Development of a High-Speed, Size-Fractionated Plankton Tow

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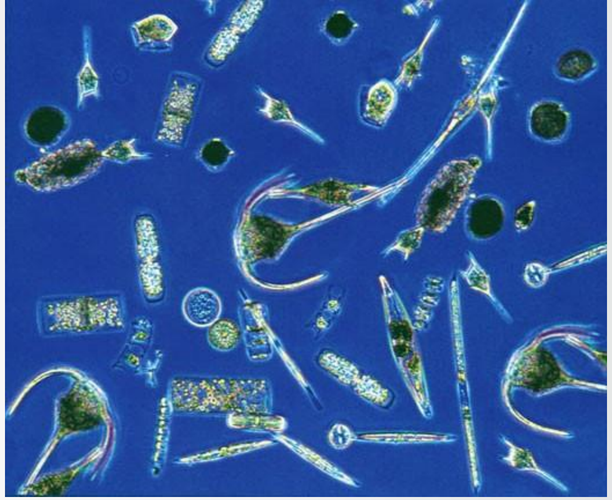
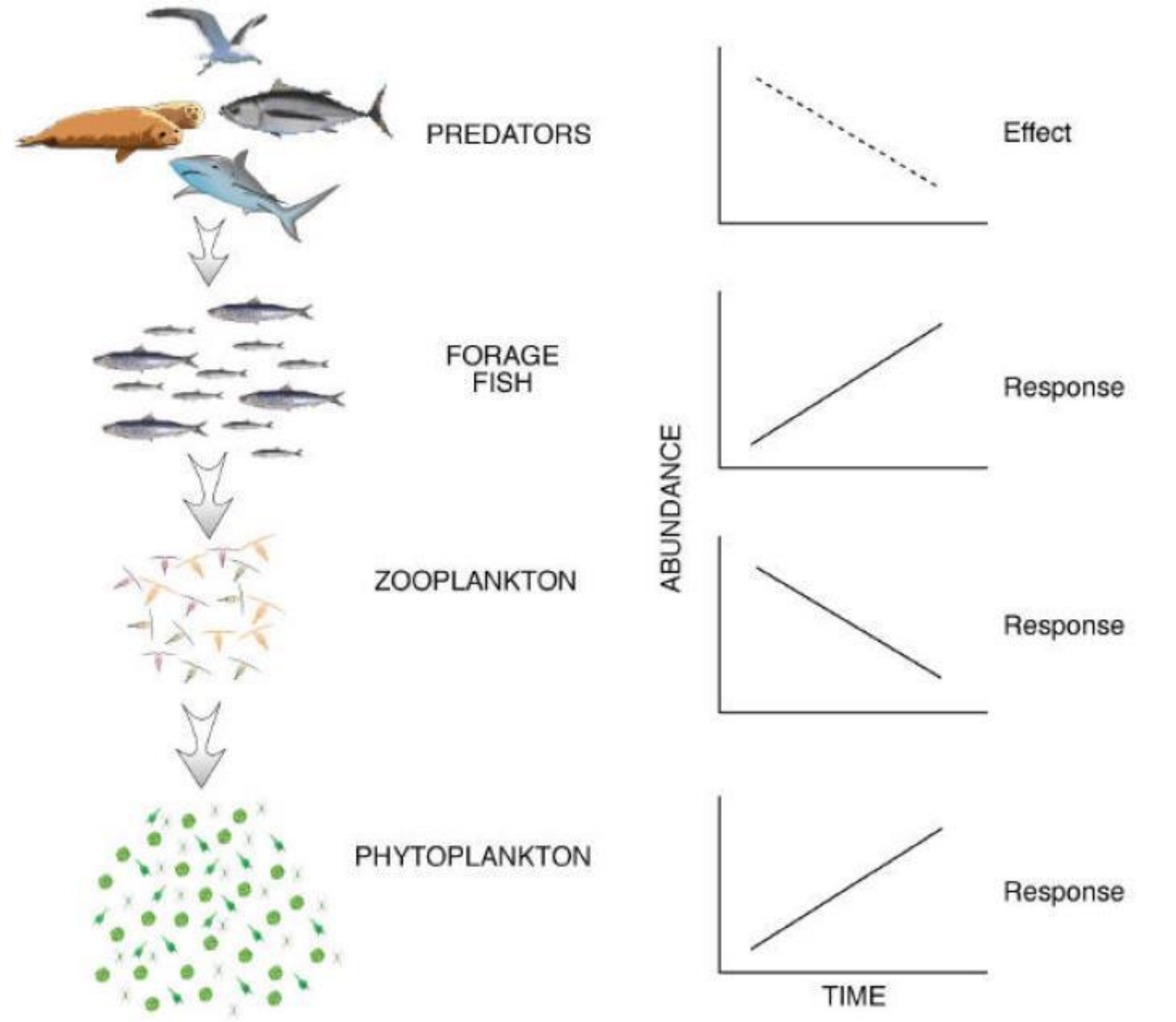
Planktonic AIS



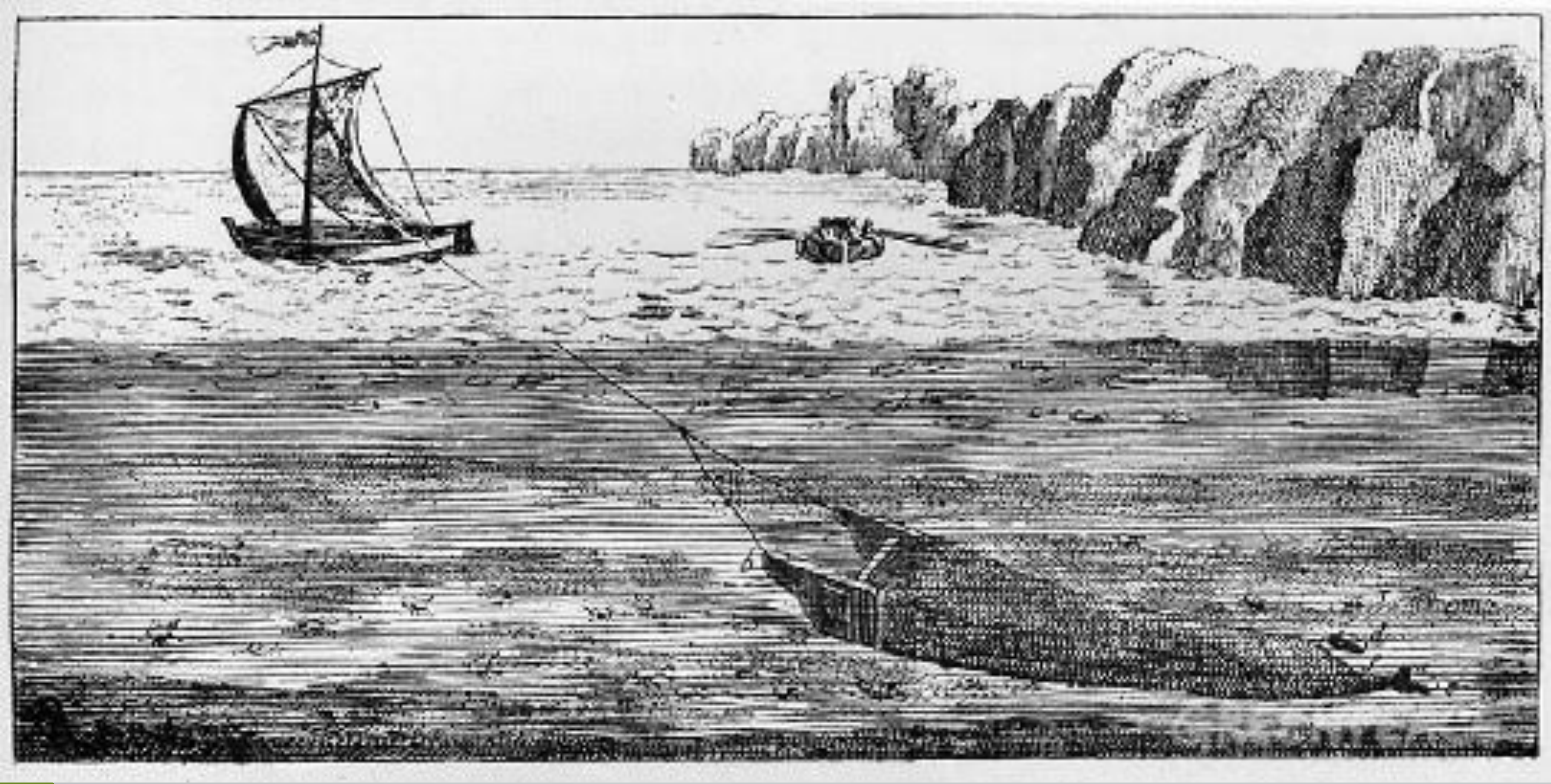
- MANY forms of planktonic AIS
  - Phytoplankton (including cyanobacteria like *Microcystis*)
  - Zooplankton (*D. lumholtzi*, *Bythotrephes longimanus*, quagga mussel veligers, trocophores, etc.)
  - Ichthyoplankton
  - Bacterioplankton
  - Range in size from 2 μm (nanoplankton) to >20 mm (megaplankton)
- Many forms of invasive zoo- and phytoplankton have been known to cause trophic cascades to the detriment of many native organisms (and anthropogenic needs).

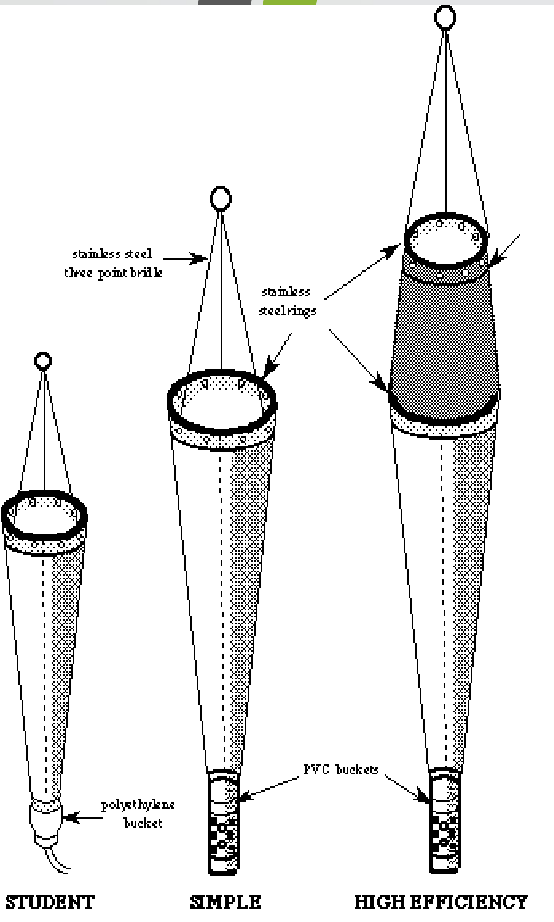


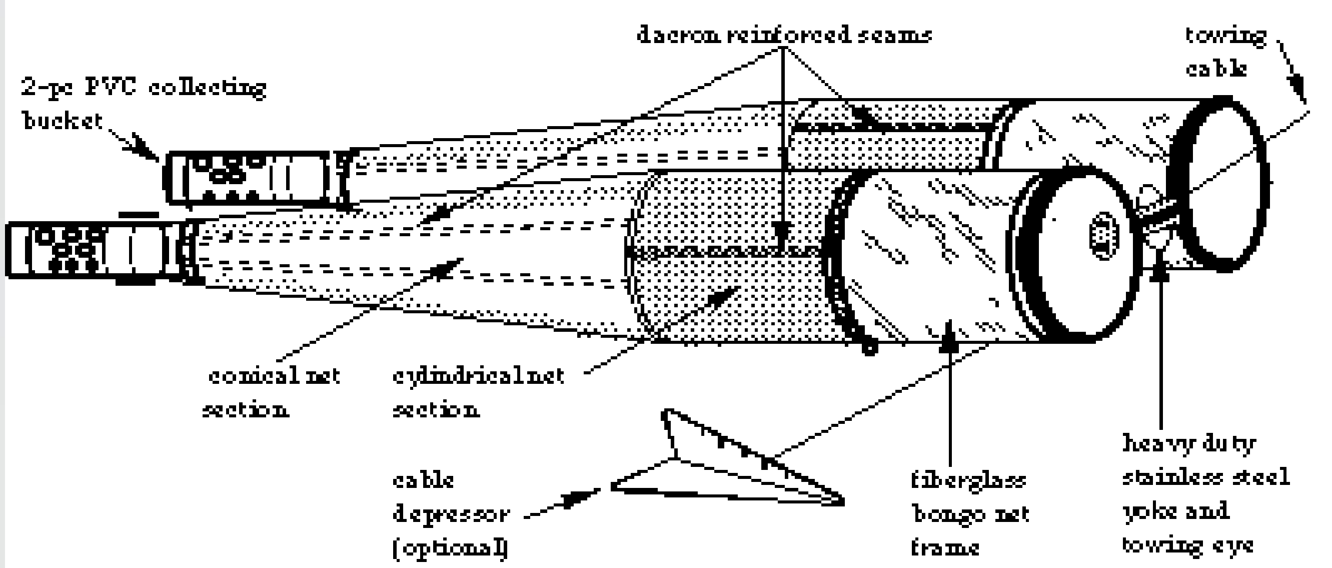
PREDATORS
FORAGE FISH
ZOOPLANKTON
PHYTOPLANKTON
ABUNDANCE
TIME
Effect
Response
Response
Response

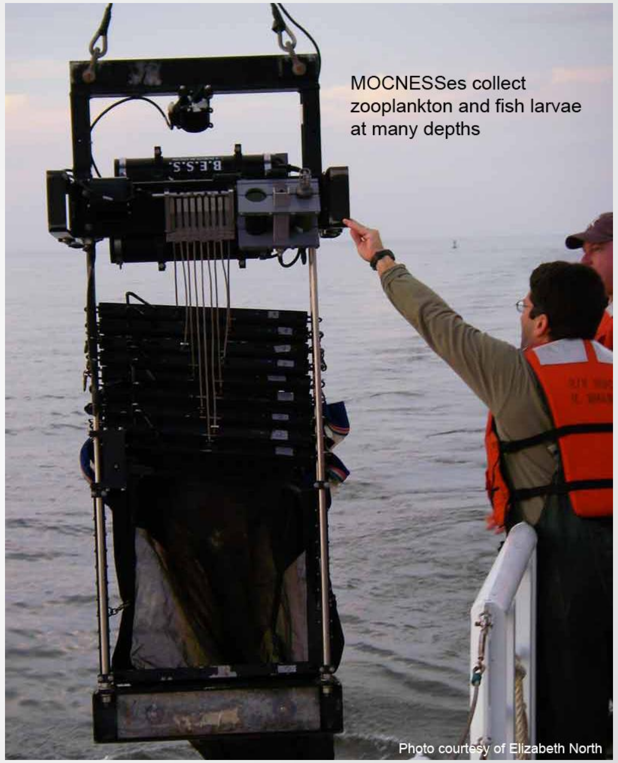
Early Detection

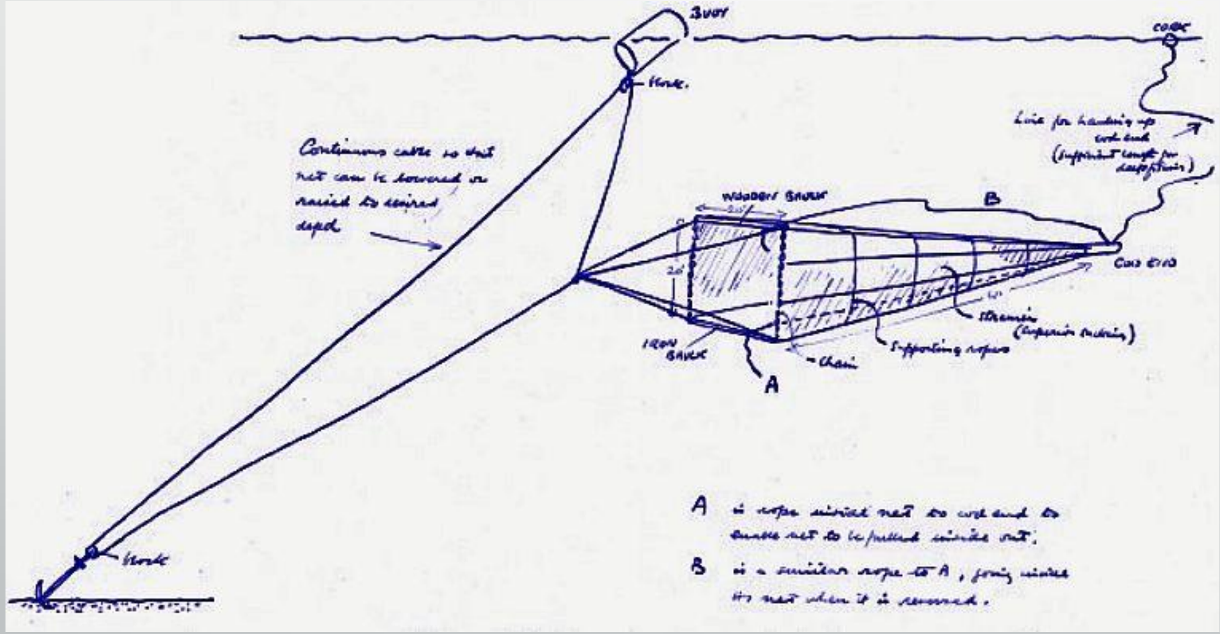
- Critical to identify native versus invasive plankters.
- To observe long-term effects, requires long-term data.
- *To observe and assess effects requires accurate, and standardized, collection techniques.*




stainless steel
three point bridle
stainless
steel rings
PVC buckets
polyethylene
bucket
STUDENT
SIMPLE
HIGH EFFICIENCY


dacron reinforced seams
towing
cable
2-pc PVC collecting
bucket
conical net
section
cylindrical net
section
cable
depressor
(optional)
fiberglass
bongo net
frame
heavy duty
stainless steel
yoke and
towing eye


MOCNESSes collect
zooplankton and fish larvae
at many depths
Photo courtesy of Elizabeth North


BUOY
Hook.
CORK
Continuous cable so that
net can be lowered or
raised to desired
depth
B
A
Chain
Supporting ropes
Hook


Tucker trawls collect
zooplankton and fish larvae
Photo courtesy of Elizabeth North

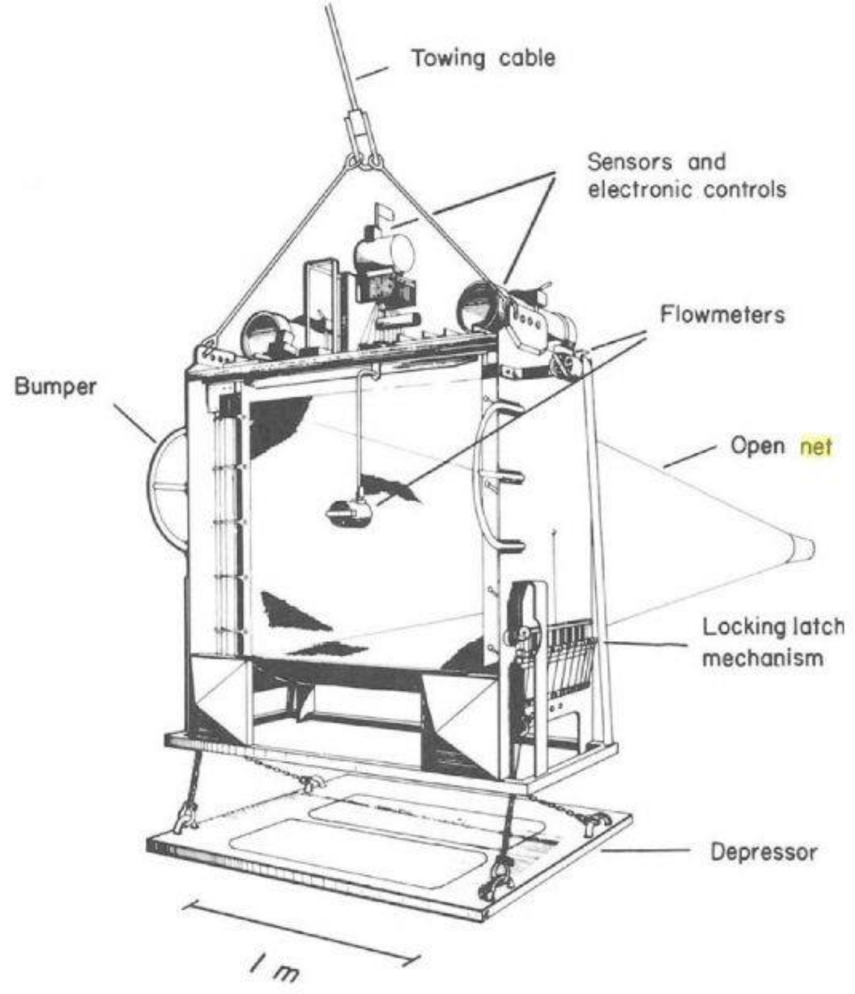
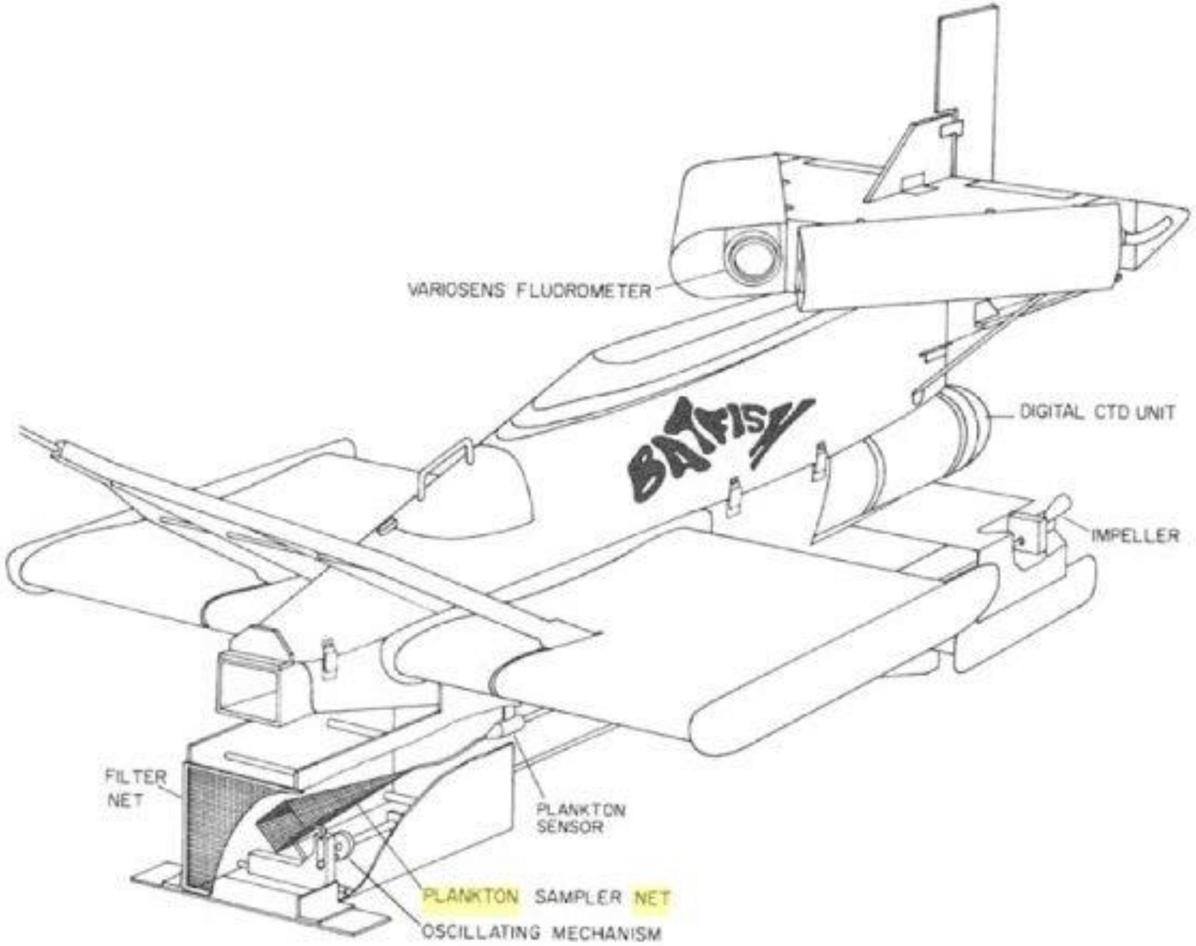


Figure 7. The BIONESS plankton sampler shown with its instrumentation and the first of ten nets in the 'open' position. (From Sameoto 1979.)



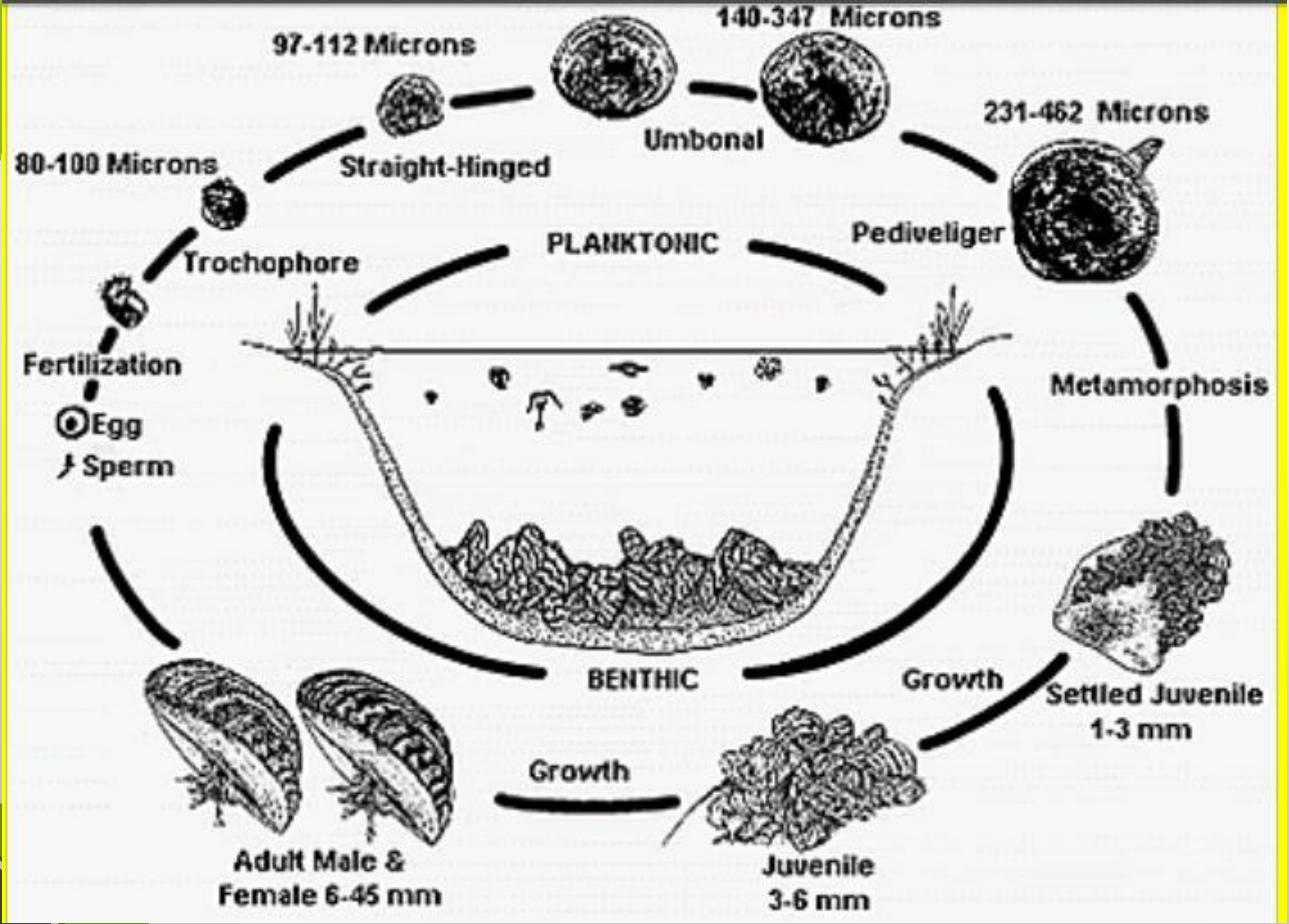
Quantitative versus Qualitative

- Qualitative: Used for presence/absence.
- Quantitative: Presence/absence with enumeration.
  - To detect long-term trends.
- Both require sampling techniques that are most-representative of the waterbody in question.
  - Determination of sampling device is very important for quantitative studies.

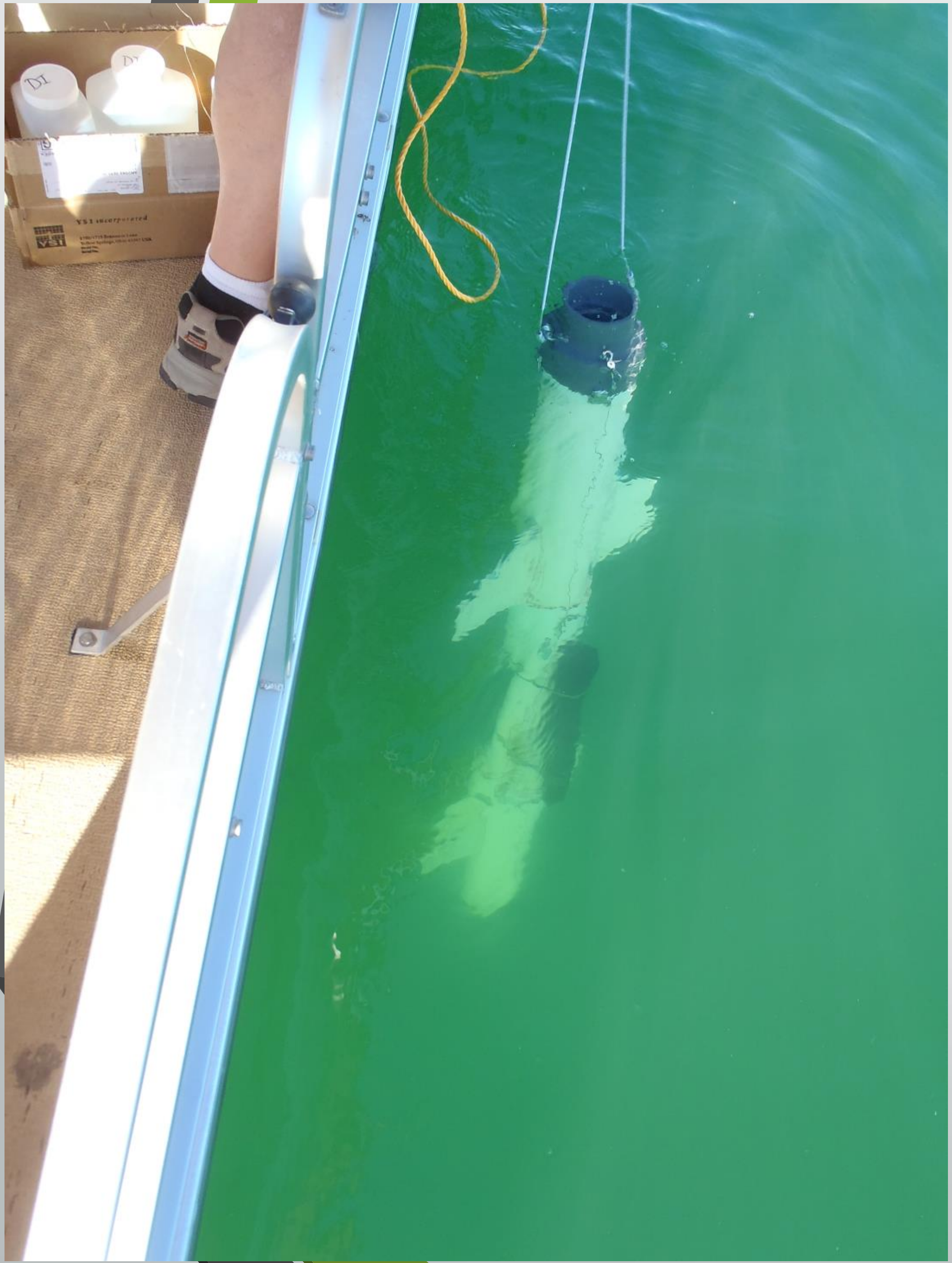
Problems with Representative Plankton Sampling

- Determination of net mesh size.
- Nets often quickly clog (depending upon primary productivity and amount of suspended sediment).
- No size fractionation of organisms.
  - Too large of a mesh size lets many organisms go undetected.
  - Too small of a mesh size quickly clogs with little water actually going through the net.
- With the exception of nets with attached flow meters, difficult to determine the volume of water passed through the net.
  - $V = \pi r^2 \mathrm{d}$
- Representative samples collected with most plankton nets are difficult at best.

- No plankton collecting device currently available offers *in situ* size fractionation of collected samples.
  - This makes sorting under the microscope extremely difficult if not impossible.
- *In situ* size fractionation makes collection of plankters that may have gone un-noticed, far more attainable.
  - Earlier detection
  - Better representative quantification
    - Especially of potential AIS species and small nanoplankters, such as cyanobacteria.
    - Also of larval forms of AIS, such as quagga veligers.
  - Can greatly enhance studies of biomagnification and bioaccumulation.
    - Between small nanoplankters up through megaplankton.


97-112 Microns
140-347 Microns
231-462 Microns
80-100 Microns
Straight-Hinged
Umbonal
Pediveliger
Trochophore
PLANKTONIC
Fertilization
Egg
Sperm
Metamorphosis
BENTHIC
Growth
Settled Juvenile
1-3 mm
Growth
Adult Male &
Female 6-45 mm
Juvenile
3-6 mm

- Nets = 250 µm, 80 µm, and 10 µm (fully adjustable)
- Water is forced through each net into the net behind it.
- The first net collects everything in the water 250 µm or larger, the 80 µm collects particles 80 – 250 µm, and the last net collects plankters from 10 – 80 µm.



Initial Results

- Patagonia Lake
  - 250 µm net : Average size = 350.5 µm in size (range = 275 and 426 µm).
  - 80 µm net: Average size = 129.5 µm (range = 187 and 72 µm)
  - 10 µm net: Average size = 41.5 µm (range = 70 and 13 µm).
- Havasu
  - 250 µm net : Average size = 267 µm in size (range = 219 and 315 µm).
  - 80 µm net: Average size = 82 µm (range = 63 and 101 µm).
  - 10 µm net: Average size = 30 µm (range = 8 and 52 µm)

Future work

- Compare against side-by-side nets of the same mesh size.
- Potential Refinements
  - Could be fitted with multiprobe sondes for simultaneous collection of gas vented depth and physico-chemical variables.
  - GPS
  - Sonar
  - Underwater cameras

- Given their importance, planktonic AIS are relatively under-studied.
  - We need a better understanding of population dynamics, immigration and emigration, fecundity, etc.
  - Early detection
- Planktonic collection techniques need to be standardized and made as representative as possible.
  - Especially for large reservoirs.