

APPENDIX 1

Chapter 1

Pictures of dominant species	2
Species inventory of micro-invertebrate species found	16
Bathymetry Map of Pleasant Bay	18
Eelgrass Locations in Pleasant Bay	19
Sidescan Map of Pleasant Bay.....	20

Chapter 2

Species inventory of macro-invertebrate and fish species by gear type	21
---	----

Chapter 3

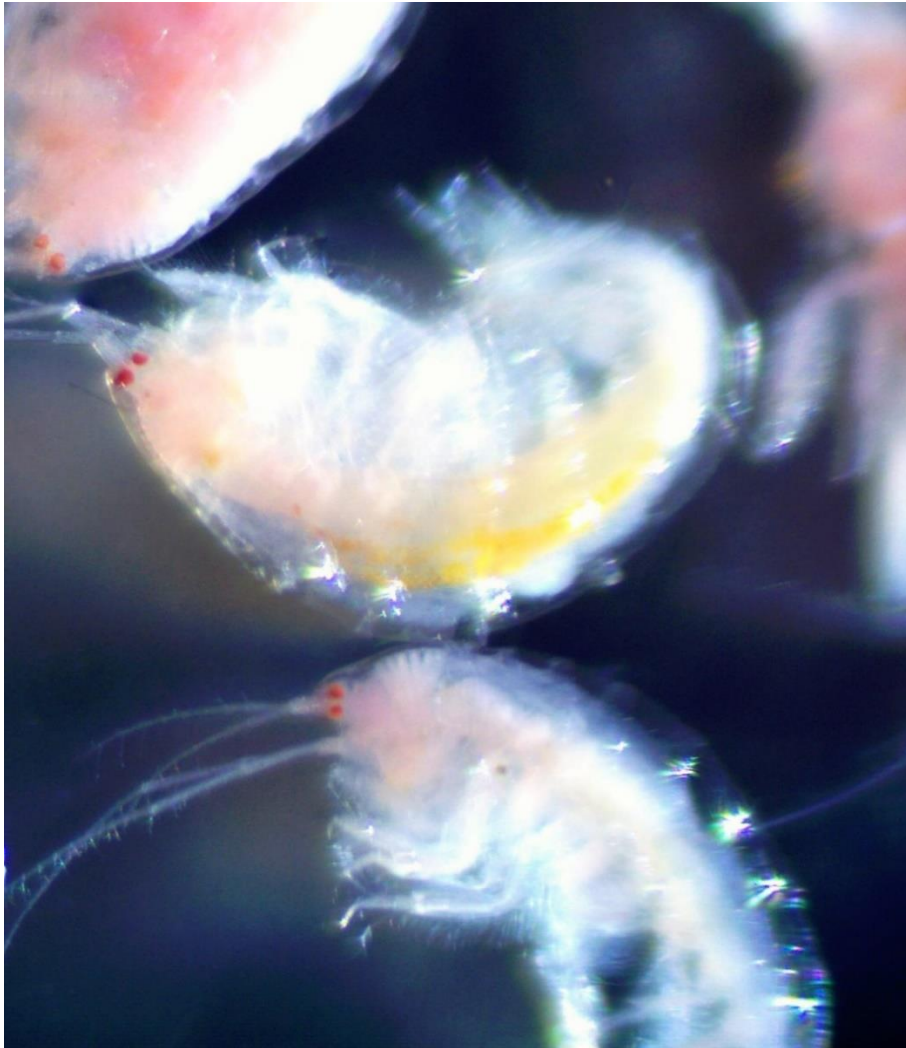
Prey otoliths and hard parts recovered during seal scat processing	24
--	----

Pictures of dominant species

Disclaimer: biological samples were treated with ethanol and Rose Bengal in the laboratory to preserve the samples. Rose Bengal is a stain commonly used in microscopy and stains cell tissue a bright pink. This is useful in the visual detection of microscopic animals in sediment samples.

An overwhelming majority of micro invertebrate species do not have common names. The common names used here are listed in Pollock's "A Practical Guide to the Marine Animals of the Northeastern North Atlantic" (1998). Many refer to families or orders, which sometimes encompass dozens of species, and are therefore not specifically referring to one single species. Some species also have more than one common name, depending on different geographic regions, further confusing the matter. Unlike fisheries, there are no national or international naming conventions for micro invertebrates. Thus, to avoid any confusion or ambiguity, scientific names have been used throughout this report.

Ampelisca spp are the most abundant species in cluster 1 and 4. Ampelisca, or four-eyed amphipods, are species of Amphipods. Amphipods are a order of crustacean with no carapace and laterally compressed bodies. Locally they range in size form 0.03 inches to 0.5 inches and are mostly detrivore or scavengers. They are mostly marine animals, but are found in almost all aquatic environments. The name Amphipods translates from Greek to “different” “foot” and refers to the two different kinds of legs amphipods have. They are also known as sideswimmers.



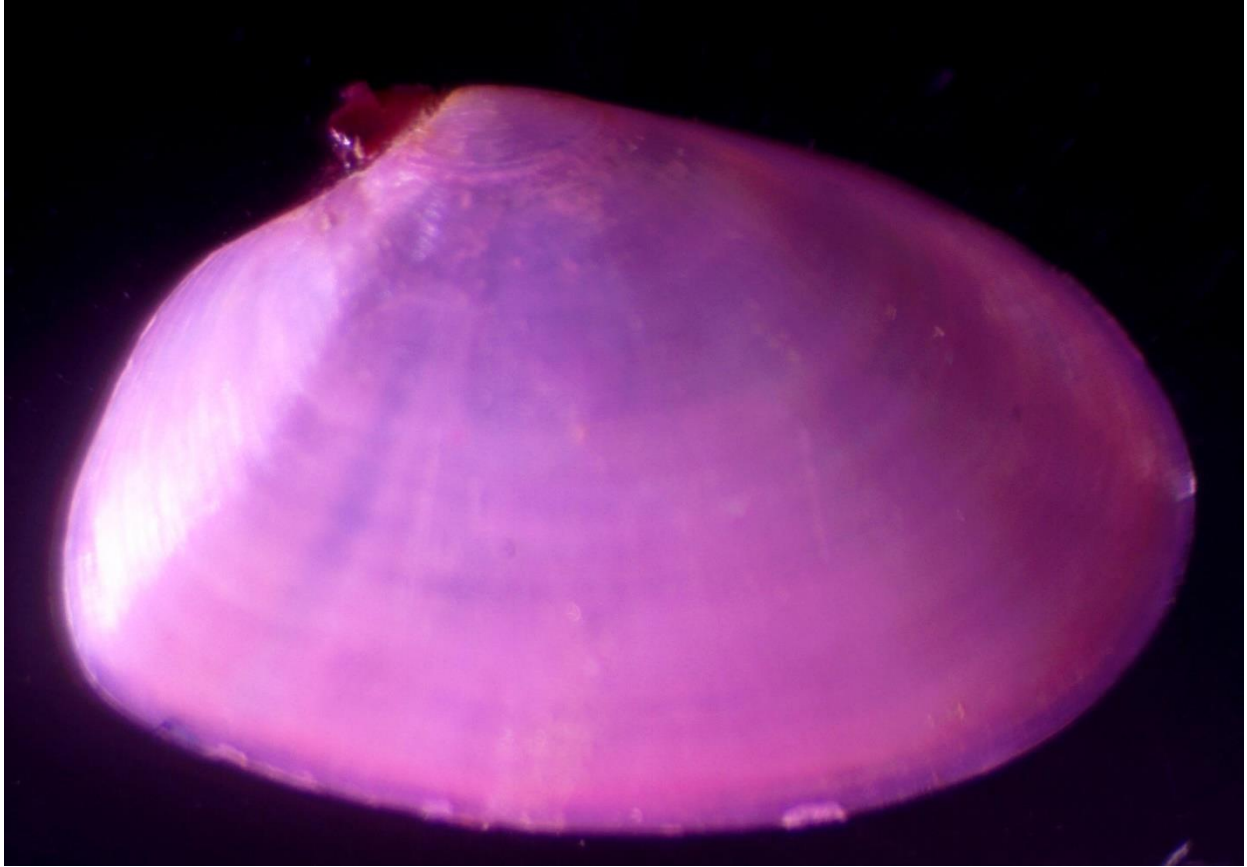
Cirratulidae (usually 0.5 in long), the most abundant family in cluster 7. Cirratulidae, or fringeworms, are a family of marine polychaets, or bristle worms. Members of the family are found worldwide, mostly living in mud or rock crevices. Most are deposit feeders, but some graze on algae or are suspension feeders. Some build muddy tubes attached to rocks or shells.



Capitellidae, or threadworms (usually 2 in long), are the most abundant family in cluster 12. Capitellidae are a family of marine polychaetes, or bristle worms. They are often earthworm-like in color. Members of this family build networks of tubes in mud. They tolerate organic-rich, low oxygen and polluted conditions.



Tellina agilis, the northern dwarf tellin (up to 0.6 in long), was the most abundant species in cluster 15. Tellins have smooth, thin shells and a long siphon for deposit feeding, which are often bitten off by fish. Members of this genus burrow horizontally in silty sands. They often prefer lower salinities.



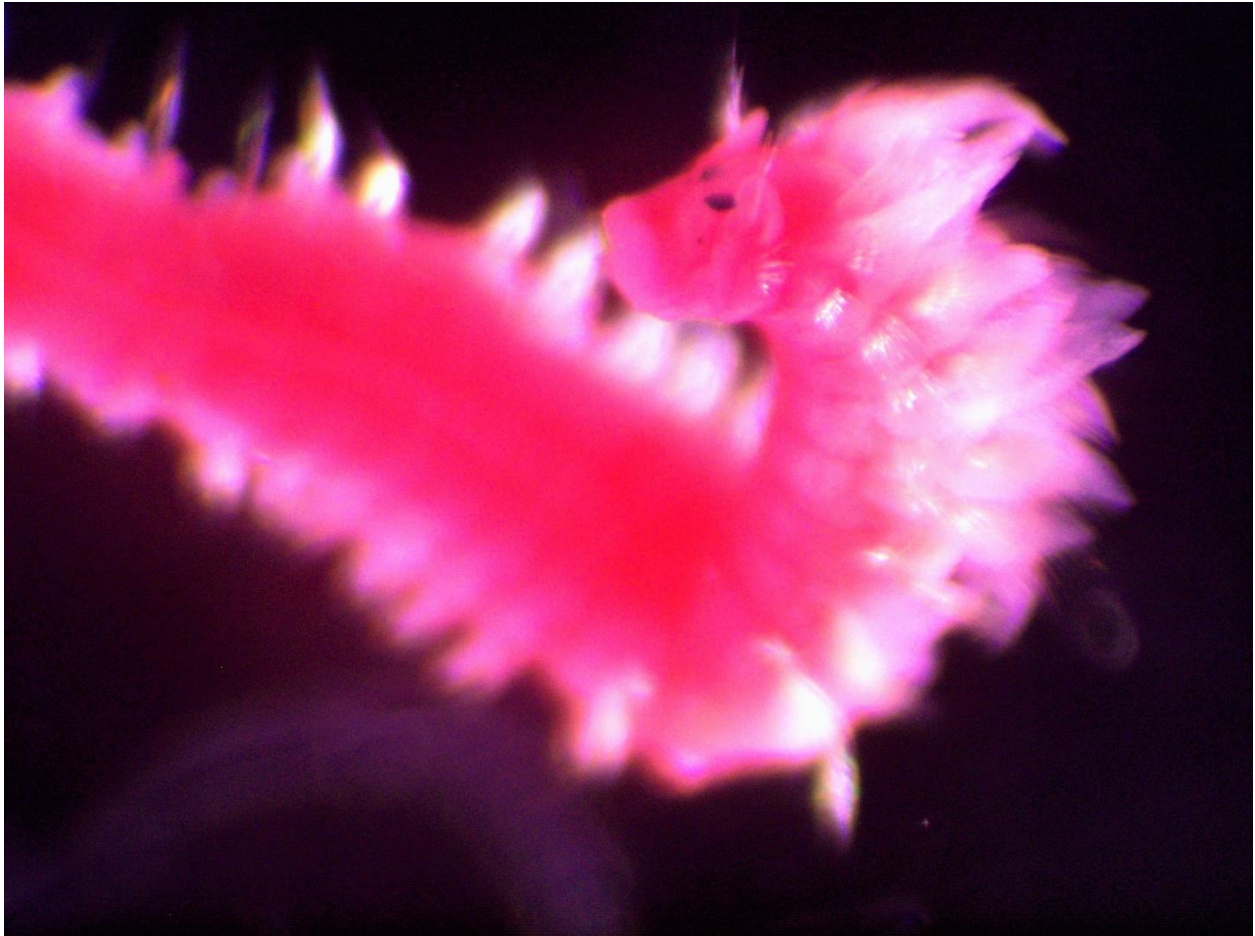
Haustoriidae, the most abundant family in cluster 16. Haustoriidae, or sand burrowers, are a species of Amphipods. Amphipods are an order of crustacean with no carapace and laterally compressed bodies. Locally they range in size from 0.03 inches to 0.5 inches and are mostly detritivore or scavengers. They are mostly marine animals, but are found in almost all aquatic environments. The name Amphipods translates from Greek to “different” “foot” and refers to the two different kinds of legs amphipods have. They are also known as sideswimmers. Haustoriidae are suspension feeders or buried detritivores.



Streblospio benedicti, bar-gill mudworm, is the most abundant species in cluster 5. This marine polychaete, or bristle worm, is up to 0.3 inches long and belongs to the family of Spionidae (mudworms). Mudworms are selective deposit feeders that use their two grooved palps to locate prey. Some mudworms produce tubes by cementing sand grains and detritus material with mucus produced by their glands.



Spionidae (mudworms), the most abundant family in cluster 13. This marine polychaete, or bristle worm, is a selective deposit feeder that uses its palps to locate prey. Some mudworms (like the one pictured below) produce tubes by cementing sand grains and detritus material with mucus produced by their glands.



Circeis spirillum, the dextral spiral tubeworm, is the most abundant species in cluster 11. This polychaete, or bristle worm, is a species of featherduster or tubeworm and about 0.25 inches in size. It forms small, whiteish, right coiled, tubes on algae, shells and stones.



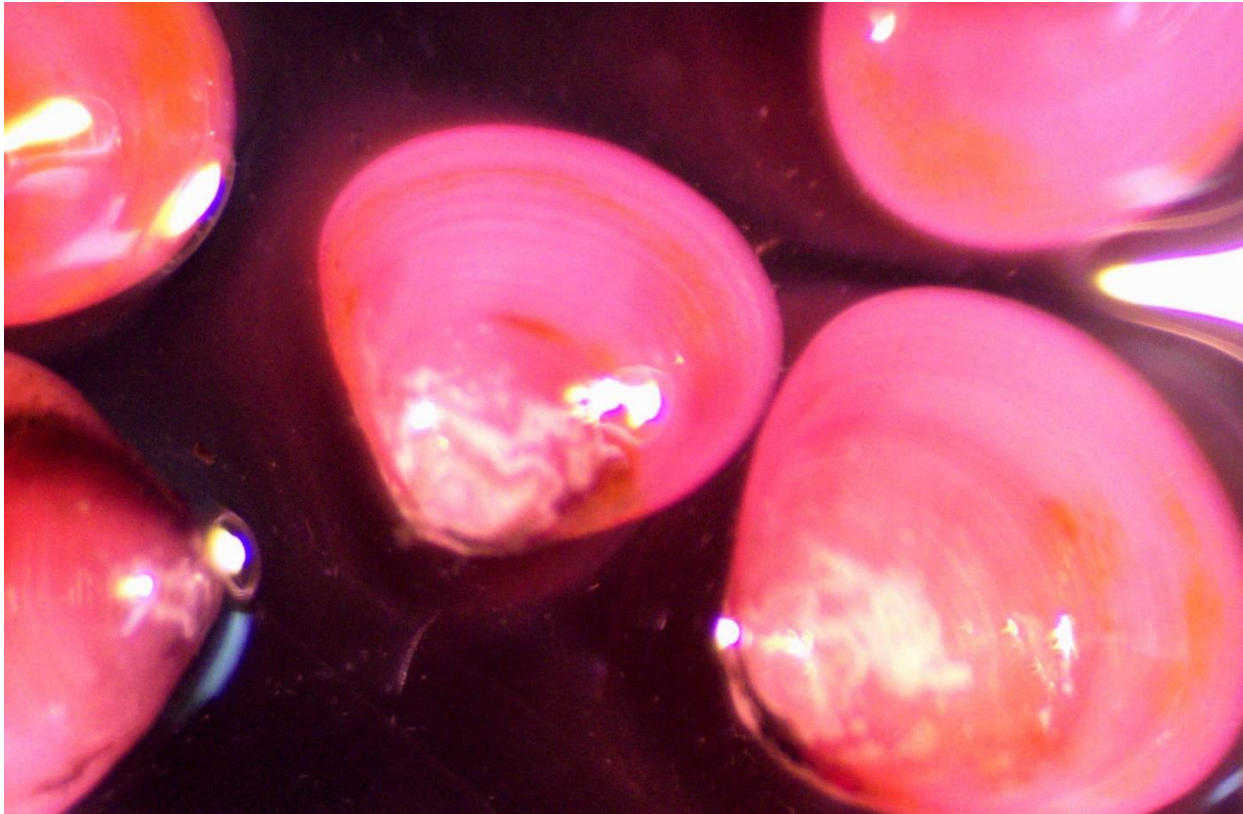
Nephtys spp, the most abundant species in cluster 10. Nephtidae, or catworms or shimmyworms, are a type of polychaete, or bristle worm, that characteristically shimmy under water. They can also dig relatively fast through sandy sediment and grow up to 2 inches long.



Idotea balthica, the Baltic isopod, is the most abundant species in cluster 17. The name isopod translates as “same” “foot” from Greek, describing the seven pairs of similar feet. They are crustaceans with more than 4500 species described in the marine realm. The Baltic isopod can grow up to 1 inch in size and varies in color, from green to brown and mostly feeds on decaying vegetation.



Gemma gemma, the amethyst gem clam, is the most abundant species in cluster 6, 8 and 9. It is a species of venus clams and grows up to 0.2 inches in size. The amethyst gem clam is common in shallow estuaries, bays and marshes. The species is native to the Atlantic coast of North America but is now found as an invasive species along the Pacific coast.



Acteocina canaliculata, the channeled barrel-bubble snail, is the most abundant species in cluster 2. It belongs to the family of bubble snails and grows up to 0.24 inches. They have a very thin, white glossy shell often stain with orange.



Caprellidae, or skeleton shrimp or ghost shrimp, are the most abundant family in cluster 3 and 14. They are a family of amphipods that frequently attach their hind legs to structures (from sea stars to waders) while waving their upper bodies in search for food. They grow up to 2 inches in size.



Species inventory of micro-invertebrate species found

Echinodermata

Amphipholis squamata
Arbacia punctulata
Asterias forbesi
Echinarachnius parma
Ophiuroidea

Chelicerata

Anoplodactylus lentus
Callipallene brevirostris
Limulus polyphemus

Anemona

Haloclava producta

Gastropoda

Acteocina canaliculata
Anachis sp
Astyris lunata
Bittium alternatum
Busycotypus canaliculatus
Crepidula fornicata
Crepidula plana
Haminoea solitaria
Hydrobiidae
Ilyanassa trivittata
Littorina littorea
Littorina sp
Naticidae
Onchidoris bilamellata
Onchidoris sp
Urosalpinx cinerea

Bivalvia

Ameritella agilis
Anadara transversa
Argopecten irradians
Cumingia tellinoides
Ensis lei
Gemma gemma
Lacuna vincta
Limecola balthica
Lyonsia hyalina
Mercenaria mercenaria
Mesodesma arctatum
Modiolus modiolus

Bivalvia (cont.)

Mulinia lateralis
Mya arenaria
Mysella planulata
Mytilus edulis
Pandora gouldiana
Parvicardium pinnulatum
Petricolaria pholadiformis
Pitar morrhuanus
Solamen glandula
Solemya velum
Tagelus spp
Thracia conradi
Turbonilla sp
Yoldia limatula

Polychaeta

Alitta succinea
Ampharetidae
Arenicola sp
Aricidea sp
Capitellidae
Circeis spirillum
Cirratulidae
Clymenella torquata
Flabelligeridae
Glycera americana
Glycera sp
Harmothoe imbricata
Harmothoe sp
Hesionidae
Hydroides dianthus
Lepidonotus squamatus
Lumbrineridae
Maldanidae
Marphysa sanguinea
Nephtys sp
Nereididae
Oeonidae
Ophelia sp
Orbiniidae
Paraonidae
Parasabella microphthalmus

Polychaeta (cont.)

Pectinaria gouldi
Phascolion strombus
 Phyllodocidae
Polycirrus eximius
Polydora sp
Polygordius sp
 Polynoidae
Prionospio steenstrupi
Scoloplos acutus
 Spionidae
Spirorbis spirorbis
Streblospio benedicti
 Syllidae
 Terebellidae

Isopoda

Chiridotea coeca
Edotia triloba
Erichsonella filiformis
Erichsonella sp
Idotea balthica
Idotea phosphorea
 Isopoda
Sphaeroma quadridentatum

Amphipoda

Ampelisca sp
 Amphipoda
Ampithoe longimana
Ampithoe sp
 Aoridae
Batea catharinensis
 Caprellidae
Corophium sp
Cymadusa compta
Elasmopus levis
Eobrolgus spinosus
Gammarus mucronatus
Gammarus sp
 Haustoriidae
Idunella barnardi
Idunella sp
Jassa falcata

Amphipoda (cont.)

Rhepoxynius epistomus
Rudilemboides naglei
Unciola sp
Jassa marmorata
Lysianopsis alba
Microdeutopus anomalus
Microdeutopus gryllotalpa
Microdeutopus sp
Microprotopus maculatus
Microprotopus raneyi
 Phoxocephalidae
Phoxocephalus holbolli

Peracarida

Cumacean
 Diastylidae
Leptochelia dubia
 Mysidae
Neomysis americana
Oxyurostylis smithi

Decapoda

Cancer irroratus
Crangon septemspinosa
 Crustacean
Hippolyte sp
Pagurus longicarpus
Pagurus sp

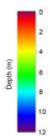
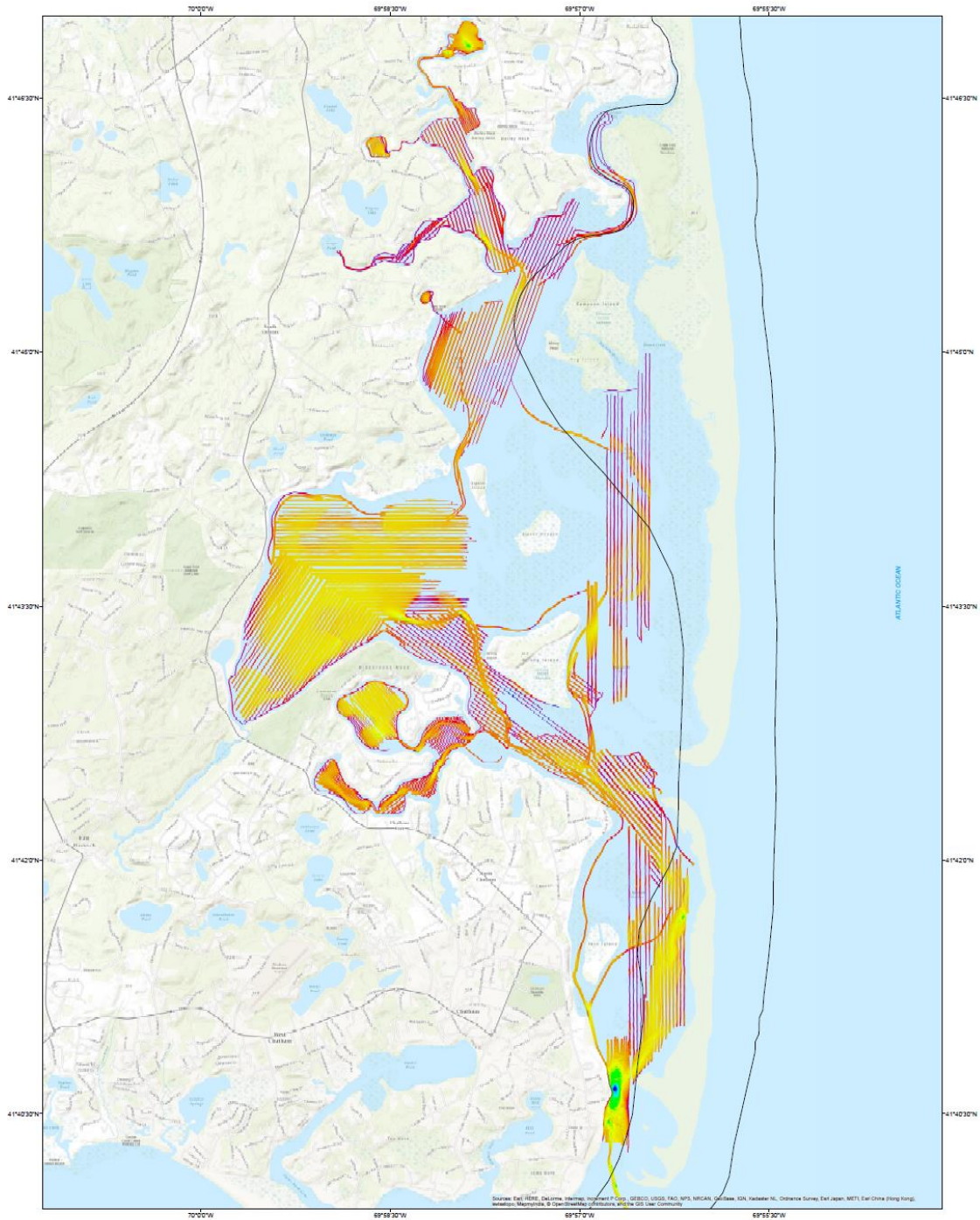
Others

Holothuroidea
 Nemertea
 Oligochaeta
 Platyhelminthes

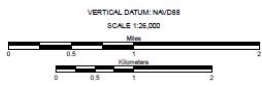
Ancillary species (fish)

Ammodytes americanus
Gobiosoma bosc
 Goniadidae
Pholis gunnellus

Bathymetry Map of Pleasant Bay



□ Cape Cod National Seashore

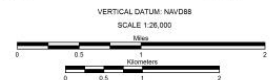
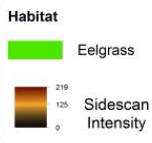
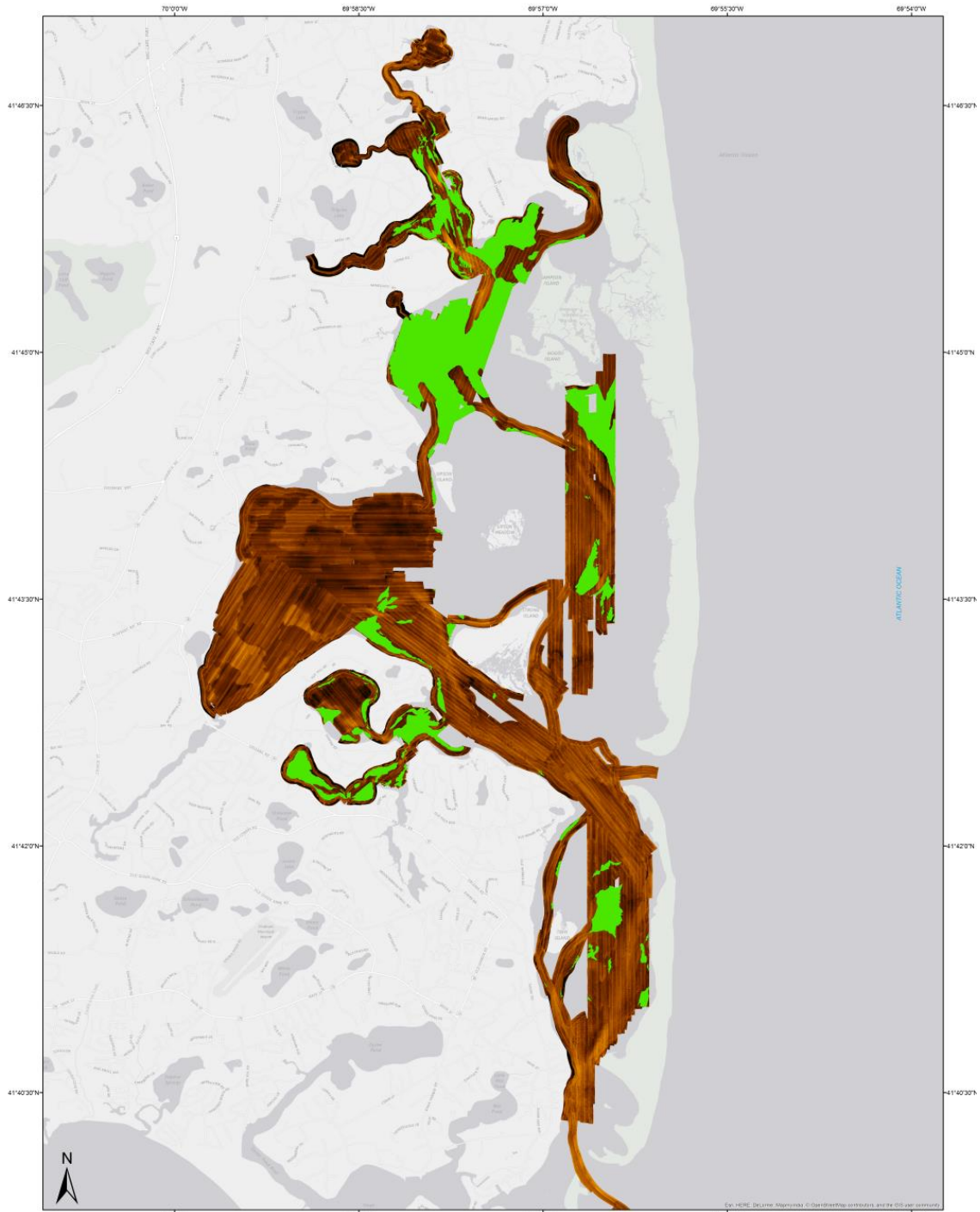


**Bathymetric Map
of the
Pleasant Bay Estuary, Massachusetts**

Bathymetry mapped for the Pleasant Bay estuary by the Center for Coastal Studies, Jul - Dec, 2014.



Eelgrass Locations in Pleasant Bay

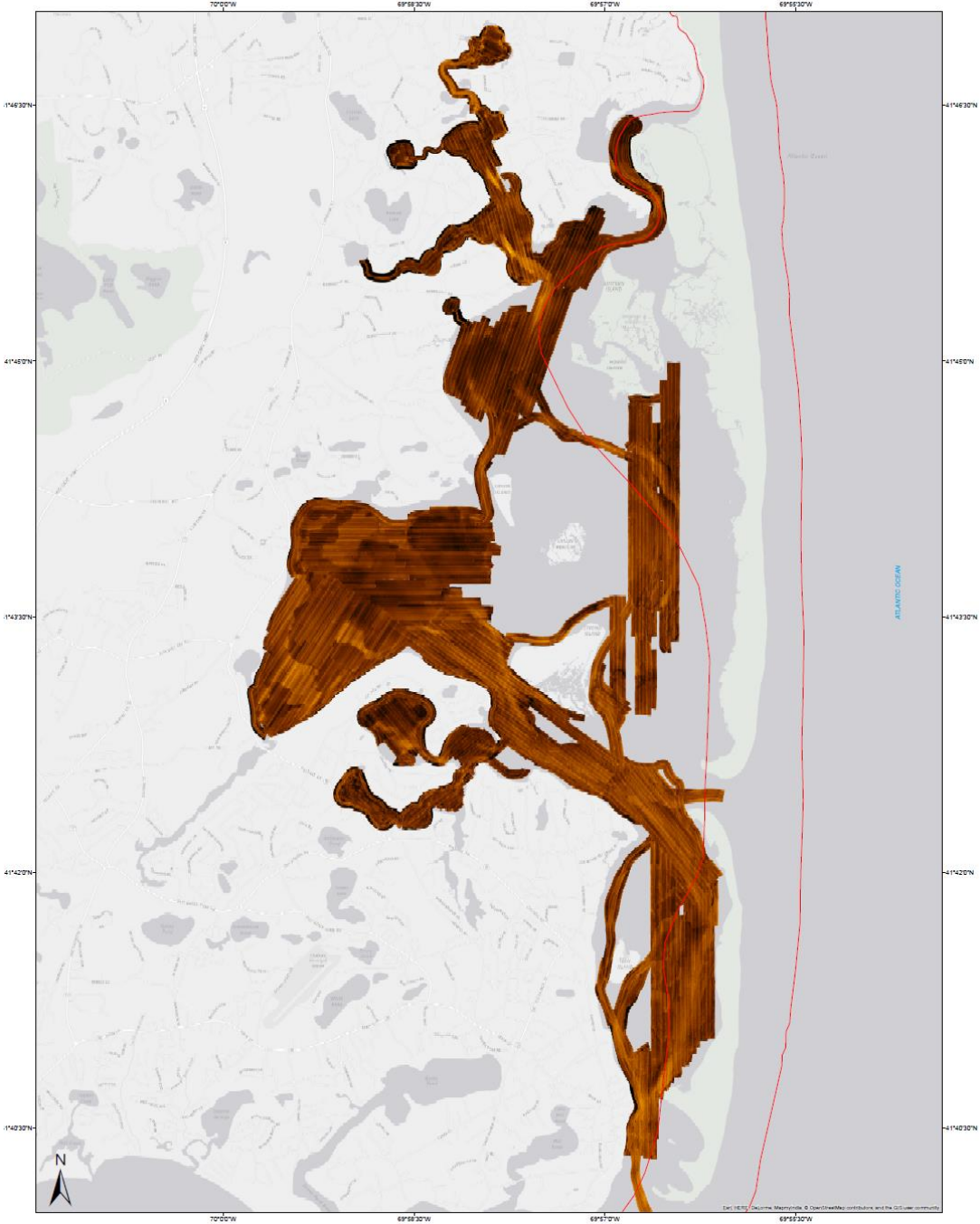


Ground Truth Locations for the Pleasant Bay estuary by the Center for Coastal Studies (Jul - Dec, 2014)

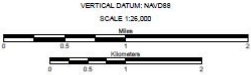


Ground Truth Locations of the Pleasant Bay Estuary, Massachusetts

Sidescan Map of Pleasant Bay



Cape Cod National Seashore
 Sidescan Intensity
 219
 128
 0



Sidescan Map of the Pleasant Bay Estuary, Massachusetts

Sidescan map for the Pleasant Bay estuary by the Center for Coastal Studies Jul - Dec 2014.



Species inventory of macro-invertebrate and fish species by gear type
including MADMF 1965-66 data (Fiske *et al.* 1967).

Common Name	Scientific Name	Systematic					Opportunistic				MADMF Historical	
		Years		2015-2016			2014	2015-2017			1955-56	
		Seine	Trawl	Dredge	Ventless Trap	Gillnet	Passive Collector	Seine	Trawl	Minnow Trap	Miscellaneous	Seine
Alewife	<i>Alosa pseudoharengus</i>	X										X
American eel	<i>Anguilla rostrata</i>	X	X	X				X		X		X
American lobster	<i>Homarus americanus</i>		X		X		X				X	
Asian shore crab	<i>Hemigrapsus sanguineus</i>								X			
Atlantic cod	<i>Gadus morhua</i>											X
Atlantic mackerel	<i>Scomber scombrus</i>								X			
Atlantic menhaden	<i>Brevoortia tyrannus</i>	X	X					X	X			X
Atlantic moonfish	<i>Selene setapinnis</i>		X						X			
Atlantic needlefish	<i>Strongylura marina</i>	X						X			X	X
Atlantic silverside	<i>Menidia menidia</i>	X	X					X	X	X		X
Atlantic surfclam	<i>Spisula solidissima</i>			X								
Atlantic tomcod	<i>Microgadus tomcod</i>	X	X		X					X	X	X
Bay anchovy	<i>Anchoa mitchilli</i>								X			
Bay scallop	<i>Argopecten irradians</i>		X	X			X		X		X	
Bittium	<i>Bittium sp.</i>		X	X					X			
Black sea bass	<i>Centropristis striata</i>							X			X	
Blackspotted stickleback	<i>Gasterosteus wheatlandi</i>											X
Blue crab	<i>Callinectes sapidus</i>		X	X	X	X		X	X	X		
Blue mussel	<i>Mytilus edulis</i>		X	X								
Bluefish	<i>Pomatomus saltatrix</i>	X						X				
Butterfish	<i>Peprilus triacanthus</i>								X			
Channeled whelk	<i>Busycotypus canaliculatus</i>			X	X							X
Common periwinkle	<i>Littorina littorea</i>		X	X								
Crevalle jack	<i>Caranx hippos</i>										X	
Cunner	<i>Tautoglabrus adspersus</i>		X	X			X		X	X	X	X
Dog whelk	<i>Nucella lapillus.</i>			X							X	

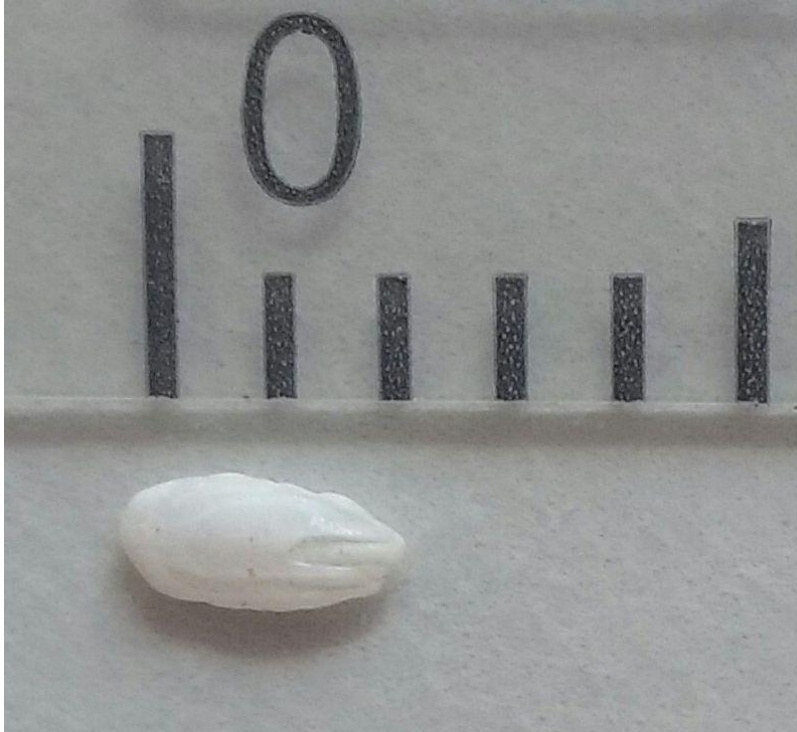
Fourspine stickleback	<i>Apeltes quadracus</i>	X	X	X				X	X	X			X
Grass shrimp	<i>Palaemonetes</i> sp.		X	X					X	X		X	X
Green crab	<i>Carcinus maenas</i>	X	X	X	X			X	X	X	X	X	X
Grubby	<i>Myoxocephalus aeneus</i>		X	X	X		X			X	X	X	X
Gulf Stream flounder	<i>Citharichthys arctifrons</i>		X						X				
Hermit crab	<i>Pagurus</i> sp.	X	X	X					X				
Hogchoker	<i>Trinectes maculatus</i>												X
Horseshoe crab	<i>Limulus polyphemus</i>		X	X	X	X		X	X				X
Knobbed whelk	<i>Busycon carica</i>			X	X				X				
Lady crab	<i>Ovalipes ocellatus</i>		X	X					X				
Longfin squid	<i>Doryteuthis pealeii</i>		X						X				X
Longhorn sculpin	<i>Myoxocephalus octodecemspinosus</i>												X
Lumpfish	<i>Cyclopterus lumpus</i>		X										
Mantis shrimp	<i>Squilla empusa</i>								X				
Mud crab	Xanthidae	X	X	X	X		X		X	X		X	X
Mud snail	<i>Ilyanassa obsoleta</i>	X						X		X			X
Mummichog	<i>Fundulus heteroclitus</i>	X	X	X				X		X		X	X
Northern pipefish	<i>Syngnathus fuscus</i>	X	X	X				X	X	X		X	X
Northern puffer	<i>Sphoeroides maculatus</i>											X	
Oyster drill	<i>Urosalpinx cinerea</i>		X	X				X	X	X			X
Oyster toadfish	<i>Opsanus tau</i>							X				X	X
Pollock	<i>Pollachius virens</i>	X	X										
Rainbow smelt	<i>Osmerus mordax</i>												X
Red hake	<i>Urophycis chuss</i>		X	X					X	X			
Rock crab	<i>Cancer irroratus</i>		X	X	X				X		X	X	X
Rock gunnel	<i>Pholis gunnellus</i>		X	X			X		X	X	X		
Sand lance	<i>Ammodytes</i> sp.	X	X										X
Sand shrimp	<i>Crangon septemspinosa</i>	X	X	X				X	X	X		X	X
Scup	<i>Stenotomus chrysops</i>		X						X				X
Sea herring	<i>Clupea harengus</i>		X										
Sea raven	<i>Hemitripterus americanus</i>												X
Sea star	<i>Asterias</i> sp.		X	X	X				X				

Seaboard goby	<i>Gobiosoma ginsburgi</i>		X	X				X				
Sheepshead minnow	<i>Cyprinodon variegatus</i>	X					X		X		X	
Shorthorn sculpin	<i>Myoxocephalus scorpius</i>		X						X			
Snowy grouper	<i>Hyporthodus niveatus</i>					X						
Softshell clam	<i>Mya arenaria</i>						X					
Solitary glassy-bubble	<i>Haminoea solitaria</i>		X	X				X				
Spider crab	<i>Libinia</i> sp.		X	X	X	X		X	X		X	X
Spotfin butterflyfish	<i>Chaetodon ocellatus</i>						X					
Spotted hake	<i>Urophycis regia</i>		X									
Striped bass	<i>Morone saxatilis</i>									X		X
Striped killifish	<i>Fundulus majalis</i>	X	X	X			X		X		X	X
Striped searobin	<i>Prionotus evolans</i>			X								
Tautog	<i>Tautoga onitis</i>		X				X					X
Threespine stickleback	<i>Gasterosteus aculeatus</i>	X	X								X	X
Transverse ark	<i>Anadara transversa</i>		X	X				X				
White hake	<i>Urophycis tenuis</i>						X					X
White mullet	<i>Mugil curema</i>							X				
Windowpane	<i>Scophthalmus aquosus</i>							X				
Winter flounder	<i>Pseudopleuronectes americanus</i>		X	X	X				X		X	X

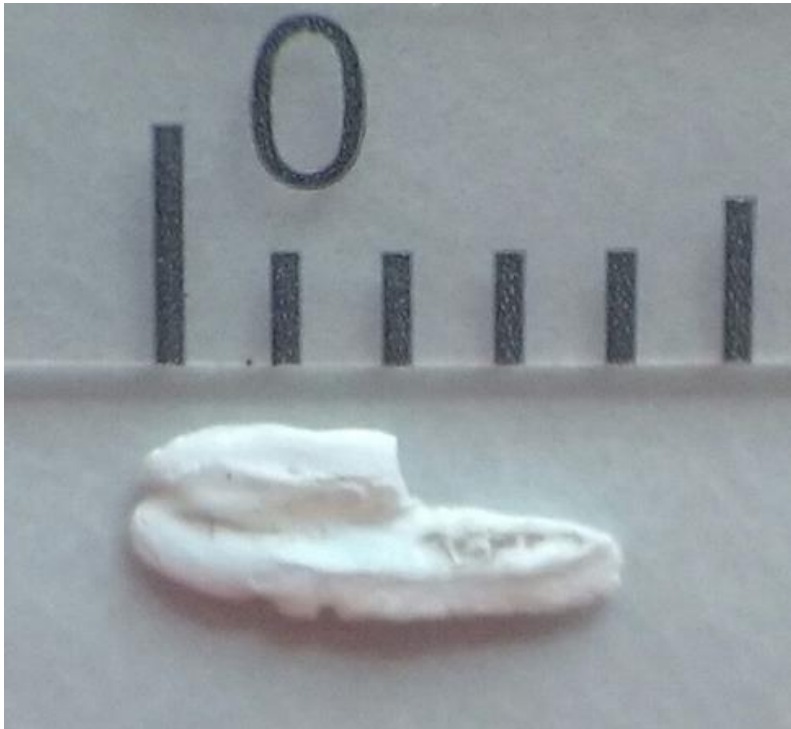
Prey otoliths and hard parts recovered during seal scat processing

Ruler scale on all pictures is in millimeters (mm)

Otolith of a sand lance



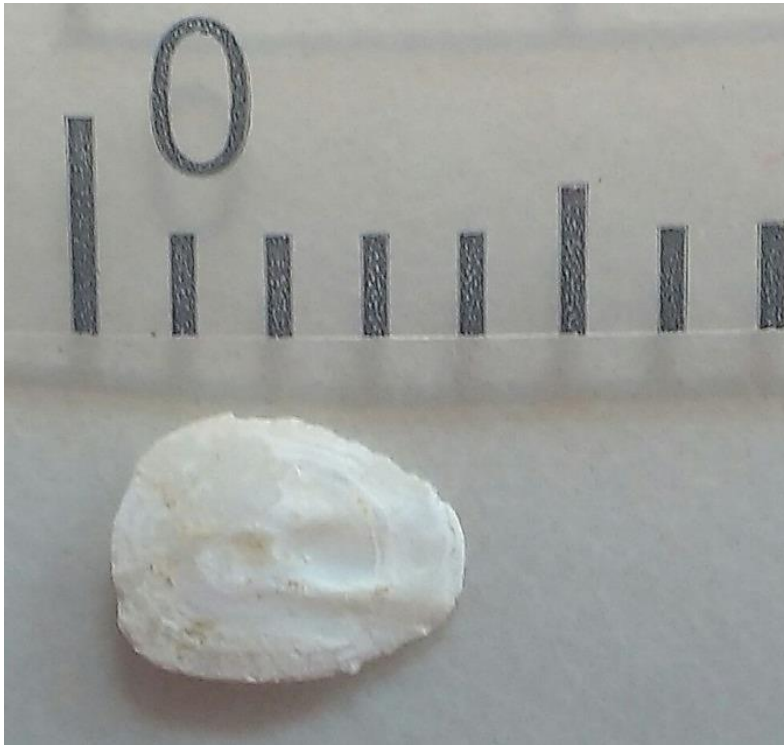
Otolith of a species of herring (Clupidae)



Otolith of a species of cod (Gadidae)



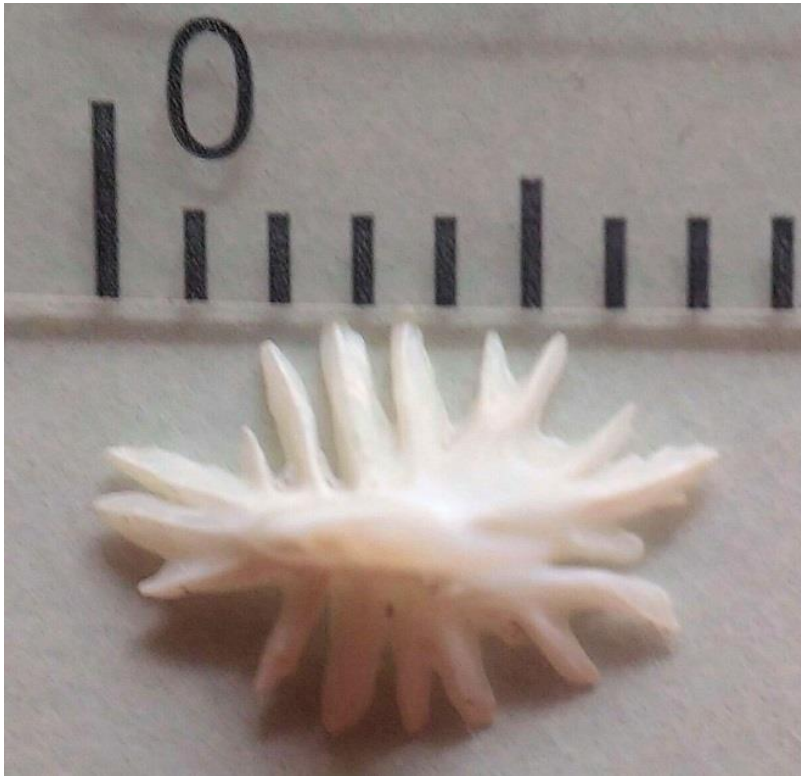
Otolith of a species of flounder (Pleuronectidae)



Beak of a longfin squid (*Doryteuthis pealeii*)



Dermal denticle of a skate species (Rajidae)



Jaw of an ocean pout (*Zoarces americanus*)



A species of marine snail (Gastropoda)



Shell fragment of a blue mussel (*Mytilus edulis*)



Carapace fragment of a crustacean species (Crustacea)

