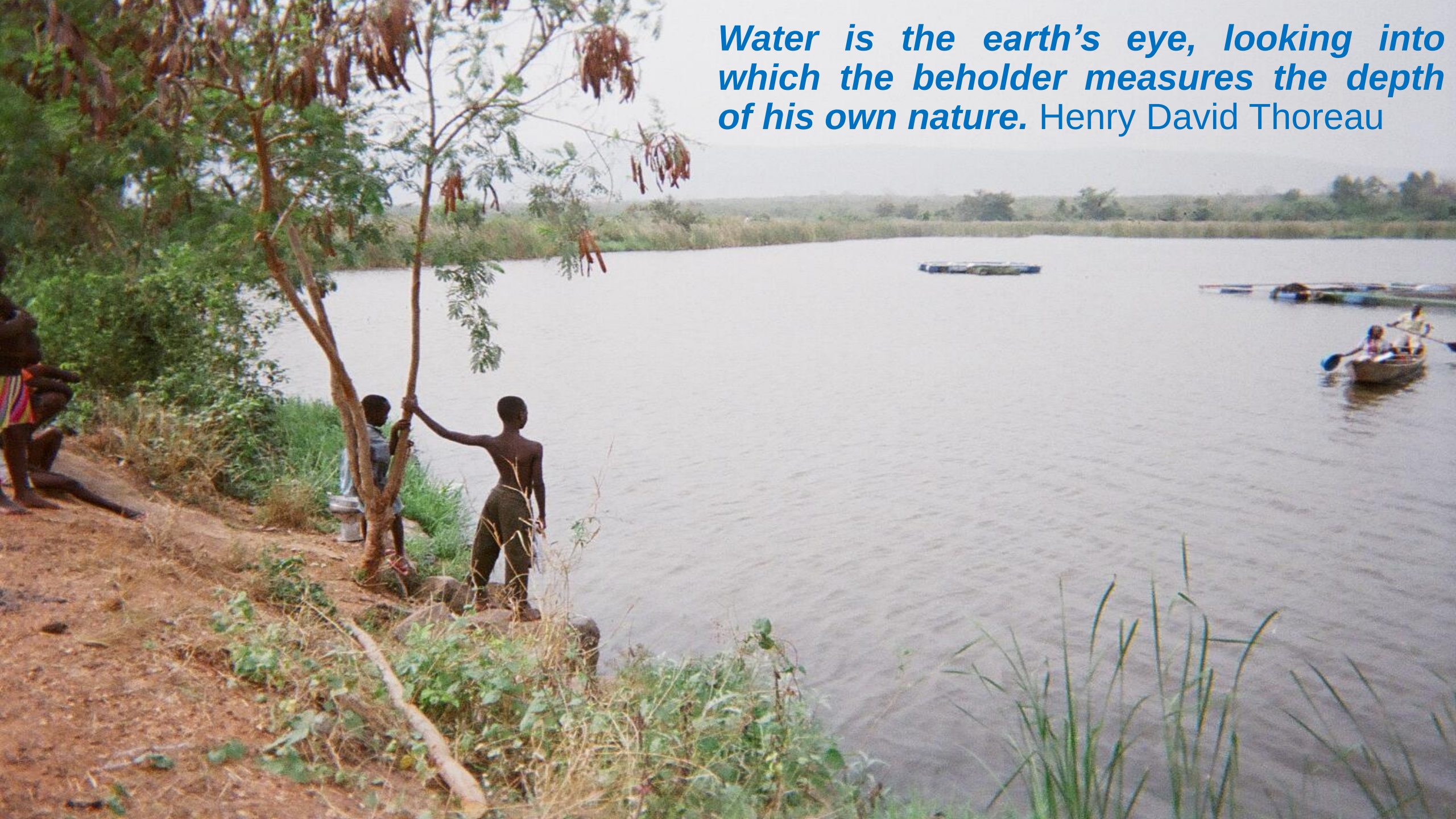

Water is the earth's eye, looking into which the beholder measures the depth of his own nature. Henry David Thoreau

Biological monitoring of coastal waters

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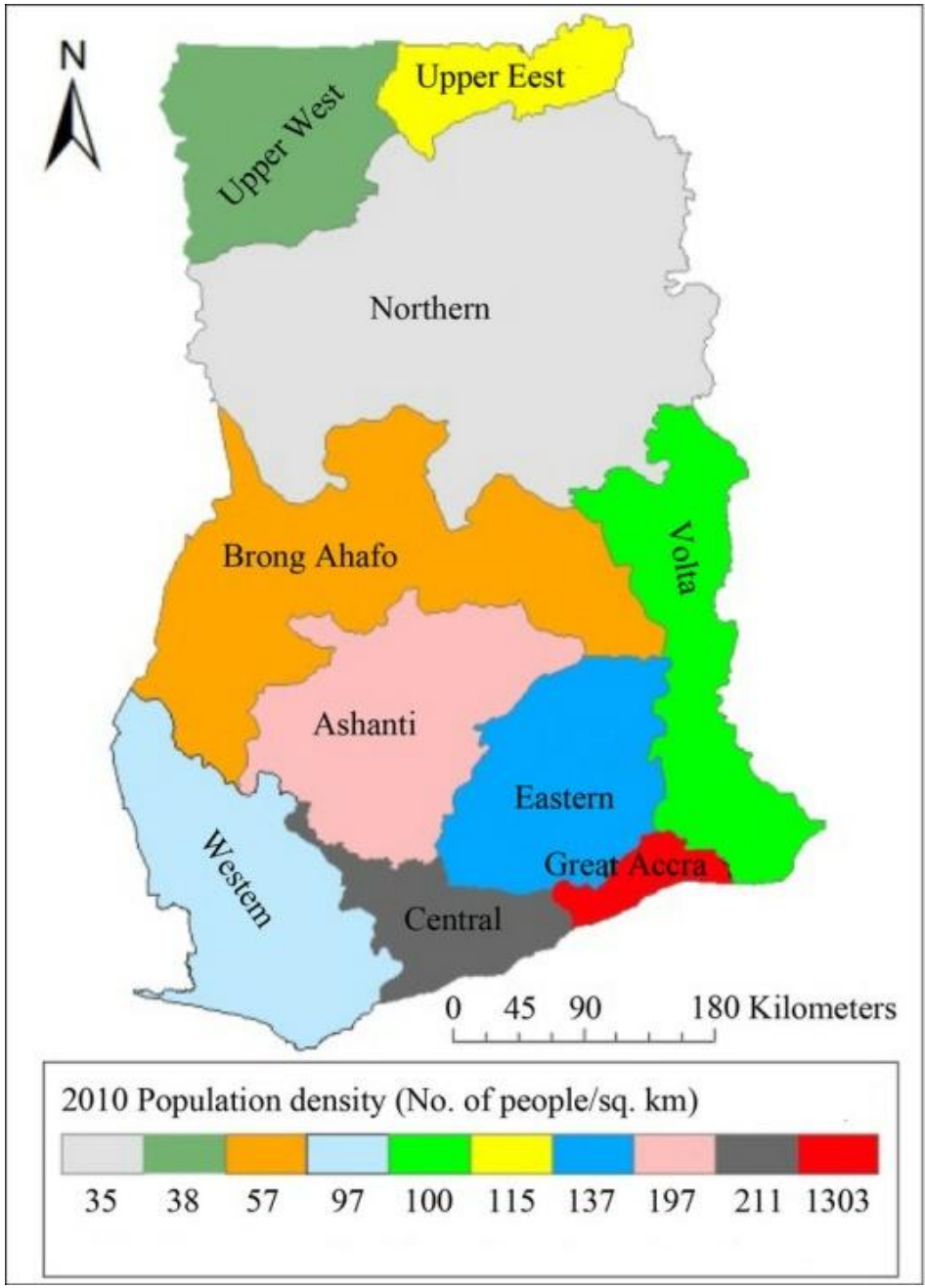
African Initiative of the Volkswagen Foundation

Ghana Summer School on Coastal Environment ,1-5 August 2016

Content

- Background and motivation
- Sampling methods
- Analysis
- Conclusions

Region: Ghana



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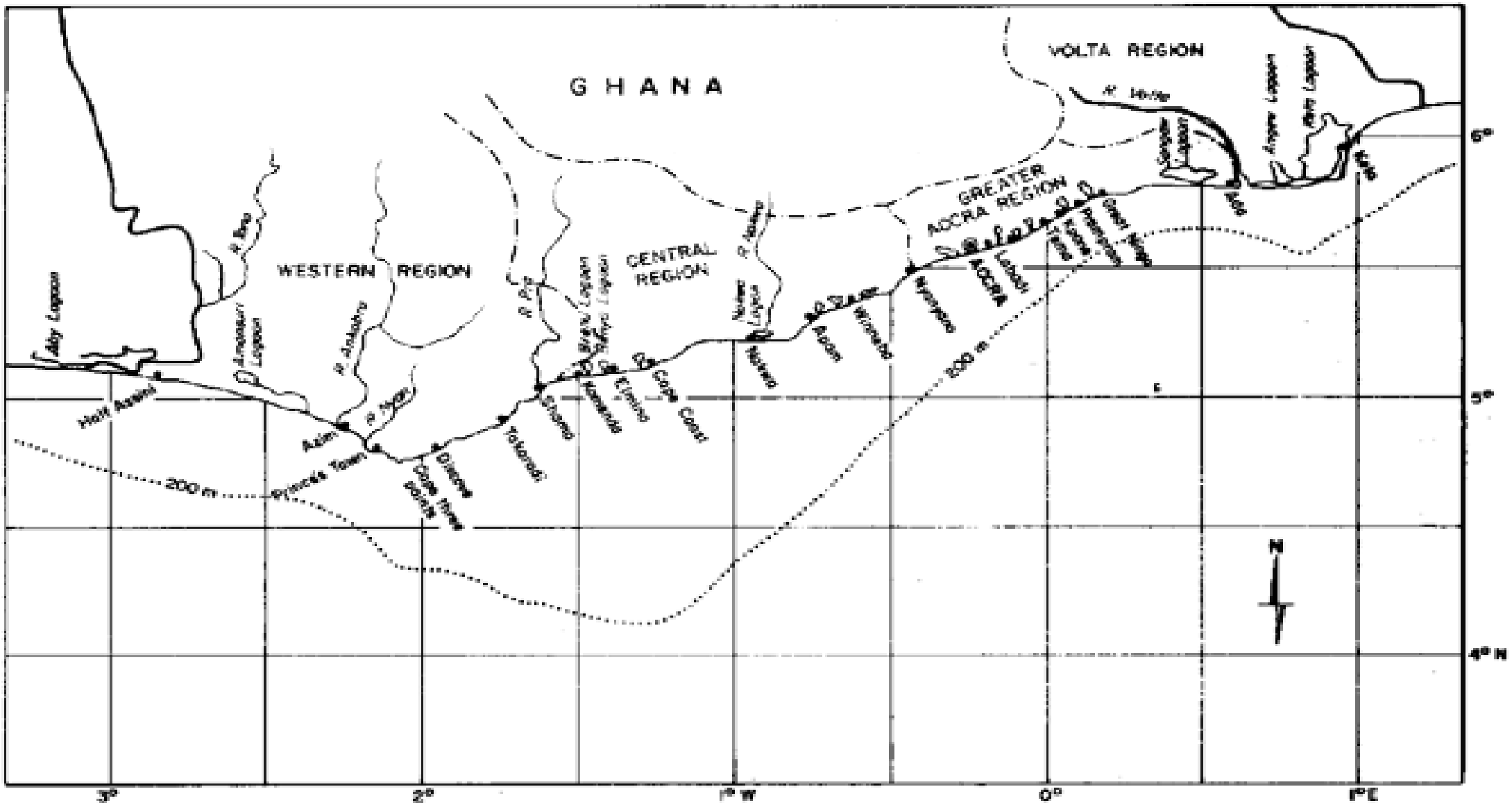
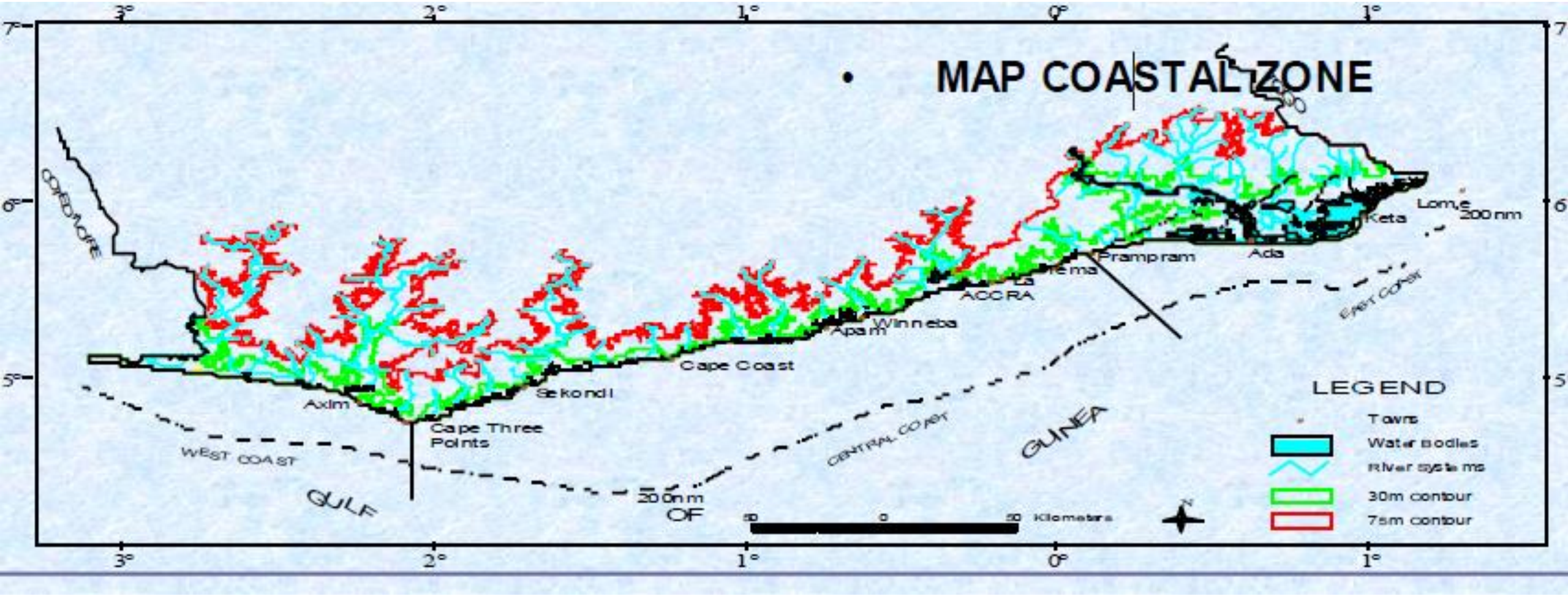
http://file.scirp.org/Html/4-2210056%5C0a42bab3-9669-46a9-bf86-531e71cf9048.jpg

Coastal Zone of Ghana

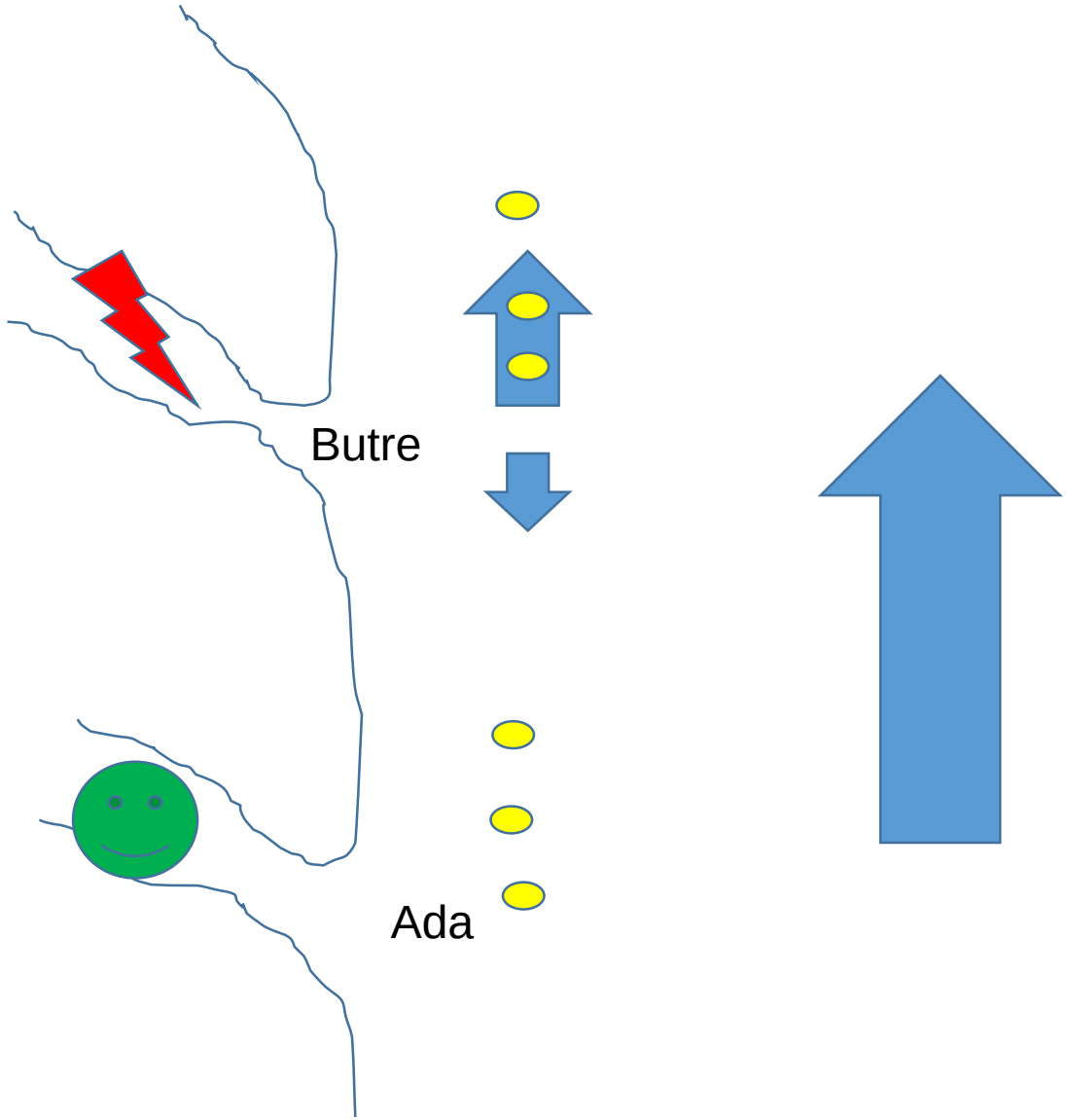


Coastal zone of Ghana and sensitivity Mapping



Armah 2004

Sampling sites



Water quality: Pollution

- **Healthy ecosystems** : maintenance of biodiversity and human well-being.

- **Contamination** of **water** bodies by chemical, physical, radioactive and pathogenic microbial substances.

- **Global** and local **concern**: **~ 50 million deaths** per year worldwide (e.g. majority in Africa and Asia).

Source: http://www.eoearth.org/view/article/156920

http://ww2.unhabitat.org/programmes/water/documents/waterreport2.pdf

Major sources of pollution in Ghana

Effects of pollution

- **Loss of ecosystems** : Species mortality
  Biodiversity reduction
  Ecosystem services

- **Health risks** : Viruses, bacteria and protozoan
  Waterborne diseases
  illness and mortality

Need for environmental monitoring

- Supports the **protection of the ecosystems** and **human health** from toxic contaminants.
- Indicate any **alarming environmental** situation.
- Provide opportunities for adoption of any **control measures**.

Need for environmental monitoring:

- Environment science **policy development**.

Who needs environmental monitoring?

Gary M Lovett[1*], Douglas A Burns[2], Charles T Driscoll[3], Jennifer C Jenkins[4], Myron J Mitchell[5], Lindsey Rustad[6], James B Shanley[7], Gene E Likens[1], and Richard Haeuber[8]

Environmental monitoring is often criticized as being unscientific, too expensive, and wasteful. While some monitoring studies do suffer from these problems, there are also many highly successful long-term monitoring programs that have provided important scientific advances and crucial information for environmental policy. Here, we discuss the characteristics of effective monitoring programs, and contend that monitoring should be considered a fundamental component of environmental science and policy. We urge scientists who develop monitoring programs to plan in advance to ensure high data quality, accessibility, and cost-effectiveness, and we urge government agencies and other funding institutions to make greater commitments to increasing the amount and long-term stability of funding for environmental monitoring programs.

Front Ecol Environ 2007; 5(5): 253–260

In a nutshell:

- Environmental monitoring is often criticized as being unscientific, expensive, and wasteful
- We argue that monitoring is a crucial part of environmental science, costs very little relative to the value of the resources it protects and the policy it informs, and has added value in that basic environmental monitoring data can be used for multiple purposes
- Effective monitoring programs address clear questions, use consistent and accepted methods to produce high-quality data, include provisions for management and accessibility of samples and data, and integrate monitoring into research programs that foster continual examination and use of the data
- Government agencies should commit to long-term support for valuable monitoring programs, and funders of basic ecological and environmental research should recognize that monitoring is a fundamental part of environmental science

Why are benthic organisms important?

1. **Important ink in the food web - primary producers to higher levels:**

(filter feeder, benthic, detritus feeders)

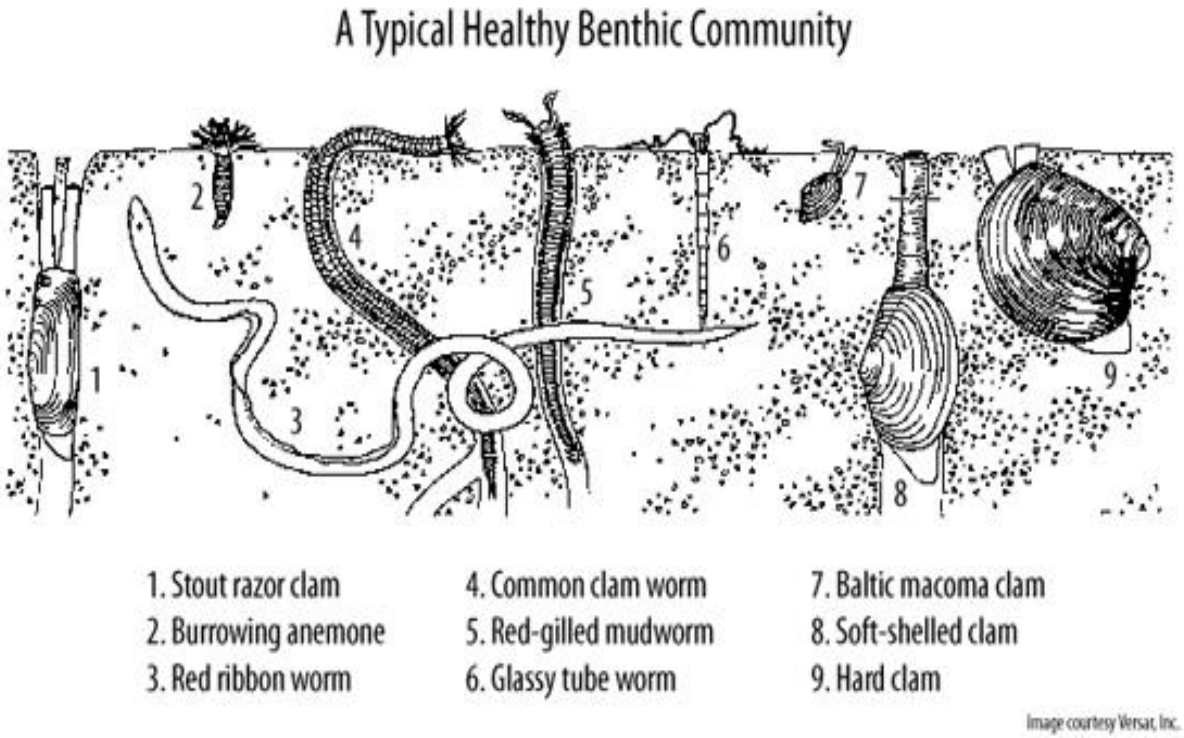
2. Excellent environmental snapshot - exposure stressors :

(low oxygen, excess sediment& contaminants)

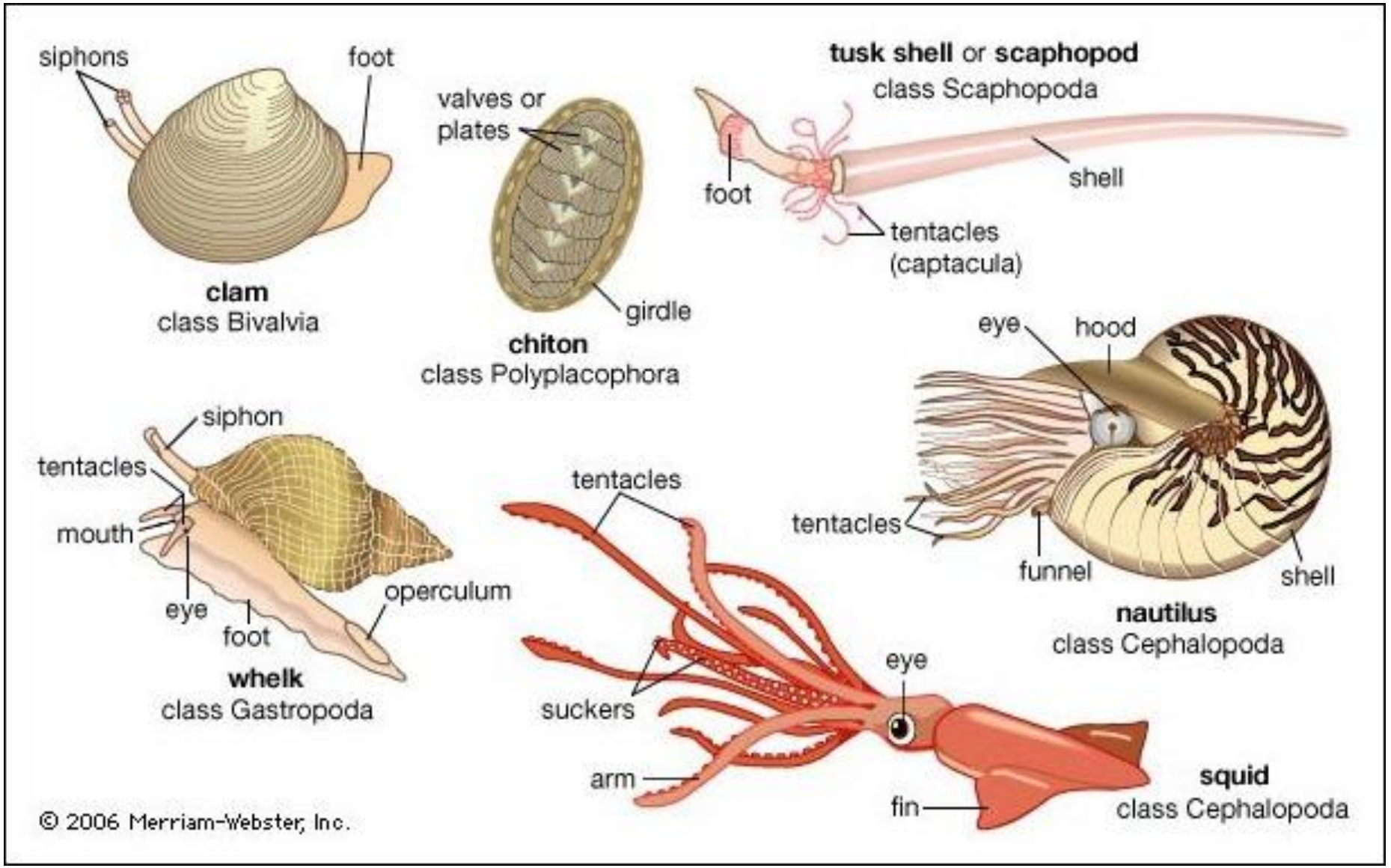
Benthic Communities

- **Macrofauna**
- **Meiofauna**
- **Preservable hard part: fossil record**

➔ reconstructing natural conditions and identification of pollution events



Identification in **mollusks**



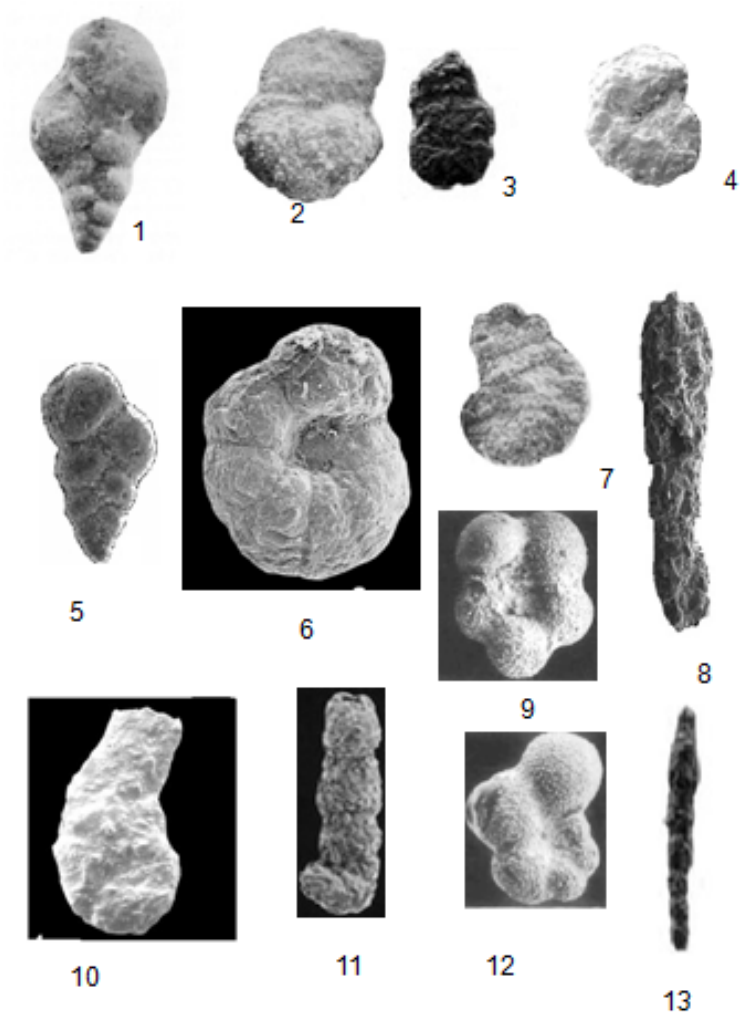
Source: http://diet.yukozimo.com/media/o/7219-2.jpg

Identification of thecamoebians and ostracods

(a)**Thecamoebians**: **1**, *Difflugia corona* Wallich, 1864, **2-12**, *Difflugia oblonga* Ehrenberg, 1832, **13-16**, *Difflugia tricuspis* Carter, 1865, **17-20**, *Difflugia urceolata* Carter, 1864.

(b) Ostracoda: **21-25**, *Afrocythere rostrata* Klie, 1935, **26-28**, *Alicennula serricaudata* (Klie, 1935), **30**, *Cypria*? sp., **31-33**, *Cypridopsis*? sp.

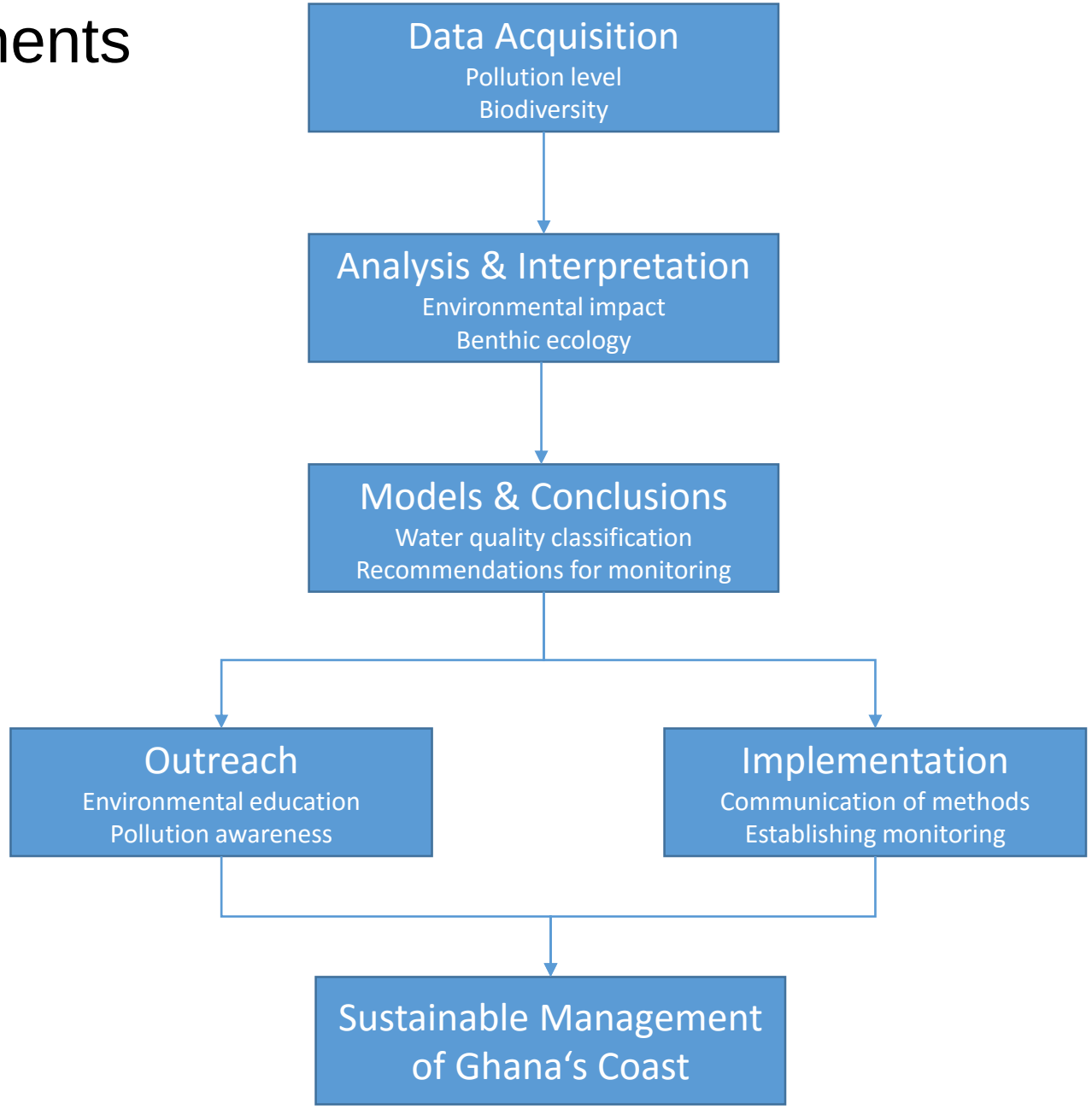
Identification of Foraminifera



1. *Heterohelix reussi*
2. *Ammobaculites numahensis*
3. Ammobaculites bauchensis
4. Haplophragmoides sabariense
6. Haplophragmoides spp.
7. *Ammobaculites pindigensis*
8. *Ammobaculites bauchensis*
9. *Hedbergella spp.*
10. *Ammobaculites pindigensis*
12. *Globigerinelloides spp.*
13. *Reophax guineana*

Source: http://pubs.sciepub.com/jgg/2/3/3/

Project Components



Motivation

Determine

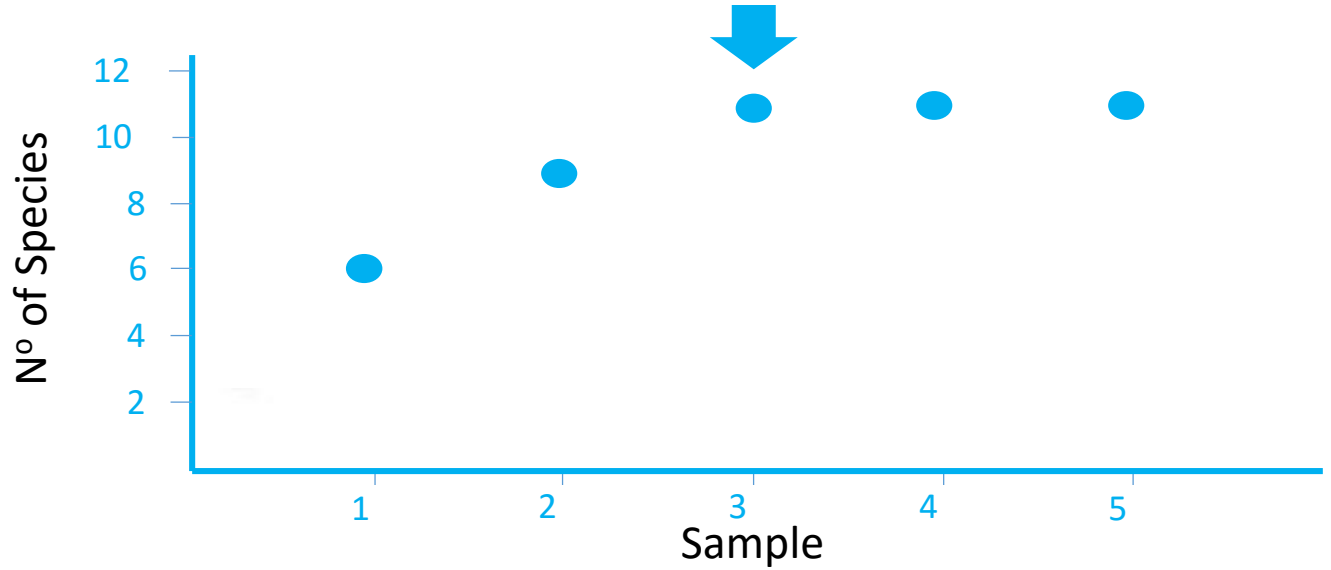
- Species inventories/biodiversity
- Biomass
- Species distribution
- Ecologically driving factors
- Historical data

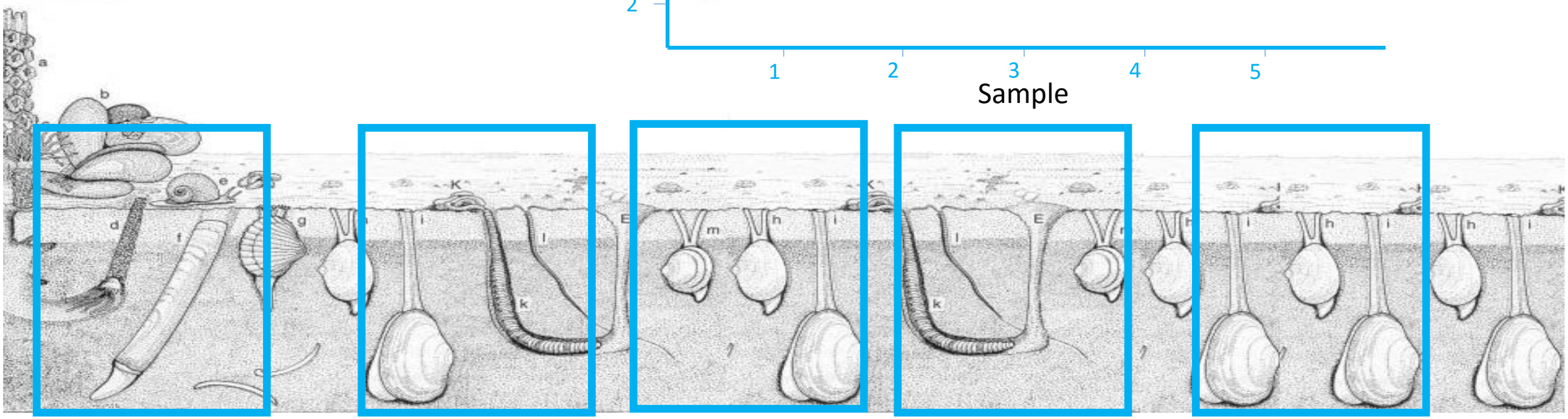
Sampling

- Assumption: small sample represents large area and complete time interval
- Representative number of replicates

Sampling

Species-Area curves

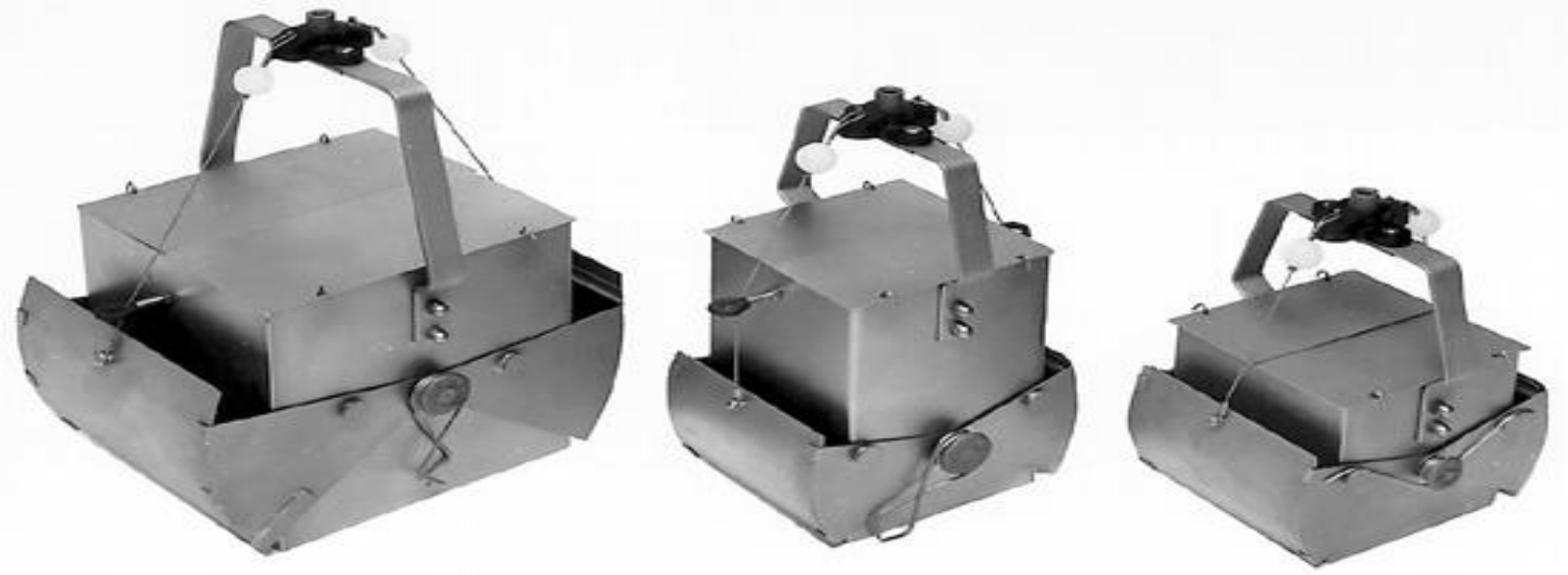




Sampling

Box corer sampling

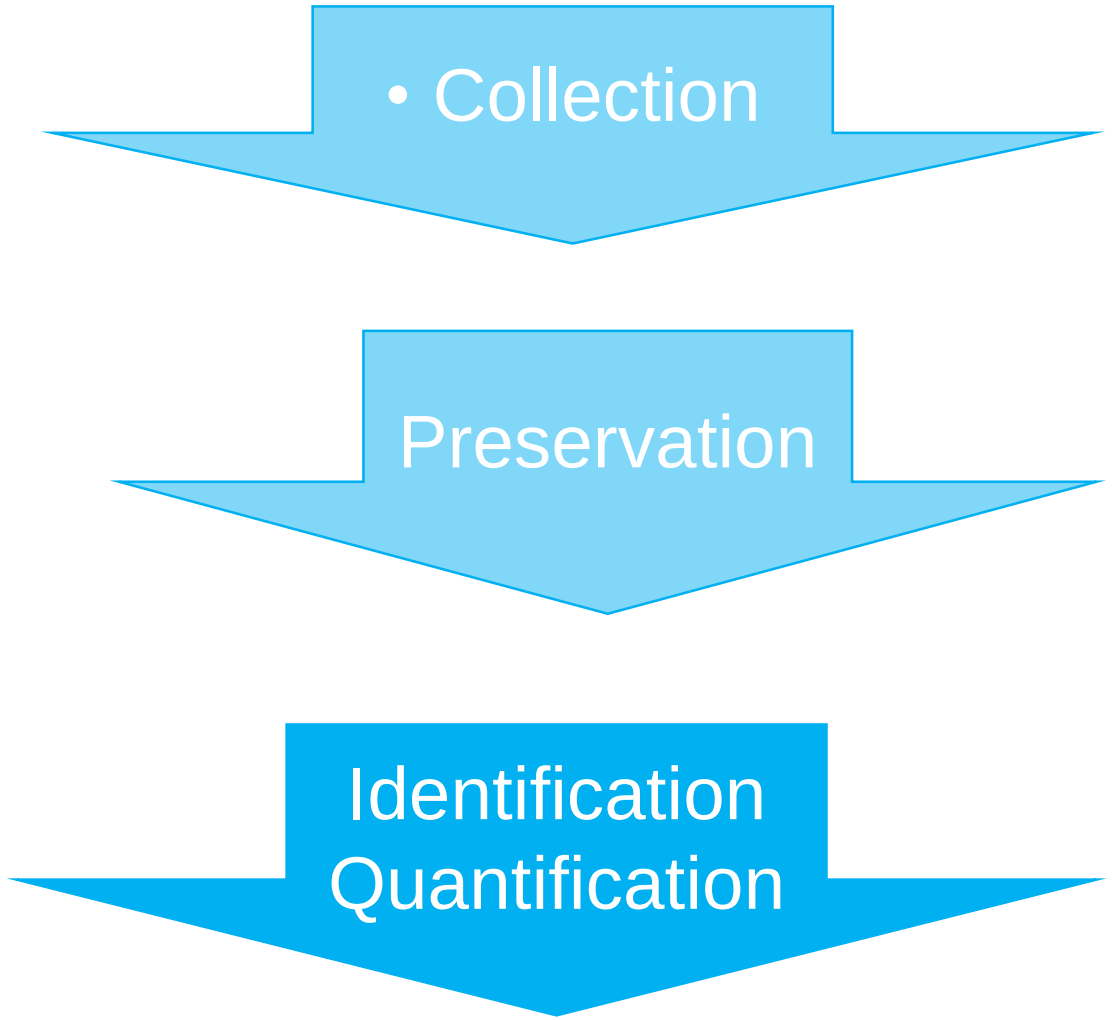
- Penetrates differently according to coarseness of sediment, stones may prevent closing.
- Epibenthic meiofauna and sediment surface not disturbed.



Sampling

- Sieve on # **0.5 mm** for macrozoobenthos and on # **0.63 mm + 0.2** mm for meiobenthos.
- Transfer of **all benthic** in jars.
- Preservation of labelled samples individually in 96% Ethanol, or 4% borax buffered formalin.

Analyses


• Collection
Preservation
Identification
Quantification

Identification/analysis

Hoosier Riverwatch

Biological Monitoring Data Sheet

Date ____/____/____ Volunteer ID _____ Site ID _____

Stream Name _____ Latitude _____ Longitude _____

Time ____:____ AM / PM Time Sampling _____ hrs Air Temp _____ C

Current Weather: ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (steady) ☐ Storm (heavy)

Worst Weather (past 48 hours): ☐ Clear/Sunny ☐ Overcast ☐ Showers ☐ Rain (steady) ☐ Storm (heavy)

Check Methods Used: ☐ Kick Seine Net (3 times) ☐ Dip Net (20 jabs or scoops

Check Habitats Sampled: ☐ Undercut Banks ☐ Riffles ☐ Leaf Packs ☐ Snags/Vegetation ☐ Sediment

Pollution Tolerance Index (PTI)

Record the taxa (group) represented in your sampling by either entering the number of organisms you counted or by a

Group 1 - Intolerant	Group 2 - Moderately Intolerant	Group 3 - Fairly Tolerant	Group 4 - Very Tolerant
☐ Stonefly Nymph	☐ Damselfly Nymph	☐ Leech	☐ Aquatic Worms
☐ Mayfly Nymph	☐ Dragonfly Nymph	☐ Midge Larva	☐ Blood Midge Larva (red)
☐ Caddis Fly Larva	☐ Scud	☐ Planaria/Flatworm	☐ Rat-tailed Maggot
☐ Riffle Beetle	☐ Sowbug	☐ Black Fly Larvae	☐ Left - Handed or Pouch Snail
☐ Dobsonfly Larva	☐ Crane Fly Larva		
☐ Right-Handed Snail	☐ Clam/Mussels		
☐ Water Penny	☐ Crayfish		
☐ # of TAXA	☐ # of TAXA	☐ # of TAXA	☐ # of TAXA
☐ Weighting Factor (x4)	☐ Weighting Factor (x3)	☐ Weighting Factor (x2)	☐ Weighting Factor (x1)

PTI Ratings	
Excellent	23 or More
Good	17 - 22
Fair	11 - 16
Bad	10 or Less

Pollution Tolerance Index Rating

(Add the final index values for each group)

Please check other Biological Indicators you observed:

☐Native Mussels ☐ Zebra Mussels ☐Rusty Crayfish ☐ Aquatic Plants _____%Algae Cover _____Diversity Index

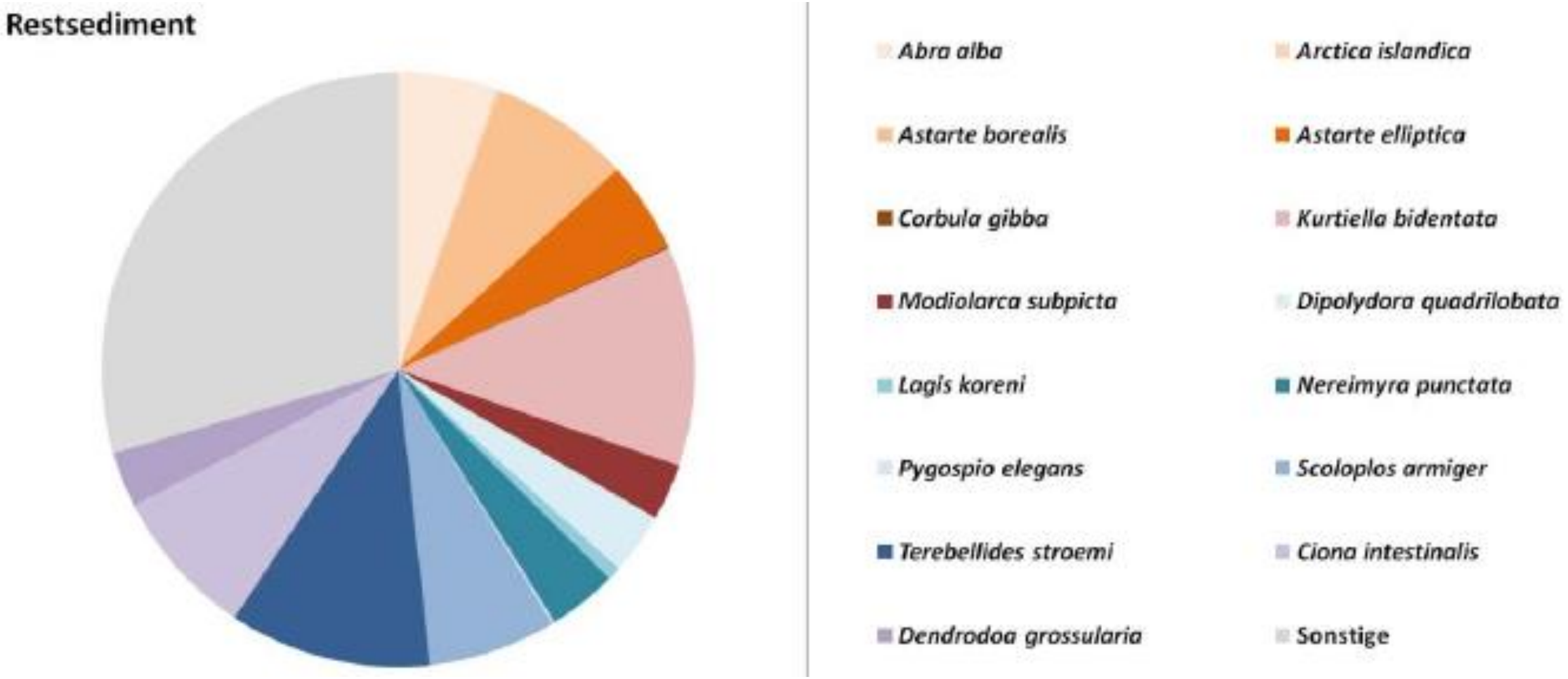
16

Source:http://midmichigannatureandscience.blogspot.ug/2013/04/aquatic-ecology-and-mother-earth-week.html

Identification& quantification

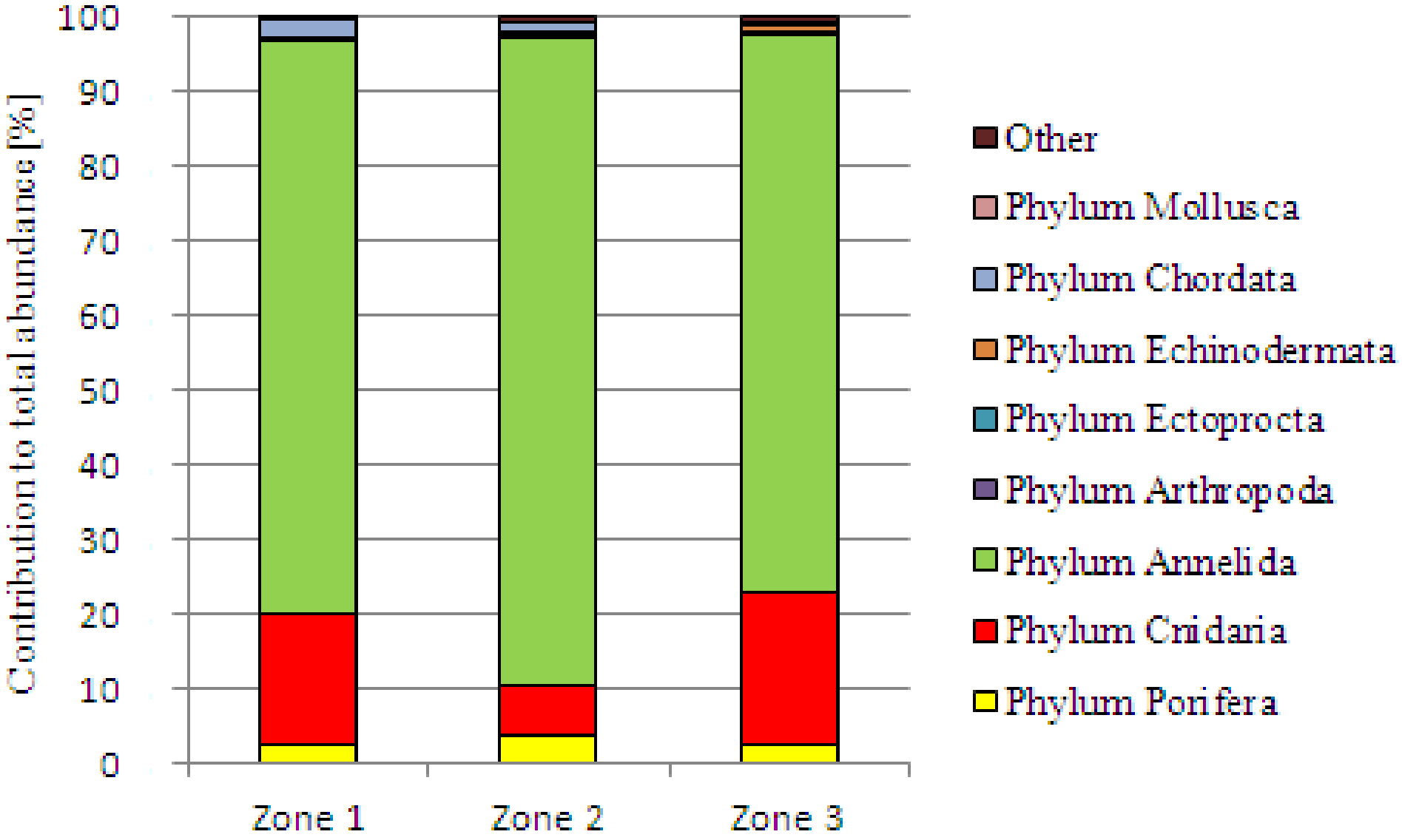
		Sample 1	Sample 2	Sample 3	…	PERCENTAGE
FAMILIES	**SPECIES**	n	n	n	n	%
Actinostolidae	*Antholoba achates*			1	1	< 0.01
Actinidae	*Anemonia alicemartinae*	5			5	
Sagartiidae	*Anthothoe chilensis*	2	2	23	27	0.12
Lineidae	*Lineus* sp.	7	6	7	20	0.09
Flabelligeridae	*Pherusa peruviana*	4	158	3	165	0.71
Glyceridae	*Glycera americana*	16	15	8	39	0.17
…						

Community Description



Analyses

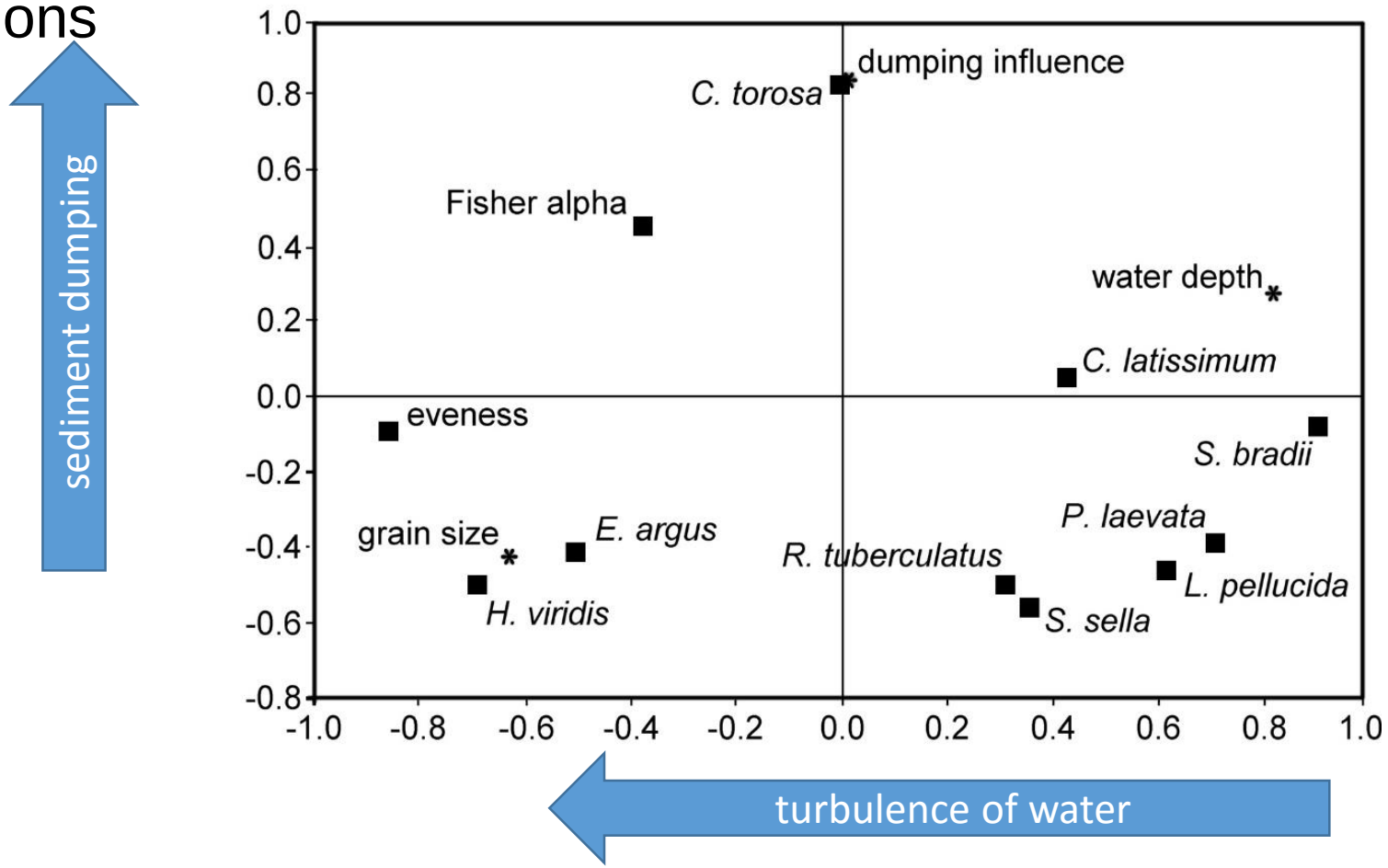
Community Description



Multivariate statistics

- Identification of environmental factors driving distribution of taxa

- Set up of transfer functions



Frenzel etal.2009

Acknowledgements

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Prof. Dr. John Farrington (Whoi)
Dr. Charles Biney (Volta Basin)
Prof. Dr. Elvis Nyarko (Regional Maritime University)

Conclusion

Biological organisms can be use for monitoring water quality due to:

- Sedentary life style
- Species specific sensitivity
- Presence or absence of certain invertebrates is a determinant of the **state of aquatic ecosystems**