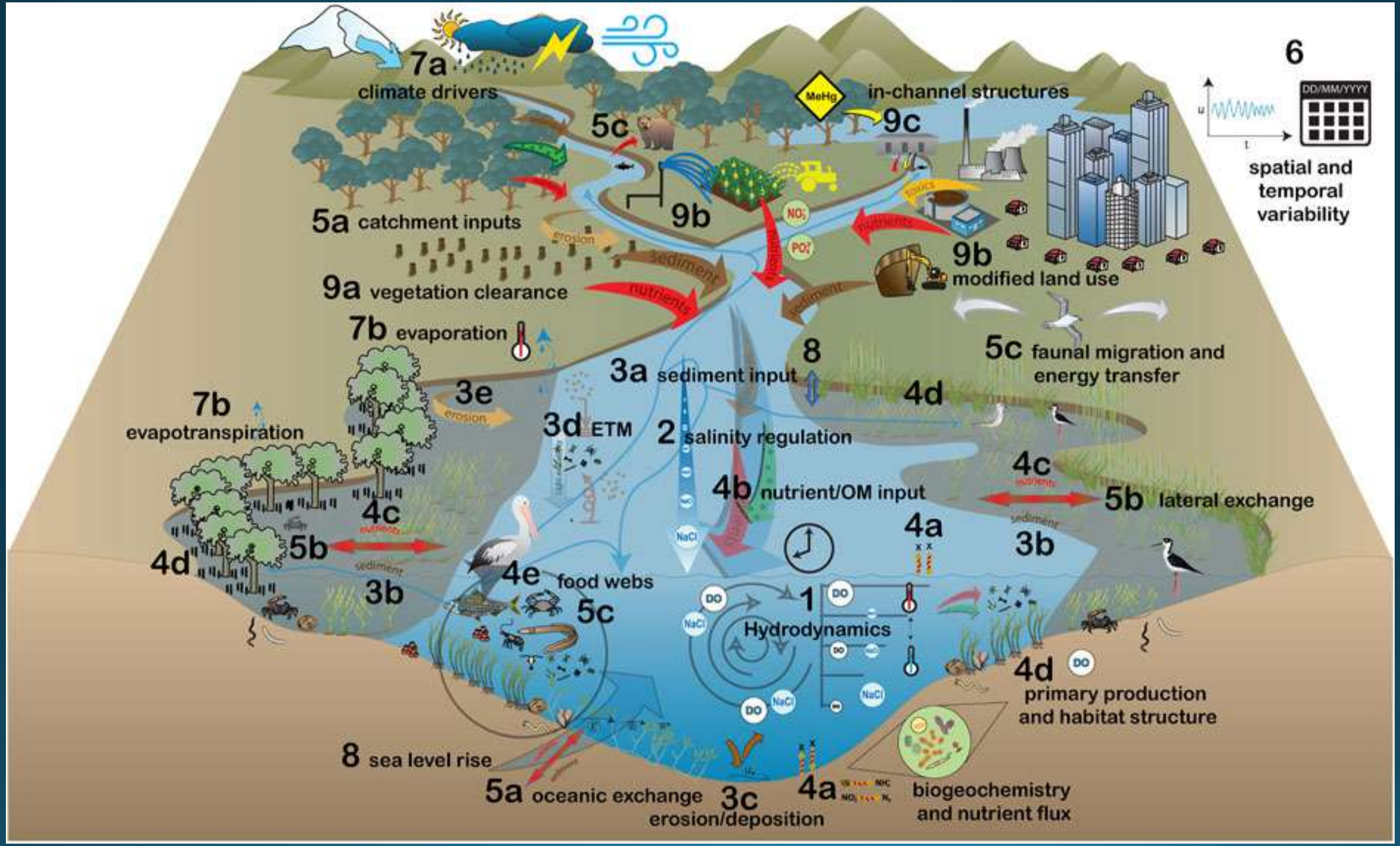
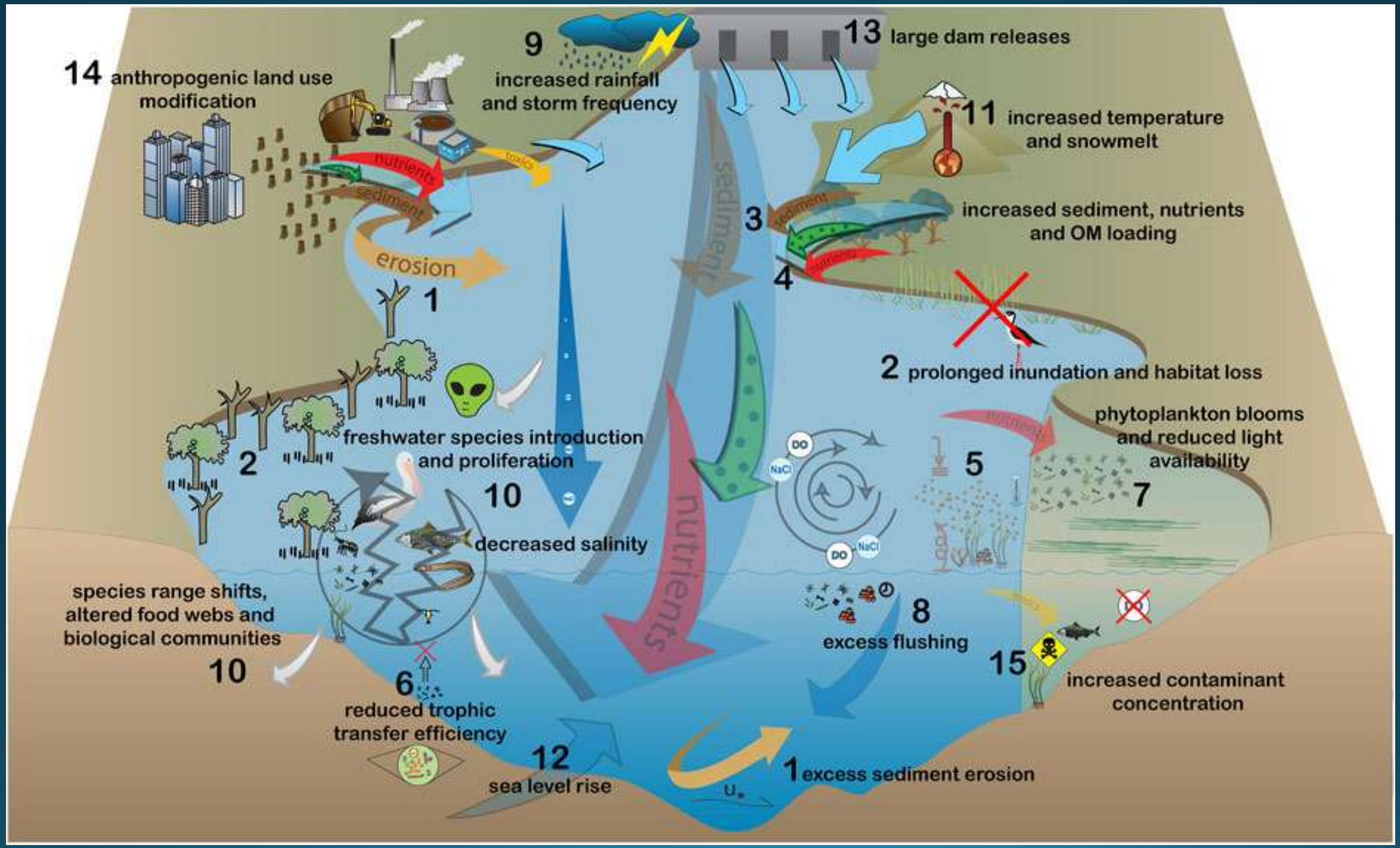
SPINELESS SEA CREATURES

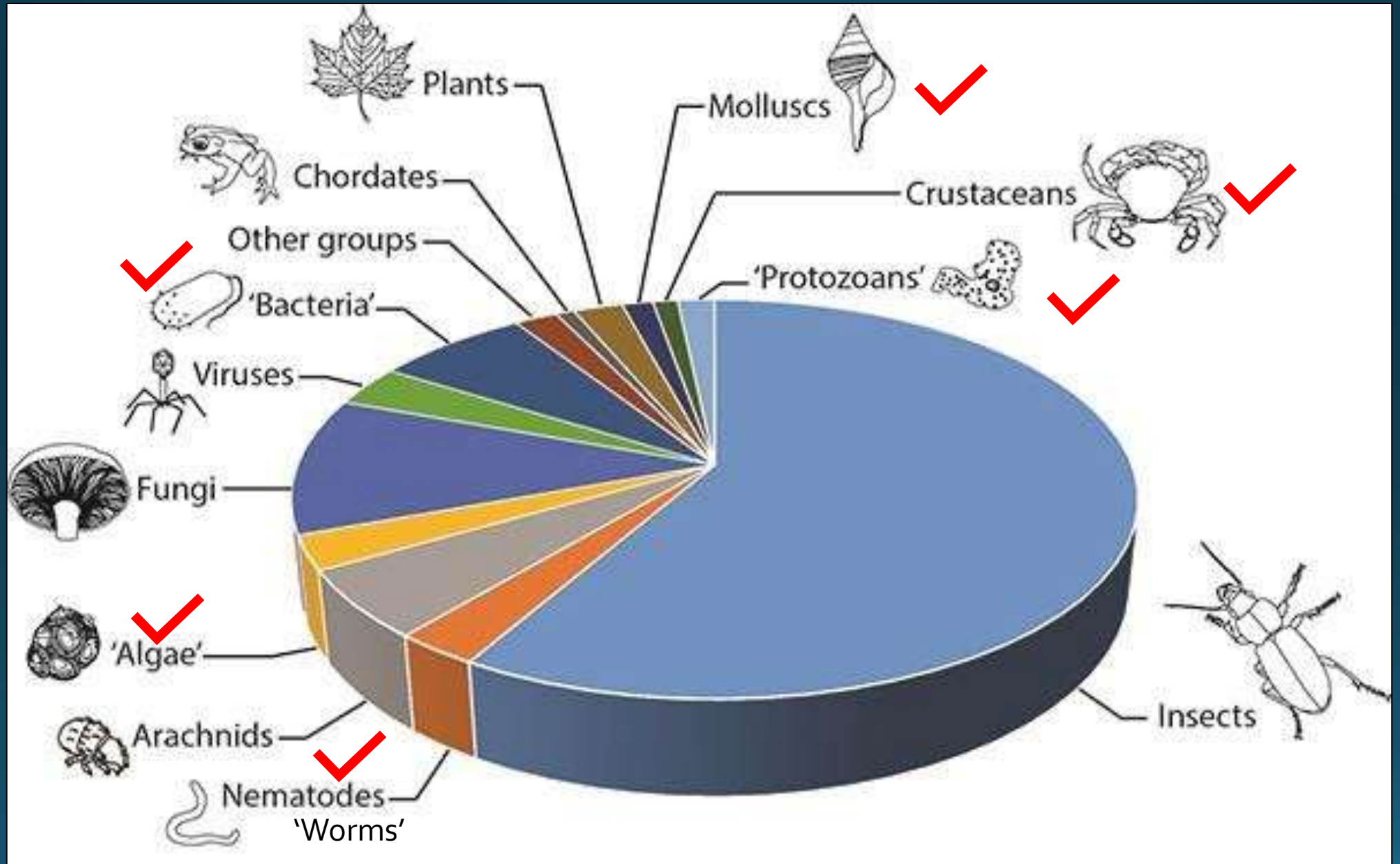
Richard Whitman, PhD

CEO, Heal Our Harbor

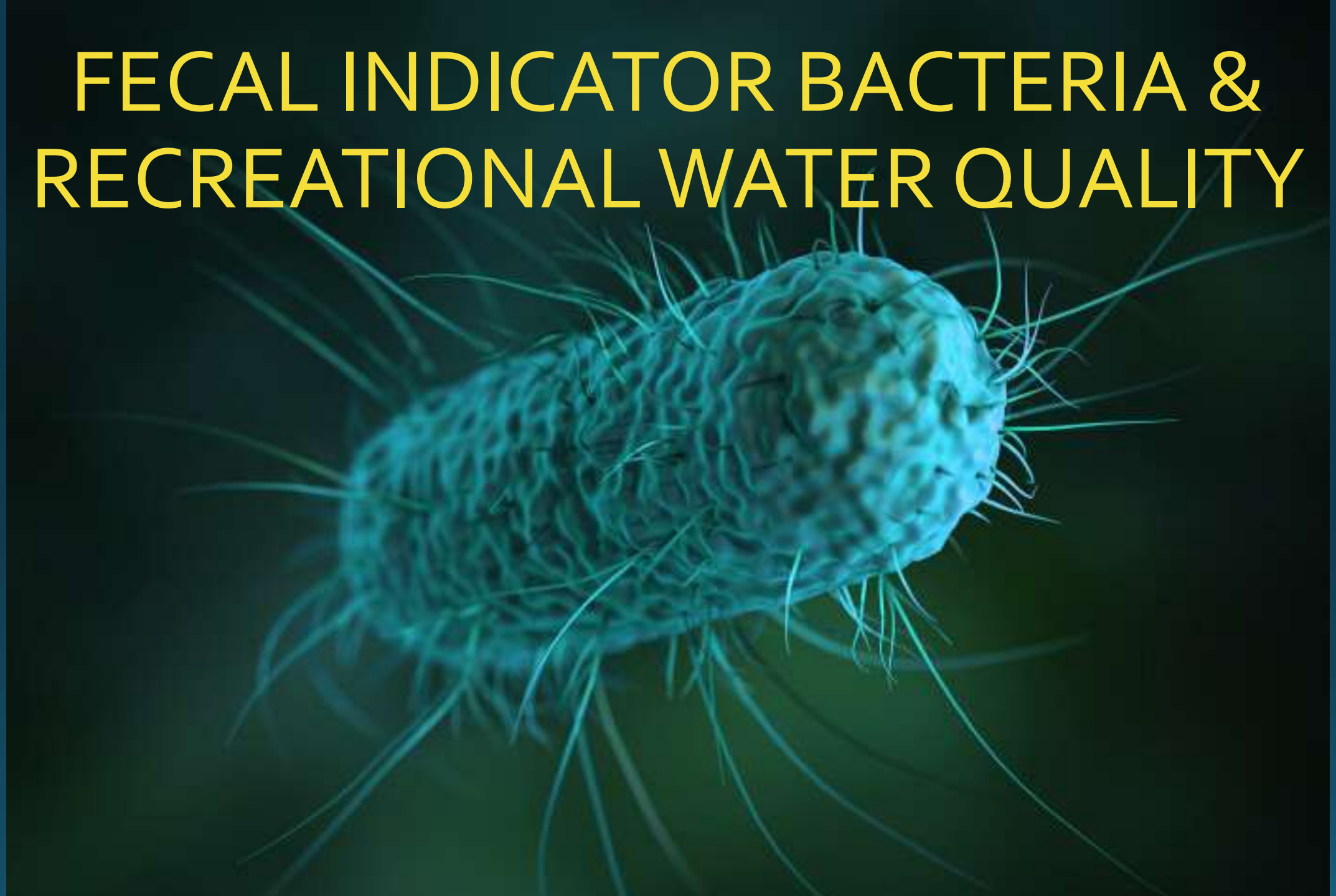

7a
climate drivers
MeHg
in-channel structures
9c
6
DD/MM/YYYY
spatial and
temporal
variability
5c
9b
5a catchment inputs
erosion
sediment
nutrients
9a vegetation clearance
9b
modified land use
7b evaporation
8
3a sediment input
4d
5c faunal migration and
energy transfer
7b
evapotranspiration
3e
erosion
3d ETM
2 salinity regulation
4c
nutrients
4b nutrient/OM input
5b lateral exchange
4a
4c
5b
sediment
3b
4d
4e food webs
5c
1
Hydrodynamics
DO
NaCl
4d
primary production
and habitat structure
8 sea level rise
5a oceanic exchange
3c
erosion/deposition
4a
biogeochemistry
and nutrient flux


14 anthropogenic land use modification
9 increased rainfall and storm frequency
13 large dam releases
11 increased temperature and snowmelt
increased sediment, nutrients and OM loading
3
4
nutrients
sediment
erosion
1
2 prolonged inundation and habitat loss
2
freshwater species introduction and proliferation
10
decreased salinity
phytoplankton blooms and reduced light availability
5
7
DO
NaCl
species range shifts, altered food webs and biological communities
10
6
reduced trophic transfer efficiency
8
excess flushing
15
increased contaminant concentration
12
sea level rise
1 excess sediment erosion

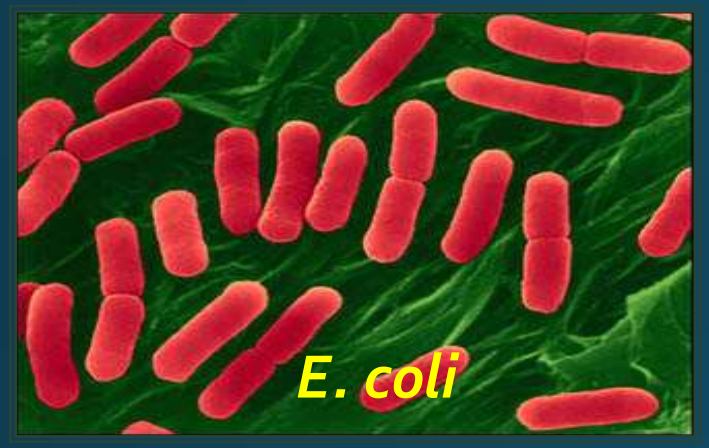
World Biodiversity

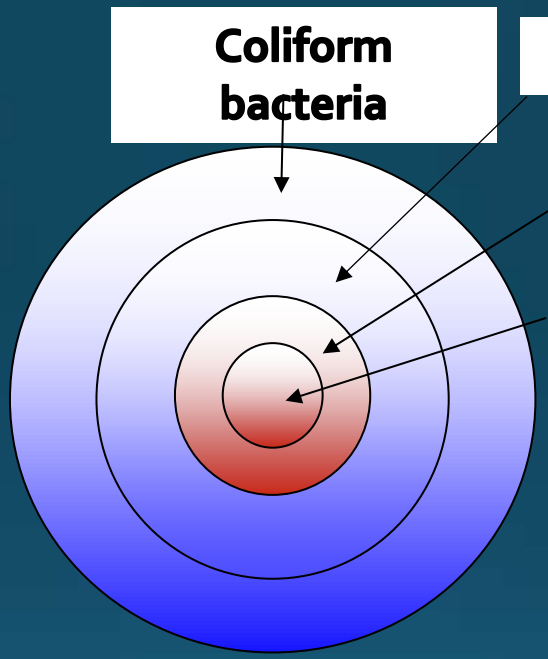


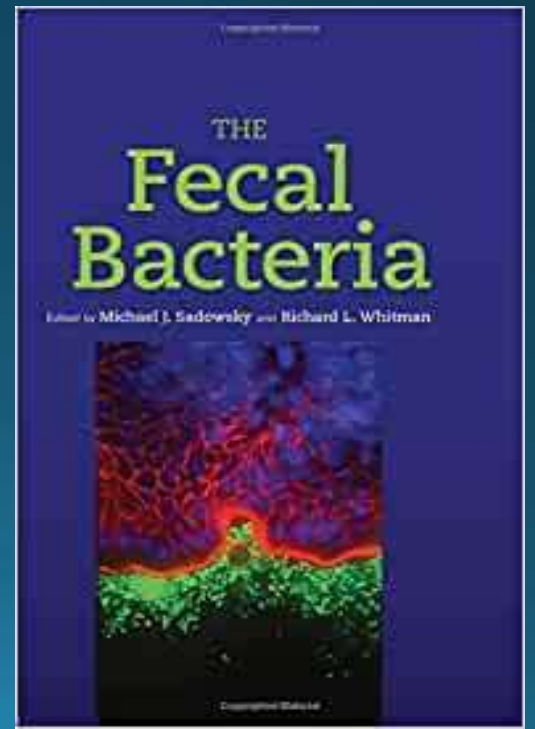
FECAL INDICATOR BACTERIA & RECREATIONAL WATER QUALITY



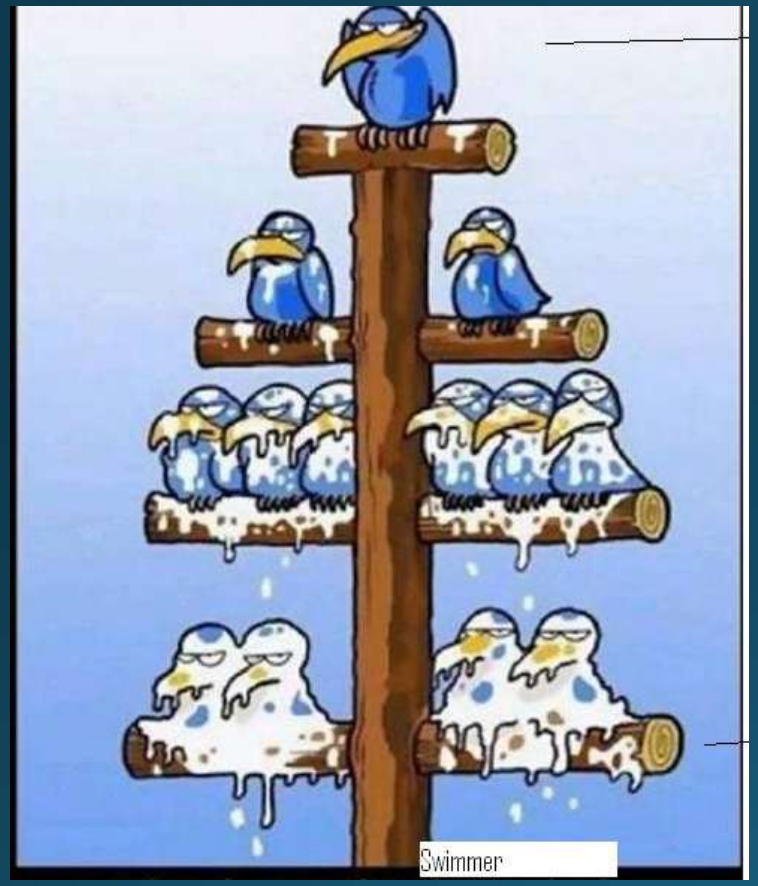
Fecal Indicator Bacteria (FIB)







Point vs. Non-point Sources



Point Source

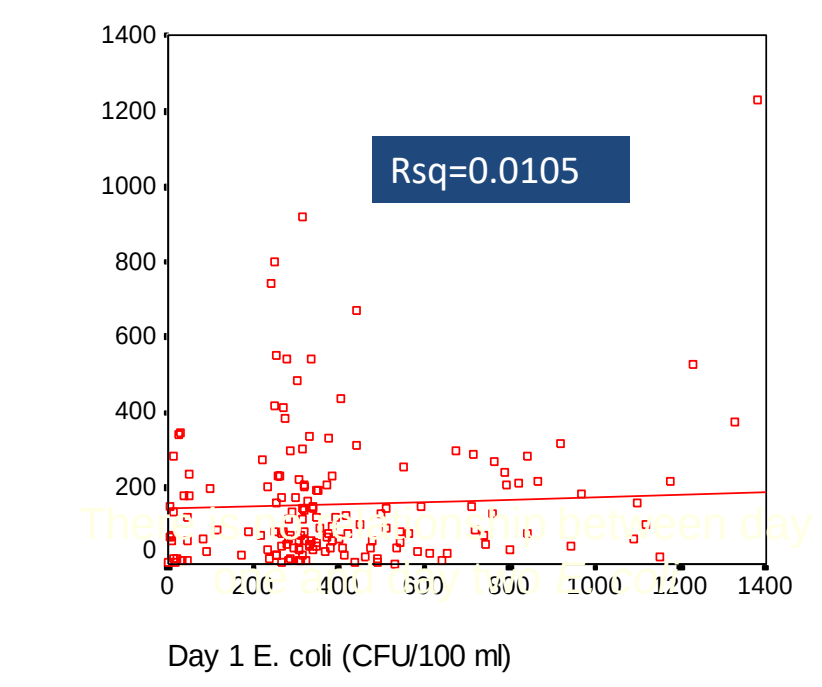
(Better Understood)
(Basis of Criteria)

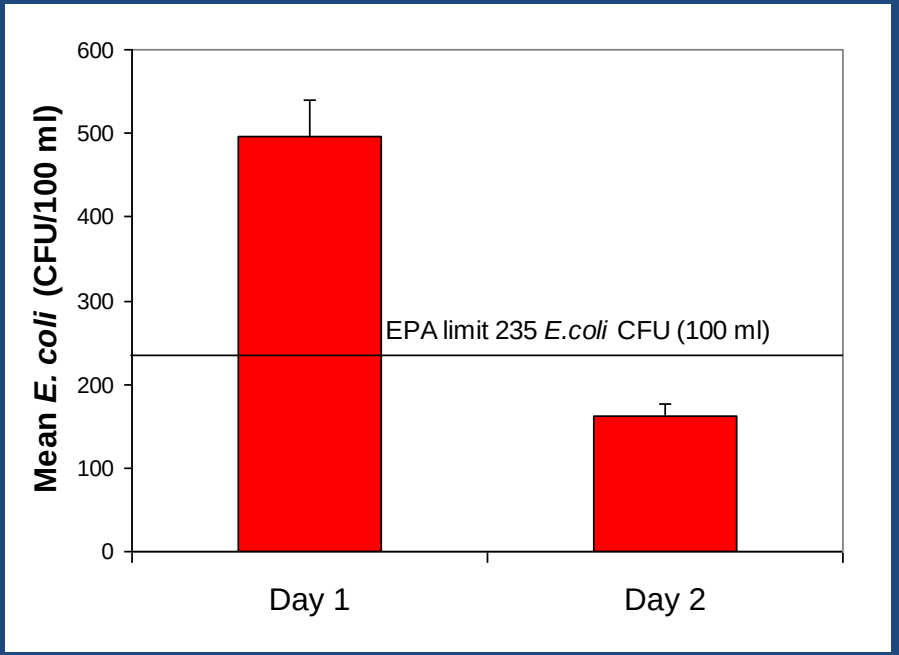
Non-point Source

Point vs. Non-Point Source
Not Easily Defined

Problems with *E. coli* monitoring protocols:

- Results not available until 18-24 hours after sample collection
- Tells you if safe to swim <u>yesterday</u>
- Twice a month!





Whitman, R. L., M. B. Nevers, and P. J. Gerovac. 1999. Interaction of ambient conditions and fecal coliform bacteria in southern Lake Michigan waters: Monitoring program implications. Natural Areas Journal 19:166-171.

FIB Highly Variable
Same Beach, Same Day

Anatomy of a closed beach

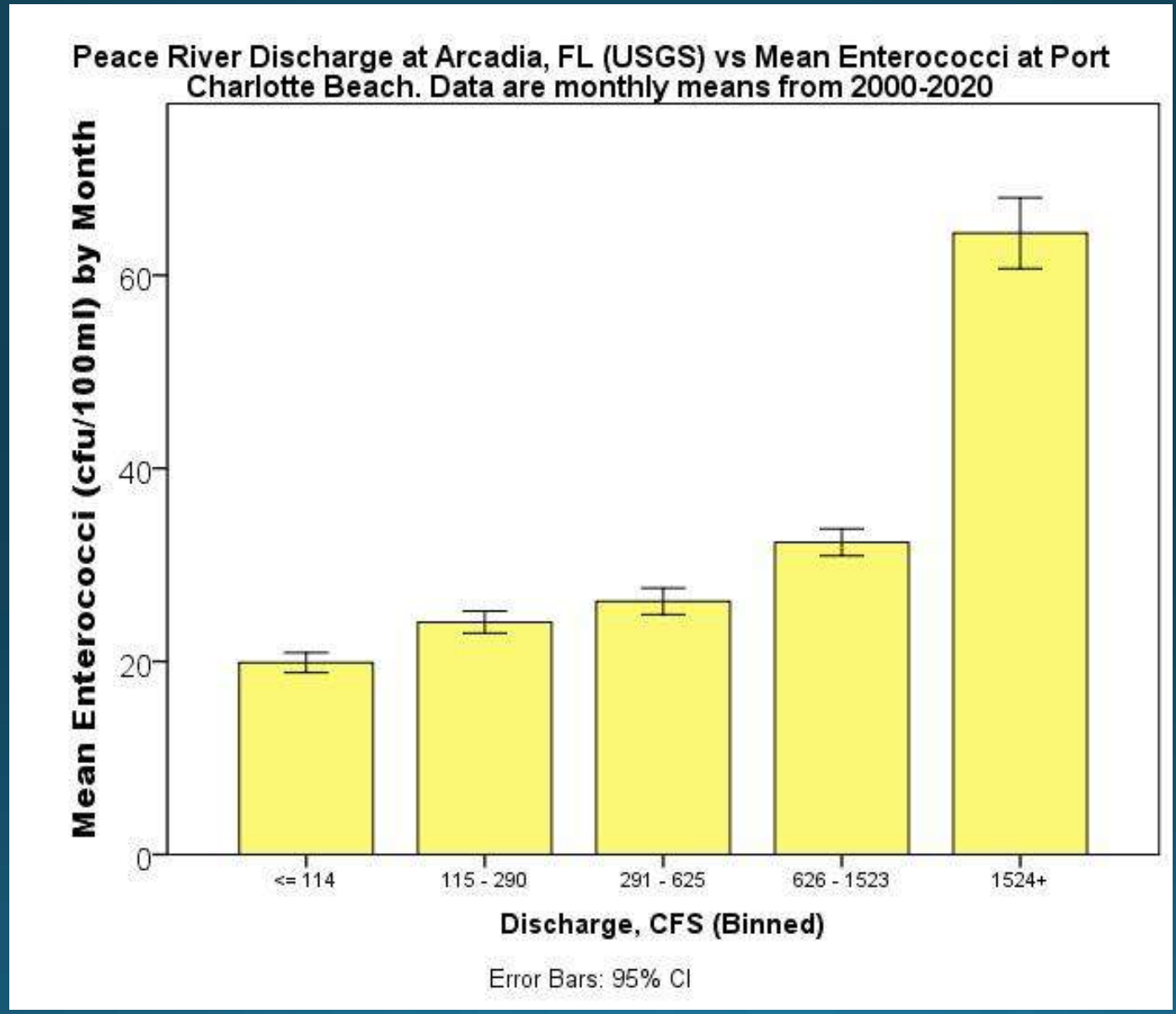
State Florida and US EPA Swimming Criteria

CRITERIA ELEMENTS	**Recommendation 1** Estimated Illness Rate 36/1,000		**Recommendation 2** Estimated Illness Rate 32/1,000	
Indicator	GM (cfu/100 mL)	STV (cfu/100 mL)	GM (cfu/100 mL)	STV (cfu/100 mL)
Enterococci (marine & fresh)	35	130	30	110
E. coli (fresh)	126	410	100	320

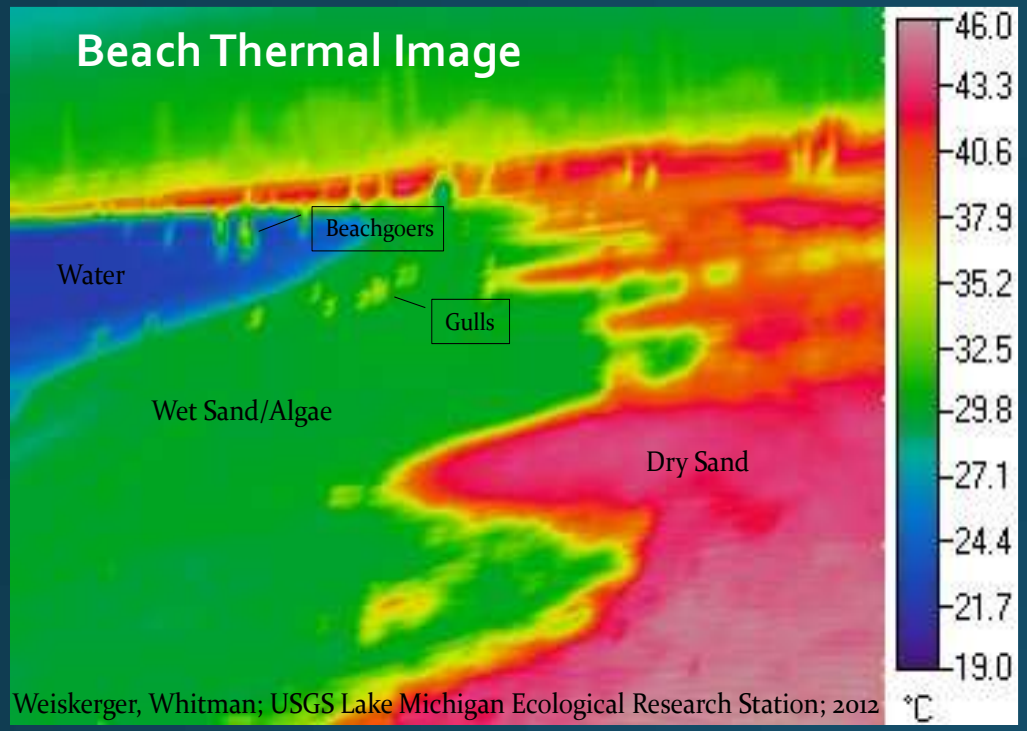
STV = Statistical Acton Value (single sample max)

FIB sources influence the risk of exposure to swimming-related illnesses (e.g. gastroenteritis)

FIB source	Relative risk
• Human feces/sewage	High
• Non-human (e.g., animal feces)	Moderate
• Environmental (e.g., plants, sand, wildlife, runoff)	poorly studied


Peace River Discharge at Arcadia, FL (USGS) vs Mean Enterococci at Port Charlotte Beach. Data are monthly means from 2000-2020
Mean Enterococci (cfu/100ml) by Month
0
20
40
60
<= 114
115 - 290
291 - 625
626 - 1523
1524+
Discharge, CFS (Binned)
Error Bars: 95% CI

Algae is an Issue



Pathogens

- *Salmonella*
- *Shigella*
- *Campylobacter*
- *C. perfringens*
- *C. botulinum*

Port Charlotte Beach, 10/3/2011

Current Research and Monitoring Punta Gorda Canals and Rivers

Thankyou

Questions?

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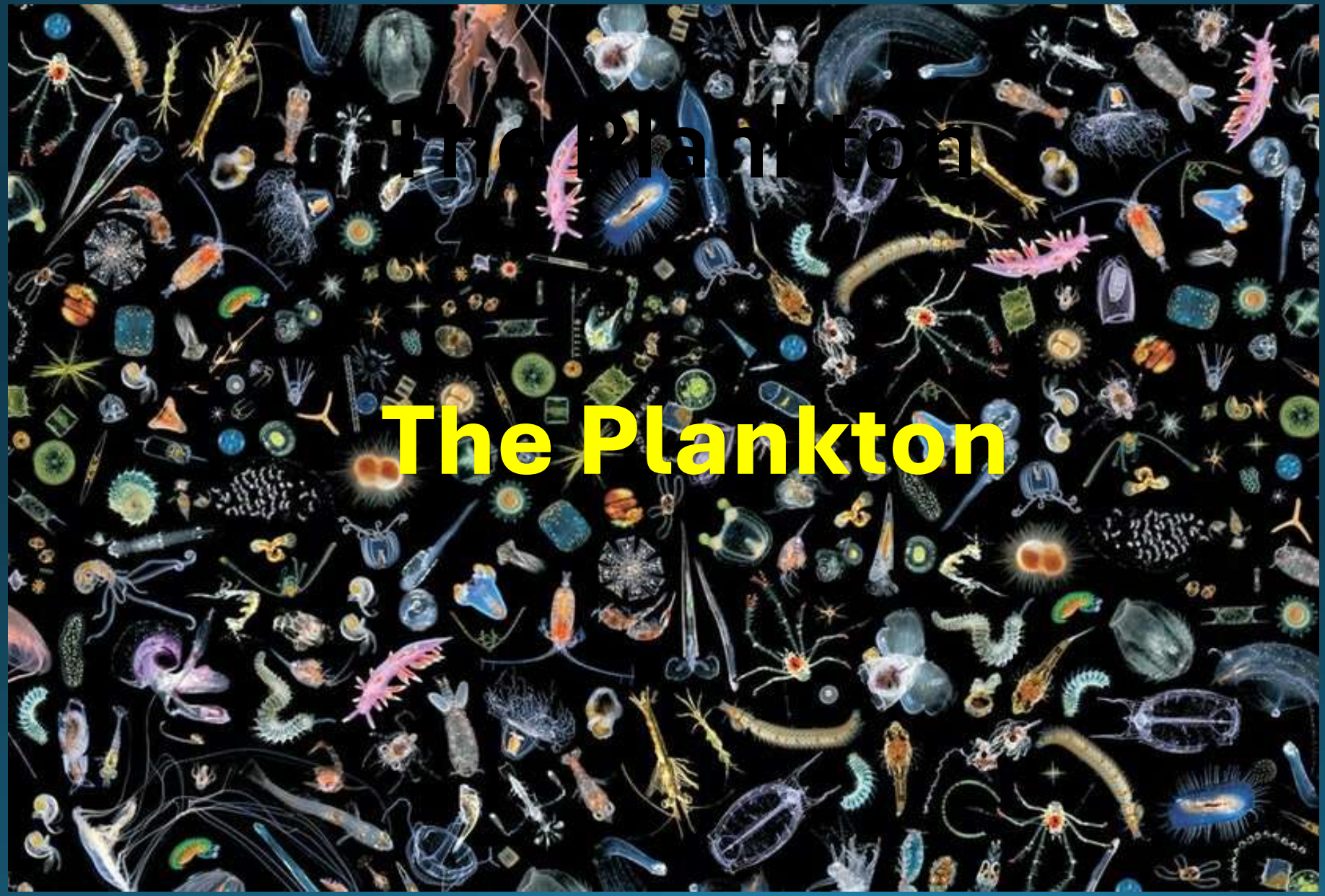
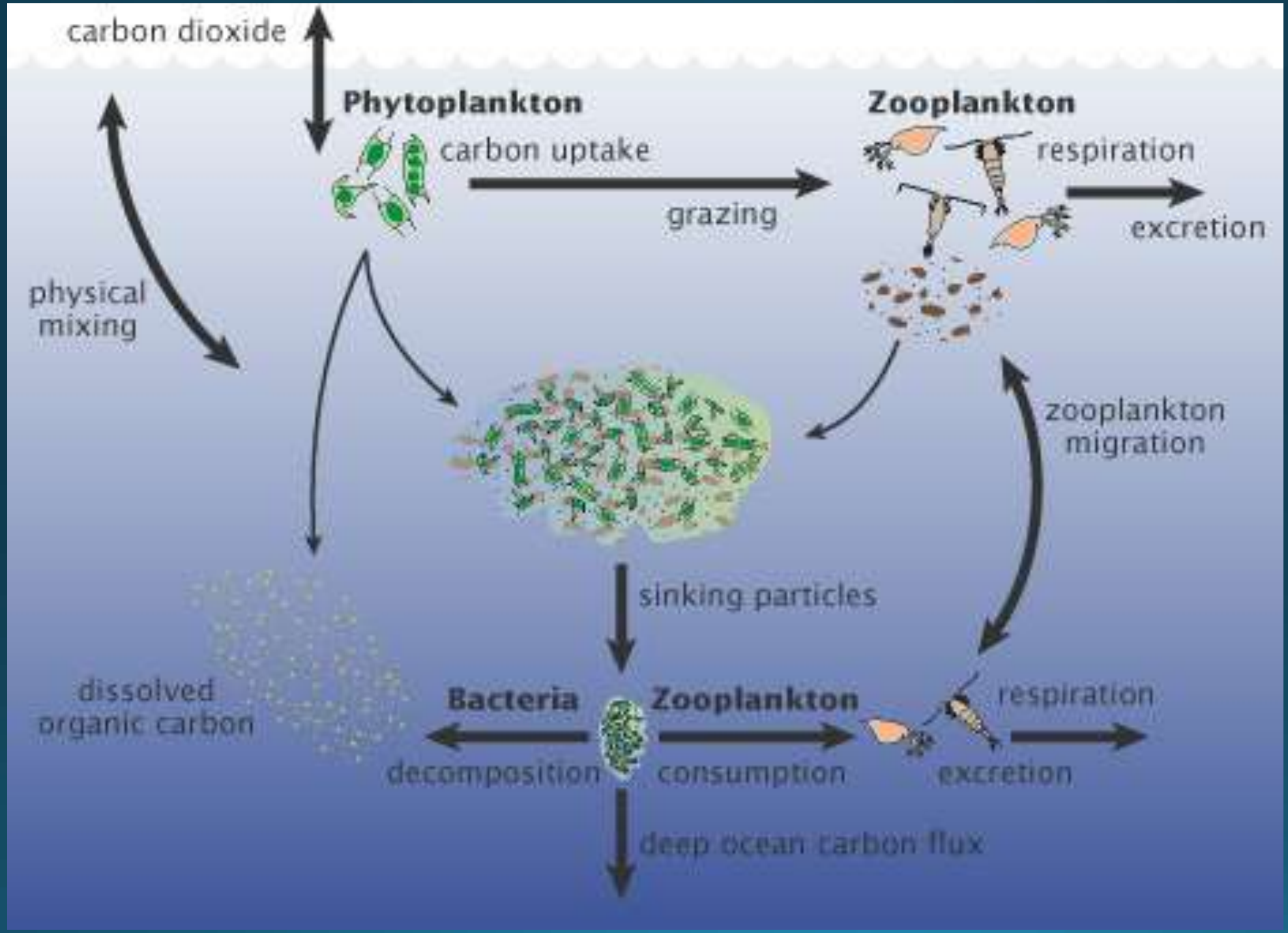
richard.Whitman@healourharbor.org


The Plankton


carbon dioxide
Phytoplankton
carbon uptake
grazing
Zooplankton
respiration
excretion
physical mixing
zooplankton migration
sinking particles
dissolved organic carbon
Bacteria
Zooplankton
respiration
decomposition
consumption
excretion
deep ocean carbon flux

Why are plankton important?

- Important part of global carbon cycle
- Food source (basis of the food web)
- Producer of oxygen (photosynthesis)
- Carbon sink (climate change)

Plankton are an energy source for marine ecosystems

- Many plankton are primary producers
- Over 90% of marine primary production (energy produced) is from phytoplankton! The rest is from marine plants and other sources.

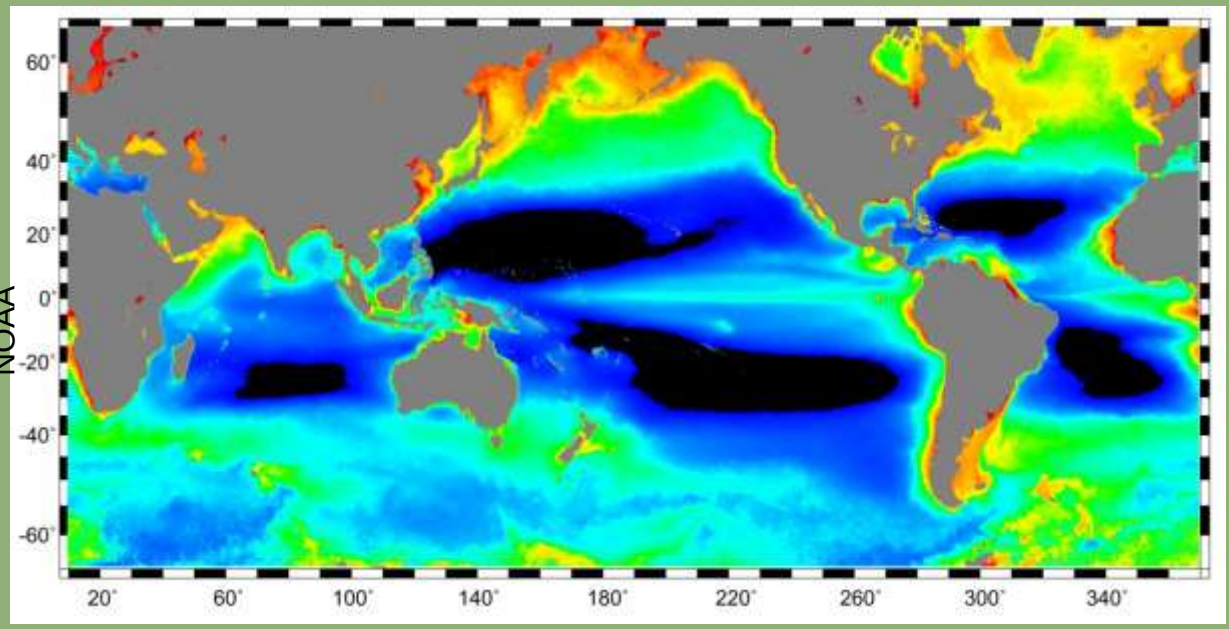


Photo: NOAA

This map shows productivity in the Oceans

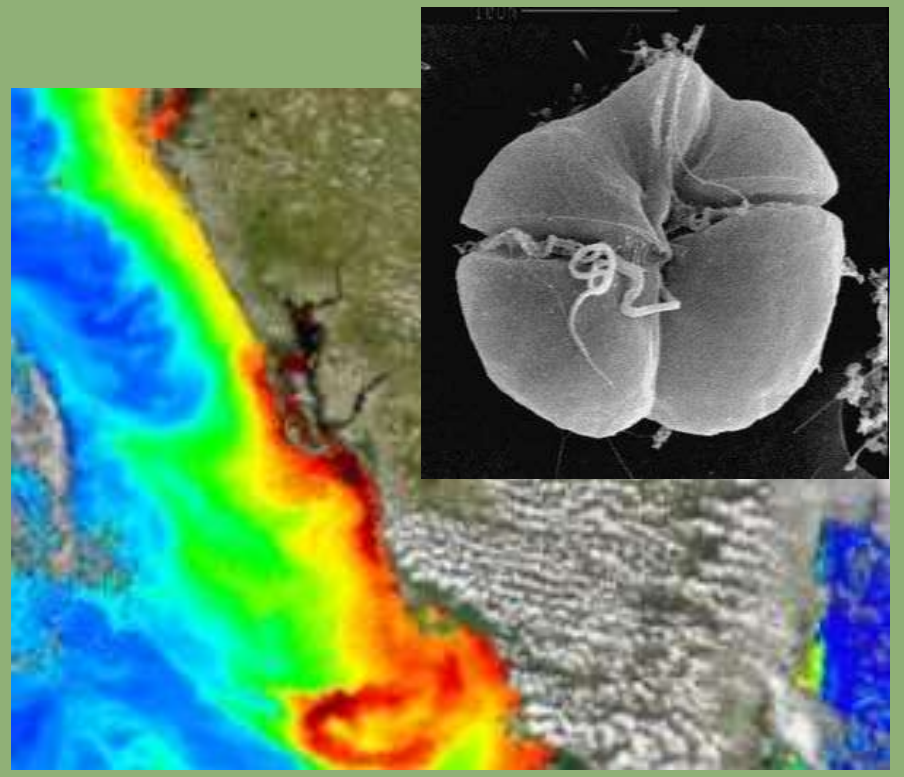
Red and yellow are most productive, followed by green and blue. Black is least productive.

How are plankton studied?

- Special nets
- Underwater cameras
- Microscopes
- Satellites

Satellites can also help scientists study plankton

- Satellites equipped with color scanners measure the concentration of chlorophyll in the ocean
- Red and orange indicate higher concentration of chlorophyll, while blue and green represent lower concentrations
- Chlorophyll is an indicator of plankton and can be used to study plankton populations

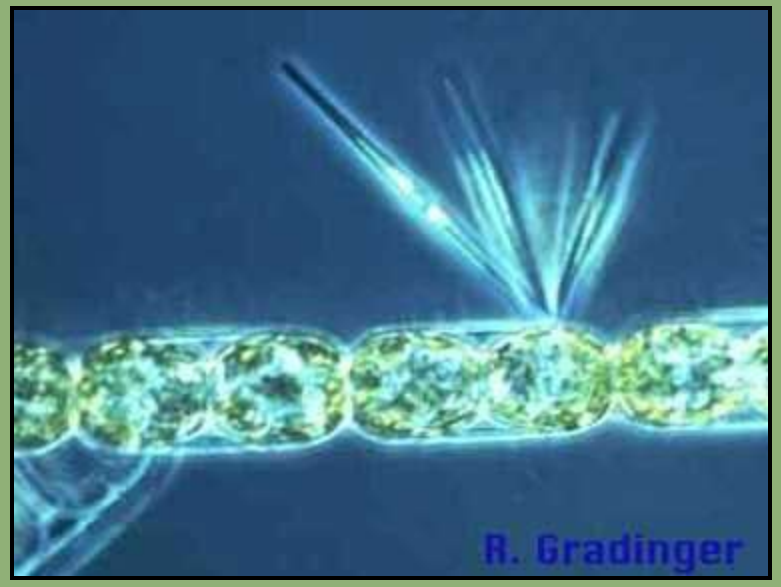


Satellite image of the Gulf of Mexico, NASA

Do organisms spend their entire lives as plankton?

- **Holoplankton** spend their entire life cycle as plankton
- Examples include dinoflagellates, diatoms and krill

Photo: Rolf Gradinger, NOAA/OER



Diatom (Unicellular phytoplankton)

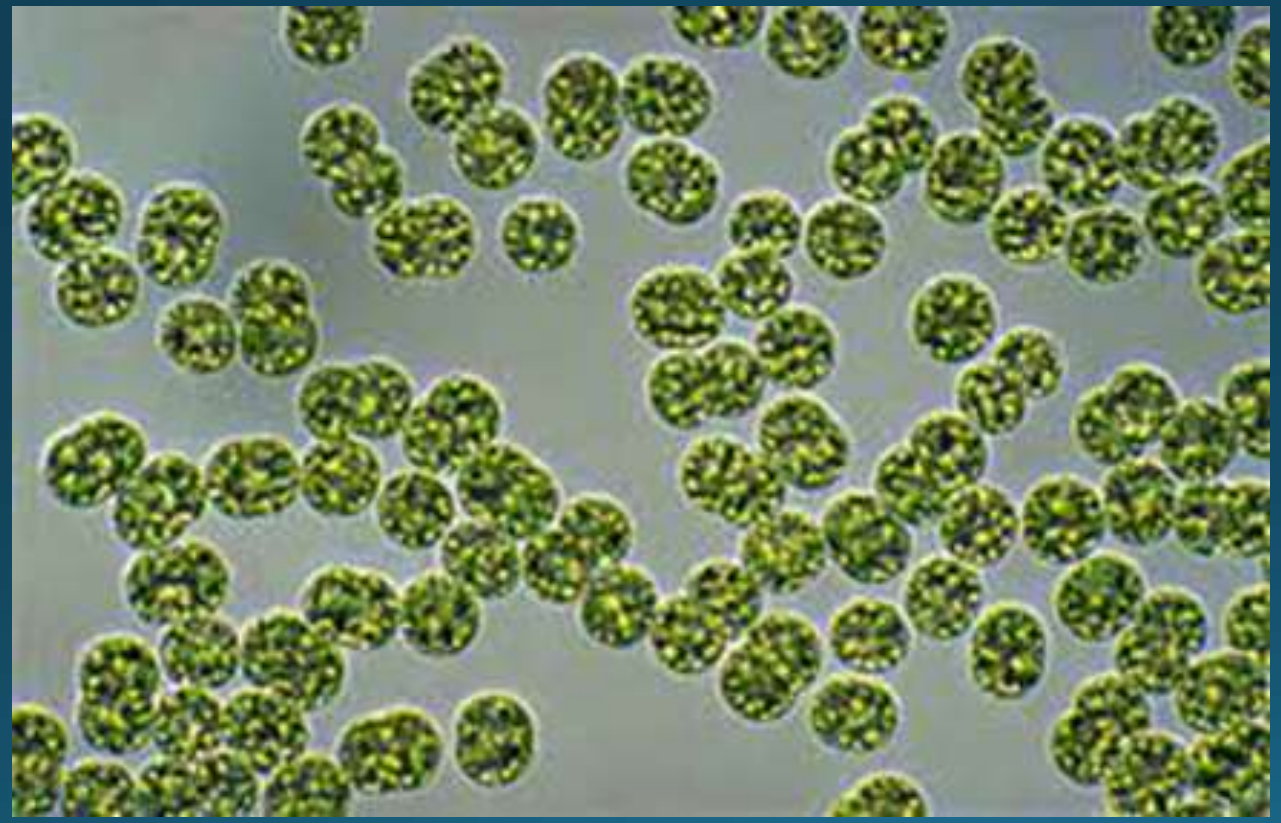
Do organisms spend their entire lives as plankton?

- **Meroplankton** spend only a part of their life cycle drifting
- As they mature they become **nekton** (free swimmers) or **benthic** (crawlers)
- Examples include blue crab and tarpon larvae


100 µm

Diatoms
Centrate
Pennate

Protists (Dinoflagellates)

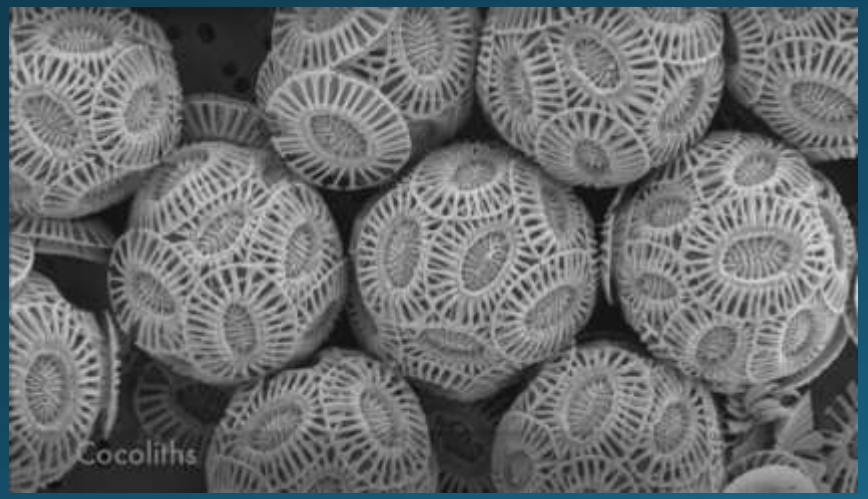


Karina brevis, Red Tide

Protists

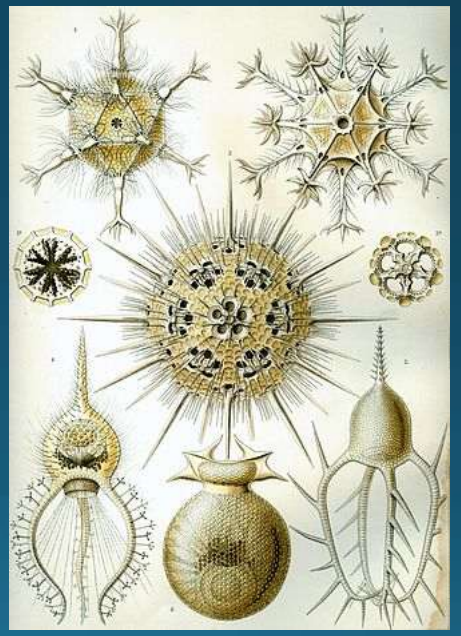
Coccoliths (chalk)

Phytoplankton, calcium



Radiolarian

Zooplankton, silica



from Christian Sardet: Plankton, Wonders of a Drifting World. Univ. Chicago Press

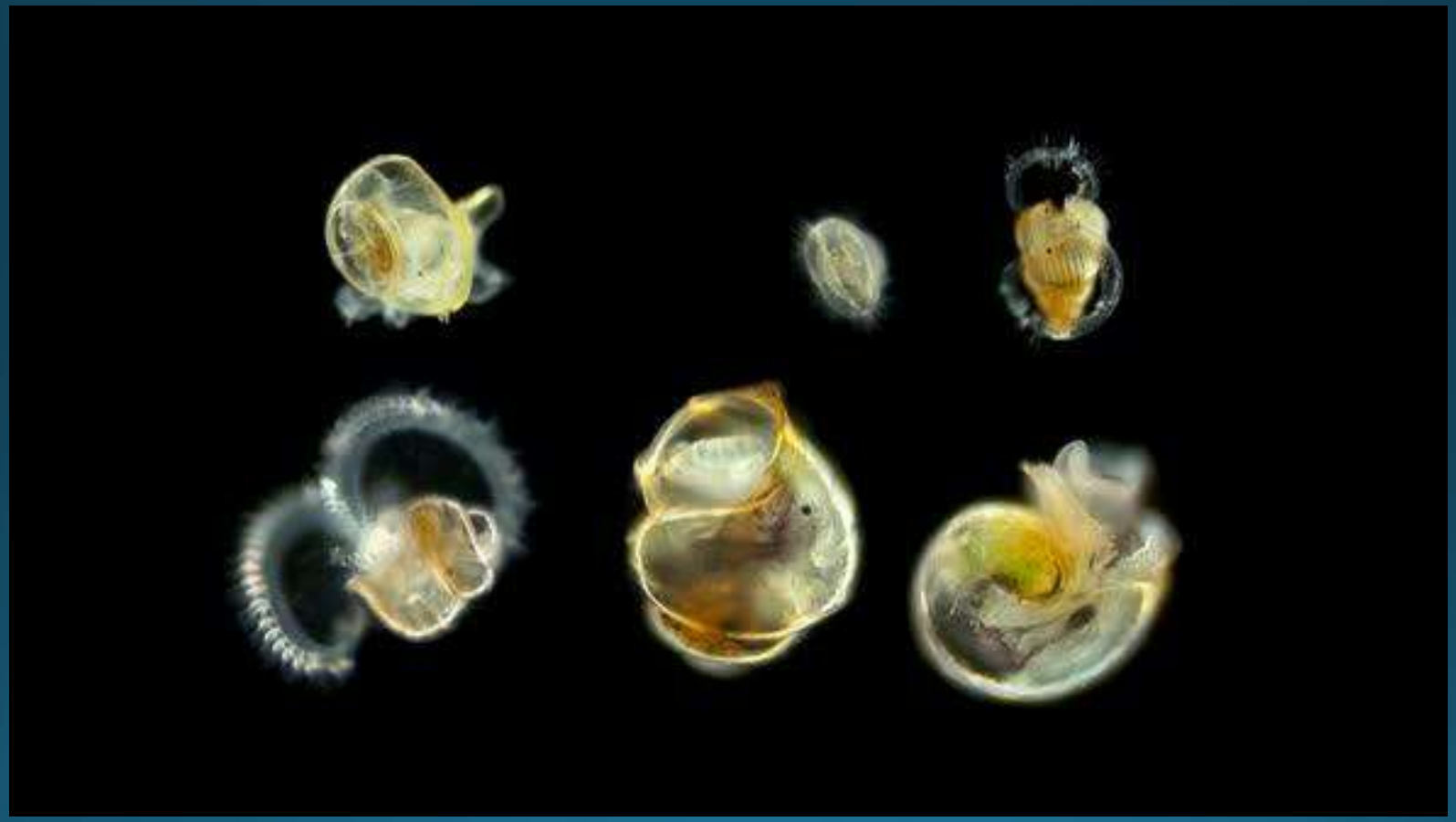
Texas A&M Univ

‘Immortal Jellyfish’ (plankton), converts to polyp stage (benthic) when threatened.

Comb Jellies

NOAA

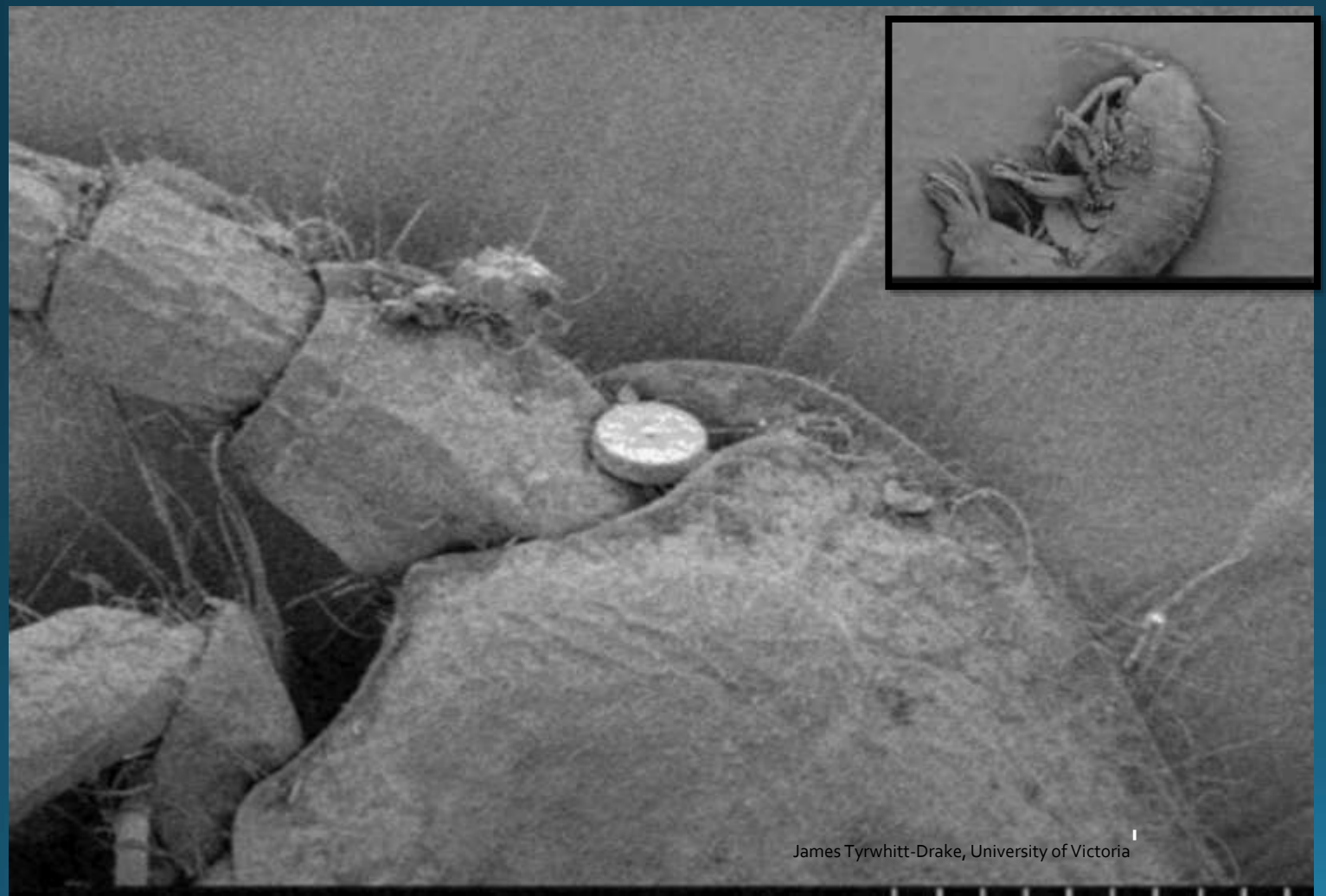
Larval Sea Snail Stages

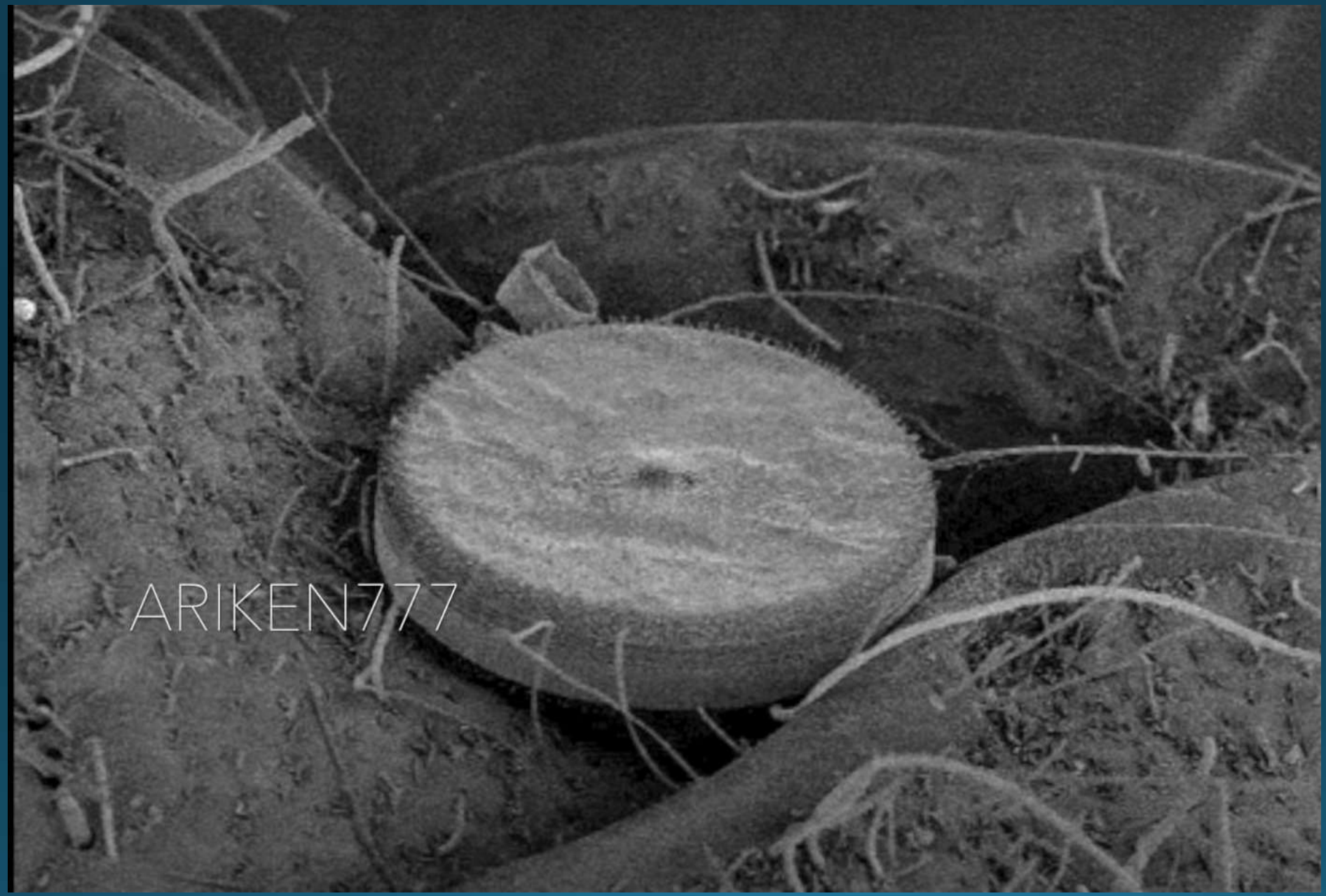


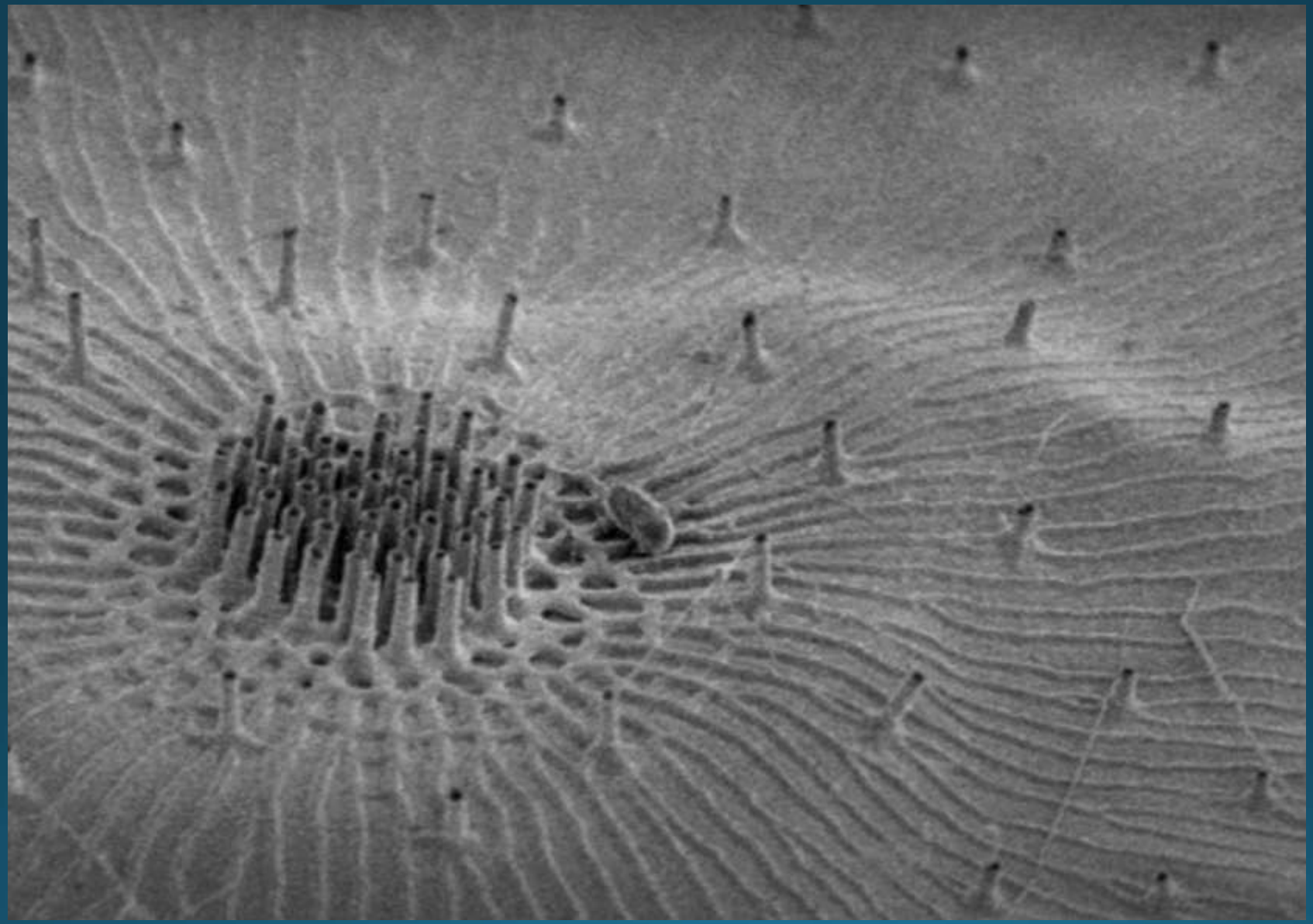
videohive.net-Envato Forums

- from Christian Sardet: Plankton, Wonders of a Drifting World. Univ. Chicago Press

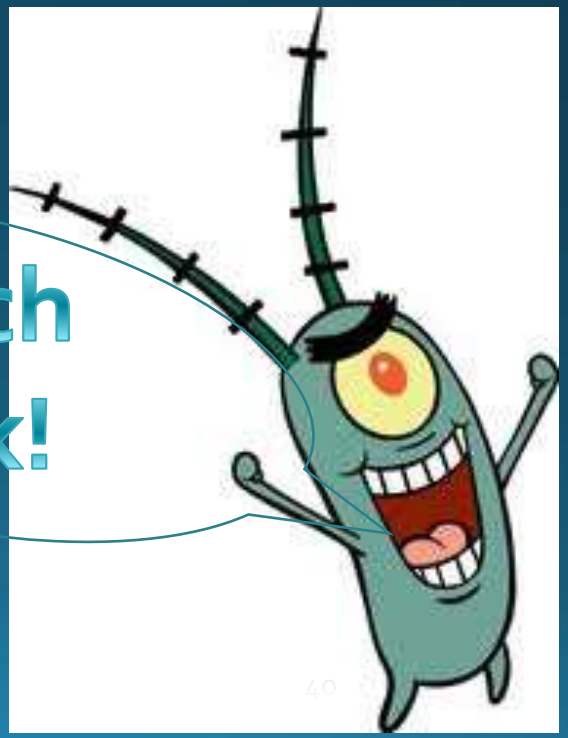
Amphipod with centric diatom



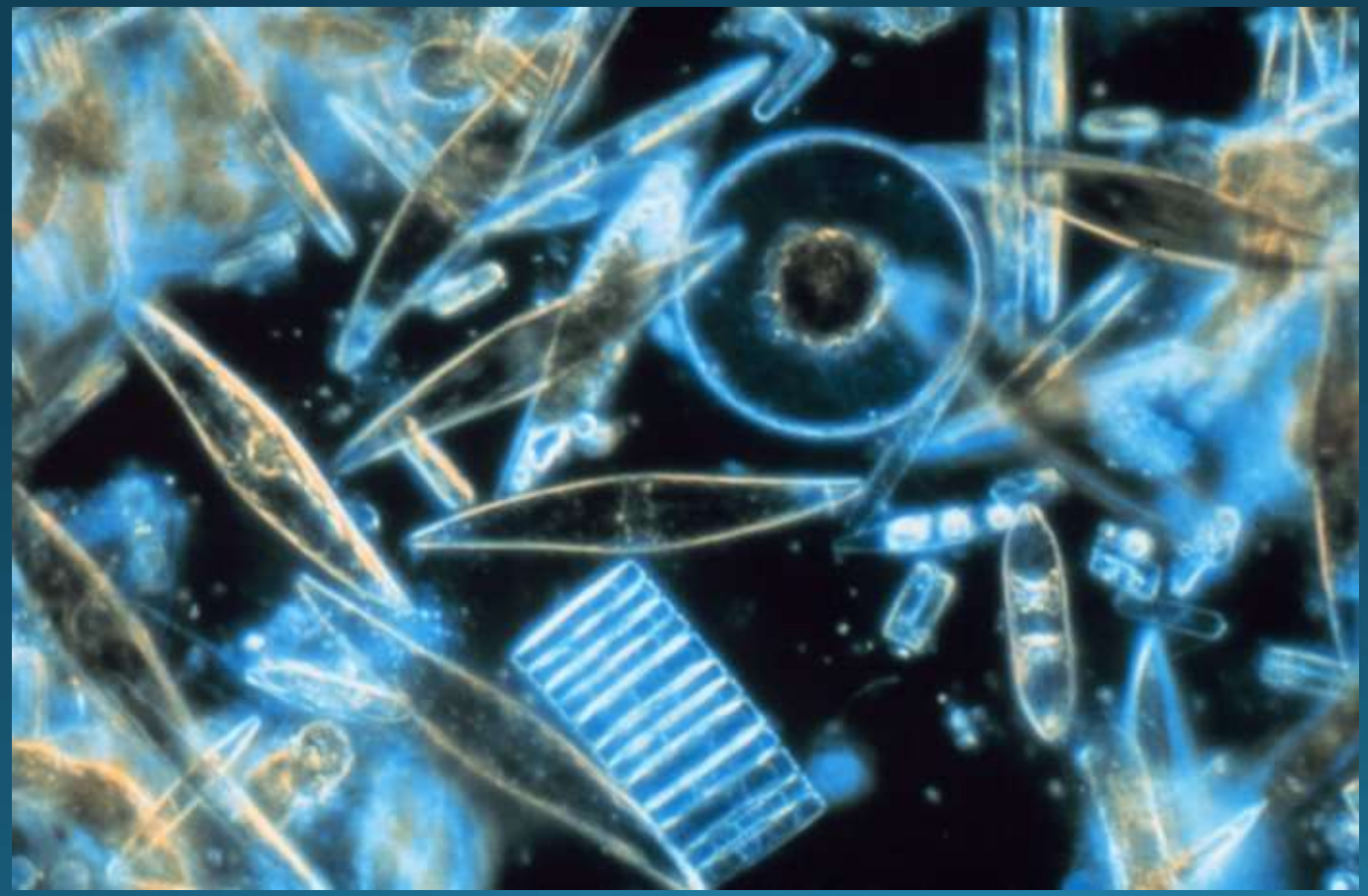

ARIKEN777



Stretch Break!



Examples of Plankton Specimen #1



Specimen #2

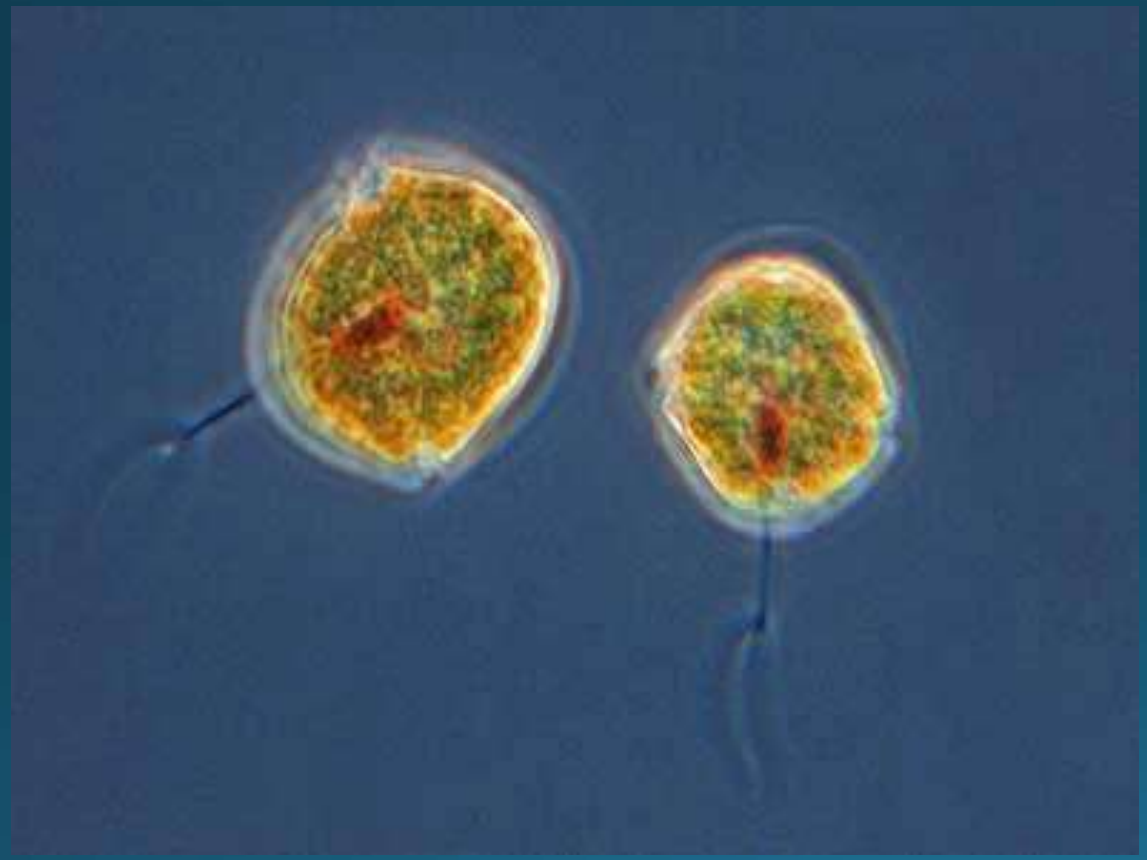
Specimen #3

Specimen #4

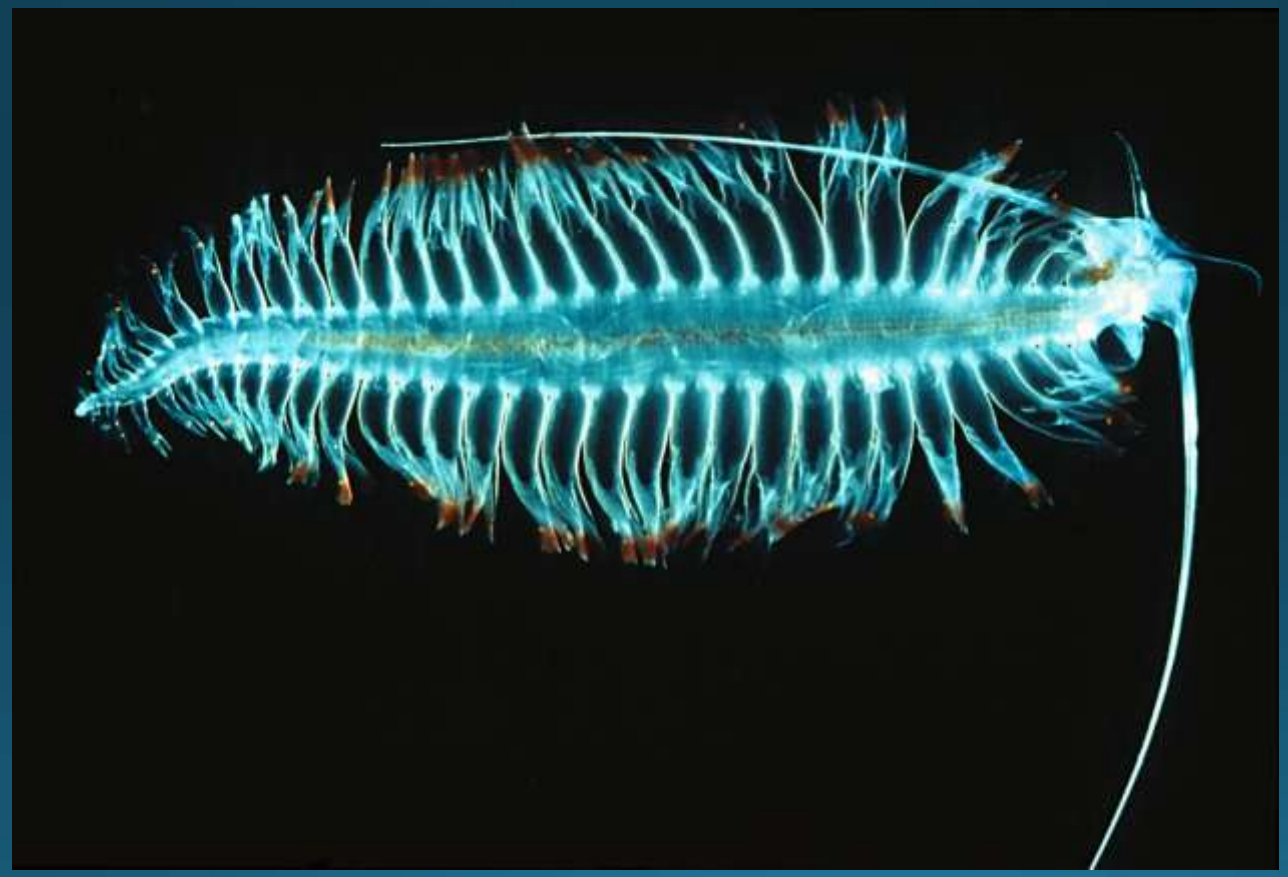
Specimen #5

Specimen #6

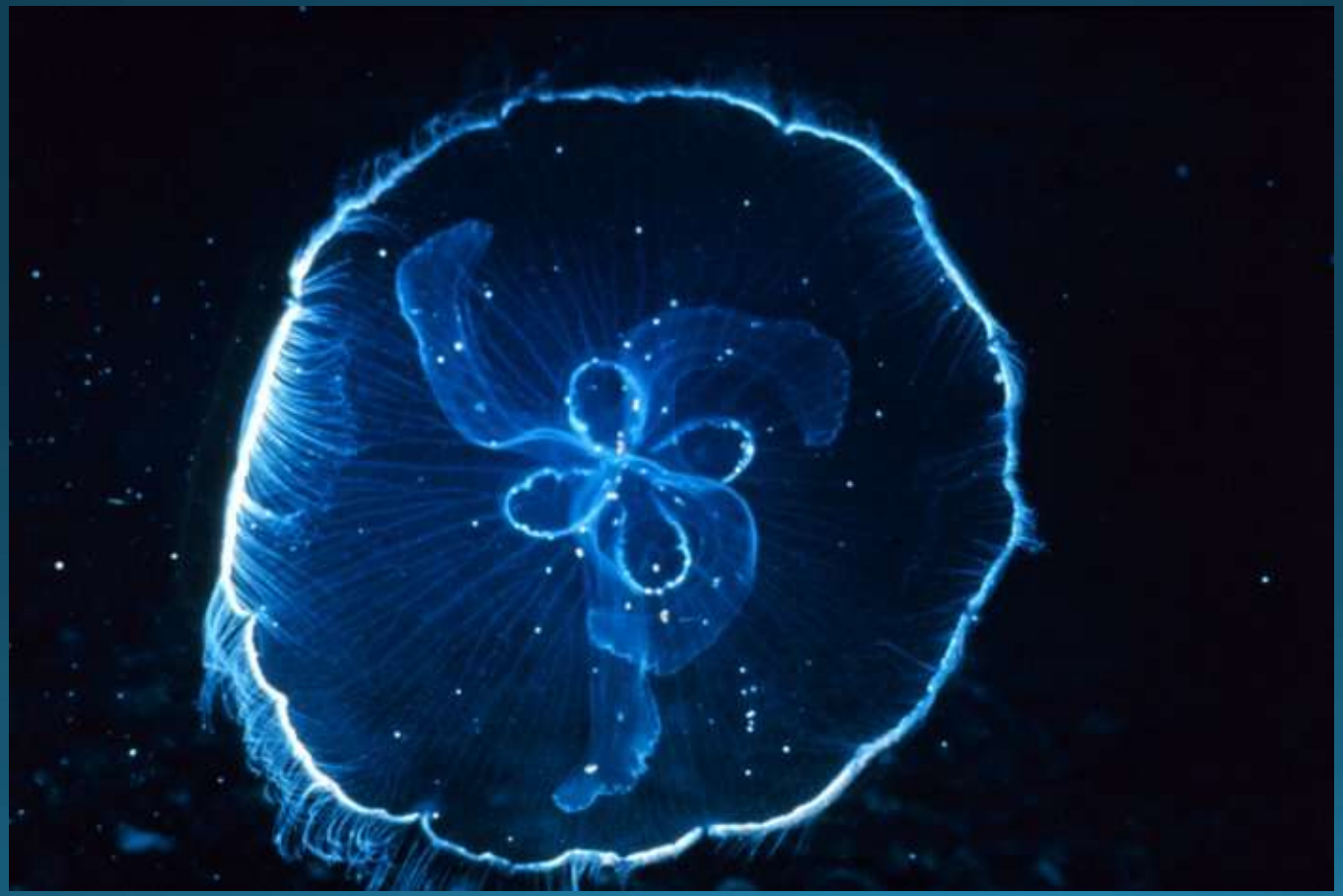
Specimen # 7



Specimen #8



Specimen #9

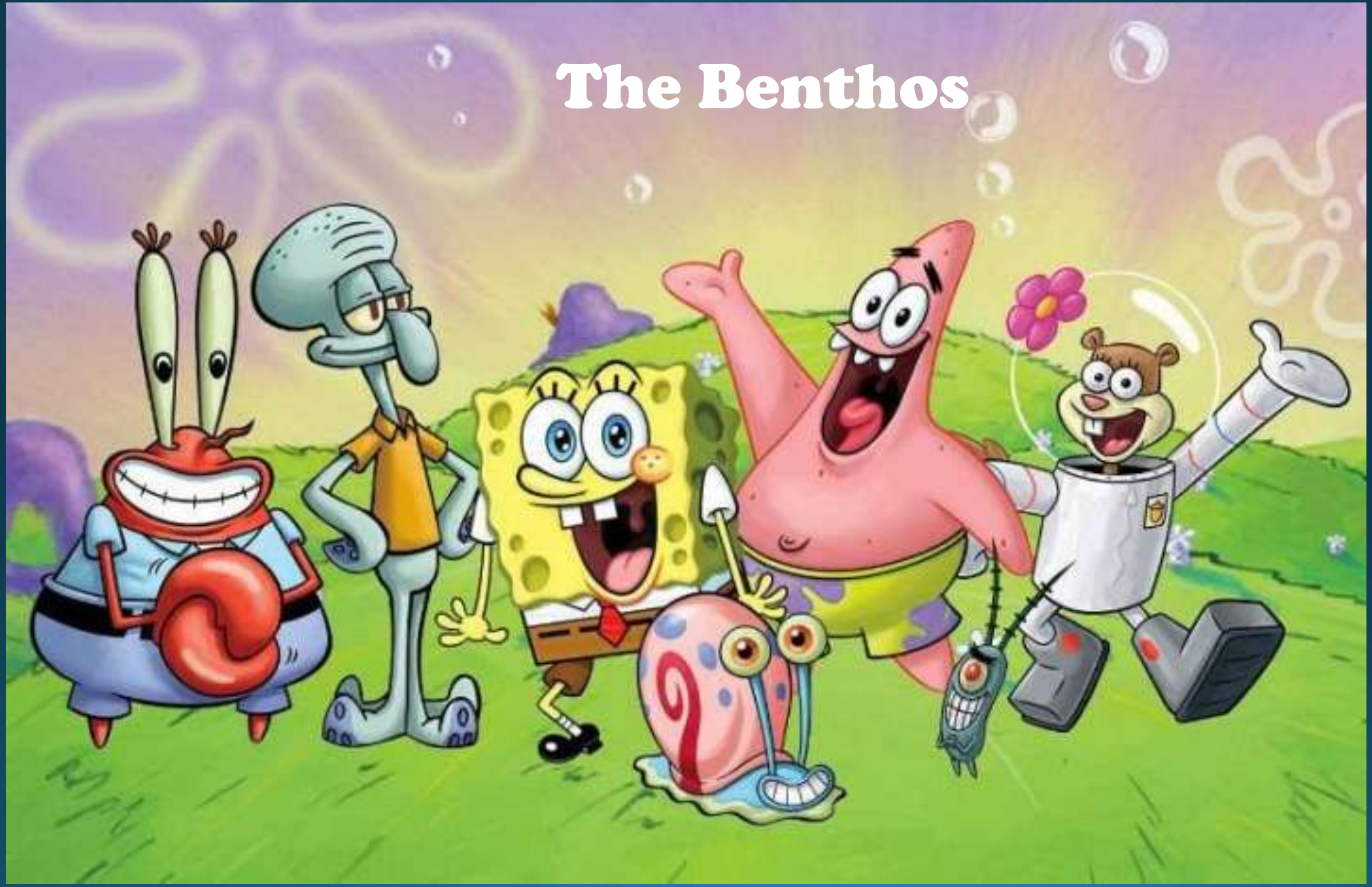


Specimen #10

Summary

- Phytoplankton Foundation of the Food Web
  - Primary Producers
    - Oxygen Production
    - Carbon Sequestration
- Zooplankton
  - Primary Consumers
  - Food for 2nd Consumers (Fishes..Whales)
- Plankton
    - Crucial to Global Economy
    - Supports World's Biodiversity
    - Indicator of Ecosystem Health
    - Enable's Biogeochemical Cycling

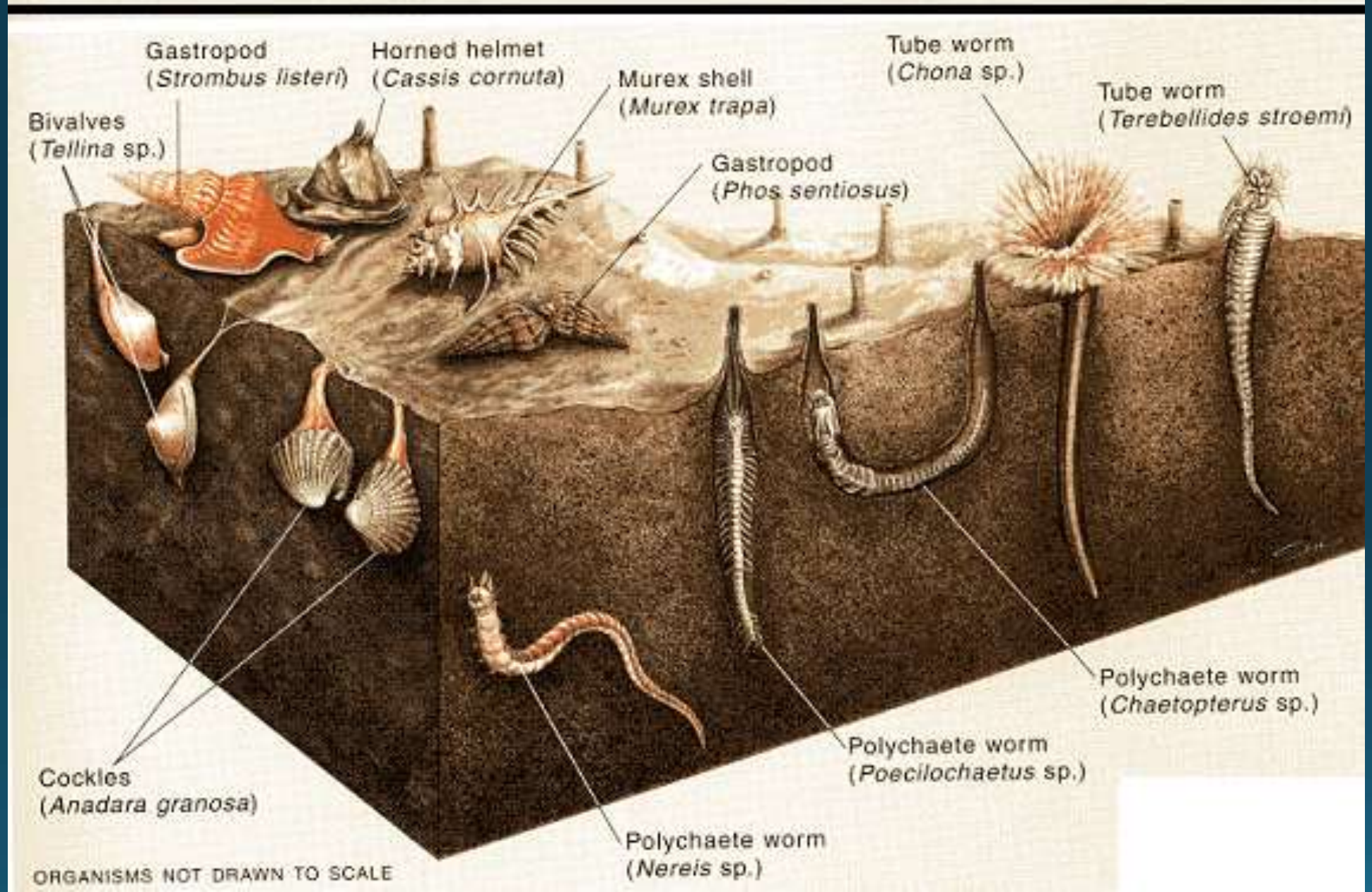
The Benthos



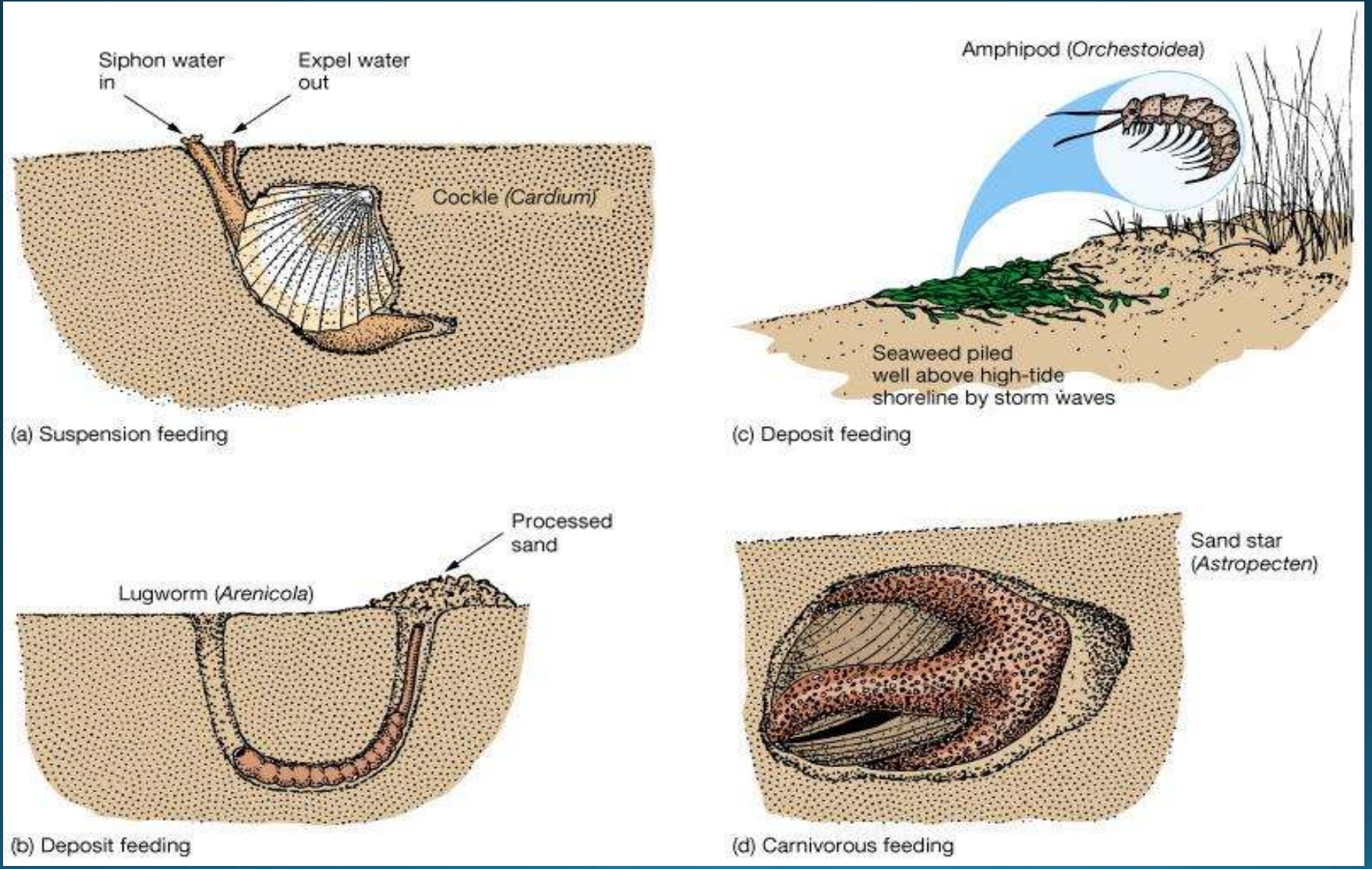
Benthos: Definitions

- Epifauna: live on or are associated with the surface
- Infauna: live within the substrate
- Microfauna: animals <0.1 mm in size (e.g. protozoa/bacteria)
- Meiofauna: animals <0.5 mm in size: “interstitial” (e.g. nematodes, small amphipods)
- Macrofauna: animals > 0.5 mm in size: most familiar kinds of animals (crabs, shrimp, starfish and mollusks)

Soft Bottom Communities



Soft sediments: Modes of feeding



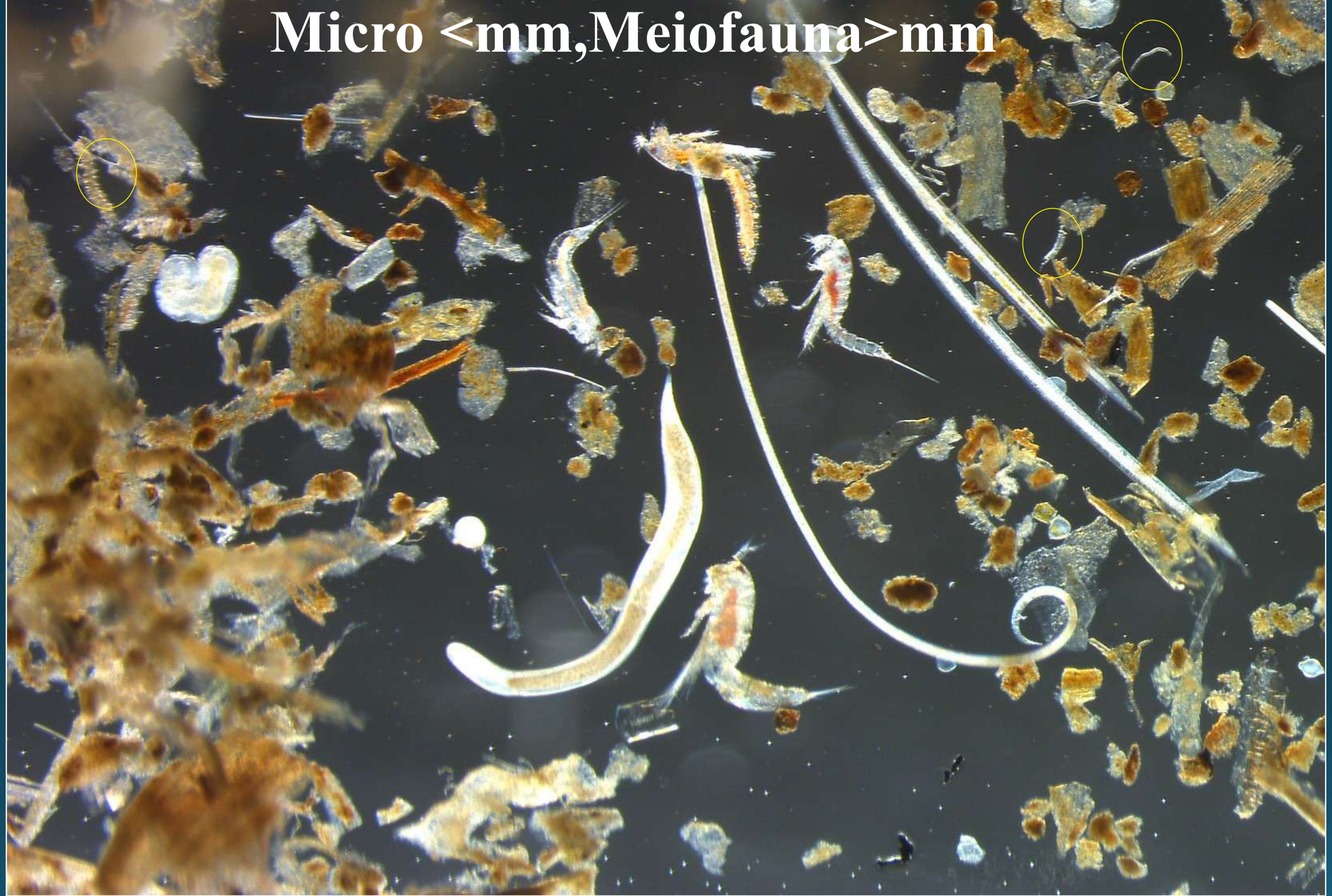
The Intertidal: Where the Benthos is Most Abundant

- Biomass in intertidal= 10X that of 200 m depth and several thousand times that of the abyss!
- Not without a cost: wave shock; desiccation; cold; osmotic issues; and land predators. But at high tide: plenty of O2; nutrients; light; and wastes washed away.
- More vertical relief and habitat diversity= more species diversity

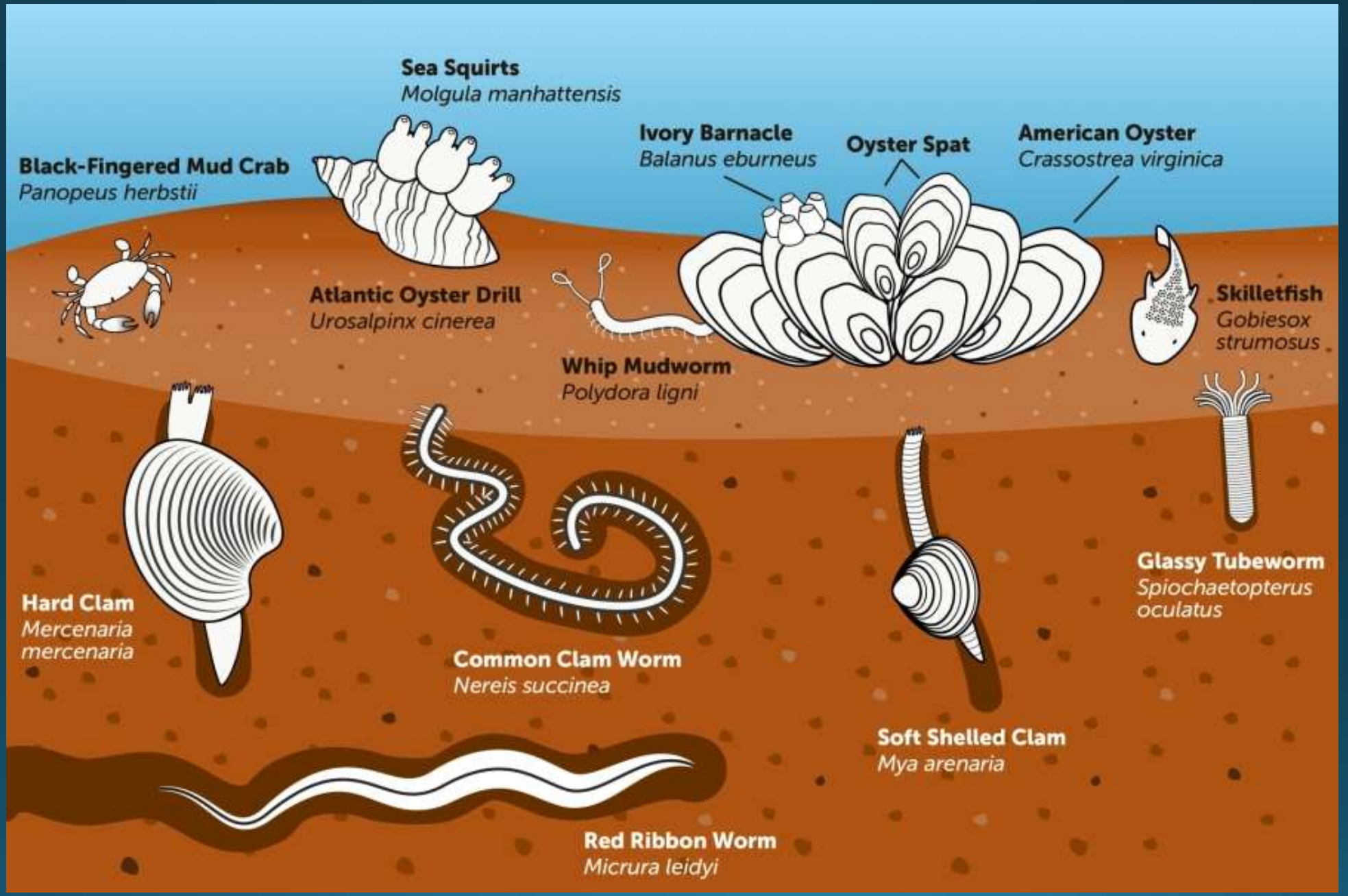
Four groups of dominant macrofauna in soft bottoms

- Class Polychaeta: most numerous: tube-building and burrowing
- Subphylum Crustacea: ostracods, amphipods, isopods, tanaids, mysids, small decapods
- Phylum Mollusca: burrowing bivalves and scaphopods, gastropods at surface
- Phylum Echinodermata: brittle stars, heart urchins, sand dollars, sea cukes

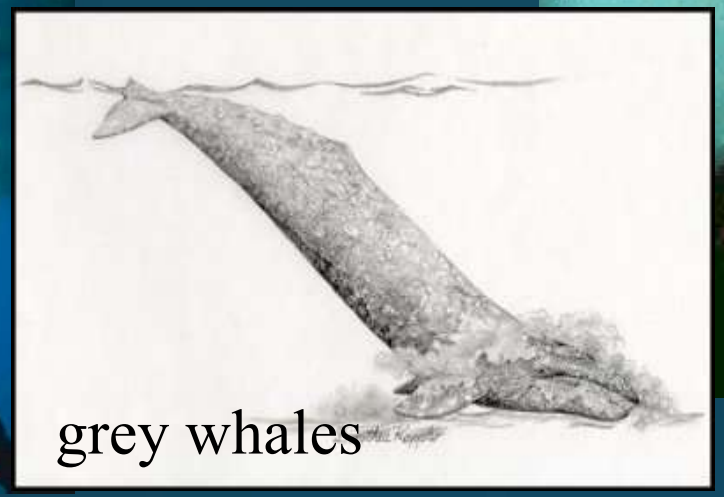
Micro <mm,Meiofauna>mm



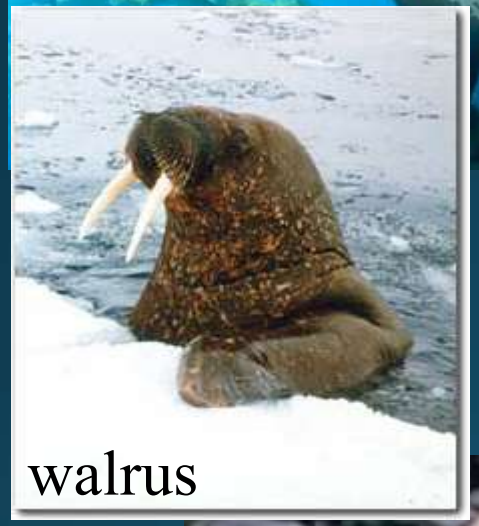
Macrobenthos(mm-cm)



Megafauna (cm-m)



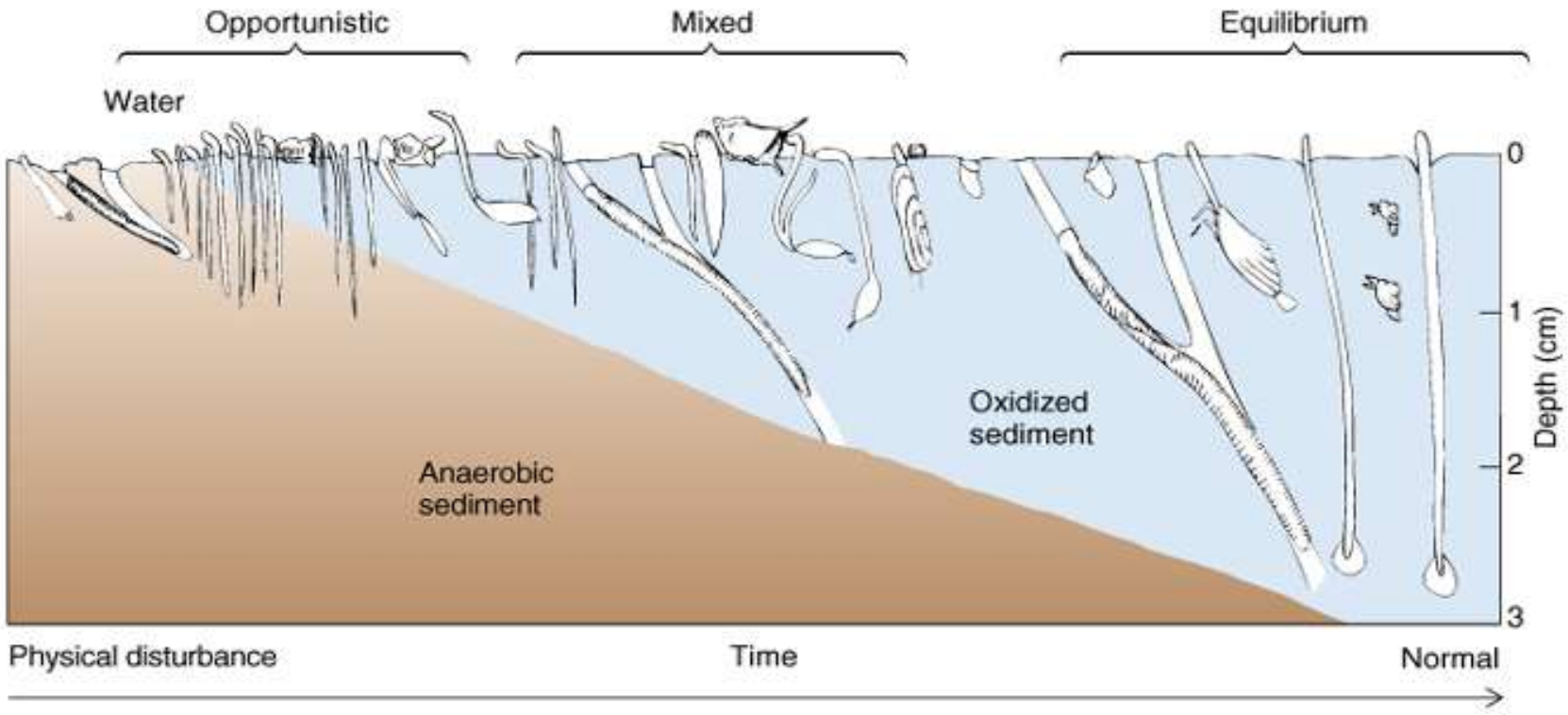
grey whales



walrus

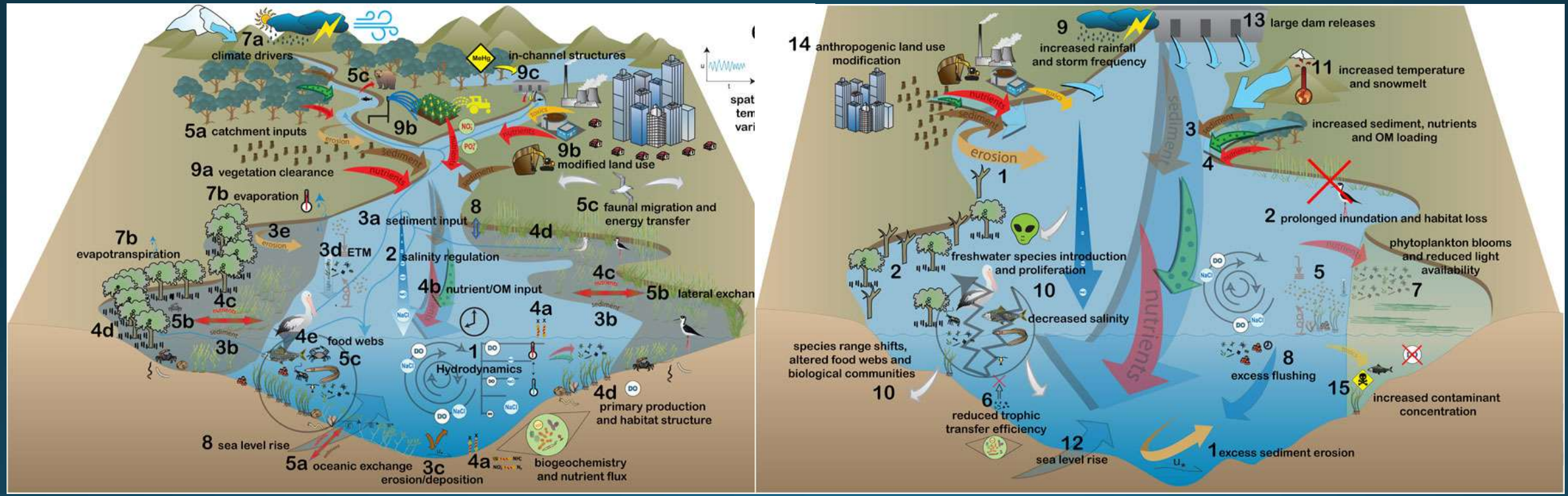
Predators have big effects on community composition

Disturbance caused by eutrophication




10 24 '98

Heal Our Harbor



Questions?