpha	Homosclerophorida	Plakinidae	<i>Plakortis</i> sp. 1
BM_66	X	X	Demospongiae	Poecilosclerida		Poecilosclerida sp. 1
BM_69	X	X	Demospongiae	Suberitida	Suberitidae	<i>Protosuberites</i> sp. 2
BM_70	X	X	Demospongiae	Suberitida	Suberitidae	<i>Protosuberites</i> sp. 3
BM_80	X	X	Demospongiae	Suberitida	Suberitidae	<i>Terpios</i> sp. 1
BM_51	X	X	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i> sp. 2
BM_52	X	X	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i> sp. 3
BM_53	X	X	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i> sp. 4
BM_54	X	X	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i> sp. 5
BM_55	X	X	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i> sp. 6
BM_93	X	X	Demospongiae	Tethyida	Tethyidae	Tethyidae sp. 1
BM_89	X	X	Demospongiae			Verongimorpha sp. 1
BM_65	X	X	Demospongiae	Poecilosclerida	Tedanidae	<i>Tedania cf. klausi</i>
BM_85		X	Homoscleromorpha	Homosclerophorida	Oscarellidae	<i>Oscarella</i> sp. 4
BM_57		X	Demospongiae	Dictyoceratida	Dysideidae	<i>Dysidea</i> sp. 5
BM_28		X	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i> sp. 2
BM_41		X	Demospongiae	Haplosclerida		Haplosclerida sp. 10
BM_111		X	Demospongiae	Haplosclerida		Haplosclerida sp. 13
BM_103		X	Demospongiae			Heteroscleromorpha sp. 1
BM_77		X	Demospongiae	Suberitida	Halichondriidae	<i>Hymeniacidon</i> sp. 5
BM_60		X	Demospongiae	Poecilosclerida	Mycalidae	<i>Mycale</i> sp. 10
BM_59		X	Demospongiae	Poecilosclerida	Mycalidae	<i>Mycale</i> sp. 9
BM_67		X	Demospongiae	Poecilosclerida		Poecilosclerida sp. 2
BM_101		X	Demospongiae	Poecilosclerida		Poecilosclerida sp. 4
BM_62		X	Demospongiae	Poecilosclerida		Poecilosclerida sp. 7
BM_68		X	Demospongiae	Suberitida	Suberitidae	<i>Protosuberites</i> sp. 1
BM_43		X	Demospongiae	Tetractinellida		Tetractinellida sp. 2
BM_46		X	Demospongiae	Tetractinellida		Tetractinellida sp. 5
BM_48		X	Demospongiae	Tetractinellida		Tetractinellida sp. 7
BM_15		X	Calcarea	Leucosolenida		Leucosolenida sp. 1
BM_14		X	Calcarea	Leucosolenida		Leucosolenida sp. 10
BM_1		X	Calcarea	Leucosolenida		Leucosolenida sp. 11
BM_2		X	Calcarea	Leucosolenida		Leucosolenida sp. 13
BM_98		X	Calcarea	Leucosolenida		Leucosolenida sp. 18
BM_17		X	Calcarea	Leucosolenida		Leucosolenida sp. 3
BM_19		X	Calcarea	Leucosolenida		Leucosolenida sp. 5
BM_21		X	Calcarea	Leucosolenida		Leucosolenida sp. 7
BM_91		X	Calcarea	Leucosolenida		Leucosolenida sp. 9
BM_23		X	Calcarea	Clathrinida		Clathrinida sp. 1
BM_7		X	Calcarea	Clathrinida	Clathrinidae	Clathrinidae sp. 1
BM_8		X	Calcarea	Clathrinida	Clathrinidae	Clathrinidae sp. 2
BM_9		X	Calcarea	Clathrinida	Clathrinidae	Clathrinidae sp. 3
BM_10		X	Calcarea	Clathrinida	Clathrinidae	Clathrinidae sp. 4
BM_11		X	Calcarea	Clathrinida	Clathrinidae	Clathrinidae sp. 5

\*The spicules from these sponges were examined in an attempt to obtain a species name from sponges previously encountered in Kāneʻohe Bay.

**Table S3:** Classification of the unique molecular operational taxonomic units (MOTUs) identified from COI metabarcoding. In the Method column, Hawai'i and Biocode are BLASTn approaches on local databases and Tree is based on positioning in Figure 1.

MOTU	Raw Reads	% ID	% Cover	Method	Class	Order	Family	Genus
MOTU_2	84023	100	100	Hawaii	Demospongiae	Suberitida	Suberitidae	<i>Protosuberites</i>
MOTU_6	65735	99.7	100	Hawaii	Homosclerophorida	Homosclerophorida	Plakinidae	<i>Plakortis</i>
MOTU_21	29027	94.8	100	INSECT (1)	Demospongiae	Biemnida	Biemnidae	
MOTU_45	17515	97.8	100	Hawaii	Demospongiae	Suberitida	Suberitidae	<i>Protosuberites</i>
MOTU_49	8939	98.4	100	Hawaii	Demospongiae	Dendroceratida	Darwinellidae	<i>Chelonaplysilla</i>
MOTU_111	8934	99.7	100	Hawaii	Demospongiae	Suberitida	Halichondridae	<i>Hymeniacion</i>
MOTU_58	7458			INSECT (1)	Homoscleromorpha	Homosclerophorida	Oscarellidae	
MOTU_132	5473	100	99	Hawaii	Demospongiae	Dendroceratida	Darwinellidae	
MOTU_128	4065	94.8	100	Biocode	Demospongiae	Dictyoceratida		
MOTU_145	3702	98.7	100	Hawaii	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i>
MOTU_161	3671	100	100	Hawaii	Demospongiae	Suberitida	Halichondridae	<i>Hymeniacion</i>
MOTU_88	3627	100	89	Hawaii	Homoscleromorpha	Homosclerophorida	Oscarellidae	
MOTU_92	2985	92.6	99	Hawaii	Demospongiae	Suberitida		
MOTU_196	2210	89.9	99	Tree	Demospongiae	Suberitida		
MOTU_142	1500	95.8	100	Hawaii	Demospongiae	Suberitida		
MOTU_168	1104	95.5	99	Hawaii	Demospongiae	Suberitida		
MOTU_147	1099	98.7	100	Biocode	Demospongiae	Dendroceratida	Darwinellidae	<i>Chelonaplysilla</i>
MOTU_222	776	93.9	100	Hawaii	Demospongiae	Suberitida		
MOTU_195	685	100	100	Hawaii	Demospongiae	Suberitida	Halichondridae	<i>Halichondria</i>
MOTU_514	544	98.7	99	Hawaii	Demospongiae	Suberitida	Suberitidae	
MOTU_217	502	100	100	Hawaii	Homoscleromorpha	Homosclerophorida	Oscarellidae	<i>Oscarella</i>
MOTU_213	485	99.7	100	Hawaii	Homosclerophorida	Homosclerophorida	Plakinidae	<i>Plakina</i>
MOTU_306	257	100	100	Hawaii	Demospongiae	Poecilosclerida	Tedaniidae	<i>Tedania</i>
MOTU_274	238	100	100	ecotag(0.98)	Demospongiae	Biemnida	Biemnidae	
MOTU_304	212	90.8	97	Tree	Demospongiae	Dendroceratida		
MOTU_324	209			ecotag (0.99)	Demospongiae	Suberitida	Halichondridae	<i>Halichondria</i>
MOTU_346	189	100	100	Tree	Demospongiae	Chondrillida		
MOTU_354	169	100	100	Hawaii	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i>
MOTU_310	144			ecotag (0.98)	Demospongiae	Poecilosclerida	Chondropsidae	
MOTU_1973	114	100	99	Biocode	Demospongiae	Suberitida	Suberitidae	
MOTU_524	83	99.7	100	Hawaii	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i>
MOTU_449	79	92.6	100	Biocode	Demospongiae	Poecilosclerida		
MOTU_445	77	100	100	Hawaii	Demospongiae	Haplosclerida	Chalinidae	
MOTU_454	57	98.7	100	Hawaii	Demospongiae	Poecilosclerida		
MOTU_506	49	100	100	Hawaii	Demospongiae	Tethyida	Tethyidae	<i>Tethya</i>
MOTU_591	41	99	98	Hawaii	Demospongiae	Poecilosclerida	Coelosphaeridae	
MOTU_602	41			INSECT (1)	Demospongiae	Poecilosclerida		
MOTU_722	37	100	100	Hawaii	Demospongiae	Haplosclerida	Chalinidae	<i>Haliclona</i>
MOTU_1125	14	90.5	98	Tree	Demospongiae	Dictyoceratida		
MOTU_907	13	99	100	Hawaii	Demospongiae	Tethyida	Tethyidae	
MOTU_223	4	100	100	Hawaii	Demospongiae	Suberitida	Suberitidae	<i>Terpios</i>