

eDNA Expeditions biodiversity survey of Everglades National Park

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1 Introduction

Environmental DNA Expeditions is a global, citizen science initiative that will help measure marine biodiversity, and the impacts climate change might have on the distribution patterns of marine life, across UNESCO World Heritage marine sites.

Ocean species shed DNA into the water around them. The genetic material from waste, mucus or cells in one liter of water can determine the species richness in a given area, without the need to actually extract organisms from their environment. The cost effective, ethical nature of eDNA sampling has the potential to revolutionize knowledge about ecosystems and species

diversity and to inspire the next generation of ocean researchers.

eDNA sampling was conducted in Everglades National Park in April 2023, by filtering up to 1800 ml of seawater through filter cartridges with a 0.8 μm pore size. 20 samples were collected at five locations in the park: Trout Creek, North Eagle Creek, Crocodile Dragover, Whip Ray, and Captain. From these 20 samples, a first batch of 11 samples covering all sites has been processed. DNA from these samples was extracted and amplified, and then sent to the sequencing facility.

2 Results

Sequencing of the DNA from 11 samples resulted in over 20 million sequence reads. From these reads we were able to collect 12,507 unique sequences or ASVs. Matching those sequences with reference sequences in public databases, we were able to detect 194 species. A total of 2566 are known from Everglades National Park in the OBIS database. Of the 194 species detected, 83 not known from the park in OBIS.

reads	species	asvs
20627859	194	12507

locality	materialSampleID	reads	species	asvs	sampleSize
Captain	EE0386	1715884	33	1261	1500
Captain	EE0391	1504564	77	5480	1800
Captain	EE0402	1768280	73	5873	1800
Crocodile Dragover	EE0389	1542386	64	5174	1500
Crocodile Dragover	EE0390	2070296	67	5042	450
North Eagle Key	EE0388	1586226	43	2831	1500
Trout Creek	EE0403	1854506	86	3590	1500
Whip Ray	EE0387	2902938	78	3101	1800
Whip Ray	EE0404	2195910	97	5838	1800
Whip Ray	EE0405	1994942	97	4808	1800
Whip Ray	EE0406	1491927	103	4685	1800

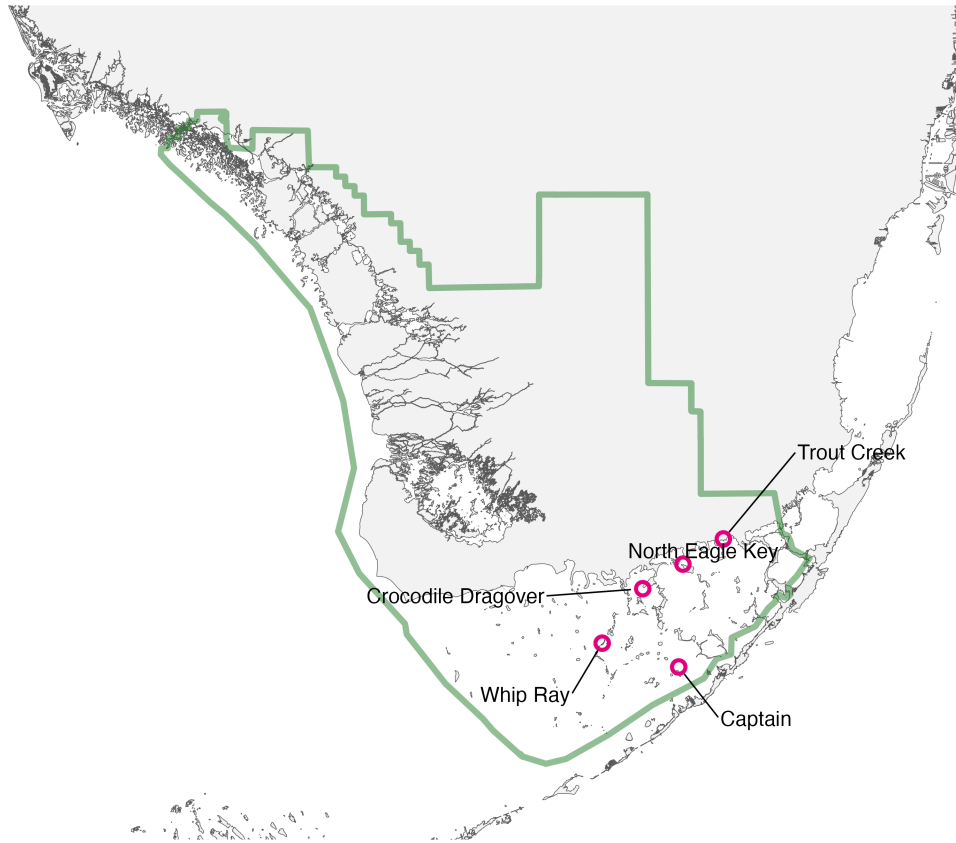


Figure 1: Map of eDNA sampling locations

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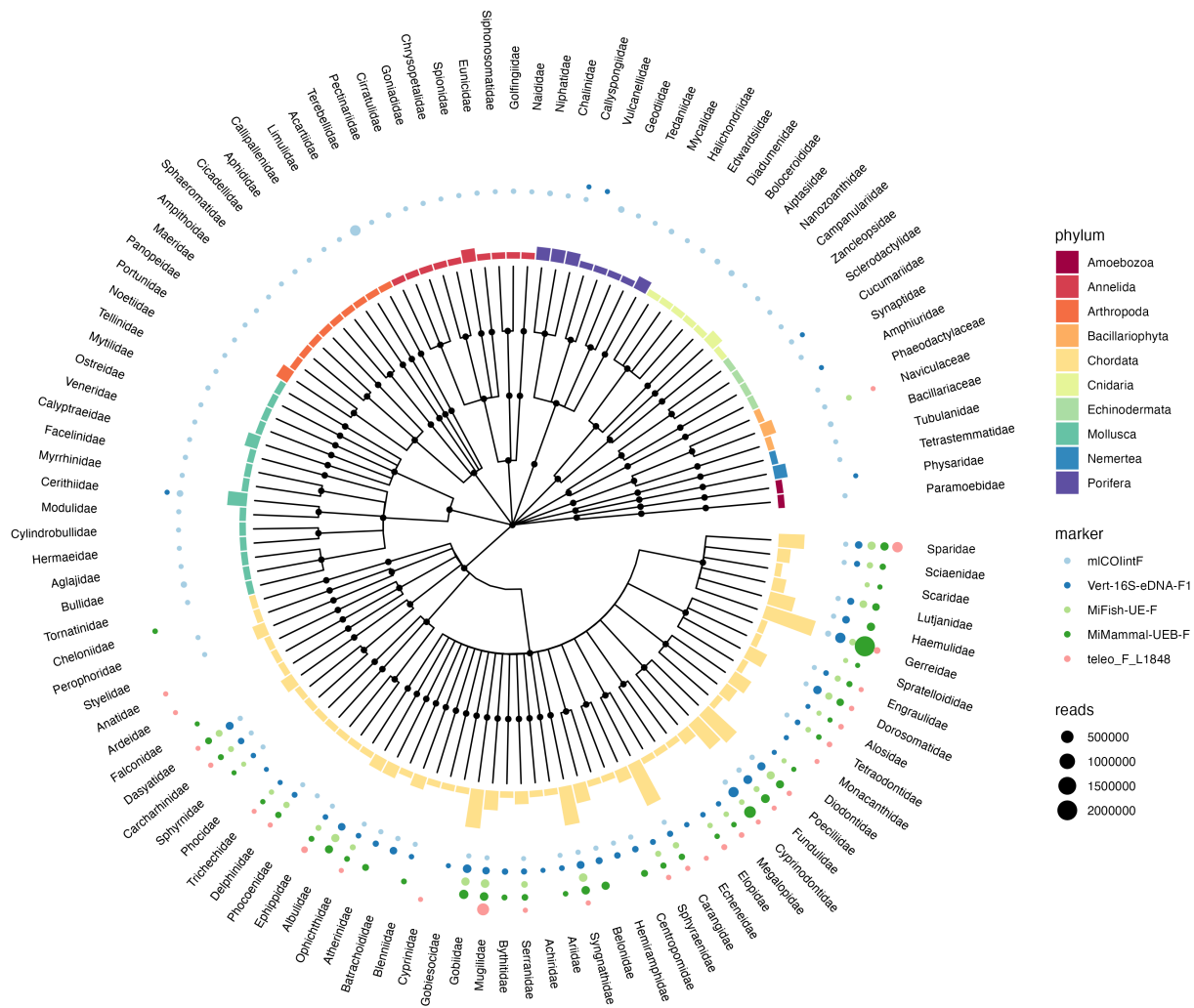


Figure 2: Number of DNA reads and species detected by family

3 Species list

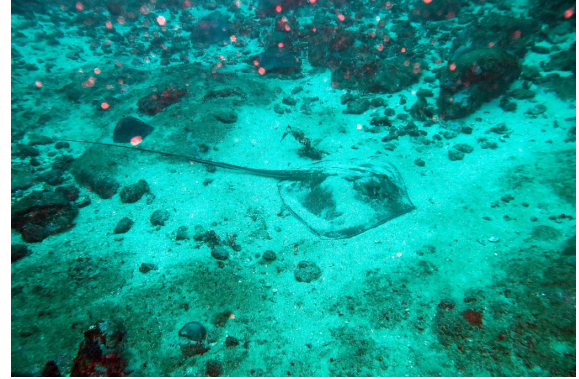
phylum	class	species	category	new
Amoebozoa	Discosea	Paramoeba aestuarina		yes
Amoebozoa	Myxogastrea	Craterium leucocephalum		yes
Annelida	Clitellata	Thalassodrilides gurwitschi		yes
Annelida	Polychaeta	Marphysa sanguinea		
Annelida	Polychaeta	Bhawania goodei		yes
Annelida	Polychaeta	Glycinde multidentis		
Annelida	Polychaeta	Polydora websteri		yes
Annelida	Polychaeta	Prionospio steenstrupi		
Annelida	Polychaeta	Timarete caribous		yes
Annelida	Polychaeta	Pectinaria gouldii		
Annelida	Polychaeta	Loimia medusa		
Annelida		Golfingia elongata		yes
Annelida		Siphonosoma cumanense		yes
Arthropoda	Copepoda	Acartia tonsa		yes
Arthropoda	Hexapoda	Rhopalosiphum padi		yes
Arthropoda	Hexapoda	Macrosteles quadrilineatus		yes
Arthropoda	Malacostraca	Cymadusa compta		
Arthropoda	Malacostraca	Elasmopus nkjaf		yes
Arthropoda	Malacostraca	Neopanope packardii		
Arthropoda	Malacostraca	Callinectes sapidus		
Arthropoda	Malacostraca	Portunus sanguinolentus		yes
Arthropoda	Malacostraca	Paracerceis caudata		
Arthropoda	Merostomata	Limulus polyphemus	VU	
Arthropoda	Pycnogonida	Callipallene brevirostris		
Ascomycota	Dothideomycetes	Cladosporium herbarum		yes
Ascomycota	Eurotiomycetes	Aspergillus versicolor		yes
Bacillariophyta	Bacillariophyceae	Cylindrotheca closterium		yes
Bacillariophyta	Bacillariophyceae	Haslea crucigera		yes
Bacillariophyta	Bacillariophyceae	Navicula minima		yes
Bacillariophyta	Bacillariophyceae	Phaeodactylum tricornutum		yes
Bryozoa	Gymnolaemata	Bugula rochae		yes
Bryozoa	Gymnolaemata	Amathia evelinae		yes
Cercozoa	Chlorarachnea	Chlorarachnion reptans		yes
Chlorophyta	Mamiellophyceae	Dolichomastix tenuilepis		yes
Chlorophyta	Mamiellophyceae	Micromonas pusilla		
Chordata	Asciacea	Ecteinascidia styeloides		yes
Chordata	Asciacea	Botrylloides niger		
Chordata	Asciacea	Botrylloides simodensis		yes
Chordata	Aves	Anas poecilorhyncha		yes
Chordata	Aves	Ardea cinerea		yes
Chordata	Aves	Falco sparverius		yes
Chordata	Elasmobranchii	Negaprion brevirostris	VU	
Chordata	Elasmobranchii	Sphyrna tiburo	EN	
Chordata	Elasmobranchii	Hypanus americanus	NT	
Chordata	Elasmobranchii	Hypanus rudis	CR	yes
Chordata	Mammalia	Mirounga leonina		yes
Chordata	Mammalia	Tursiops truncatus		
Chordata	Mammalia	Neophocaena phocaenoides	VU	yes
Chordata	Mammalia	Trichechus manatus	VU	
Chordata	Teleostei	Chaetodipterus faber		
Chordata	Teleostei	Albula glossodonta	VU	yes
Chordata	Teleostei	Albula vulpes	NT	
Chordata	Teleostei	Myrophis punctatus		
Chordata	Teleostei	Myrophis vafer		yes
Chordata	Teleostei	Atherinomorus stipes		
Chordata	Teleostei	Opsanus beta		
Chordata	Teleostei	Opsanus tau		
Chordata	Teleostei	Strongylura notata		
Chordata	Teleostei	Strongylura timucu		
Chordata	Teleostei	Tylosurus crocodilus		
Chordata	Teleostei	Chriodorus atherinoides		

Chordata	Teleostei	Chasmodes bosquianus	
Chordata	Teleostei	Centropomus undecimalis	
Chordata	Teleostei	Sphyræna barracuda	
Chordata	Teleostei	Sphyræna jello	yes
Chordata	Teleostei	Caranx crysos	
Chordata	Teleostei	Caranx hippos	
Chordata	Teleostei	Caranx ignobilis	yes
Chordata	Teleostei	Caranx latus	
Chordata	Teleostei	Oligoplites saurus	
Chordata	Teleostei	Selene vomer	
Chordata	Teleostei	Trachinotus carolinus	
Chordata	Teleostei	Echeneis naucrates	
Chordata	Teleostei	Brevoortia tyrannus	yes
Chordata	Teleostei	Harengula humeralis	yes
Chordata	Teleostei	Harengula jaguana	
Chordata	Teleostei	Opisthonema oglinum	
Chordata	Teleostei	Anchoa mitchilli	
Chordata	Teleostei	Jenkinsia lamprotaenia	
Chordata	Teleostei	Carassius auratus	yes
Chordata	Teleostei	Cyprinodon variegatus	
Chordata	Teleostei	Floridichthys carpio	
Chordata	Teleostei	Adinia xenica	yes
Chordata	Teleostei	Fundulus confluentus	
Chordata	Teleostei	Fundulus grandis	
Chordata	Teleostei	Lucania goodei	yes
Chordata	Teleostei	Lucania parva	
Chordata	Teleostei	Belonesox belizanus	
Chordata	Teleostei	Gambusia affinis	
Chordata	Teleostei	Gambusia holbrooki	
Chordata	Teleostei	Gambusia rhizophorae	
Chordata	Teleostei	Poecilia latipinna	
Chordata	Teleostei	Poecilia sphenops	yes
Chordata	Teleostei	Elops saurus	
Chordata	Teleostei	Megalops atlanticus	VU
Chordata	Teleostei	Diapterus auratus	
Chordata	Teleostei	Eucinostomus argenteus	
Chordata	Teleostei	Eucinostomus gula	
Chordata	Teleostei	Eucinostomus jonesii	
Chordata	Teleostei	Eucinostomus melanopterus	
Chordata	Teleostei	Eugerres plumieri	
Chordata	Teleostei	Gerres cinereus	
Chordata	Teleostei	Ulaema lefroyi	
Chordata	Teleostei	Haemulon aurolineatum	
Chordata	Teleostei	Haemulon parra	
Chordata	Teleostei	Haemulon plumierii	
Chordata	Teleostei	Haemulon sciurus	
Chordata	Teleostei	Lutjanus argentimaculatus	yes
Chordata	Teleostei	Lutjanus griseus	
Chordata	Teleostei	Nicholsina usta	
Chordata	Teleostei	Cynoscion nebulosus	
Chordata	Teleostei	Pogonias cromis	
Chordata	Teleostei	Archosargus probatocephalus	
Chordata	Teleostei	Archosargus rhomboidalis	
Chordata	Teleostei	Diplodus kotschy	yes
Chordata	Teleostei	Lagodon rhomboides	
Chordata	Teleostei	Gobiesox strumosus	
Chordata	Teleostei	Gobiosoma bosc	
Chordata	Teleostei	Gobiosoma ginsburgi	yes
Chordata	Teleostei	Gobiosoma robustum	
Chordata	Teleostei	Lophogobius cyprinoides	
Chordata	Teleostei	Microgobius gulosus	
Chordata	Teleostei	Microgobius microlepis	
Chordata	Teleostei	Mugil cephalus	
Chordata	Teleostei	Mugil curema	
Chordata	Teleostei	Mugil rubrioculus	
Chordata	Teleostei	Ogilbia cayorum	

Chordata	Teleostei	Epinephelus itajara	VU	
Chordata	Teleostei	Epinephelus lanceolatus		yes
Chordata	Teleostei	Trinectes maculatus		
Chordata	Teleostei	Ariopsis felis		
Chordata	Teleostei	Anarchopterus criniger		
Chordata	Teleostei	Hippocampus zosterae		
Chordata	Teleostei	Syngnathus floridae		
Chordata	Teleostei	Syngnathus fuscus		
Chordata	Teleostei	Syngnathus schlegeli		yes
Chordata	Teleostei	Syngnathus scovelli		
Chordata	Teleostei	Chilomycterus schoepfii		
Chordata	Teleostei	Stephanolepis cirrifer		yes
Chordata	Teleostei	Stephanolepis hispida		
Chordata	Teleostei	Sphoeroides maculatus		
Chordata	Teleostei	Sphoeroides parvus		yes
Chordata	Teleostei	Sphoeroides spengleri		
Chordata		Caretta caretta	VU	
Cnidaria	Anthozoa	Exaiptasia diaphana		
Cnidaria	Anthozoa	Boloceroideus mcmurrichi		yes
Cnidaria	Anthozoa	Diadumene leucolea		yes
Cnidaria	Anthozoa	Edwardsia longicornis		yes
Cnidaria	Anthozoa	Nanozoanthus harenaceus		yes
Cnidaria	Hydrozoa	Zancleopsis dichotoma		yes
Cnidaria	Hydrozoa	Clytia hemisphaerica		yes
Cnidaria	Hydrozoa	Obelia bidentata		yes
Ctenophora	Tentaculata	Vallicula multiformis		yes
Echinodermata	Holothuroidea	Leptosynapta tenuis		
Echinodermata	Holothuroidea	Thyonella gemmata		yes
Echinodermata	Holothuroidea	Sclerodactyla briareus		
Echinodermata	Ophiuroidea	Amphipholis squamata		
Gnathostomulida		Gnathostomula axi		yes
Mollusca	Bivalvia	Arcopsis adamsi		
Mollusca	Bivalvia	Ameritella mitchelli		yes
Mollusca	Bivalvia	Brachidontes exustus		
Mollusca	Bivalvia	Crassostrea virginica		
Mollusca	Bivalvia	Anomalocardia auberiana		yes
Mollusca	Bivalvia	Chione cancellata		
Mollusca	Gastropoda	Philinopsis pusa		yes
Mollusca	Gastropoda	Bulla arabica		yes
Mollusca	Gastropoda	Acteocina canaliculata		
Mollusca	Gastropoda	Crepidula convexa		
Mollusca	Gastropoda	Learchis poica		yes
Mollusca	Gastropoda	Nanuca occidentalis		yes
Mollusca	Gastropoda	Bittium varium		
Mollusca	Gastropoda	Cerithium eburneum		
Mollusca	Gastropoda	Cerithium muscarum		
Mollusca	Gastropoda	Modulus modulus		
Mollusca	Gastropoda	Cylindrobulla beauui		
Mollusca	Gastropoda	Cyerce antillensis		yes
Myxozoa	Dinophyceae	Amphidinium massartii		yes
Nemertea	Hoplonemertea	Tetrastemma elegans		yes
Nemertea	Hoplonemertea	Tetrastemma wilsoni		yes
Nemertea	Palaeonemertea	Tubulanus riceae		yes
Phoronida		Phoronis psammophila		yes
Porifera	Demospongiae	Callyspongia diffusa		yes
Porifera	Demospongiae	Callyspongia vaginalis		yes
Porifera	Demospongiae	Cladocroce burapha		yes
Porifera	Demospongiae	Haliclona vansoesti		yes
Porifera	Demospongiae	Gelliodes wilsoni		yes
Porifera	Demospongiae	Pachychalina tenera		yes
Porifera	Demospongiae	Mycale fibrexilis		yes
Porifera	Demospongiae	Tedania ignis		yes
Porifera	Demospongiae	Amorphinopsis fenestrata		yes
Porifera	Demospongiae	Halichondria melanadocia		yes
Porifera	Demospongiae	Geodia neptuni		yes
Porifera	Demospongiae	Poecillastra laminaris		yes



(a) *Sphyrna tiburo*



(b) *Hypanus rudis*



(c) *Epinephelus itajara*

Figure 3: Some of the detected fish species.

Rhodophyta	Florideophyceae	Polysiphonia echinata	yes
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