Chapter 11

Invertebrates

11.1 Introduction

Invertebrate Data Important to (cont.)

- Determine prey base for sport fish

Invertebrate Data Important to

- Evaluate habitat improvement efforts
- Determine biological integrity of water
- Document pollution or other degradations

Steps in Any Invertebrate Project

- Identify objectives
- Determine what gear to use
- Where to sample
- How many times to sample

Steps in Any Invertebrate Project (cont.)

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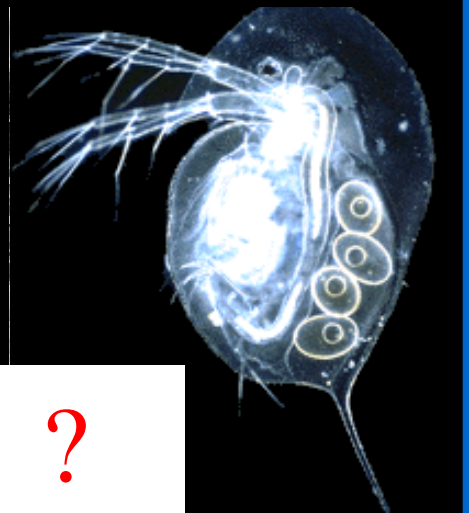

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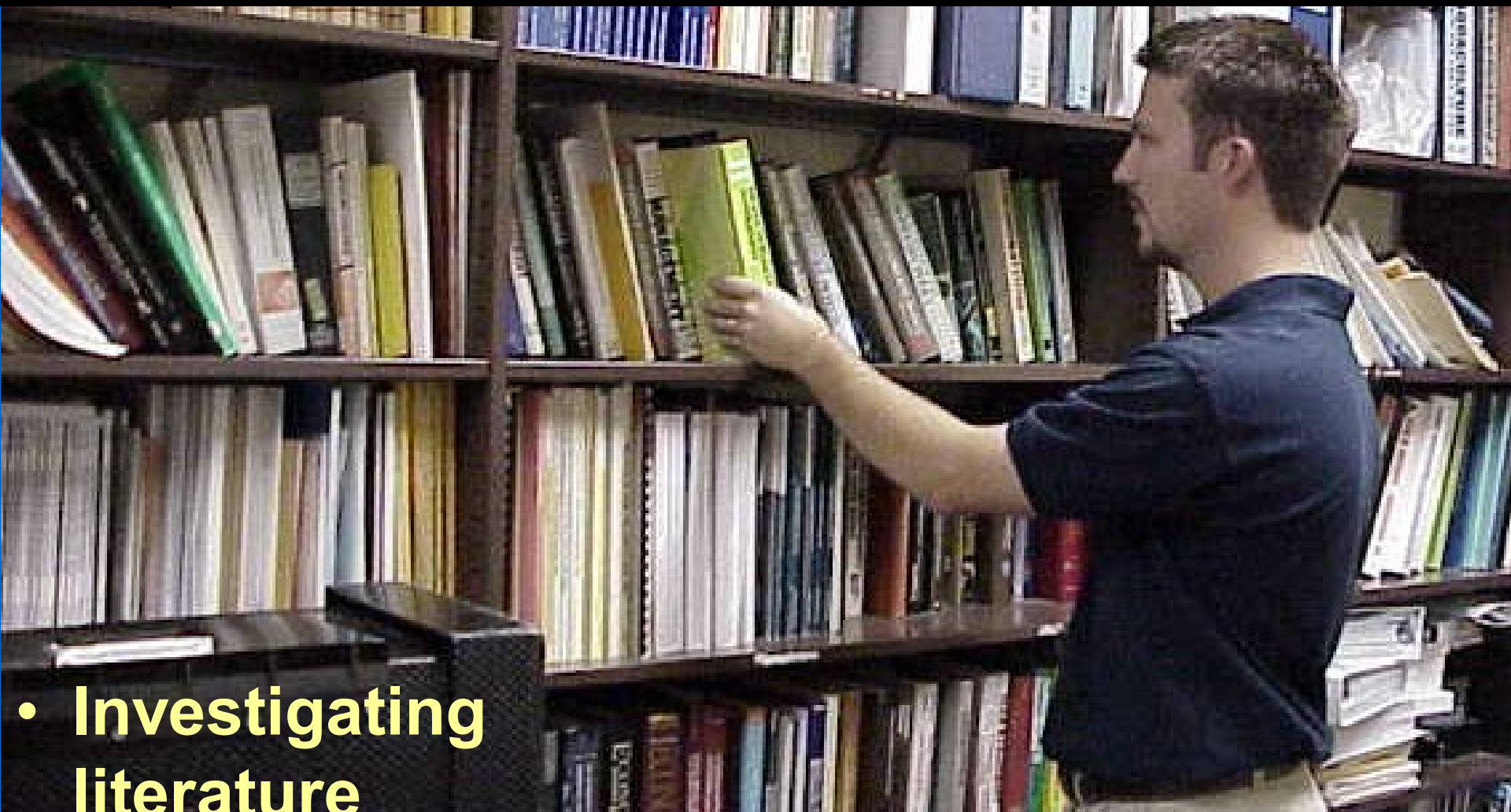
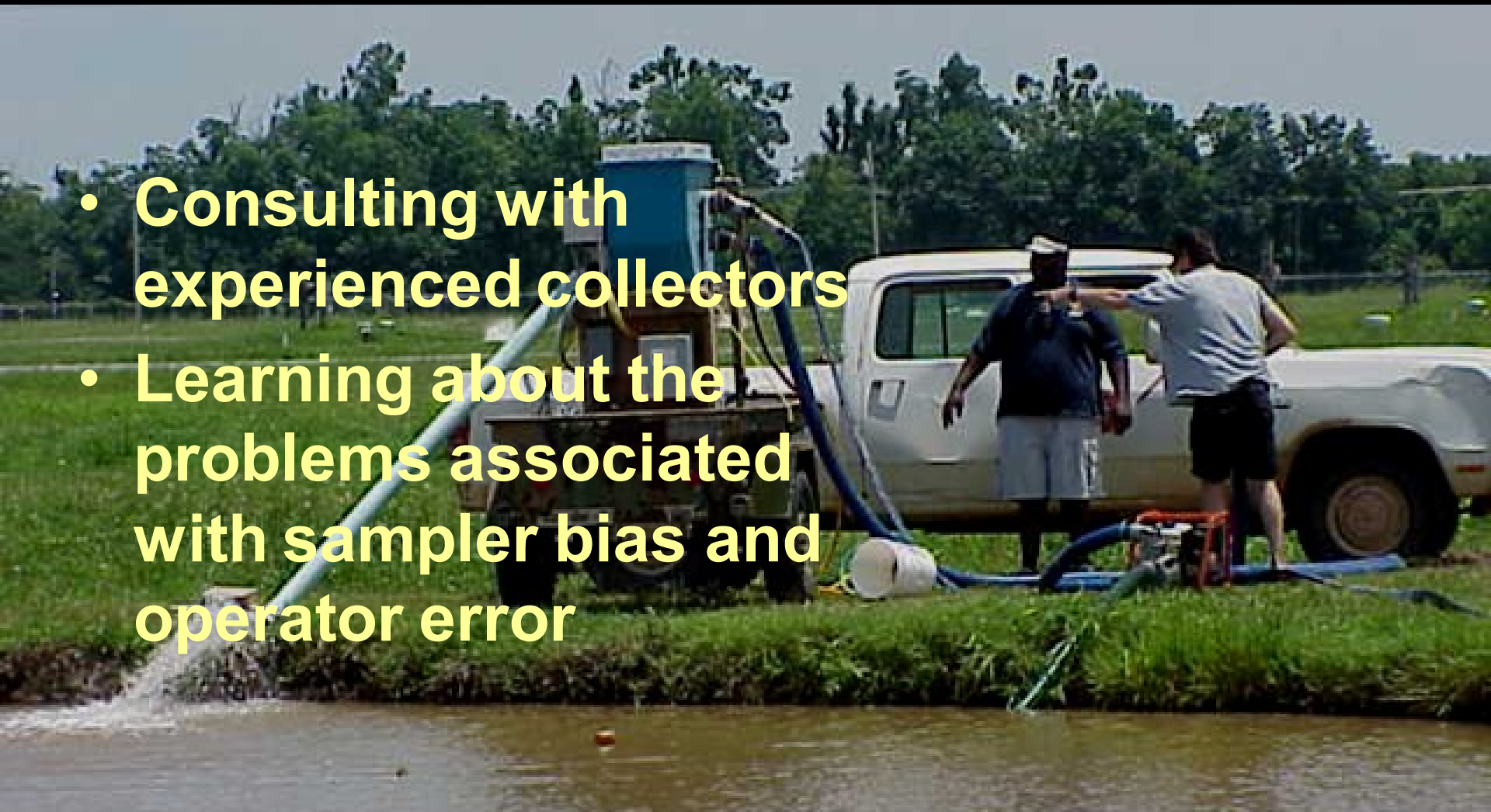
- How to preserve and catalog
- How to best sort invertebrates
- How best to enumerate and identify
- How best to analyze data

Mistakes can be avoided by



- Investigating literature

Mistakes can be avoided by (cont.)



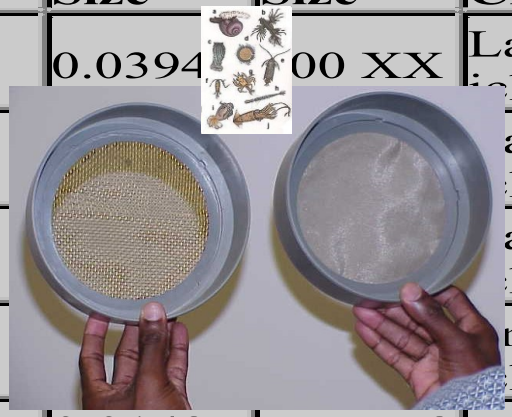
- Consulting with experienced collectors
- Learning about the problems associated with sampler bias and operator error

11.2 Devices for Collecting Invertebrates

- Decide smallest organism to be harvested to determine the mesh size

FRESH WATER PLANKTON CLASSIFICATIONS with BOLTING CLOTH SIZES

Micron Size	Inch Size	Silk Size	Plankton Classification
1000	0.0394	00 XX	Largest zooplankton and ichthyoplankton
750			arger zooplankton and chthyoplankton
600			arge zooplankton and chthyoplankton
500			mall zooplankton and chthyoplankton
363	0.0143	2	Large microcrustacea
243	0.0096	6	Microcrustacea
153	0.0060	10	Microcrustacea and most rotifers
118	0.0046	12	Small rotifers
80	0.0031	20	Net phytoplankton and net zooplankton
63	0.0024	25	Large nannoplankton and large diatoms
10	0.0004	none	Small nannoplankton



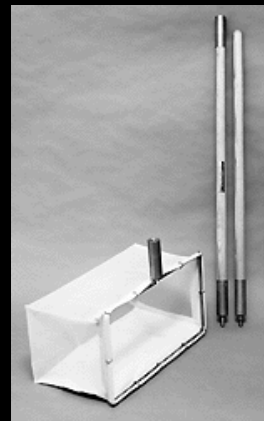
Collecting Macroinvertebrates

- Corer
  - Standing water
  - With or without vegetation

- D-frame aquatic net main tool
  - Versatile
  - Low cost
  - Portable

- Sampling ponds, wetlands, and littoral zones of lakes

Shallow Streams (cont.)



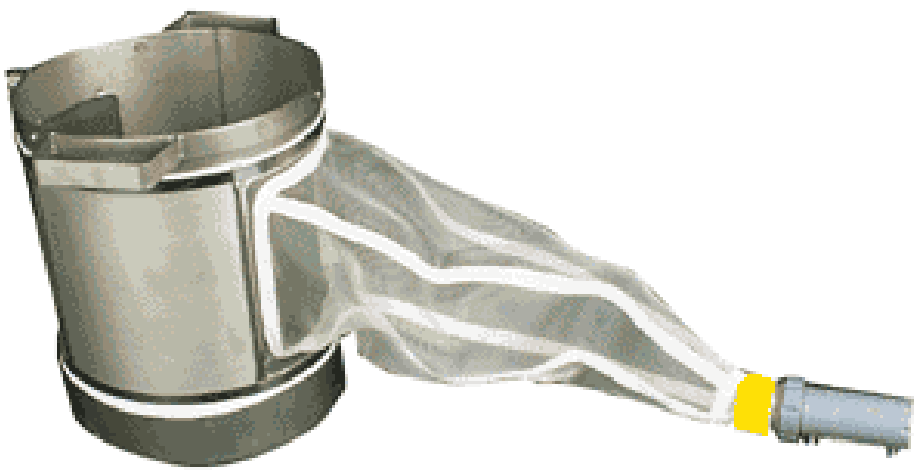
- D-frame net commonly used (kick net)
  - Held at bottom
  - Water upstream agitated by foot

Shallow Streams (cont.)

- Surber sampler
  - Opening upstream
  - Rim delineates 1 square foot
  - Substrate within rim removed or agitated
  - Organisms drift into bag

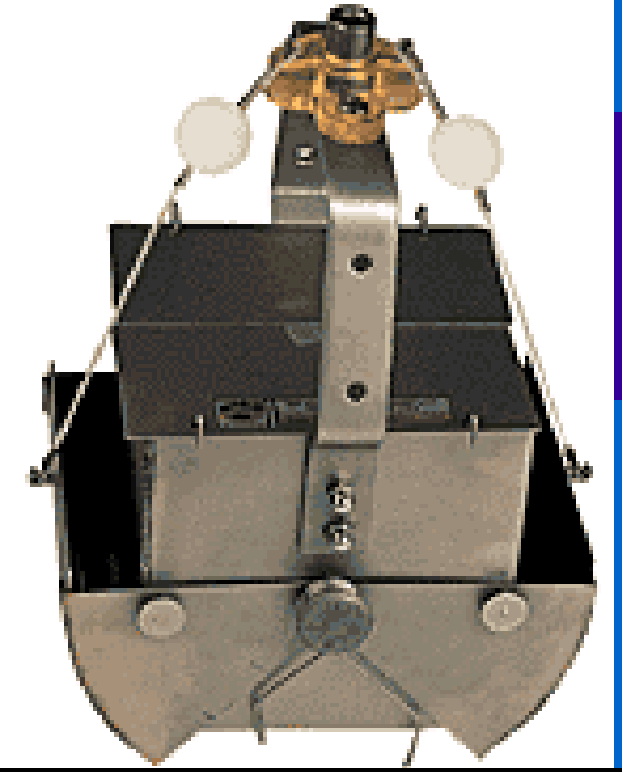
Shallow Streams

- Hess sampler
  - Attributes of corer and surber
  - Mesh corer attached to collection bag
  - Operation similar surber
  - Can be used in deeper water
  - No backwash problem



Deep Streams and Rivers

- Problem when water is deep
- Primary concern is safety
- Scuba/other underwater gear generally needed
- Samplers totally enclosed except for bottom



Lakes

- Ekman grab
  - Metal box with jaws on the bottom
  - Lowered to the bottom with jaws open
  - Sinks into substrate
  - Metal weight sent to shut jaws
  - Sampler and content retrieved

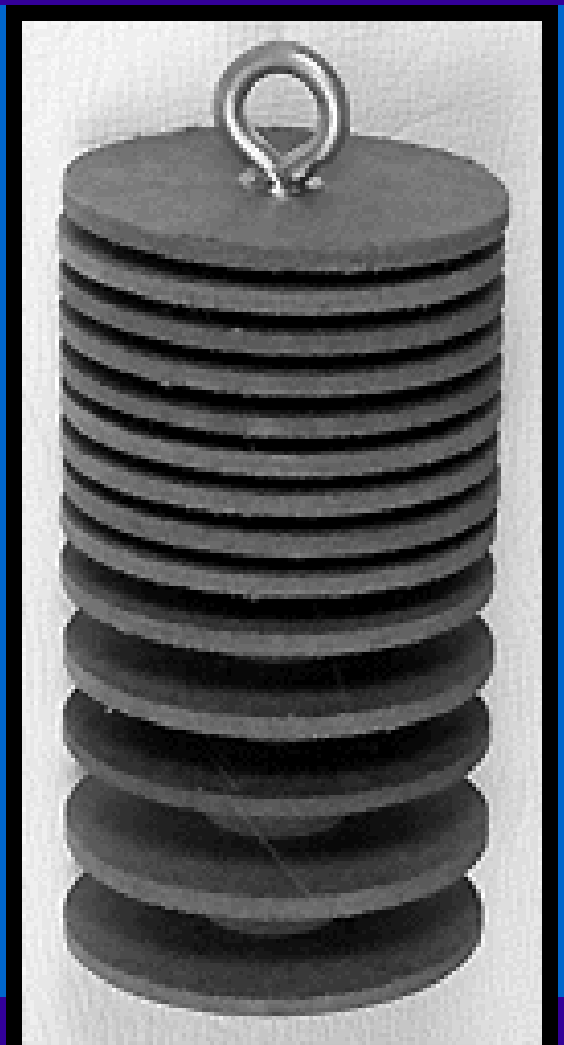
Introduced Substrates

- Materials placed into an aquatic environment colonized by invertebrates

Introduced Substrates (cont.)

- Rock-filled basket
  - Basket can be filled with any material
  - Better if material like natural substrate

Introduced Substrates (cont.)



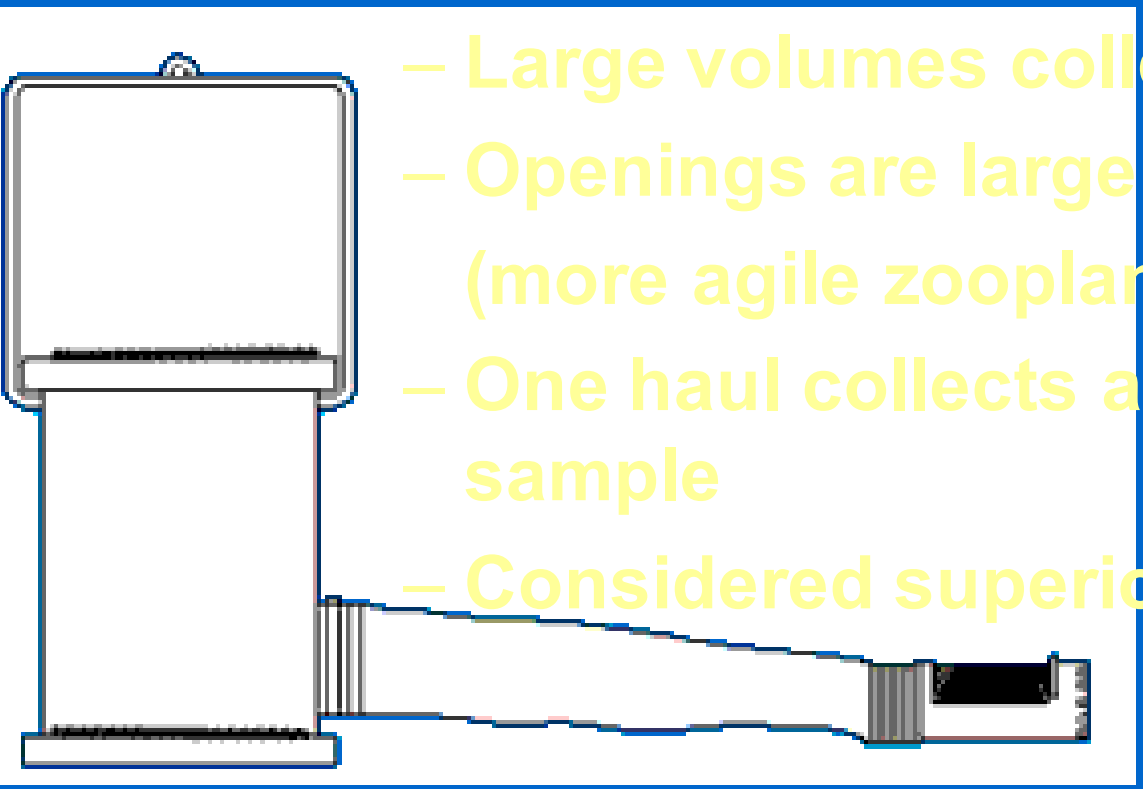
- Multiplate sampler
  - Suspended in water column
  - Less work to process
  - More sample replicates

Collecting Zooplankton - Types of Samplers

- Closing samplers
  - Held open at each end
  - Closed by messenger
  - Obtain quantitative sample of water

Collecting Zooplankton - Types of Samplers (cont.)

- **Traps**
  - Developed to minimize zooplankter avoidance
  - Large volumes collected
  - Openings are large (more agile zooplankters)
  - One haul collects and concentrates sample
  - Considered superior to closing samplers

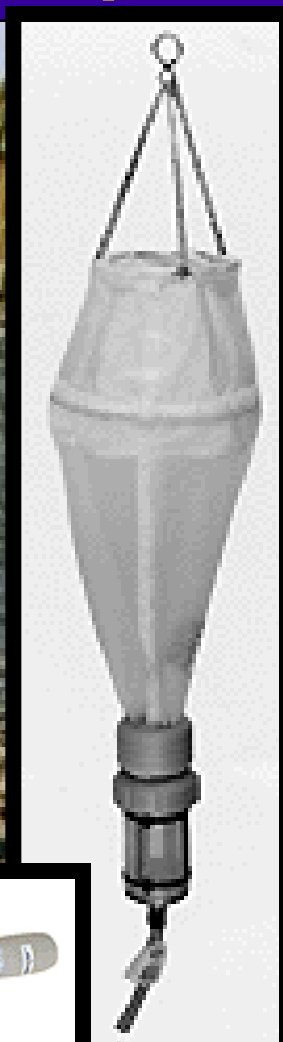


Collecting Zooplankton - Types of Samplers (cont.)

- Pumps
  - Used in conjunction with hollow flexible tube or hose
  - Allow large volume filtered (the better the estimate)
  - Tubes with pumps collect sample at particular depth
  - Flow meter or calibrated container required for quantitative estimate

Collecting Zooplankton - Types of Samplers (cont.)

- Zooplankton nets
  - Widely used...Wisconsin model
  - Can collect both qualitatively and quantitatively
  - Pulled horizontally or vertically for particular distance or time
  - For more accuracy, attach flow meter



Sampling in Specialized Habitats

- Vegetation
  - D-frame net for qualitative
  - Corer for quantitative

Sampling in Specialized Habitats (cont.)

- Woody debris
  - Sawing off pieces of wood and bringing to surface
  - Qualitative...assume wood piece is a cylinder and calculate surface area
  - If too large, can be scraped over a designated area into bag

Sampling in Specialized Habitats (cont.)

- Stream drift
  - Drift nets anchored to stream bottom
  - Quantification
  - Velocity at mouth
  - Area of sampler
  - No. of organisms per X volume of water

Sampling in alized Habitats (cont.)

- Large substrates
  - Large cobble, boulders or bedrock hard to sample
  - Hess or Brown benthos sampler modified to sample
  - Difficult to get representative sample

Sampling in Specialized Habitats (cont.)

- Hyporheos (within-substrate habitat)

  - Freeze coring
    - Metal tubes driven into substrate
    - After re-acclimation period, liquid nitrogen poured down tubes
    - Solidifies nearby substrate and everything in it
    - Frozen substrate pulled from stream bottom
    - Invertebrates examined

11.3 Collection Strategies

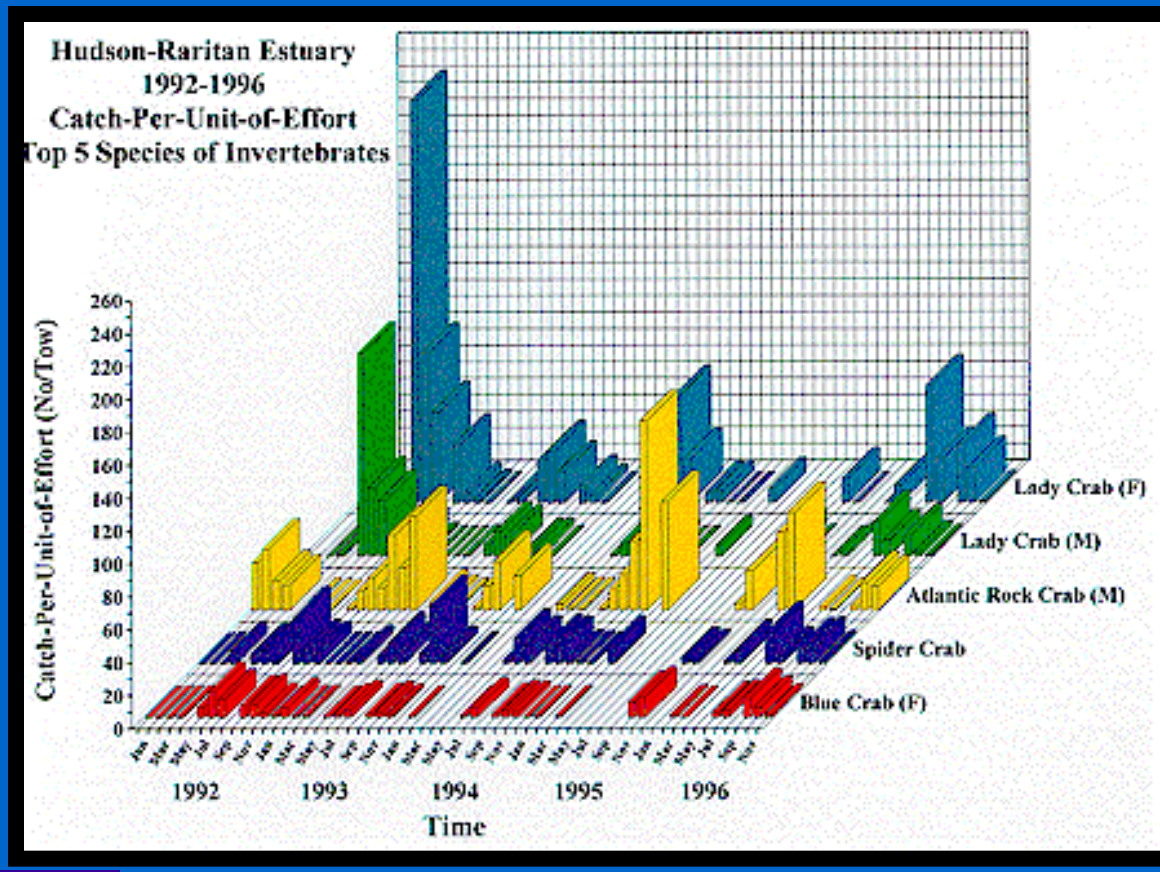
- Best time to sample
- Where in a particular place to sample
- How many samples to take

Good sampling strategy results from

- Reviewing extensive literature
- Conducting pilot study

When to Sample

- Knowledge of temporal variation of biota
- Each life-stage may occupy different habitat
- Some species produce many generations a year

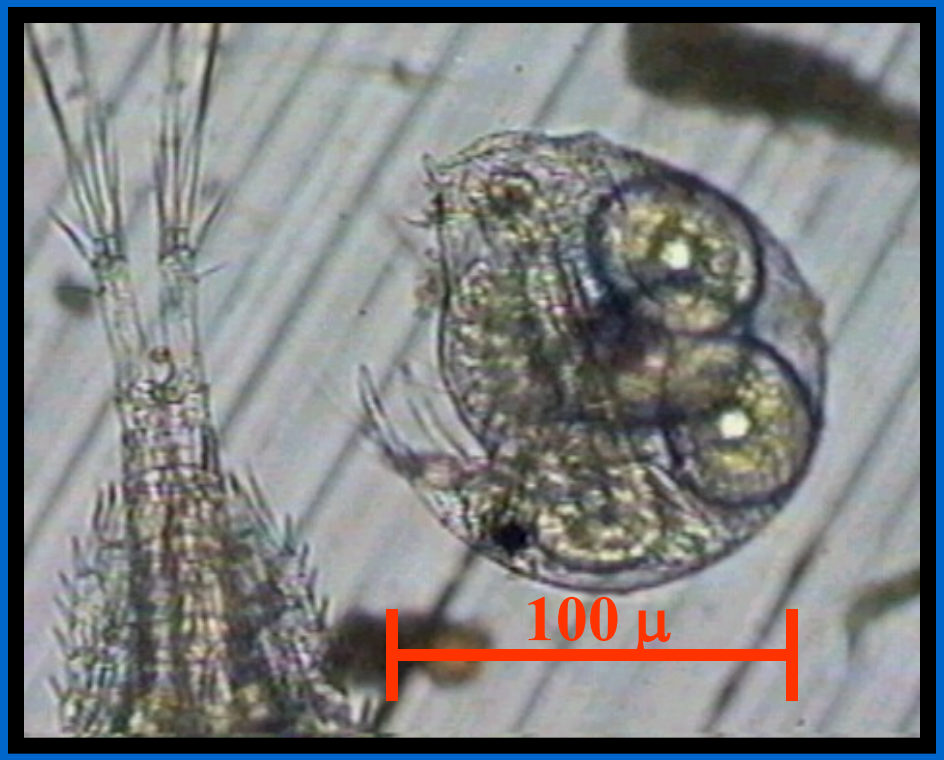


When to Sample (cont.)

GUIDELINES for NET APERTURE SELECTION Rough Guidelines - General Sampling Fresh Water		
ZOOPLANKTON		
500 µm	X-Coarse	Late Summer, Fall
243 µm	Coarse	Spring, Early Summer
118 µm	Medium	Includes Most Rotifers
PHYTOPLANKTON		
153 µm	Standard	Late Summer, Fall
80 µm	Fine	Late Spring, Early Summer
63 µm	Very Fine	Winter, Early Spring
DIATOMS		
10 µm	Super Fine	All Seasons

- Community composition
- changes by season
- and/or time of day

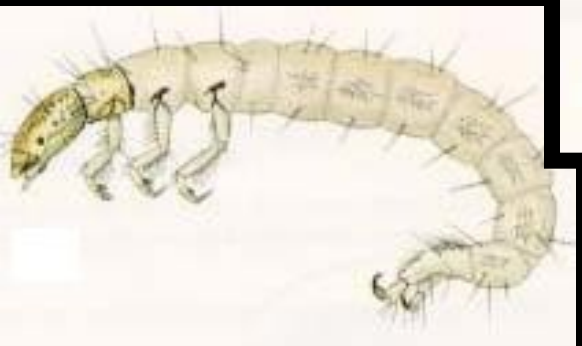
Factors Influencing Sampling Scheme



- Release of eggs all at one or over a period of time
- Size range of organism as growth progresses
- Changes in habitat preferences as organism grows

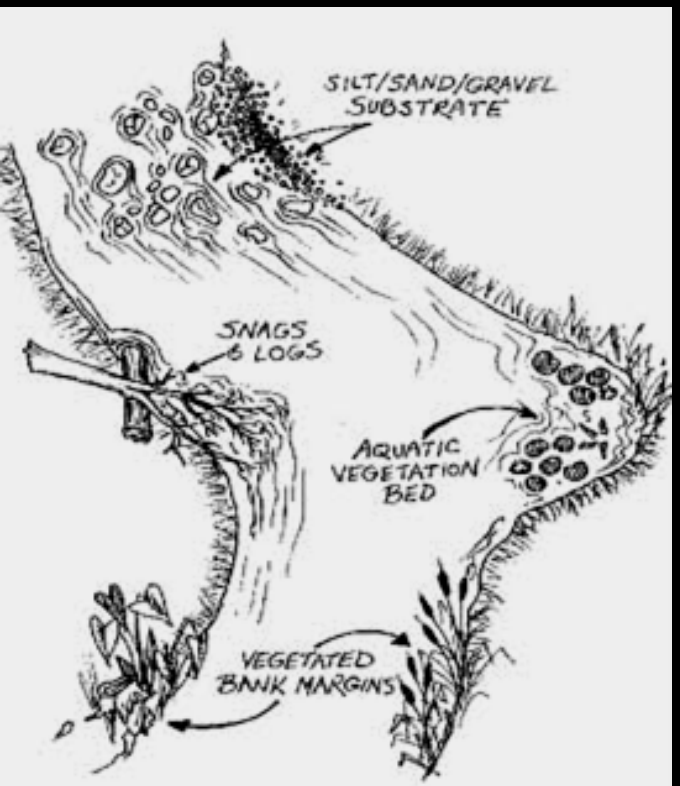
Factors Influencing Sampling Scheme (cont.)

- Changes in mobility during the life cycle
- Differences in size or behavior between sexes
- Possession of an inactive (resting) stage

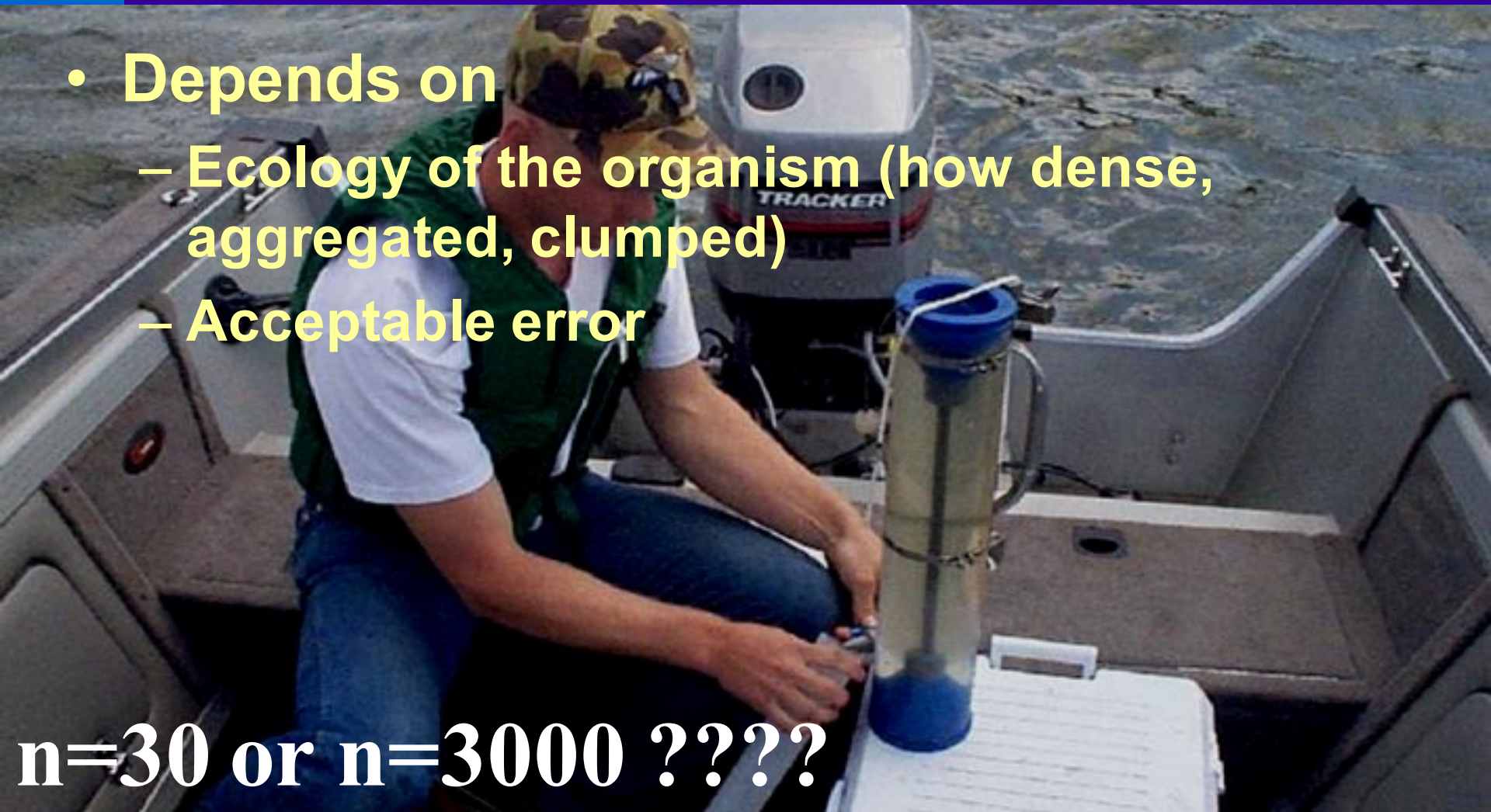


Where to Sample

- Knowledge of variation in the spatial distribution of the organism
  - Invertebrates not equally distributed among all habitat types
  - Not equally distributed within habitat
  - Clumped rather than randomly or uniformly distributed



Appropriate Sample Size

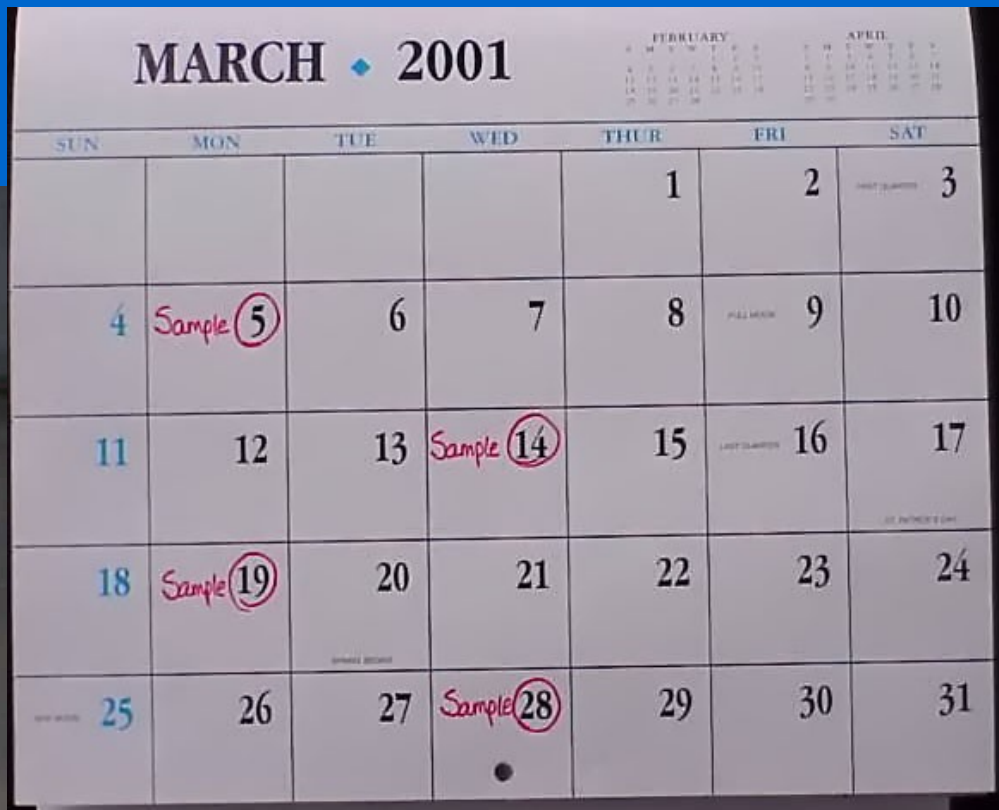


- Depends on
  - Ecology of the organism (how dense, aggregated, clumped)
  - Acceptable error

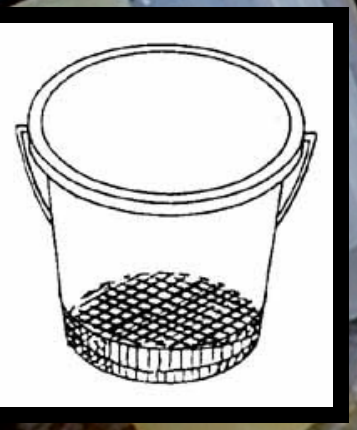
n=30 or n=3000 ????

11.4 Preservation and Storage of Samples

- Formalin (3-5%)
- Wash and transfer to 80% ethanol after a few days



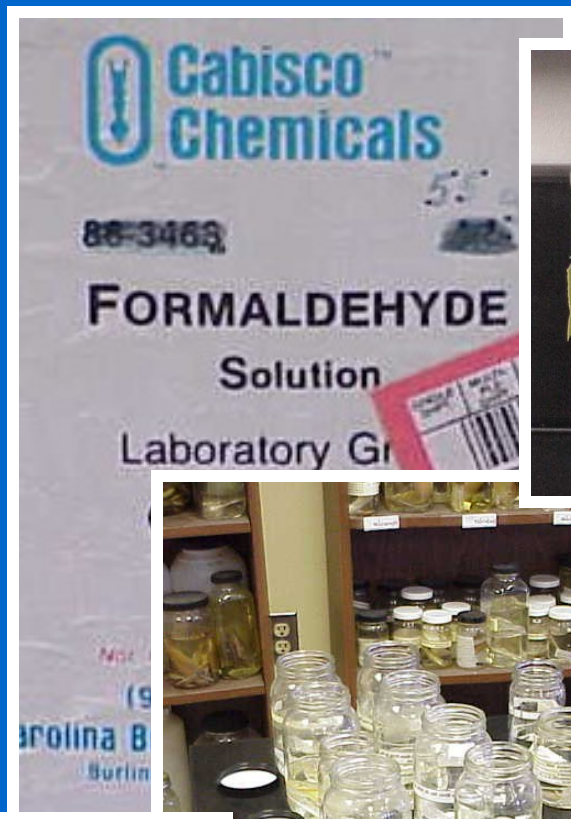
Macroinvertebrates

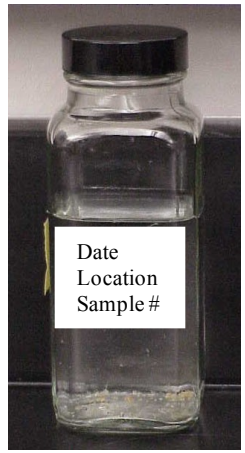


- Collect in mesh-bottomed bucket
- Washed and collected in one area of bucket

Macroinvertebrates

- Preserved in 3-5% formaldehyde
- Ensure that container is labeled
- Transfer to 80% ethanol after a few days



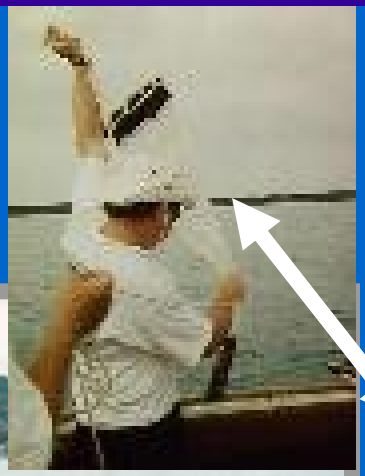


or 90% isopropol

To Avoid too much Sorting Time of Macroinvertebrates

- Add stains
- Flotation
- Elutriation

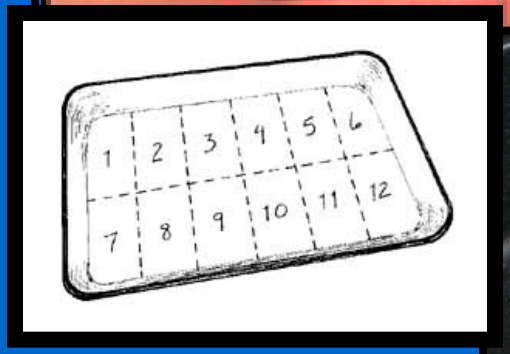
Zooplankton



- Concentrated by washing through Wisconsin Zooplanton net
- Stored in a 3-5% formalin solution

11.5 Sub-samples

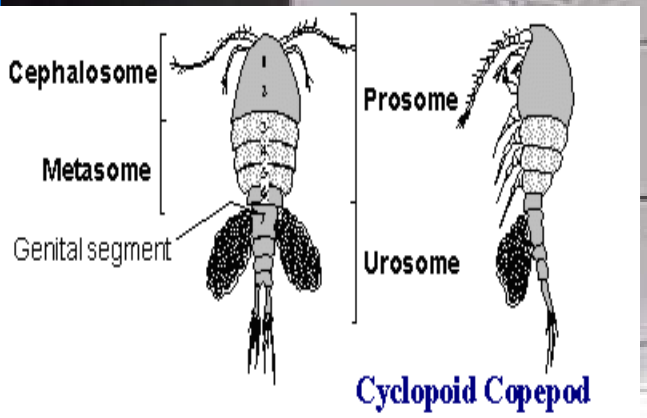
- May greatly reduce sorting and identification times
- Has to be representative of the whole sample
- Gridded plan or gridded sieve used



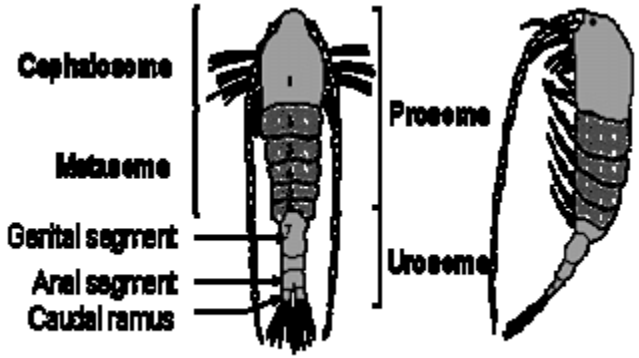
Sub-samples (cont.)

- Best done by washing and diluting to known volume
- (eg. 100mL)
- Sub-sample placed in Sedgewick- Rafter or other counting cell for analysis

11.6 Identification and References



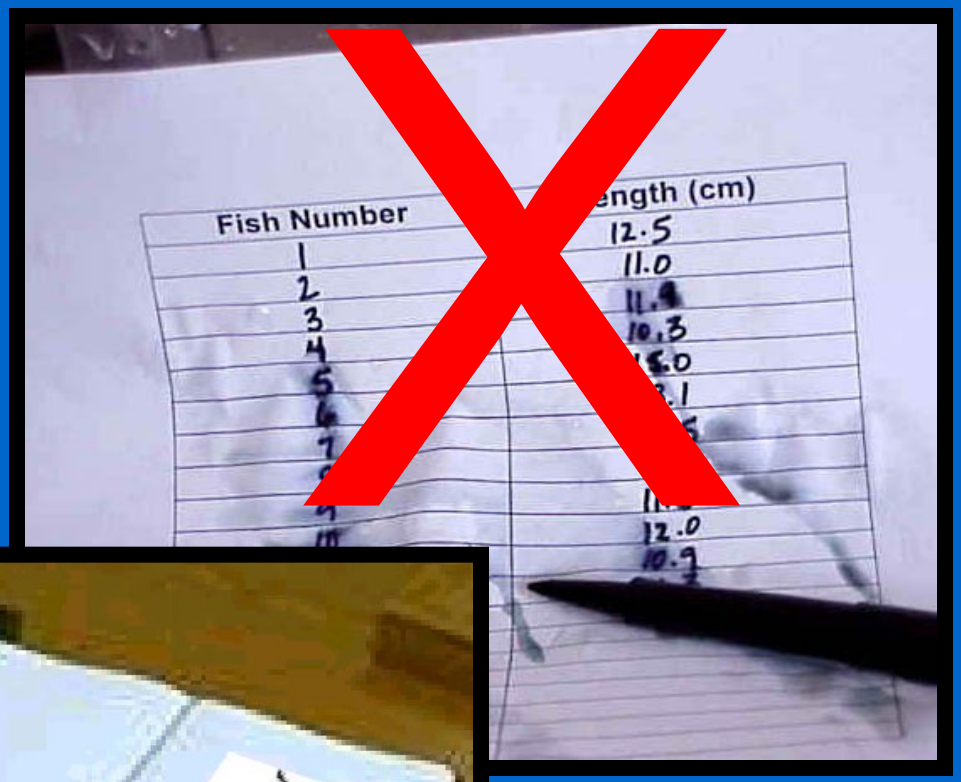
Cyclopoid Copepod



Calanoid Copepod

- Use appropriate taxonomic keys
- Verified by one with taxonomic expertise

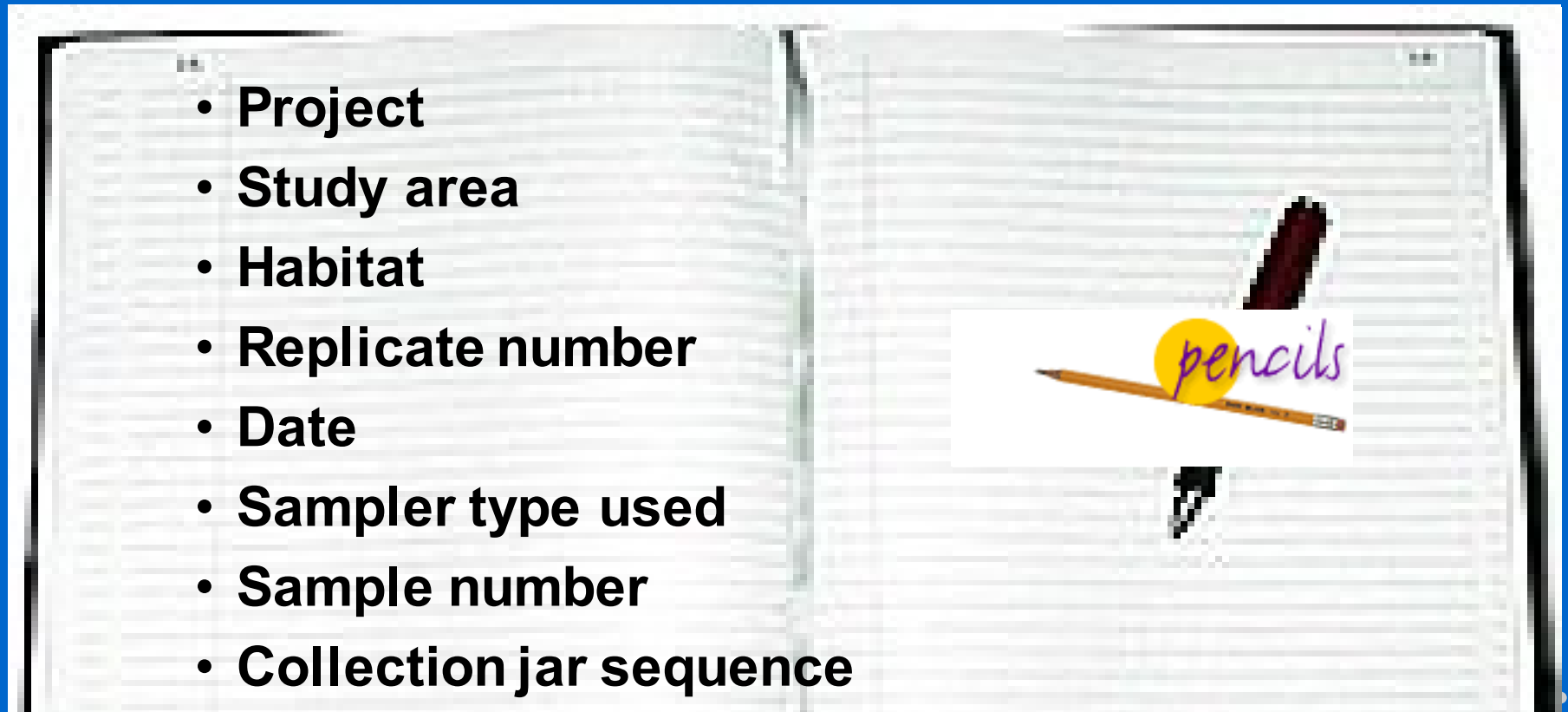
11.7 Record Keeping



- Keep track of samples at every step
- Master (waterproof) logbook should be maintained

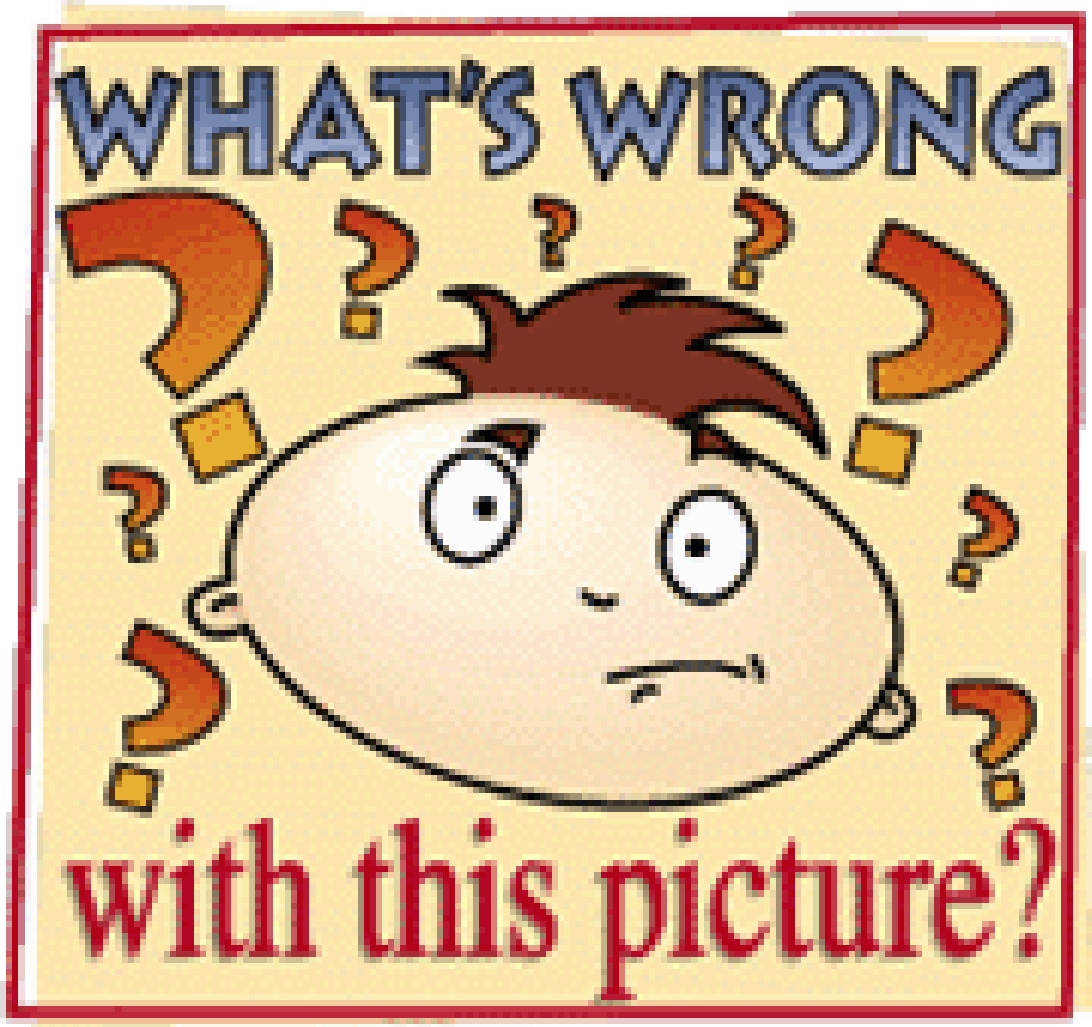
Record Keeping (cont.)

- **Each sample should have a Sample Identification Code (SIC) specifiying**



- **Project**
- **Study area**
- **Habitat**
- **Replicate number**
- **Date**
- **Sampler type used**
- **Sample number**
- **Collection jar sequence**

11.8 Evaluation of Data Quality



- Valid conclusions can only be made from properly collected data set

Questions that should be answered

- Are you sampling the right place?
- Are you sampling during the correct time?
- Are you taking enough samples?

More questions that should be answered

- Do you understand the error involved in the sampler you are using?
- Are the mesh sizes on your sampling, sorting and washing equipment appropriate to the project?

And more questions that should be answered

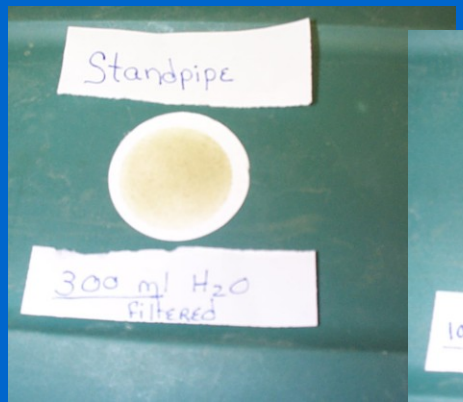
- When sample is sorted, are most invertebrates found?
- Is your sorting procedure biased toward large organisms?
- Are you confident of your identification?

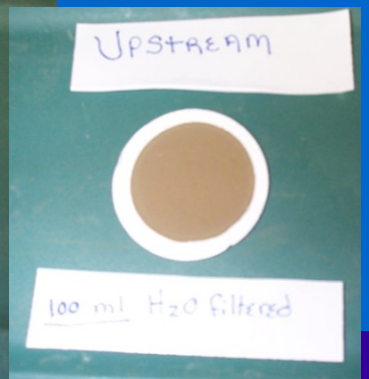
11.9 Analysis

- Guided by study objectives
- Basic data must be analyzed to extract additional information

Biomass

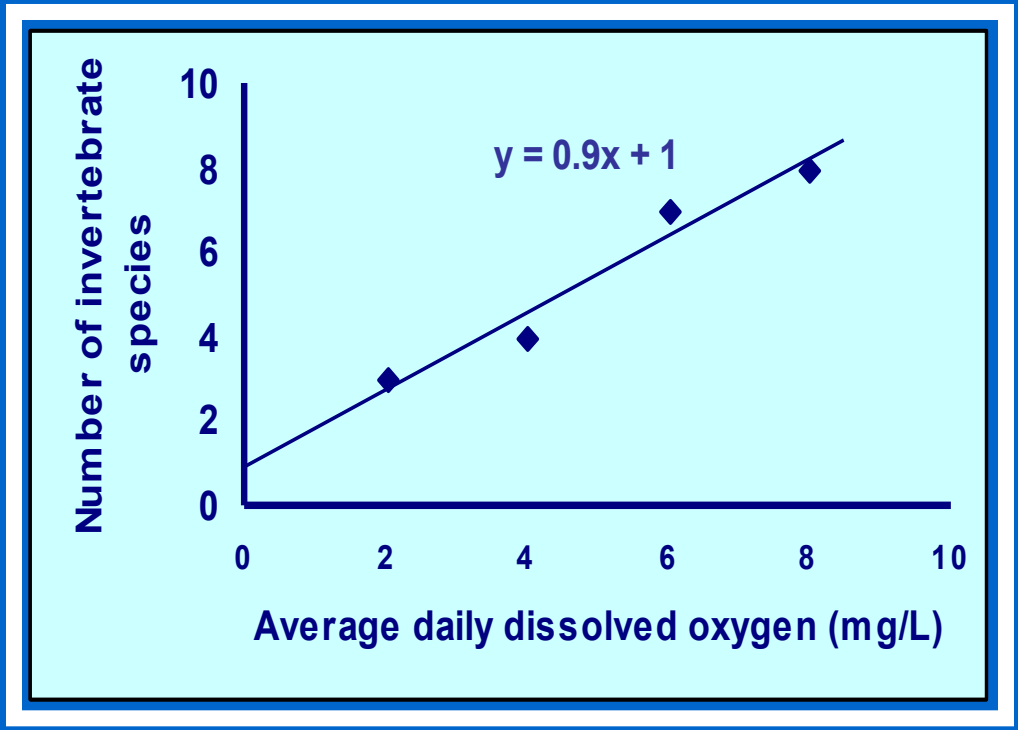
- Gravimetric- direct weighing
  - Wet weight...live weight of organism
  - Dry weight...excess water removed by blotting or centrifuging
    - Dry weights preferred





Biomass (cont.)

- Indirect method of estimation of biomass
  - Use regression equations
  - Information from predetermined weight or subset of collected animals



Invertebrates often used as an index of

- Fishing quality
- Ecological integrity
- Degree of pollution

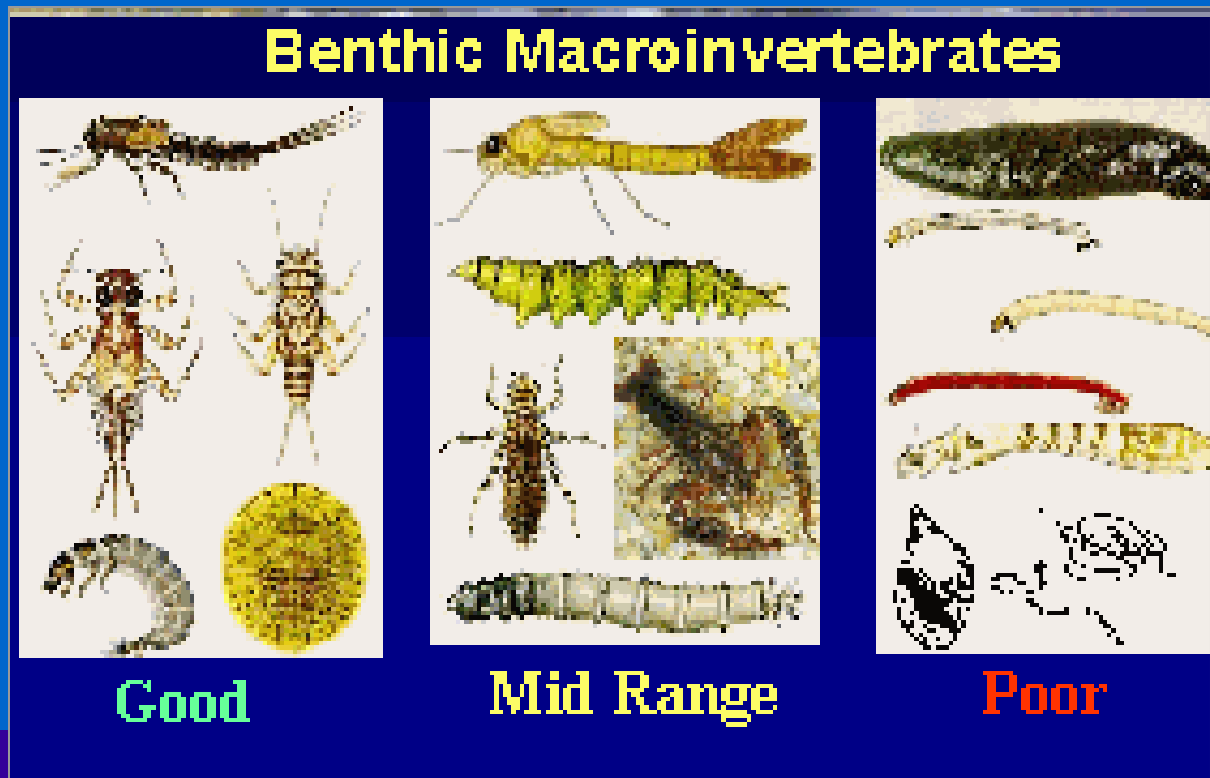
Indicators of Good Water Quality

Indicators of Moderate Water Quality

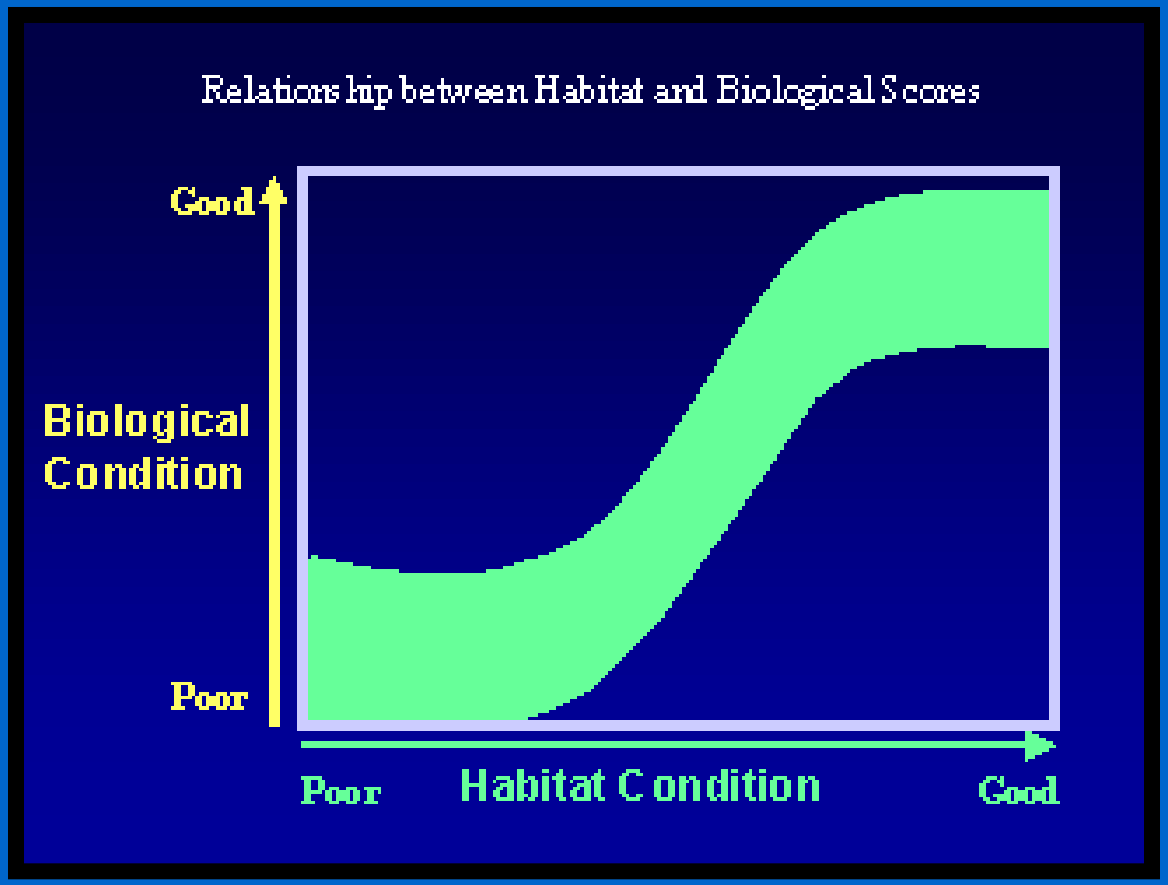
Indicators of Poor Water Quality

Indices may focus on

- Single (sentinel) taxon
- All collected taxa



Indices successfully used because



- Incorporate a biological response to environmental conditions

Rapid Bioassessment

- Easily and quickly obtained
- Compares data with standards from unaffected site