

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

Biodiversity survey for Socotra Archipelago

Interim Results
Not for public distribution



Credit: Salem Hawash A; Abdulwahab Saad A.; Ahmed Saeed S.; Fouad Naseeb KH.; Mazen Saeed S.

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 Socotra Archipelago in June and July 2023. A total of 7 samples were collected at 6 locations in the park covering different habitats: di_hamri, ditwh_pa, mahfarhin_qasharihan_mpa, qariah, roosh_mpa, and shoeb_lagoon (Figure 1). Up to 1,680 mL of seawater was filtered through filter cartridges containing a filter with a 0.8 μ m 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.

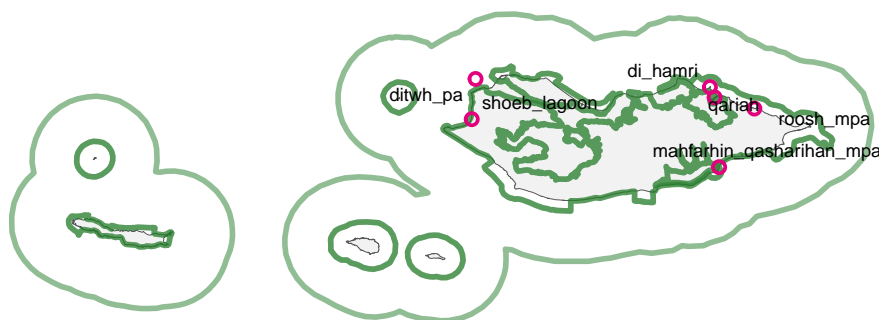


Figure 1: Map of the sampling locations.

DNA sequencing

Sequencing of the DNA from 7 samples resulted in over 6 million sequence reads, from which we collected 10,631 unique sequences or ASVs (Tables 1 and 2).

reads	asvs
6507574	10631

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

locality	materialSampleID	sampleSize	reads	asvs	species
Socotra Archipelago	EE0524	660	1995270	1351	15
Socotra Archipelago	EE0526	1560	1685194	6008	183
Socotra Archipelago	EE0528	1680	2723191	7624	174
Socotra Archipelago	EE0531	1560	20350	82	2
Socotra Archipelago	EE0537	1380	27671	138	5
Socotra Archipelago	EE0539	1260	51255	157	0
Socotra Archipelago	EE0541	1560	4643	50	3

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

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 247 species, including 144 fish species, 1 mammalian species, and 1 turtle species (Table

3). Species from other groups, such as algae, molluscs, crustaceans, echinoderms, and cnidarians, were also detected (Figures 2 and 3). This number of species detected represents about 20% of the 1,489 species known from Socotra Archipelago in the OBIS database. Of the 247 species detected, 117 are not among the species previously reported from Socotra Archipelago to the UNESCO OBIS database. 3 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.

group	eDNA species	total species	fraction
fish	144	722	0.20
mammals	1	4	0.25
turtles	0	3	

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	0	4	
EN	0	14	
VU	3	39	0.08

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

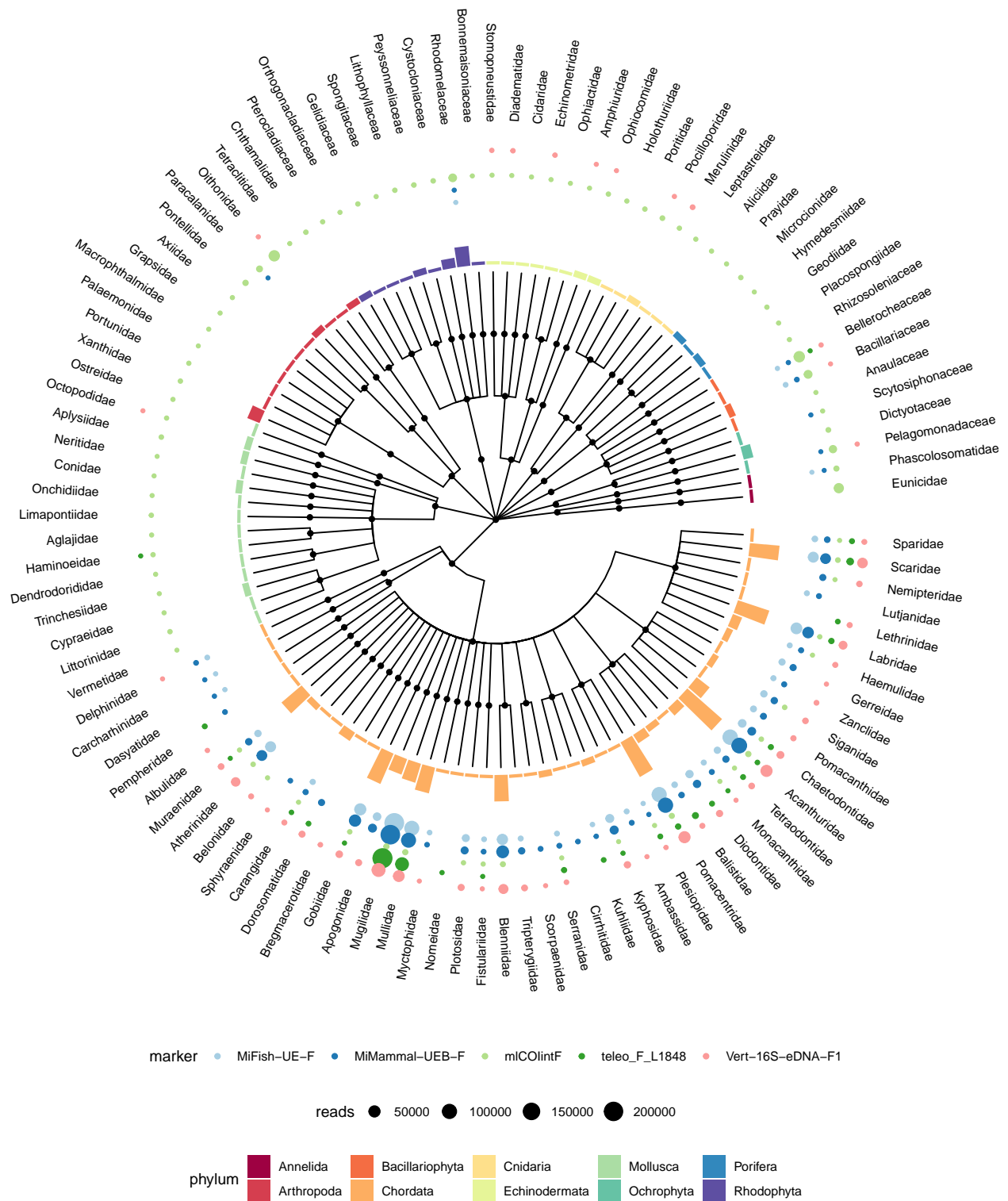


Figure 2: Number of DNA reads (bubbles) and species detected (bars) by family.

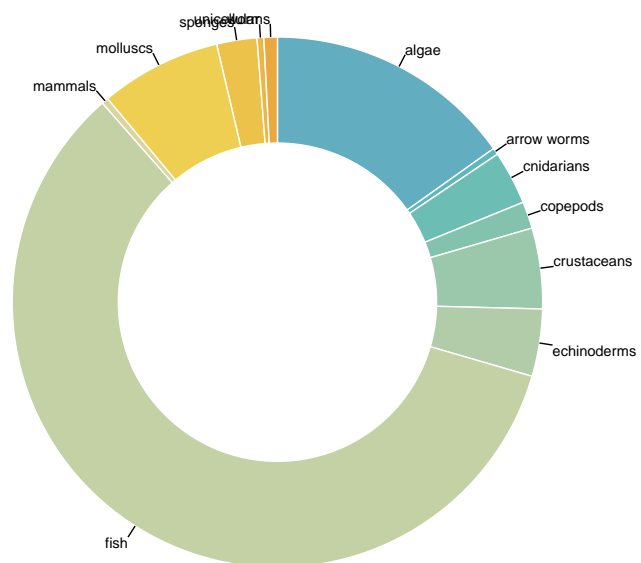


Figure 3: Distribution of detected species across groups.

phylum	class	species	group	category	new	vernacular
Annelida	Polychaeta	Palola viridis	worms		yes	Pacific palolo worm
Annelida		Phascolosoma (Phascolosoma) stephensoni	worms		yes	
Arthropoda	Copepoda	Calanopia minor	copepods		yes	
Arthropoda	Copepoda	Calocalanus plumulosus	copepods			
Arthropoda	Copepoda	Oithona dissimilis	copepods		yes	
Arthropoda	Copepoda	Paracalanus indicus	copepods		yes	
Arthropoda	Malacostraca	Actaeodes tomentosus	crustaceans			
Arthropoda	Malacostraca	Axiopsis serratifrons	crustaceans			serrated axiid
Arthropoda	Malacostraca	Chaenostoma sinuspersici	crustaceans			
Arthropoda	Malacostraca	Cuapetes elegans	crustaceans			
Arthropoda	Malacostraca	Danielea noelensis	crustaceans		yes	
Arthropoda	Malacostraca	Grapsus albolineatus	crustaceans			mottled lightfoot crab
Arthropoda	Malacostraca	Leptodius exaratus	crustaceans			
Arthropoda	Malacostraca	Luniella spinipes	crustaceans			
Arthropoda	Malacostraca	Thalamita admete	crustaceans			
Arthropoda	Thecostraca	Chthamalus barnesi	crustaceans		yes	
Arthropoda	Thecostraca	Tetrachthamalus obliteratus	crustaceans		yes	
Arthropoda	Thecostraca	Tetraclita rufotincta	crustaceans		yes	
Bacillariophyta	Bacillariophyceae	Anaulus australis	algae		yes	
Bacillariophyta	Bacillariophyceae	Bellerochea polymorpha	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia cuspidata	algae		yes	
Bacillariophyta	Bacillariophyceae	Pseudo-nitzschia sabit	algae		yes	
Bacillariophyta	Bacillariophyceae	Sundstroemia setigera	algae		yes	
Cercozoa	Chlorarachnea	Bigelowiella natans	unicellular		yes	
Chaetognatha	Sagittoidea	Aidanosagitta neglecta	arrow worms			
Chlorophyta	Mamiellophyceae	Micromonas pusilla	algae		yes	
Chlorophyta		Chloroparvula pacifica	algae		yes	
Chlorophyta		Chloropicon laureae	algae		yes	
Chlorophyta		Chloropicon mariensis	algae		yes	
Chlorophyta		Chloropicon primus	algae		yes	
Chlorophyta		Chloropicon roscoffensis	algae		yes	
Chlorophyta		Chloropicon sieburthii	algae		yes	
Chordata	Elasmobranchii	Carcharhinus sorrah	fish	NT		spottail shark
Chordata	Elasmobranchii	Urogymnus asperrimus	fish	VU	yes	porcupine ray
Chordata	Mammalia	Stenella longirostris	mammals	LC		long-snouted spinner dolphin, dauphin longirostre
Chordata	Teleostei	Abudefduf notatus	fish	LC		yellowtail sergeant
Chordata	Teleostei	Abudefduf septemfasciatus	fish	LC		banded sergeant
Chordata	Teleostei	Abudefduf sexfasciatus	fish	LC		scissortail sergeant
Chordata	Teleostei	Abudefduf sordidus	fish	LC		blackspot sergeant
Chordata	Teleostei	Acanthopagrus bifasciatus	fish	LC		doublebar bream
Chordata	Teleostei	Acanthurus bariene	fish	LC	yes	black-spot surgeonfish
Chordata	Teleostei	Acanthurus leucocheilus	fish	LC		
Chordata	Teleostei	Acanthurus leucosternon	fish	LC		powder-blue surgeonfish
Chordata	Teleostei	Acanthurus lineatus	fish	LC		lined surgeonfish
Chordata	Teleostei	Acanthurus nigricauda	fish	LC		epaulette surgeonfish
Chordata	Teleostei	Acanthurus nigrofuscus	fish	LC		brown surgeonfish
Chordata	Teleostei	Acanthurus sohal	fish	LC		Sohal
Chordata	Teleostei	Acanthurus tennentii	fish	LC		
Chordata	Teleostei	Acanthurus triostegus	fish	LC		convict surgeonfish
Chordata	Teleostei	Aethaloperca rogaa	fish			redmouth grouper

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phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Albula glossodonta	fish	VU	yes	roundjaw bonefish
Chordata	Teleostei	Alticus kirkii	fish	LC		leaping blenny
Chordata	Teleostei	Aluterus scriptus	fish	LC		scrawled filefish
Chordata	Teleostei	Ambassis gymnocephalus	fish	LC	yes	bald glassy
Chordata	Teleostei	Arothron meleagris	fish	LC		Guineafowl puffer
Chordata	Teleostei	Arothron nigropunctatus	fish	LC		blackspotted puffer
Chordata	Teleostei	Aspidontus taeniatus	fish	LC		mimic blenny
Chordata	Teleostei	Atherinomorus lacunosus	fish	LC		robust silverside
Chordata	Teleostei	Balistapus undulatus	fish	LC		orangestriped
Chordata	Teleostei	Bathygobius cyclopterus	fish	LC	yes	roundfin goby
Chordata	Teleostei	Bregmaceros maclellandi	fish		yes	Unicorn cod
Chordata	Teleostei	Canthigaster solandri	fish	LC	yes	spotted sharpnose
Chordata	Teleostei	Carangoides ferdau	fish	LC		blue trevally
Chordata	Teleostei	Caranx melampygus	fish	LC		bluefin trevally
Chordata	Teleostei	Caranx sexfasciatus	fish	LC		bigeye trevally
Chordata	Teleostei	Cephalopholis argus	fish	LC		peacock grouper
Chordata	Teleostei	Chaetodon austriacus	fish	LC	yes	exquisite butterflyfish
Chordata	Teleostei	Chaetodon collare	fish	LC		
Chordata	Teleostei	Chaetodon decussatus	fish	LC	yes	
Chordata	Teleostei	Chaetodon lunula	fish	LC		raccoon butterflyfish
Chordata	Teleostei	Chaetodon trifasciatus	fish	LC		melon butterflyfish
Chordata	Teleostei	Cheilinus trilobatus	fish	LC		tripletail wrasse
Chordata	Teleostei	Cheilodipterus macrodon	fish			largetoothed cardinalfish
Chordata	Teleostei	Chlorurus gibbus	fish	LC	yes	
Chordata	Teleostei	Chlorurus microrhinos	fish	LC	yes	
Chordata	Teleostei	Chlorurus sordidus	fish	LC		
Chordata	Teleostei	Chromis flavaxilla	fish			
Chordata	Teleostei	Chrysiptera annulata	fish			footballer
Chordata	Teleostei	Chrysiptera brownriggii	fish	LC		
Chordata	Teleostei	Chrysiptera unimaculata	fish	LC		onespot damselfish
Chordata	Teleostei	Cirrhitus pinnulatus	fish	LC		stocky hawkfish
Chordata	Teleostei	Coryogalops anomolus	fish	LC	yes	
Chordata	Teleostei	Crenimugil crenilabis	fish	LC		fringelip mullet
Chordata	Teleostei	Crenimugil seheli	fish	LC		
Chordata	Teleostei	Cryptocentroides arabicus	fish	LC		
Chordata	Teleostei	Ctenochaetus striatus	fish	LC		lined bristletooth
Chordata	Teleostei	Cubiceps whiteleggii	fish		yes	
Chordata	Teleostei	Dascyllus marginatus	fish	LC		blackbordered dascyllus
Chordata	Teleostei	Diodon holocanthus	fish	LC		balloonfish
Chordata	Teleostei	Diodon liturosus	fish			black-blotched porcupinefish
Chordata	Teleostei	Echidna nebulosa	fish	LC		snowflake moray
Chordata	Teleostei	Ecsenius gravieri	fish	LC	yes	Red Sea mimic blenny
Chordata	Teleostei	Enneapterygius philippinus	fish	LC	yes	
Chordata	Teleostei	Eviota prasina	fish	LC	yes	green bubble goby
Chordata	Teleostei	Fistularia commersonii	fish	LC		cornetfish
Chordata	Teleostei	Gerres longirostris	fish	LC		
Chordata	Teleostei	Gerres oblongus	fish	LC	yes	slender silver-biddy
Chordata	Teleostei	Gnatholepis cauerensis	fish	LC	yes	eyebars goby
Chordata	Teleostei	Gobiodon citrinus	fish	LC		citron goby
Chordata	Teleostei	Gobiodon fuscioruber	fish	LC	yes	

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phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Gobiodon reticulatus	fish	VU	yes	
Chordata	Teleostei	Gomphosus caeruleus	fish	LC		Red Sea bird wrasse
Chordata	Teleostei	Gymnomuraena zebra	fish	LC		zebra moray
Chordata	Teleostei	Gymnothorax favagineus	fish	LC		laced moray
Chordata	Teleostei	Gymnothorax fimbriatus	fish	LC	yes	fimbriated moray
Chordata	Teleostei	Gymnothorax flavimarginatus	fish	LC		yellowmargin moray
Chordata	Teleostei	Gymnothorax griseus	fish	LC		
Chordata	Teleostei	Gymnothorax pictus	fish	LC		
Chordata	Teleostei	Gymnothorax thyrsoideus	fish	LC	yes	
Chordata	Teleostei	Halichoeres marginatus	fish	LC		splendid rainbow wrasse
Chordata	Teleostei	Halichoeres nebulosus	fish	LC		nebulous wrasse
Chordata	Teleostei	Hemigymnus fasciatus	fish	LC		barred wrasse
Chordata	Teleostei	Hemigymnus melapterus	fish	LC		thicklip wrasse
Chordata	Teleostei	Herklotsichthys quadrimaculatus	fish	LC		fourspot sardine
Chordata	Teleostei	Hypoatherina temminckii	fish		yes	Samoan silverside
Chordata	Teleostei	Istiblennius edentulus	fish	LC		rockskipper
Chordata	Teleostei	Istiblennius lineatus	fish	LC	yes	
Chordata	Teleostei	Istiblennius pox	fish	LC	yes	
Chordata	Teleostei	Istiblennius spilatus	fish	LC		
Chordata	Teleostei	Istigobius decoratus	fish	LC		decorated goby
Chordata	Teleostei	Kuhlia mugil	fish	LC		barred flagtail
Chordata	Teleostei	Kyphosus cinerascens	fish	LC		snubnose chub
Chordata	Teleostei	Kyphosus vaigiensis	fish	LC		brassy chub
Chordata	Teleostei	Lethrinus nebulosus	fish	LC		spangled emperor
Chordata	Teleostei	Lutjanus monostigma	fish	LC		one-spot snapper
Chordata	Teleostei	Mugil cephalus	fish	LC		grey mullet, muge
Chordata	Teleostei	Mulloidichthys flavolineatus	fish	LC		yellowstripe goatfish
Chordata	Teleostei	Mulloidichthys vanicolensis	fish	LC		yellowfin goatfish
Chordata	Teleostei	Naso elegans	fish	LC		
Chordata	Teleostei	Naso thynnoides	fish	LC		oneknife unicornfish
Chordata	Teleostei	Naso unicornis	fish	LC		bluespine unicornfish
Chordata	Teleostei	Omobranchus fasciatus	fish	LC	yes	Arab blenny
Chordata	Teleostei	Ostorhinchus cookii	fish	LC		
Chordata	Teleostei	Ostorhinchus cyanosoma	fish	LC		
Chordata	Teleostei	Palutrus scapulopunctatus	fish	LC	yes	
Chordata	Teleostei	Parupeneus barberinus	fish	LC		dash-and-dot goatfish
Chordata	Teleostei	Parupeneus cyclostomus	fish	LC		yellowsaddle goatfish
Chordata	Teleostei	Parupeneus macronemus	fish	LC		
Chordata	Teleostei	Parupeneus multifasciatus	fish	LC	yes	
Chordata	Teleostei	Parupeneus porphyreus	fish	NT	yes	
Chordata	Teleostei	Parupeneus trifasciatus	fish	LC		
Chordata	Teleostei	Pempheris schwenkii	fish		yes	
Chordata	Teleostei	Planiliza carinata	fish		yes	
Chordata	Teleostei	Planiliza macrolepis	fish	LC		
Chordata	Teleostei	Plectorhinchus playfairi	fish	LC		whitebarred rubberlips
Chordata	Teleostei	Plectorhinchus schotaf	fish	LC		minstrel sweetlips
Chordata	Teleostei	Plectorhinchus sordidus	fish	LC		sordid rubberlips
Chordata	Teleostei	Plectroglyphidodon leucozonus	fish	LC		
Chordata	Teleostei	Plesiops coeruleolineatus	fish	LC		crimsontip longfin
Chordata	Teleostei	Plicomugil labiosus	fish		yes	

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phylum	class	species	group	category	new	vernacular
Chordata	Teleostei	Plotosus lineatus	fish			striped eel catfish
Chordata	Teleostei	Pomacanthus imperator	fish	LC		emperor angelfish
Chordata	Teleostei	Pomacentrus baenschii	fish		yes	Baensch's damsel
Chordata	Teleostei	Pomacentrus caeruleus	fish	LC		Caerulean damsel
Chordata	Teleostei	Rhabdamia gracilis	fish		yes	luminous cardinalfish
Chordata	Teleostei	Scarus arabicus	fish	LC		
Chordata	Teleostei	Scarus ferrugineus	fish	LC		rusty parrotfish
Chordata	Teleostei	Scarus frenatus	fish	LC		bridled parrotfish
Chordata	Teleostei	Scarus ghobban	fish	LC		bluechin parrotfish
Chordata	Teleostei	Scarus niger	fish	LC		dusky parrotfish
Chordata	Teleostei	Scarus rubroviolaceus	fish	LC		ember parrotfish
Chordata	Teleostei	Scolopsis ghanam	fish	LC		Arabian monocle bream
Chordata	Teleostei	Scorpaenodes evides	fish	LC		
Chordata	Teleostei	Siganus canaliculatus	fish	LC	yes	white-spotted spinefoot
Chordata	Teleostei	Siganus sutor	fish	LC	yes	shoemaker spinefoot
Chordata	Teleostei	Sphyraena obtusata	fish		yes	obtuse barracuda
Chordata	Teleostei	Stethojulis interrupta	fish	LC		cutribbon wrasse
Chordata	Teleostei	Sufflamen chrysopterum	fish	LC		
Chordata	Teleostei	Sufflamen fraenatum	fish	LC		
Chordata	Teleostei	Symbolophorus evermanni	fish	LC		Evermann's lantern fish
Chordata	Teleostei	Taeniamia macroptera	fish	LC	yes	
Chordata	Teleostei	Thalassoma lunare	fish	LC		moon wrasse
Chordata	Teleostei	Thalassoma lutescens	fish	LC		
Chordata	Teleostei	Thalassoma purpureum	fish	LC		surge wrasse
Chordata	Teleostei	Tylosurus crocodilus	fish	LC	yes	houndfish
Chordata	Teleostei	Zanclus cornutus	fish	LC		Moorish idol
Chordata	Teleostei	Zebbrasoma xanthurum	fish	LC		yellowtail surgeonfish
Cnidaria	Anthozoa	Dipsastraea rotumana	cnidarians	LC		
Cnidaria	Anthozoa	Favites abdita	cnidarians	NT	yes	larger star coral
Cnidaria	Anthozoa	Leptastrea purpurea	cnidarians	LC		crust coral
Cnidaria	Anthozoa	Porites lutea	cnidarians	LC		hump coral
Cnidaria	Anthozoa	Stylophora pistillata	cnidarians	NT		hood coral
Cnidaria	Anthozoa	Triactis producta	cnidarians		yes	crab anemone
Cnidaria	Hydrozoa	Rosacea flaccida	cnidarians		yes	
Cryptophyta	Cryptophyceae	Hemiarma marina			yes	
Ctenophora	Tentaculata	Vallicula multiformis	cnidarians		yes	
Echinodermata	Echinoidea	Diadema savignyi	echinoderms			
Echinodermata	Echinoidea	Echinometra mathaei	echinoderms		yes	rock-boring urchin
Echinodermata	Echinoidea	Eucidaris metularia	echinoderms		yes	
Echinodermata	Echinoidea	Stomopneustes variolaris	echinoderms		yes	
Echinodermata	Holothuroidea	Holothuria (Lessonothuria) lineata	echinoderms		yes	
Echinodermata	Holothuroidea	Holothuria (Platyperona) difficilis	echinoderms		yes	
Echinodermata	Ophiuroidea	Amphipholis squamata	echinoderms		yes	dwarf brittle star
Echinodermata	Ophiuroidea	Breviturma brevipes	echinoderms		yes	
Echinodermata	Ophiuroidea	Ophiactis savignyi	echinoderms		yes	
Echinodermata	Ophiuroidea	Ophiocomella valenciae	echinoderms		yes	
Gastrotricha		Urodasys calicostylis			yes	
Haptophyta	Coccolithophyceae	Emiliana huxleyi	algae		yes	
Haptophyta	Coccolithophyceae	Phaeocystis globosa	algae		yes	
Hemichordata	Enteropneusta	Ptychodera flava			yes	Hawaiian acorn worm

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phylum	class	species	group	category	new	vernacular
Mollusca	Bivalvia	Saccostrea mordax	molluscs		yes	
Mollusca	Cephalopoda	Callistoctopus aspirosomatis	molluscs	LC	yes	
Mollusca	Cephalopoda	Octopus cyanea	molluscs	LC	yes	Cyane's octopus
Mollusca	Gastropoda	Aplysia oculifera	molluscs		yes	spotted sea hare
Mollusca	Gastropoda	Biuve fulvipunctata	molluscs		yes	
Mollusca	Gastropoda	Conus frigidus	molluscs	LC	yes	
Mollusca	Gastropoda	Conus namocanus	molluscs	LC		namocanus cone
Mollusca	Gastropoda	Dendrodoris fumata	molluscs			
Mollusca	Gastropoda	Monetaria annulus	molluscs		yes	ring cowrie
Mollusca	Gastropoda	Naria nebrites	molluscs		yes	
Mollusca	Gastropoda	Nerita adenensis	molluscs		yes	
Mollusca	Gastropoda	Peasiella mauritiana	molluscs		yes	
Mollusca	Gastropoda	Peronia madagascariensis	molluscs		yes	
Mollusca	Gastropoda	Petalochonchus keenae	molluscs		yes	
Mollusca	Gastropoda	Phanerophthalmus tibiricae	molluscs		yes	
Mollusca	Gastropoda	Phestilla sibogae	molluscs		yes	
Mollusca	Gastropoda	Placida kevinleei	molluscs		yes	
Mollusca	Gastropoda	Stylocheilus striatus	molluscs		yes	
Ochrophyta	Pelagophyceae	Pelagomonas calceolata	algae		yes	
Ochrophyta	Phaeophyceae	Canistrocarpus cervicornis	algae			
Ochrophyta	Phaeophyceae	Dictyota ceylanica	algae			
Ochrophyta	Phaeophyceae	Hydroclathrus tenuis	algae		yes	
Ochrophyta	Phaeophyceae	Padina boergesenii	algae			
Porifera	Demospongiae	Clathria (Thalysias) reinwardti	sponges		yes	
Porifera	Demospongiae	Clathria (Wilsonella) rugosa	sponges		yes	
Porifera	Demospongiae	Geodia californica	sponges		yes	
Porifera	Demospongiae	Geodia vosmaeri	sponges		yes	
Porifera	Demospongiae	Phorbos bihamiger	sponges		yes	
Porifera	Demospongiae	Placospongia carinata	sponges		yes	
Rhodophyta	Florideophyceae	Aphanta ligulata	algae		yes	
Rhodophyta	Florideophyceae	Asparagopsis taxiformis	algae			
Rhodophyta	Florideophyceae	Chondria baileyana	algae		yes	
Rhodophyta	Florideophyceae	Chondrophycus anabeliae	algae		yes	
Rhodophyta	Florideophyceae	Chondrophycus undulatus	algae		yes	
Rhodophyta	Florideophyceae	Gelidium sclerophyllum	algae		yes	
Rhodophyta	Florideophyceae	Hypnea nidulans	algae		yes	
Rhodophyta	Florideophyceae	Hypnea spinella	algae			
Rhodophyta	Florideophyceae	Hypnea valentiae	algae			
Rhodophyta	Florideophyceae	Laurencia dendroidea	algae			
Rhodophyta	Florideophyceae	Laurencia natalensis	algae		yes	
Rhodophyta	Florideophyceae	Laurencia obtusa	algae		yes	
Rhodophyta	Florideophyceae	Lithophyllum kaiserii	algae		yes	
Rhodophyta	Florideophyceae	Lithophyllum okamurai	algae		yes	
Rhodophyta	Florideophyceae	Neogoniolithon fosliei	algae		yes	
Rhodophyta	Florideophyceae	Pterocladia caerulea	algae		yes	
Rhodophyta	Florideophyceae	Pterocladia musciformis	algae		yes	
Rhodophyta	Florideophyceae	Ramircrusta appressa	algae		yes	