

UNESCO environmental DNA (eDNA) Expeditions in marine World Heritage sites

Biodiversity survey for Coiba National Park and its Special Zone of Marine Protection

Interim Results
Not for public distribution



Credit: Coiba Scientific Station (COIBA AIP).

About eDNA Expeditions

UNESCO's eDNA Expeditions is a global, citizen science initiative that is conducted with the intention to measure marine biodiversity and predict the impact climate change on marine community composition across UNESCO World Heritage marine sites.

eDNA is a cost effective and minimally invasive method to measure biodiversity in any given area. Marine species continuously shed DNA into the water around them in the form of waste, mucus, or cells. By extracting this DNA from water samples, and subsequently multiplying and sequencing specific regions within these DNA strands, a wide variety of species can be detected without removing any organisms from their environment. The regions in the DNA targeted for sequencing are selected depending on the scope of the study: while some markers are suitable to obtain a broad overview of biodiversity across many groups of species, other markers are particularly suited to get high resolution insight for a more specific taxonomic group such as fish. The UNESCO eDNA Expeditions initiative combines a number of markers tailored for marine vertebrates (fish, mammals, and turtles). A general marker was added to also allow detection of species from other groups such as invertebrates, which can give a broader insight in the marine species diversity in a given area.

Between September 2022 and May 2023, UNESCO organized eDNA sampling campaigns in 21 marine World Heritage sites across 17 countries around the world. At every World Heritage site, about 20 samples were collected from different habitats. Over 250 young people participated in the local sampling expeditions. They were guided by local experts and park management staff, using protocols and eDNA sampling equipment provided by UNESCO.

Biodiversity inventories generated from the samples are being combined with existing species distribution data from public biodiversity databases such as the Ocean Biodiversity Information System (OBIS) in view of obtaining a comprehensive overview of marine life across marine World Heritage sites. Through the use of climate scenarios and species distribution models, an estimate will be made of the impact of climate change, in particular rising temperatures, on local biodiversity and its potential future distribution patterns.

More information about the initiative and a press kit are available on the UNESCO website: <https://www.unesco.org/en/edna-expeditions>.

Results

Sampling and sample processing

eDNA sampling was conducted in Coiba National Park and its Special Zone of Marine Protection in July to September 2023. A total of 21 samples were collected at 6 locations in the park covering different habitats: canales_de_afuero, granito_de_oro, isla_tortuga, oceanica, rio_san_juan, and tres_islas (Figure 1). Up to 1,800 mL of seawater was filtered through filter cartridges containing a filter with a 0.8 µm pore size. After sampling, the filter cartridges were flushed with preservation liquid and shipped to UNESCO. DNA from the samples was extracted and amplified, and subsequently sent to the sequencing facility at KU Leuven in Belgium, a specialized university eDNA lab contracted by UNESCO for this work. PCR amplification was done using five primer pairs selected to capture as much biodiversity as possible in the target groups of the study: fish, mammals, and turtles.

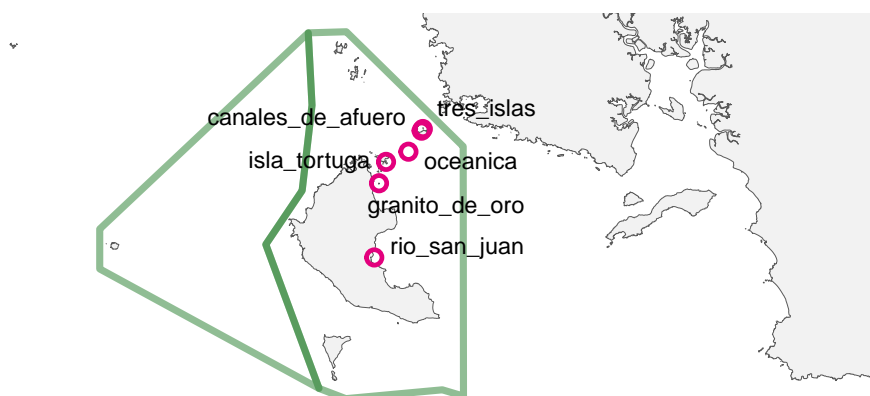


Figure 1: Map of the sampling locations.

DNA sequencing

Sequencing of the DNA from 21 samples resulted in over 32 million sequence reads, from which we collected 31,057 unique sequences or ASVs (Tables 1 and 2).

reads	asvs
32944557	31057

Table 1: Reads, ASVs, and species across all samples.

Species identification

The marker sequences obtained from sequencing were matched with sequence reference databases built using public data available from the National Center for Biotechnology Information (NCBI). This resulted in the identification of 492 species, including 236 fish species, 1 mammalian species, and 1 turtle species (Table 3). Species from other groups, such as algae, cnidarians, molluscs, crustaceans, and echinoderms, were also detected (Figures 2 and 3). This number of species detected represents about 37% of the 1,625 species known from Coiba National Park and its Special Zone of Marine Protection in the OBIS database. Of the 492 species detected, 306 are not among the species previously reported from Coiba National Park and its Special Zone of Marine Protection to the UNESCO OBIS database. 15 of the detected species are listed as threatened on the IUCN Red List (Table 4). A full list of species is added at the end of this report.



locality	materialSampleID	sampleSize	reads	asvs	species
Canales de afuero	EE0160	1800	2083026	5707	110
Canales de afuero	EE0238	1800	1644498	8980	90
Canales de afuero	EE0244	1500	1422745	10700	197
Canales de afuero	EE0250	1500	1769618	9736	161
Granito de oro	EE0242	600	1834823	10960	213
Granito de oro	EE0246	1500	1679898	10628	190
Granito de oro	EE0248	1560	1662754	9291	96
Granito de oro	EE0249	1500	2018063	11244	200
Isla tortuga	EE0207	1500	1452893	1208	57
Isla tortuga	EE0208	1380	935017	7078	148
Isla tortuga	EE0245	1500	1290116	6040	137
Isla tortuga	EE0247	1500	1531985	9379	169
Oceanica	EE0237	1500	1309084	8507	90
Oceanica	EE0240	1500	1142154	8535	106
Oceanica	EE0254	1500	830490	6624	48
Oceanica	EE0255	720	872720	5992	44
Rio San Juan	EE0192	1500	1546095	4904	50
Rio San Juan	EE0209	1500	1481781	1371	59
Rio San Juan	EE0241	1500	3098907	902	19
Rio San Juan	EE0243	1500	1441421	6095	93
Tres Islas	EE0239	1440	1896469	9433	139

Table 2: Reads, ASVs, and species by sample.

group	eDNA species	total species	fraction
fish	236	630	0.37
mammals	1	8	0.12
turtles	1	3	0.33

Table 3: Number of species in the three target groups, from the OBIS database and from eDNA sampling.

category	eDNA species	total species	fraction
CR	2	5	0.40
EN	4	8	0.50
VU	9	31	0.29

Table 4: Number of species by IUCN Red List category, from the OBIS database and from eDNA sampling.

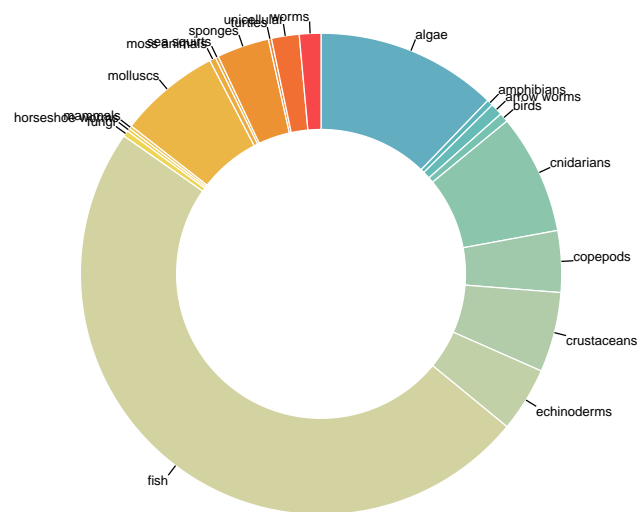


Figure 3: Distribution of detected species across groups.

phylum	class	species	group	category	new	vernacular
Amoebozoa	Discosea	Neoparamoeba aestuarina	unicellular		yes	
Amoebozoa	Myxogastrea	Craterium leucocephalum	unicellular		yes	
Annelida	Polychaeta	Lphione henshawi	worms		yes	
Annelida	Polychaeta	Notopygos ornata	worms			
Annelida	Polychaeta	Odontosyllis phosphorea	worms		yes	
Annelida	Polychaeta	Phyllochaetopterus verrilli	worms		yes	
Annelida	Polychaeta	Pseudonereis pseudonoodti	worms		yes	
Annelida		Phascolosoma (Phascolosoma) perlucens	worms		yes	
Annelida		Sipunculus (Sipunculus) nudus	worms		yes	
Arthropoda	Branchiopoda	Penilia avirostris	crustaceans		yes	
Arthropoda	Branchiopoda	Pseudevadne tergestina	crustaceans		yes	
Arthropoda	Copepoda	Acartia (Acartia) negligens	copepods		yes	
Arthropoda	Copepoda	Acrocalanus gracilis	copepods		yes	
Arthropoda	Copepoda	Bestiolina similis	copepods		yes	
Arthropoda	Copepoda	Calanopia minor	copepods		yes	
Arthropoda	Copepoda	Calocalanus minutus	copepods		yes	
Arthropoda	Copepoda	Calocalanus pavo	copepods		yes	
Arthropoda	Copepoda	Calocalanus plumulosus	copepods		yes	
Arthropoda	Copepoda	Candacia curta	copepods		yes	
Arthropoda	Copepoda	Centropages furcatus	copepods		yes	
Arthropoda	Copepoda	Clausocalanus furcatus	copepods		yes	
Arthropoda	Copepoda	Copilia mirabilis	copepods		yes	
Arthropoda	Copepoda	Farranula gibbula	copepods		yes	
Arthropoda	Copepoda	Labidocera acuta	copepods		yes	
Arthropoda	Copepoda	Labidocera detruncata	copepods		yes	
Arthropoda	Copepoda	Macrosetella gracilis	copepods		yes	
Arthropoda	Copepoda	Oithona attenuata	copepods		yes	
Arthropoda	Copepoda	Paracalanus indicus	copepods		yes	
Arthropoda	Copepoda	Pontellina plumata	copepods		yes	
Arthropoda	Copepoda	Subeucalanus subcrassus	copepods		yes	
Arthropoda	Copepoda	Temora discaudata	copepods		yes	
Arthropoda	Hexapoda	Megaselia scalaris			yes	
Arthropoda	Malacostraca	Ala cornuta	crustaceans			
Arthropoda	Malacostraca	Alpheus paracrinitus	crustaceans		yes	smoothclaw snapping shrimp
Arthropoda	Malacostraca	Arenaeus mexicanus	crustaceans		yes	
Arthropoda	Malacostraca	Calcinus obscurus	crustaceans		yes	
Arthropoda	Malacostraca	Callinectes arcuatus	crustaceans			arched swimming crab
Arthropoda	Malacostraca	Clibanarius albidigitus	crustaceans		yes	
Arthropoda	Malacostraca	Clibanarius lineatus	crustaceans		yes	
Arthropoda	Malacostraca	Epixanthus tenuidactylos	crustaceans		yes	
Arthropoda	Malacostraca	Euphausia distinguenda	crustaceans		yes	
Arthropoda	Malacostraca	Euphausia eximia	crustaceans		yes	
Arthropoda	Malacostraca	Euphausia lamelligera	crustaceans		yes	
Arthropoda	Malacostraca	Goniopsis pulchra	crustaceans			
Arthropoda	Malacostraca	Mithraculus denticulatus	crustaceans			
Arthropoda	Malacostraca	Neosergestes edwardsii	crustaceans		yes	
Arthropoda	Malacostraca	Palaemonella holmesi	crustaceans			southern algae shrimp
Arthropoda	Malacostraca	Paractaea rufopunctata	crustaceans		yes	nodose rubble crab
Arthropoda	Malacostraca	Penaeus californiensis	crustaceans		yes	yellowleg shrimp
Arthropoda	Malacostraca	Petramithrax pygmaeus	crustaceans			

Continued on next page

phylum	class	species	group	category	new	vernacular
Arthropoda	Malacostraca	Plagusia squamosa	crustaceans		yes	scaly rock crab
Arthropoda	Malacostraca	Teleophrys cristulipes	crustaceans			
Arthropoda	Malacostraca	Trapezia bidentata	crustaceans			
Arthropoda	Thecostraca	Balanus trigonus	crustaceans		yes	
Arthropoda	Thecostraca	Chthamalus hedgecocki	crustaceans		yes	
Arthropoda	Thecostraca	Chthamalus panamensis	crustaceans		yes	
Ascomycota	Dothideomycetes	Cladosporium herbarum	fungi		yes	
Bacillariophyta	Bacillariophyceae	Bellerochea polymorpha	algae		yes	
Bacillariophyta	Bacillariophyceae	Chaetoceros socialis	algae		yes	
Bacillariophyta	Bacillariophyceae	Cylindrotheca closterium	algae		yes	
Bacillariophyta	Bacillariophyceae	Eucampia striata	algae		yes	
Bacillariophyta	Bacillariophyceae	Eucampia zodiacus	algae		yes	
Bacillariophyta	Bacillariophyceae	Helicotheca tamesis	algae		yes	
Bacillariophyta	Bacillariophyceae	Hemiaulus sinensis	algae		yes	
Bacillariophyta	Bacillariophyceae	Lithodesmioides polymorpha	algae		yes	
Bacillariophyta	Bacillariophyceae	Navicula minima	algae		yes	
Bacillariophyta	Bacillariophyceae	Pinnularia acrosphaeria	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia circumpora	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia cuspidata	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia multistriata	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia sabit	algae		yes	
Bacillariophyta	Bacillariophyceae	Skeletonema menzelii	algae		yes	
Bacillariophyta	Bacillariophyceae	Stephanopyxis turris	algae		yes	
Bacillariophyta	Bacillariophyceae	Sundstroemia setigera	algae		yes	
Bacillariophyta	Bacillariophyceae	Thalassionema nitzschioides	algae		yes	
Bacillariophyta	Bacillariophyceae	Triceratium intricatum	algae		yes	
Basidiomycota	Agaricomycetes	Schizophyllum commune			yes	
Bryozoa	Gymnolaemata	Amathia evelinae	moss animals		yes	
Bryozoa	Gymnolaemata	Celleporaria inaudita	moss animals		yes	
Chaetognatha	Sagittoidea	Aidanosagitta neglecta	arrow worms		yes	
Chaetognatha	Sagittoidea	Flaccisagitta enflata	arrow worms		yes	
Chaetognatha	Sagittoidea	Krohnitta subtilis	arrow worms		yes	
Chaetognatha	Sagittoidea	Zonosagitta pulchra	arrow worms		yes	
Chlorarachniophyta	Chlorarachniophyceae	Bigelowiella natans			yes	
Chlorarachniophyta	Chlorarachniophyceae	Chlorarachnion reptans			yes	
Chlorophyta	Chlorocophyceae	Chloroparvula pacifica	algae		yes	
Chlorophyta	Mamiellophyceae	Bathycoccus prasinos	algae		yes	
Chlorophyta	Mamiellophyceae	Dolichomastix tenuilepis	algae		yes	
Chlorophyta	Mamiellophyceae	Micromonas commoda	algae		yes	
Chlorophyta	Mamiellophyceae	Micromonas pusilla	algae		yes	
Chlorophyta	Pyramimonadophyceae	Pseudoscofieldia marina	algae		yes	
Chlorophyta	Pyramimonadophyceae	Pycnococcus provasolii	algae		yes	
Chlorophyta	Ulvophyceae	Oltmannsiellopsis viridis	algae		yes	
Chlorophyta		Chloropicon laureae	algae		yes	
Chlorophyta		Chloropicon primus	algae		yes	
Chlorophyta		Chloropicon roscoffensis	algae		yes	
Chlorophyta		Chloropicon sieburthii	algae		yes	
Chordata	Amphibia	Rhinella horribilis	amphibians		yes	
Chordata	Amphibia	Rhinella marina	amphibians	LC		cane toad
Chordata	Ascidacea	Botrylloides niger	sea squirts		yes	Black synascidia , Synascidie noire

Continued on next page

phylum	class	species	group	category	new	vernacular
Chordata	Aves	Columba livia	birds	LC	yes	
Chordata	Aves	Meleagris gallopavo	birds	LC	yes	
Chordata	Aves	Pelecanus occidentalis	birds	LC		brown pelican, pélican brun
Chordata	Elasmobranchii	Aetobatus narinari	fish	EN	yes	spotted eagle ray
Chordata	Elasmobranchii	Alopias pelagicus	fish	EN	yes	thresher shark, renard pélagique
Chordata	Elasmobranchii	Carcharhinus leucas	fish	VU		bull shark, requin-bouledogue
Chordata	Elasmobranchii	Carcharhinus limbatus	fish	VU		blacktip shark
Chordata	Elasmobranchii	Hypanus americanus	fish	NT	yes	
Chordata	Elasmobranchii	Hypanus longus	fish	VU		
Chordata	Elasmobranchii	Mobula birostris	fish	EN	yes	
Chordata	Elasmobranchii	Mobula munkiana	fish	VU	yes	pygmy devil ray
Chordata	Elasmobranchii	Mobula thurstoni	fish	EN		smoothtail mobula
Chordata	Elasmobranchii	Trienodon obesus	fish	VU		whitetip reef shark
Chordata	Leptocardii	Branchiostoma lanceolatum			yes	lancelet, amphioxus
Chordata	Mammalia	Tursiops truncatus	mammals	LC		bottlenose dolphin, grand dauphin
Chordata	Teleostei	Abantennarius coccineus	fish	LC		
Chordata	Teleostei	Abantennarius sanguineus	fish			
Chordata	Teleostei	Ablennes hians	fish	LC		flat needlefish
Chordata	Teleostei	Abudefduf saxatilis	fish	LC		sergeant major
Chordata	Teleostei	Abudefduf taurus	fish	LC	yes	night sergeant
Chordata	Teleostei	Abudefduf troschelii	fish	LC		Panamic sergeant major
Chordata	Teleostei	Acanthocybium solandri	fish	LC		wahoo
Chordata	Teleostei	Acanthurus triostegus	fish	LC		convict surgeonfish
Chordata	Teleostei	Acanthurus xanthopterus	fish	LC		yellowfin surgeonfish
Chordata	Teleostei	Alectis ciliaris	fish	LC		African pompano
Chordata	Teleostei	Aluterus scriptus	fish	LC		scrawled filefish
Chordata	Teleostei	Anchoa hepsetus	fish	LC	yes	striped anchovy
Chordata	Teleostei	Anchoa ischana	fish	LC	yes	sharpnose anchovy
Chordata	Teleostei	Anchoa mundeoloides	fish	LC	yes	northern Gulf anchovy
Chordata	Teleostei	Anchoa nasus	fish	LC	yes	bignose anchovy
Chordata	Teleostei	Anchovia macrolepidota	fish	LC		bigscale anchovy
Chordata	Teleostei	Apogon binotatus	fish	LC	yes	barred cardinalfish
Chordata	Teleostei	Apogon pacificus	fish	LC		pink cardinalfish
Chordata	Teleostei	Arothron hispidus	fish	LC		bristly puffer
Chordata	Teleostei	Arothron meleagris	fish	LC		Guineafowl puffer
Chordata	Teleostei	Atule mate	fish	LC	yes	yellowtail scad
Chordata	Teleostei	Auxis rochei	fish	LC	yes	Bonito, bonite
Chordata	Teleostei	Auxis thazard	fish	LC	yes	frigate tuna, auxide
Chordata	Teleostei	Axoclinus lucillae	fish	LC		Panamic triplefin
Chordata	Teleostei	Azurina atrilobata	fish			
Chordata	Teleostei	Bagre panamensis	fish	LC	yes	chihuil
Chordata	Teleostei	Balistes polylepis	fish	LC		finescale triggerfish
Chordata	Teleostei	Bathygobius andrei	fish	LC		
Chordata	Teleostei	Bathygobius fuscus	fish	LC	yes	dusky frill-goby
Chordata	Teleostei	Bathygobius lineatus	fish	VU		
Chordata	Teleostei	Bathygobius ramosus	fish	LC		Panamic frillfin
Chordata	Teleostei	Benthoosema panamense	fish	LC		
Chordata	Teleostei	Benthoosema pterotum	fish	LC	yes	skinnycheek lanternfish
Chordata	Teleostei	Bodianus diplotaenia	fish	LC		Mexican hogfish
Chordata	Teleostei	Bregmaceros bathymaster	fish	LC		East Pacific codlet

Continued on next page

phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Bryx dunckeri	fish	LC	yes	pugnose pipefish
Chordata	Teleostei	Calamus penna	fish	LC	yes	sheepshead porgy
Chordata	Teleostei	Canthidermis maculata	fish	LC		rough triggerfish
Chordata	Teleostei	Canthigaster janthinoptera	fish	LC		spotted puffer
Chordata	Teleostei	Caranx caballus	fish	LC		green jack
Chordata	Teleostei	Caranx caninus	fish	LC		Pacific crevalle jack
Chordata	Teleostei	Caranx hippos	fish	LC	yes	common jack, carangue crevalle
Chordata	Teleostei	Caranx latus	fish	LC	yes	horse-eye jack
Chordata	Teleostei	Caranx melampygus	fish	LC		bluefin trevally
Chordata	Teleostei	Caranx sexfasciatus	fish	LC		bigeye trevally
Chordata	Teleostei	Centropomus armatus	fish	LC		longspine snook
Chordata	Teleostei	Centropomus medius	fish	LC		blackfin snook
Chordata	Teleostei	Centropomus nigrescens	fish	LC		black snook
Chordata	Teleostei	Cephalopholis cruentata	fish	LC	yes	graysby
Chordata	Teleostei	Cephalopholis panamensis	fish	LC		Panama graysby
Chordata	Teleostei	Cetengraulis mysticetus	fish	LC	yes	anchoveta
Chordata	Teleostei	Chaenomugil proboscideus	fish	LC		snouted mullet
Chordata	Teleostei	Chaenopsis celeste	fish		yes	
Chordata	Teleostei	Chaetodipterus faber	fish	LC	yes	Atlantic spadefish
Chordata	Teleostei	Chaetodon ocellatus	fish	LC	yes	spotfin butterflyfish
Chordata	Teleostei	Chanos chanos	fish	LC		milkfish, chano
Chordata	Teleostei	Cheilopogon spilonotopterus	fish		yes	stained flyingfish
Chordata	Teleostei	Chilara taylori	fish	LC	yes	spotted cusk-eel
Chordata	Teleostei	Chloroscombrus chrysurus	fish	LC	yes	Atlantic bumper
Chordata	Teleostei	Cirrhitichthys oxycephalus	fish	LC		pixy hawkfish
Chordata	Teleostei	Cirrhitus rivulatus	fish	LC		giant hawkfish
Chordata	Teleostei	Citharichthys gilberti	fish	LC		bigmouth sanddab
Chordata	Teleostei	Citharichthys sordidus	fish	LC	yes	Pacific sanddab, limande sordide
Chordata	Teleostei	Conodon serrifer	fish	LC	yes	armed grunt
Chordata	Teleostei	Coryphaena hippurus	fish	LC		common dolphinfish, corphène commune
Chordata	Teleostei	Coryphopterus urospilus	fish	LC		redlight goby
Chordata	Teleostei	Ctenogobius sagittula	fish	LC		longtail goby
Chordata	Teleostei	Cyclopsetta fimbriata	fish	LC	yes	spotfin flounder
Chordata	Teleostei	Decapterus macarellus	fish	LC		mackerel scad
Chordata	Teleostei	Deckertichthys aureolus	fish			
Chordata	Teleostei	Dialommus macrocephalus	fish	LC		four-eye rockskipper
Chordata	Teleostei	Diapterus auratus	fish	LC	yes	Irish mojarra
Chordata	Teleostei	Diapterus brevirostris	fish			
Chordata	Teleostei	Diodon holocanthus	fish	LC		balloonfish
Chordata	Teleostei	Diodon hystrix	fish	LC		spot-fin porcupinefish
Chordata	Teleostei	Echidna catenata	fish	LC	yes	chain moray
Chordata	Teleostei	Echidna nebulosa	fish	LC		snowflake moray
Chordata	Teleostei	Elacatinus puncticulatus	fish	LC		redhead goby
Chordata	Teleostei	Elagatis bipinnulata	fish	LC		rainbow runner
Chordata	Teleostei	Eleotris picta	fish	LC		spotted sleeper
Chordata	Teleostei	Elops saurus	fish	LC	yes	ladyfish
Chordata	Teleostei	Enchelycore nigricans	fish	LC	yes	viper moray
Chordata	Teleostei	Engraulis japonicus	fish	LC	yes	Japanese anchovy
Chordata	Teleostei	Engraulis mordax	fish	DD	yes	Californian anchovy, anchois du Pacifique
Chordata	Teleostei	Entomacrodus chiostictus	fish	LC		notchfin blenny

Continued on next page

phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Entomacrodus sealei	fish	LC	yes	
Chordata	Teleostei	Erotelis armiger	fish	DD		flathead sleeper
Chordata	Teleostei	Etropus crossotus	fish	LC	yes	fringed flounder
Chordata	Teleostei	Eucinostomus currani	fish	LC		Pacific flagfin mojarra
Chordata	Teleostei	Eucinostomus dowii	fish	LC	yes	Pacific spotfin mojarra
Chordata	Teleostei	Eucinostomus gracilis	fish	LC		graceful mojarra
Chordata	Teleostei	Eucinostomus gula	fish	LC	yes	Jenny mojarra
Chordata	Teleostei	Eucinostomus melanopterus	fish	LC	yes	flagfin mojarra
Chordata	Teleostei	Euleptorhamphus viridis	fish			ribbon halfbeak
Chordata	Teleostei	Euthynnus affinis	fish	LC	yes	kawakawa, thonine orientale
Chordata	Teleostei	Evorthodus minutus	fish	LC		small goby
Chordata	Teleostei	Fistularia commersonii	fish	LC		cornetfish
Chordata	Teleostei	Fodiator acutus	fish	LC		sharpchin flyingfish
Chordata	Teleostei	Gerres cinereus	fish	LC		yellowfin mojarra
Chordata	Teleostei	Gillellus greyae	fish	LC	yes	arrow stargazer
Chordata	Teleostei	Gnathanodon speciosus	fish	LC		golden trevally
Chordata	Teleostei	Gobiomorus maculatus	fish	LC	yes	Pacific sleeper
Chordata	Teleostei	Gobulus birdsongi	fish	CR	yes	
Chordata	Teleostei	Gymnomuraena zebra	fish	LC		zebra moray
Chordata	Teleostei	Gymnothorax buroensis	fish	LC		vagrant moray
Chordata	Teleostei	Gymnothorax castaneus	fish	LC		Panamic green moray
Chordata	Teleostei	Gymnothorax miliaris	fish	LC	yes	goldentail moray
Chordata	Teleostei	Gymnothorax undulatus	fish	LC		undulated moray
Chordata	Teleostei	Haemulon aurolineatum	fish	LC	yes	tomtate grunt
Chordata	Teleostei	Haemulon flaviguttatum	fish	LC		Cortez grunt
Chordata	Teleostei	Haemulon maculicauda	fish	LC		spottail grunt
Chordata	Teleostei	Haemulon plumierii	fish	LC	yes	grunt
Chordata	Teleostei	Haemulon sexfasciatum	fish	LC		graybar grunt
Chordata	Teleostei	Haemulopsis axillaris	fish	LC	yes	yellowstripe grunt
Chordata	Teleostei	Haemulopsis leuciscus	fish	LC		raucous grunt
Chordata	Teleostei	Haemulopsis nitidus	fish	LC		shining grunt
Chordata	Teleostei	Halichoeres adustus	fish	VU	yes	black wrasse
Chordata	Teleostei	Halichoeres chierchiae	fish	LC		wounded wrasse
Chordata	Teleostei	Halichoeres dispilus	fish	LC		chameleon wrasse
Chordata	Teleostei	Halichoeres garnoti	fish	LC	yes	yellowhead wrasse
Chordata	Teleostei	Halichoeres melanotis	fish	LC		golden wrasse
Chordata	Teleostei	Halichoeres nicholsi	fish	LC		spinster wrasse
Chordata	Teleostei	Halichoeres notospilus	fish	LC		banded wrasse
Chordata	Teleostei	Harengula humeralis	fish	LC	yes	pilchard
Chordata	Teleostei	Hemanthias signifer	fish	LC		hookthroat bass
Chordata	Teleostei	Hemiramphus balao	fish	LC	yes	balao
Chordata	Teleostei	Hemiramphus lutkei	fish		yes	Lutke's halbeak
Chordata	Teleostei	Holacanthus passer	fish	LC		king angelfish
Chordata	Teleostei	Holocentrus adscensionis	fish	LC	yes	squirrelfish
Chordata	Teleostei	Hoplopagrus guentherii	fish	LC		barred pargo
Chordata	Teleostei	Hyporhamphus unifasciatus	fish	LC	yes	common halfbeak
Chordata	Teleostei	Isopisthus remifer	fish	LC	yes	bigeye corvina
Chordata	Teleostei	Istiophorus platypterus	fish	VU		Indo-Pacific sailfish, voilier indo-pacifique
Chordata	Teleostei	Johnrandallia nigrirostris	fish	LC		barberfish
Chordata	Teleostei	Kyphosus elegans	fish	LC		Cortez sea chub

Continued on next page

phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Kyphosus ocyurus	fish			
Chordata	Teleostei	Kyphosus vaigiensis	fish	LC		brassy chub
Chordata	Teleostei	Larimus breviceps	fish	LC	yes	
Chordata	Teleostei	Larimus pacificus	fish	LC	yes	Pacific drum
Chordata	Teleostei	Lutjanus aratus	fish	LC		mullet snapper
Chordata	Teleostei	Lutjanus argentiventris	fish	LC		amarillo snapper
Chordata	Teleostei	Lutjanus campechanus	fish	VU	yes	northern red snapper
Chordata	Teleostei	Lutjanus colorado	fish	LC		colorado snapper
Chordata	Teleostei	Lutjanus fulvus	fish	LC	yes	blacktail snapper
Chordata	Teleostei	Lutjanus griseus	fish	LC	yes	grey snapper
Chordata	Teleostei	Lutjanus guttatus	fish	LC		spotted rose snapper
Chordata	Teleostei	Lutjanus novemfasciatus	fish	LC		Pacific dog snapper
Chordata	Teleostei	Malacoctenus ebisui	fish	LC		fishgod blenny
Chordata	Teleostei	Malacoctenus triangulatus	fish	LC	yes	saddled blenny
Chordata	Teleostei	Melichthys vidua	fish	LC	yes	pinktail triggerfish
Chordata	Teleostei	Microgobius brevispinis	fish	LC	yes	Balboa goby
Chordata	Teleostei	Microspathodon chrysurus	fish	LC	yes	yellowtail damselfish
Chordata	Teleostei	Microspathodon dorsalis	fish	LC		giant damselfish
Chordata	Teleostei	Mugil curema	fish	LC		silverside mullet
Chordata	Teleostei	Mulloidichthys martinicus	fish	LC	yes	yellow goatfish
Chordata	Teleostei	Mulloidichthys vanicolensis	fish	LC		yellowfin goatfish
Chordata	Teleostei	Muraena lentiginosa	fish	LC		jewel moray
Chordata	Teleostei	Myctophum nitidulum	fish	LC	yes	lanternfish
Chordata	Teleostei	Myripristis leiognathus	fish	LC		Panamic soldierfish
Chordata	Teleostei	Myrophis vafer	fish	LC		Pacific worm eel
Chordata	Teleostei	Nematistius pectoralis	fish			roosterfish
Chordata	Teleostei	Novaculichthys taeniourus	fish	LC		rockmover wrasse
Chordata	Teleostei	Ocyurus chrysurus	fish	DD	yes	yellowtail snapper
Chordata	Teleostei	Ogilbia cayorum	fish	LC	yes	key brotula
Chordata	Teleostei	Oligoplites altus	fish	LC		longjaw leatherjack
Chordata	Teleostei	Oligoplites saurus	fish	LC	yes	leatherjack
Chordata	Teleostei	Ophichthus zophochir	fish	LC	yes	yellow snake eel
Chordata	Teleostei	Ophioblennius atlanticus	fish	LC	yes	
Chordata	Teleostei	Ophioblennius steindachneri	fish	LC		Panamic fanged blenny
Chordata	Teleostei	Opisthonema bulleri	fish	LC		slender thread herring
Chordata	Teleostei	Opisthonema libertate	fish	LC	yes	deepbody thread herring, Chardin du Pacifique
Chordata	Teleostei	Opisthonema oglinum	fish	LC	yes	Atlantic thread herring
Chordata	Teleostei	Oxyzygonectes dovii	fish	LC		
Chordata	Teleostei	Paraconger caudilimbatus	fish	LC	yes	margintail conger
Chordata	Teleostei	Paranthias colonus	fish			Pacific creolefish
Chordata	Teleostei	Parexocoetus brachypterus	fish			sailfin flyingfish
Chordata	Teleostei	Plagiotremus azaleus	fish	LC		sabertooth blenny
Chordata	Teleostei	Platybelone argalus	fish	LC		keeltail needlefish
Chordata	Teleostei	Poeciliopsis elongata	fish	NT		
Chordata	Teleostei	Polydactylus approximans	fish	LC		blue bobo, barbare bleu
Chordata	Teleostei	Polydactylus virginicus	fish	LC	yes	barbu, barbare de flaque
Chordata	Teleostei	Pomacanthus zonipectus	fish	LC		Cortez angelfish
Chordata	Teleostei	Prionurus laticlavus	fish	LC		razor surgeonfish
Chordata	Teleostei	Pronotogrammus multifasciatus	fish	LC	yes	threadfin bass
Chordata	Teleostei	Pseudobalistes naufragium	fish	LC		blunthead triggerfish

Continued on next page

phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Pseudogramma thaumasia	fish			
Chordata	Teleostei	Pseudupeneus grandisquamis	fish	LC		bigscale goatfish
Chordata	Teleostei	Ptereleotris carinata	fish	LC		Panamic dartfish
Chordata	Teleostei	Rhencus macracanthus	fish			
Chordata	Teleostei	Rhonciscus branickii	fish		yes	
Chordata	Teleostei	Rypticus saponaceus	fish	LC	yes	greater soapfish
Chordata	Teleostei	Sargocentron suborbitale	fish			
Chordata	Teleostei	Scarus ghobban	fish	LC		bluechin parrotfish
Chordata	Teleostei	Scarus perrico	fish	LC		bumphead parrotfish
Chordata	Teleostei	Scarus rubroviolaceus	fish	LC		ember parrotfish
Chordata	Teleostei	Sciades dowii	fish	LC		
Chordata	Teleostei	Scomberomorus sierra	fish	LC		Pacific sierra
Chordata	Teleostei	Scorpaenodes xyris	fish	LC		rainbow scorpionfish
Chordata	Teleostei	Selar crumenophthalmus	fish	LC		bigeye scad
Chordata	Teleostei	Selene peruviana	fish	LC		Pacific moonfish
Chordata	Teleostei	Seriola lalandi	fish	LC		yellowtail, sériele chicard
Chordata	Teleostei	Serranus aequidens	fish	LC		deepwater serrano
Chordata	Teleostei	Sicydium salvini	fish		yes	
Chordata	Teleostei	Sphoeroides annulatus	fish	LC		bullseye puffer
Chordata	Teleostei	Sphyaena ensis	fish	LC		Mexican barracuda
Chordata	Teleostei	Sphyaena guachancho	fish	LC	yes	guaguanche
Chordata	Teleostei	Spratelloides delicatulus	fish	LC	yes	delicate round herring
Chordata	Teleostei	Starksia ocellata	fish	LC	yes	checkered blenny
Chordata	Teleostei	Stegastes flavilatus	fish	LC		beaubrummel
Chordata	Teleostei	Stegastes rectifraenum	fish	LC		Cortez damselfish
Chordata	Teleostei	Sufflamen verres	fish	LC		orangeside triggerfish
Chordata	Teleostei	Syacium papillosum	fish	LC	yes	dusky flounder
Chordata	Teleostei	Synodus lacertinus	fish	LC		calico lizardfish
Chordata	Teleostei	Tetrapturus angustirostris	fish	DD	yes	shortbill spearfish, makaire à rostre court
Chordata	Teleostei	Thalassoma lucasanum	fish	LC		Cortez rainbow wrasse
Chordata	Teleostei	Thunnus alalunga	fish	LC	yes	albacore, thon blanc
Chordata	Teleostei	Trachinotus carolinus	fish	LC	yes	pompano
Chordata	Teleostei	Trachinotus goodei	fish	LC	yes	palometa
Chordata	Teleostei	Trachinotus rhodopus	fish	LC		gafttopsail pompano
Chordata	Teleostei	Trichiurus lepturus	fish	LC		largehead hairtail, poisson-sabre commun
Chordata	Teleostei	Tylosurus acus	fish	LC		agujon needlefish
Chordata	Teleostei	Tylosurus crocodilus	fish	LC		houndfish
Chordata	Teleostei	Uropterygius macularius	fish	LC	yes	marbled moray
Chordata	Teleostei	Vinciguerria lucetia	fish	LC		
Chordata	Teleostei	Xenichthys xanti	fish	LC		longfin salema
Chordata	Teleostei	Zanclus cornutus	fish	LC		Moorish idol
Chordata		Eretmochelys imbricata	turtles	CR		hawksbill turtle, caret
Chordata		Iguana iguana		LC	yes	
Cnidaria	Hexacorallia	Diadumene leucolena	cnidarians		yes	white anemone
Cnidaria	Hexacorallia	Exaiptasia diaphana	cnidarians		yes	
Cnidaria	Hexacorallia	Heterocyathus sulcatus	cnidarians	LC	yes	striped bum coral
Cnidaria	Hexacorallia	Isarachnanthus nocturnus	cnidarians		yes	
Cnidaria	Hexacorallia	Nanozoanthus harenaceus	cnidarians		yes	
Cnidaria	Hexacorallia	Oulastrea crispata	cnidarians	LC	yes	zebra coral
Cnidaria	Hexacorallia	Pocillopora acuta	cnidarians		yes	

Continued on next page

phylum	class	species	group	category	new	vernacular
Cnidaria	Hexacorallia	Pocillopora damicornis	cnidarians	LC	yes	cauliflower coral
Cnidaria	Hexacorallia	Pocillopora verrucosa	cnidarians	LC	yes	cauliflower coral
Cnidaria	Hydrozoa	Agalma okenii	cnidarians		yes	
Cnidaria	Hydrozoa	Aglaophenia prominens	cnidarians		yes	
Cnidaria	Hydrozoa	Athorybia rosacea	cnidarians		yes	
Cnidaria	Hydrozoa	Campanularia hincksii	cnidarians		yes	
Cnidaria	Hydrozoa	Clytia brevithecata	cnidarians		yes	
Cnidaria	Hydrozoa	Clytia gracilis	cnidarians		yes	
Cnidaria	Hydrozoa	Clytia linearis	cnidarians		yes	
Cnidaria	Hydrozoa	Diphyes bojani	cnidarians		yes	
Cnidaria	Hydrozoa	Diphyes dispar	cnidarians		yes	
Cnidaria	Hydrozoa	Forskalia edwardsii	cnidarians		yes	
Cnidaria	Hydrozoa	Forskalia tholoides	cnidarians		yes	
Cnidaria	Hydrozoa	Halopteris violae	cnidarians		yes	
Cnidaria	Hydrozoa	Kirchenpaueria halecioides	cnidarians		yes	
Cnidaria	Hydrozoa	Larsonia pterophylla	cnidarians		yes	
Cnidaria	Hydrozoa	Lensia conoidea	cnidarians		yes	
Cnidaria	Hydrozoa	Liriope tetraphylla	cnidarians		yes	
Cnidaria	Hydrozoa	Macrorhynchia philippina	cnidarians			stinging hydroid
Cnidaria	Hydrozoa	Nanomia bijuga	cnidarians		yes	
Cnidaria	Hydrozoa	Nemalcium lighti	cnidarians		yes	
Cnidaria	Hydrozoa	Obelia bidentata	cnidarians			doubletoothed hydroid
Cnidaria	Hydrozoa	Obelia dichotoma	cnidarians			sea thread hydroid
Cnidaria	Hydrozoa	Plumularia floridana	cnidarians		yes	
Cnidaria	Hydrozoa	Plumularia setacea	cnidarians		yes	little seabristle
Cnidaria	Hydrozoa	Porpita porpita	cnidarians			blue button
Cnidaria	Hydrozoa	Rhizophysa filiformis	cnidarians		yes	
Cnidaria	Hydrozoa	Rosacea flaccida	cnidarians		yes	
Cnidaria	Hydrozoa	Sphaeronectes koellikeri	cnidarians		yes	
Cnidaria	Hydrozoa	Zancleopsis dichotoma	cnidarians		yes	
Cnidaria	Scyphozoa	Nausithoe maculata	cnidarians		yes	
Cryptophyta	Cryptophyceae	Hemiarma marina			yes	
Ctenophora	Tentaculata	Ocyropsis maculata	cnidarians		yes	ocyroé tachée
Echinodermata	Asteroidea	Acanthaster planci	echinoderms			crown-of-thorns
Echinodermata	Asteroidea	Astropecten armatus	echinoderms			
Echinodermata	Asteroidea	Luidia magnifica	echinoderms		yes	
Echinodermata	Asteroidea	Pentaceraster cumingi	echinoderms			
Echinodermata	Echinoidea	Agassizia scrobiculata	echinoderms		yes	
Echinodermata	Echinoidea	Diadema mexicanum	echinoderms			
Echinodermata	Echinoidea	Echinometra vanbrunti	echinoderms			
Echinodermata	Echinoidea	Encope micropora	echinoderms		yes	
Echinodermata	Echinoidea	Lovenia cordiformis	echinoderms		yes	
Echinodermata	Echinoidea	Mellitella stokesii	echinoderms		yes	
Echinodermata	Echinoidea	Toxopneustes pileolus	echinoderms		yes	
Echinodermata	Echinoidea	Toxopneustes roseus	echinoderms			
Echinodermata	Holothuroidea	Holothuria (Mertensiothuria) hilla	echinoderms		yes	
Echinodermata	Holothuroidea	Holothuria (Thymiosycia) impatiens	echinoderms			
Echinodermata	Holothuroidea	Polypsectana kefersteinii	echinoderms		yes	
Echinodermata	Ophiuroidea	Amphipholis squamata	echinoderms		yes	dwarf brittle star
Echinodermata	Ophiuroidea	Ophiactis savignyi	echinoderms		yes	

Continued on next page

phylum	class	species	group	category	new	vernacular
Echinodermata	Ophiuroidea	Ophiactis simplex	echinoderms		yes	
Echinodermata	Ophiuroidea	Ophiocomella ophiactoides	echinoderms		yes	
Echinodermata	Ophiuroidea	Ophiocomella sexradia	echinoderms		yes	
Echinodermata	Ophiuroidea	Ophiothrix (Ophiothrix) spiculata	echinoderms		yes	
Gastrotricha		Urodasys calicostylis			yes	
Haptophyta	Coccolithophyceae	Chrysochromulina tobinii	algae		yes	
Haptophyta	Coccolithophyceae	Gephyrocapsa huxleyi	algae		yes	
Haptophyta	Coccolithophyceae	Gephyrocapsa oceanica	algae		yes	
Haptophyta	Coccolithophyceae	Phaeocystis globosa	algae		yes	
Mollusca	Cephalopoda	Dosidicus gigas	molluscs	DD	yes	jumbo flying squid, encornet géant
Mollusca	Cephalopoda	Octopus hubbsorum	molluscs	LC		
Mollusca	Gastropoda	Acanthais brevidentata	molluscs		yes	
Mollusca	Gastropoda	Bittium watsoni	molluscs		yes	
Mollusca	Gastropoda	Boasia chierchiaie	molluscs		yes	
Mollusca	Gastropoda	Cardiapoda placenta	molluscs		yes	
Mollusca	Gastropoda	Cerithium adustum	molluscs			
Mollusca	Gastropoda	Cerithium stercusmuscarum	molluscs			
Mollusca	Gastropoda	Cerithium uncinatum	molluscs			
Mollusca	Gastropoda	Cliopsis krohnii	molluscs		yes	
Mollusca	Gastropoda	Corolla spectabilis	molluscs		yes	
Mollusca	Gastropoda	Crepidula striolata	molluscs		yes	
Mollusca	Gastropoda	Creseis conica	molluscs		yes	
Mollusca	Gastropoda	Diacavolinia longirostris	molluscs		yes	
Mollusca	Gastropoda	Dolabella auricularia	molluscs		yes	wedge sea hare
Mollusca	Gastropoda	Echinolittorina conspersa	molluscs			
Mollusca	Gastropoda	Haminoea vesicula	molluscs		yes	
Mollusca	Gastropoda	Hyalocylis striata	molluscs		yes	
Mollusca	Gastropoda	Limenandra rosanae	molluscs		yes	
Mollusca	Gastropoda	Littoraria varia	molluscs			
Mollusca	Gastropoda	Lottia subrotundata	molluscs		yes	
Mollusca	Gastropoda	Modulus modulus	molluscs		yes	Atlantic modulus
Mollusca	Gastropoda	Nerita funiculata	molluscs			
Mollusca	Gastropoda	Persististrombus granulatus	molluscs			
Mollusca	Gastropoda	Phestilla sibogae	molluscs		yes	
Mollusca	Gastropoda	Philinopsis speciosa	molluscs			
Mollusca	Gastropoda	Placida brookae	molluscs		yes	
Mollusca	Gastropoda	Spurilla braziliana	molluscs		yes	
Mollusca	Gastropoda	Stylocheilus rickettsi	molluscs			
Mollusca	Gastropoda	Talostolida pellucens	molluscs			
Mollusca	Gastropoda	Tambja eliora	molluscs		yes	
Mollusca	Gastropoda	Turbo squamiger	molluscs			
Mollusca	Gastropoda	Vasula melones	molluscs			
Myzozoa	Dinophyceae	Amphidinium massartii	unicellular		yes	
Myzozoa	Dinophyceae	Biecheleria cincta	unicellular		yes	
Myzozoa	Dinophyceae	Heterocapsa rotundata	unicellular		yes	
Myzozoa	Dinophyceae	Karenia brevis	unicellular		yes	
Myzozoa	Dinophyceae	Karlodinium veneficum	unicellular		yes	
Myzozoa	Dinophyceae	Kryptoperidinium triquetrum	unicellular		yes	
Myzozoa	Dinophyceae	Protoceratium reticulatum	unicellular		yes	
Ochrophyta	Dictyochophyceae	Octactis octonaria	algae		yes	

Continued on next page

phylum	class	species	group	category	new	vernacular
Ochrophyta	Dictyochophyceae	Pseudochattonella farcimen	algae		yes	
Ochrophyta	Pelagophyceae	Pelagomonas calceolata	algae		yes	
Ochrophyta	Phaeophyceae	Colpomenia sinuosa	algae			
Ochrophyta	Phaeophyceae	Hydroclathrus tenuis	algae		yes	
Ochrophyta	Phaeophyceae	Mesospora indopacifica	algae		yes	
Ochrophyta	Raphidophyceae	Chattonella subsalsa	algae		yes	
Ochrophyta	Raphidophyceae	Fibrocapsa japonica	algae		yes	
Ochrophyta	Raphidophyceae	Heterosigma akashiwo	algae		yes	
Oomycota	Peronosporae	Albugo candida	fungi		yes	
Phoronida		Phoronopsis californica	horseshoe worms		yes	golden phoronid
Porifera	Demospongiae	Chelonaplysilla erecta	sponges		yes	
Porifera	Demospongiae	Chondrosia collectrix	sponges		yes	
Porifera	Demospongiae	Cladocroce burapha	sponges		yes	
Porifera	Demospongiae	Cliona celata	sponges		yes	boring sponge, clione jaune
Porifera	Demospongiae	Cliona mariae	sponges		yes	Maria Santana's Cliona
Porifera	Demospongiae	Cliona vermifera	sponges		yes	orange boring sponge
Porifera	Demospongiae	Dictyonella funicularis	sponges		yes	
Porifera	Demospongiae	Gelliodes wilsoni	sponges		yes	
Porifera	Demospongiae	Haliclona (Reniera) tubifera	sponges			
Porifera	Demospongiae	Haliclona pigmentifera	sponges		yes	
Porifera	Demospongiae	Igernella notabilis	sponges		yes	
Porifera	Demospongiae	Mycale (Carmia) cecilia	sponges			
Porifera	Demospongiae	Pione vastifica	sponges			boring sponge, clione rouge
Porifera	Demospongiae	Spirastrella cunctatrix	sponges		yes	encrusting orange sponge, éponge encroûtante orange
Porifera	Demospongiae	Svenzea cristinae	sponges		yes	
Porifera	Homoscleromorpha	Oscarella pearsei	sponges		yes	
Porifera	Homoscleromorpha	Plakortis halichondrioides	sponges		yes	
Rhodophyta	Florideophyceae	Acanthophora spicifera	algae		yes	
Rhodophyta	Florideophyceae	Antithamnion antillanum	algae		yes	
Rhodophyta	Florideophyceae	Aphanta ligulata	algae		yes	
Rhodophyta	Florideophyceae	Asparagopsis taxiformis	algae		yes	
Rhodophyta	Florideophyceae	Ceratodictyon scoparium	algae		yes	
Rhodophyta	Florideophyceae	Herposiphonia secunda	algae			
Rhodophyta	Florideophyceae	Hypnea pannosa	algae		yes	
Rhodophyta	Florideophyceae	Hypnea valentiae	algae		yes	
Rhodophyta	Florideophyceae	Liagora ceranoides	algae		yes	
Rhodophyta	Florideophyceae	Lithophyllum prototypum	algae		yes	
Rhodophyta	Florideophyceae	Melanothamnus pseudovillum	algae		yes	
Rhodophyta	Florideophyceae	Melanothamnus ramireziae	algae		yes	
Rhodophyta	Florideophyceae	Melanothamnus tongatensis	algae		yes	
Rhodophyta	Florideophyceae	Pterocladia caerulescens	algae		yes	
Rhodophyta	Florideophyceae	Rhodachlya hawaiiiana	algae		yes	