



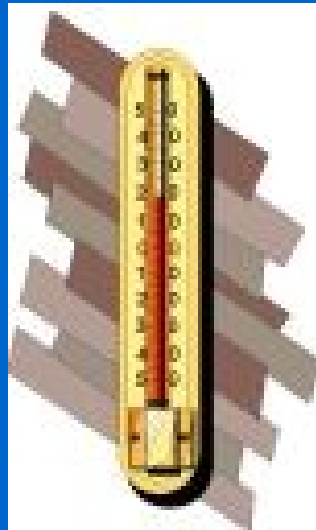
# Chapter 4



## Aquatic Habitat Measurements

# 4.1 Introduction - Habitat Measurements Include...

- Physical
- Chemical
- Biological



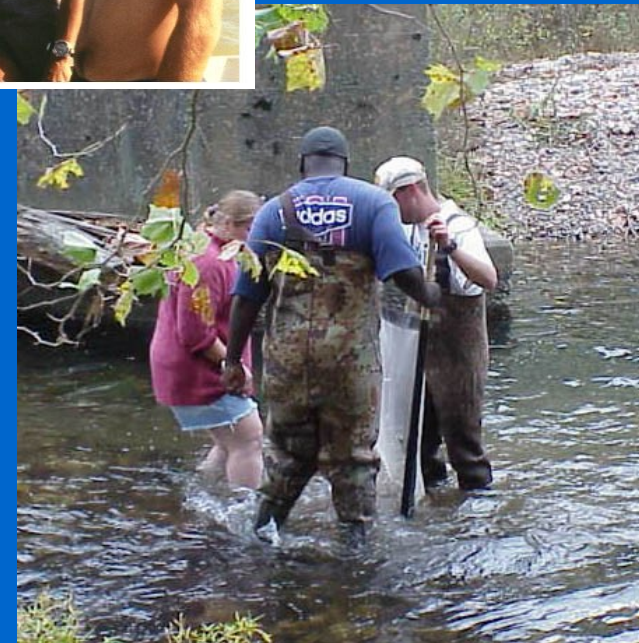
# Habitat quality influences

- Numbers
- Sizes
- Species of fish



## 4.2 Variable selection and study - Investigators must...

- Define objectives
- Select relevant habitat characteristics
- Select most appropriate method to measure characteristics



# Techniques selected

- Repeatable
- Accurate
- Precise
- Meet budget



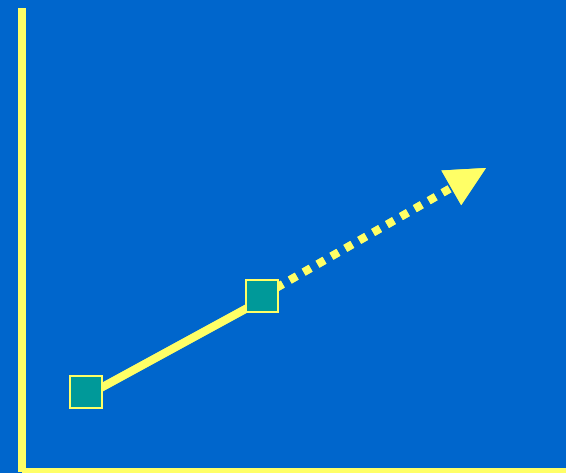
# Define spatial and temporal boundaries

- Zones
- Reaches
- Habitat types
- Seasons



# Two types of error

- **Measurement error**  
(measured vs. true)
- **Extrapolation error**  
(accuracy of extrapolation)



# To correct



- **Measurement error, increase # of measurements**

- **Extrapolation error, increase # of areas sampled**



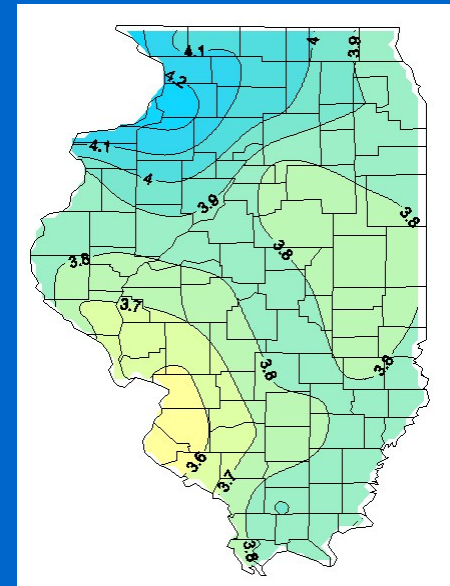


# 4.3 Habitat Mapping

## - Use of existing maps



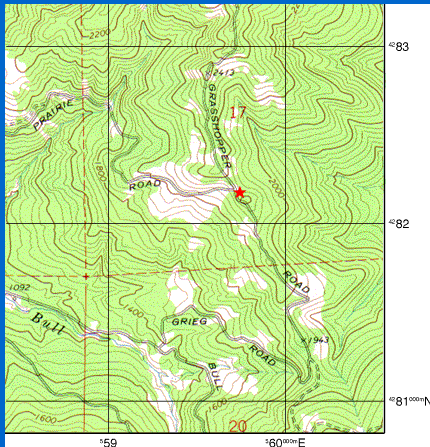
- Maps and photos-springs, irrigation, dams
- Topographic-aquatic habitats, contour lines
- Thematic-geology, soils, vegetation, climate
- Aerial photos-snow, fires, floodplain, vegetation



# Features can be located by

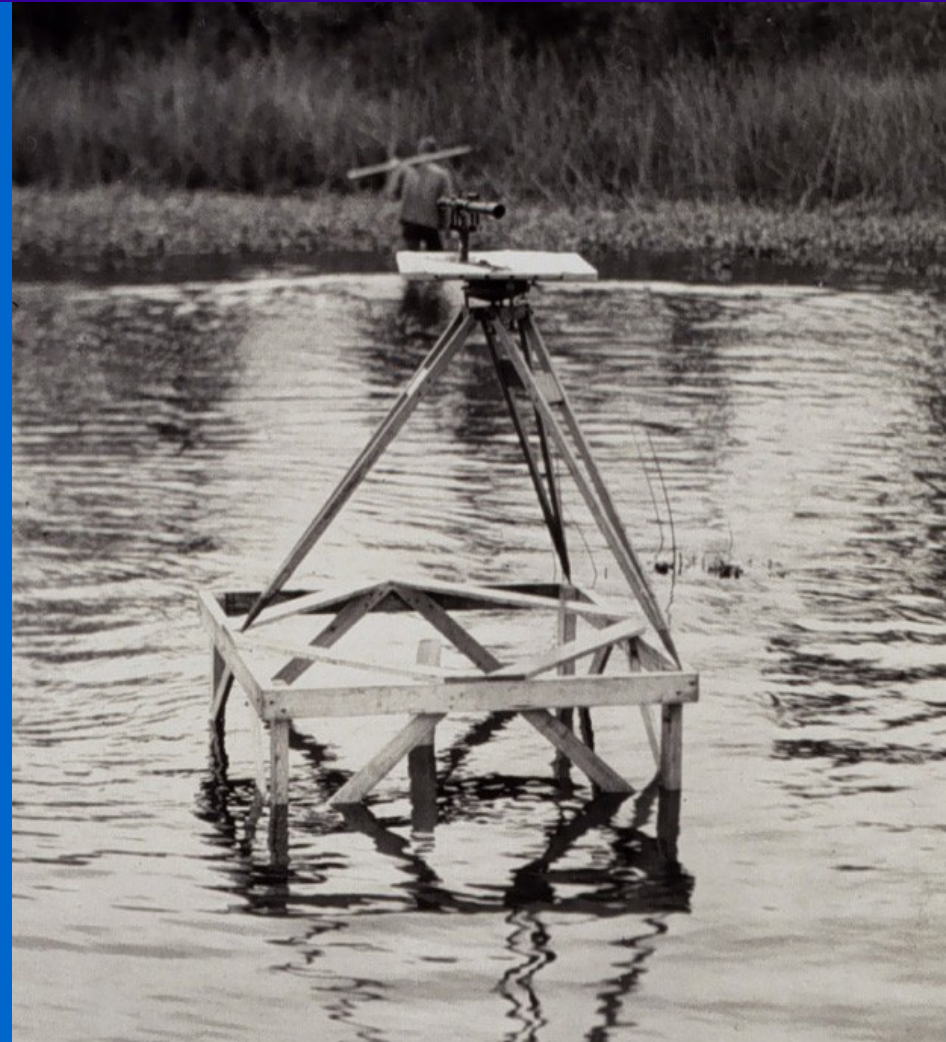


- Latitude and longitude
- Universal transverse mercator (UTM) coordinates
- Township and range coordinates of public lands



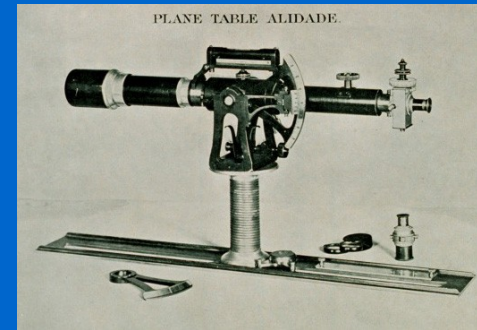
# Mapping techniques - Plane table alidade

- Outside mapping of small lakes with regular shoreline
- Mapping segments of medium to large rivers



# Method requires

- Plane table on tripod
- Alidade
- Measuring tape
- Marking stakes
- Brightly marked range pole
- Map paper affixed to plane  
– (Pg. 89 Fig. 4.4)



# Deflection angle transverse method



- **Small streams**  
– (Pg. 89 Fig 4.4)

# Watershed area influences



- **Water yield**
- **Sediment transport**
- **No. and size of streams**

# Watershed area measured

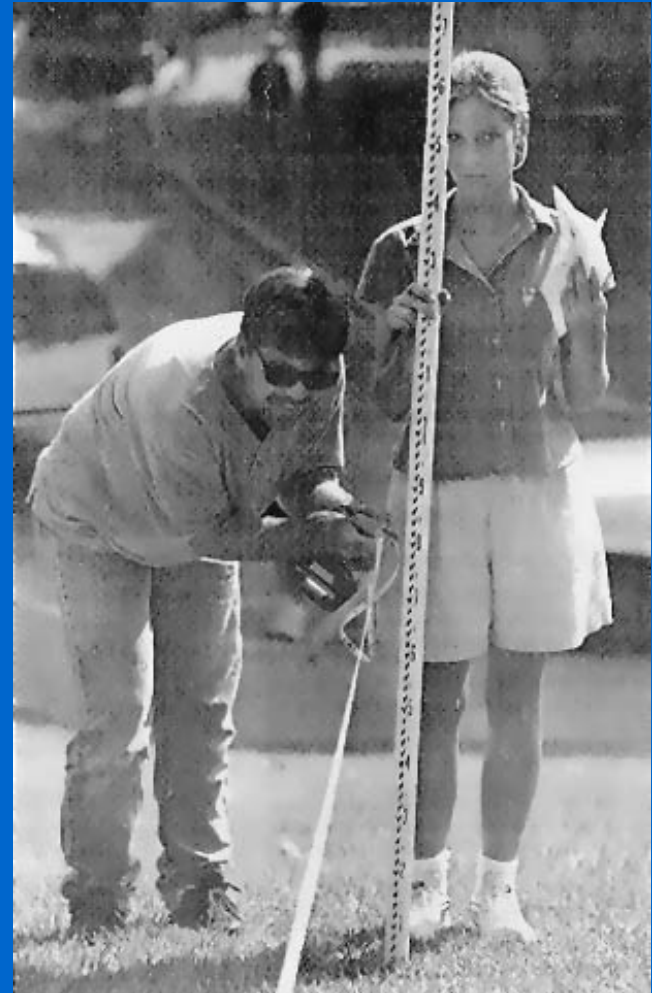


- Acreage grid
- Planimeter (Box 4.1, Pg. 92)
- Computer digitizing system

# Geomorphic features



- **Stream gradient**
- **Basin size**
- **Drainage density**
- **Geologic type**





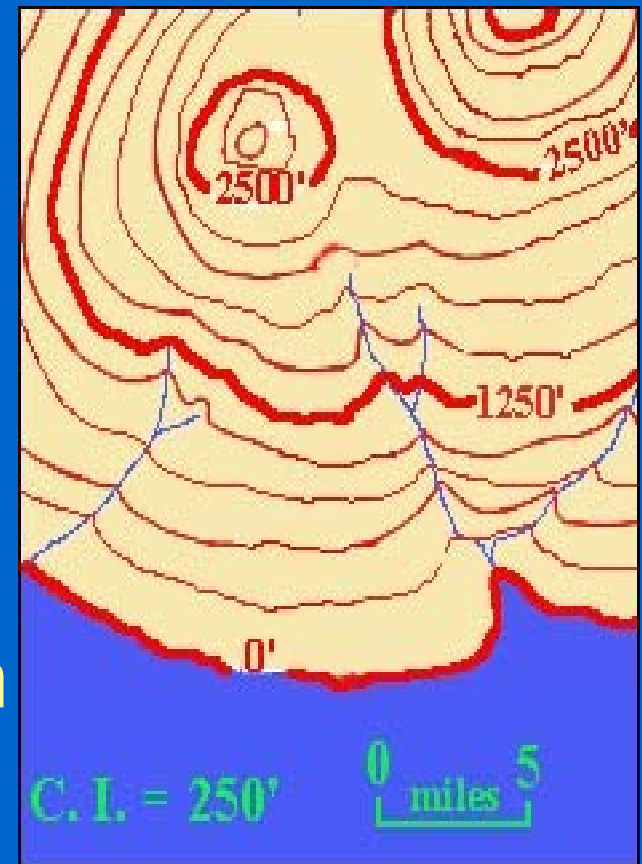
# Geomorphic features influence



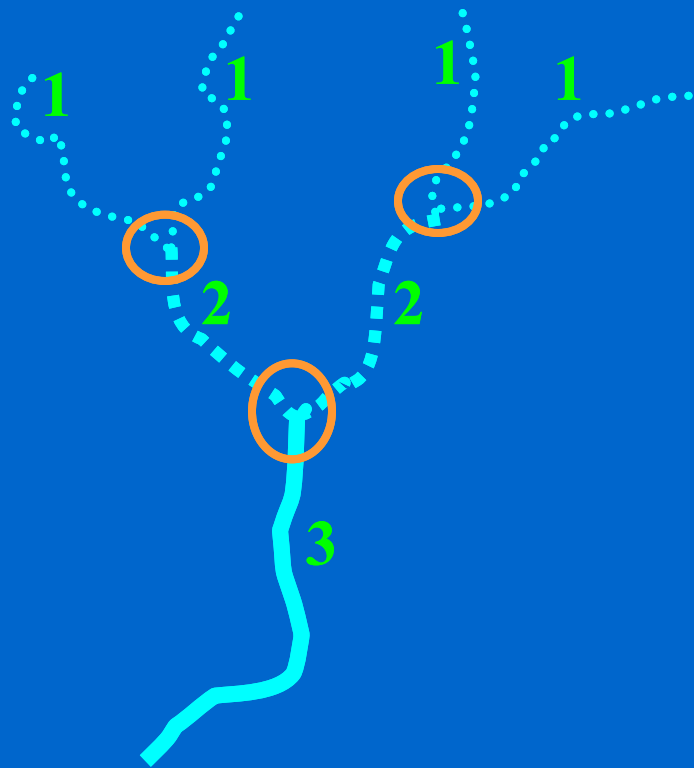
- **Lake productivity**
- **Composition of stream habitat**
- **Fish species & abundance**

# Physical Stream Measures

- Drainage density-total stream length of watershed/ watershed area
- Gradient-No of contour intervals crossed by stream/ distance
- Sinuosity-meander; stream length/valley length between same two points



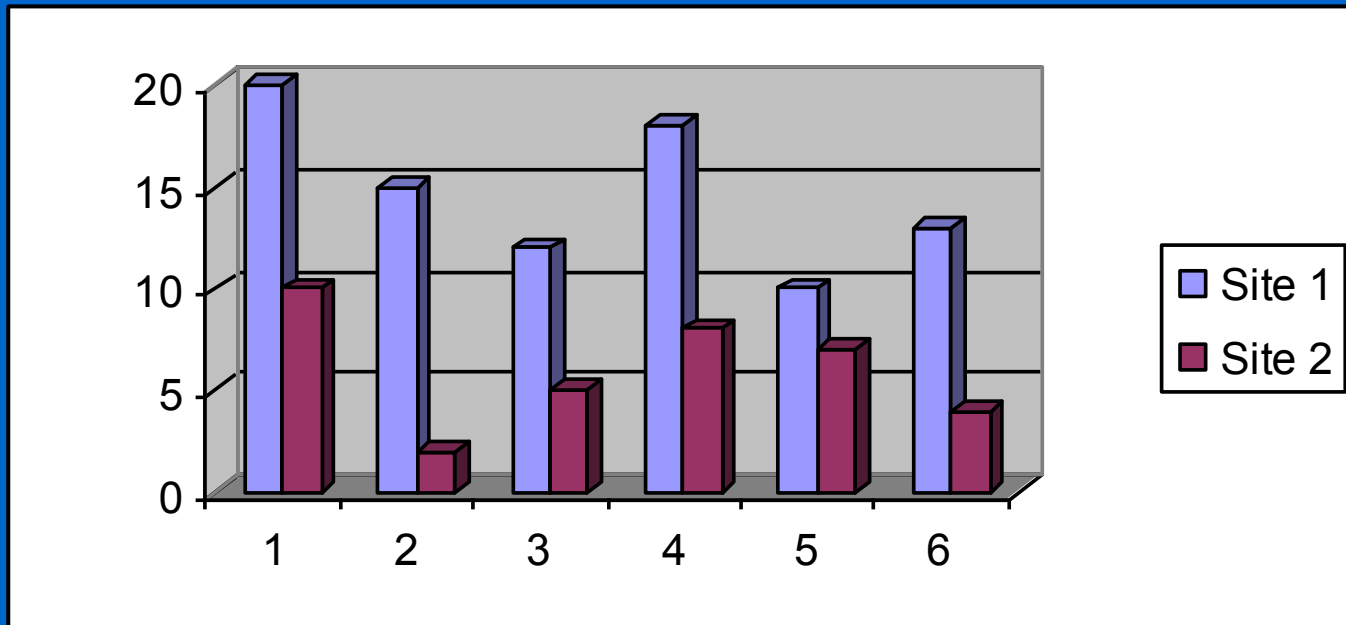
# Stream order-rank of relative size



- 1st order-smallest unbranched on headwater
- 2nd order-two first order streams meet
- 3rd order-two second order streams meet
- Note...order increased only when two of the same order join

# Stream order

- Related to...
  - Species diversity
  - Abundance patterns



# 4.4 Stream Measurements - Transect Vs Habitat Sampling

- **Transect**

- Systematically measured
- Visually estimated



- **Habitat based**

- Divides area to habitat types
- Visually estimates habitat features

# Water Quality Measures

- Hach Kits
- Electronic sensors/  
meters
  - Yellow Springs  
Instruments (YSI)
  - ICM Perstorp
  - Hydrolab
  - Orion

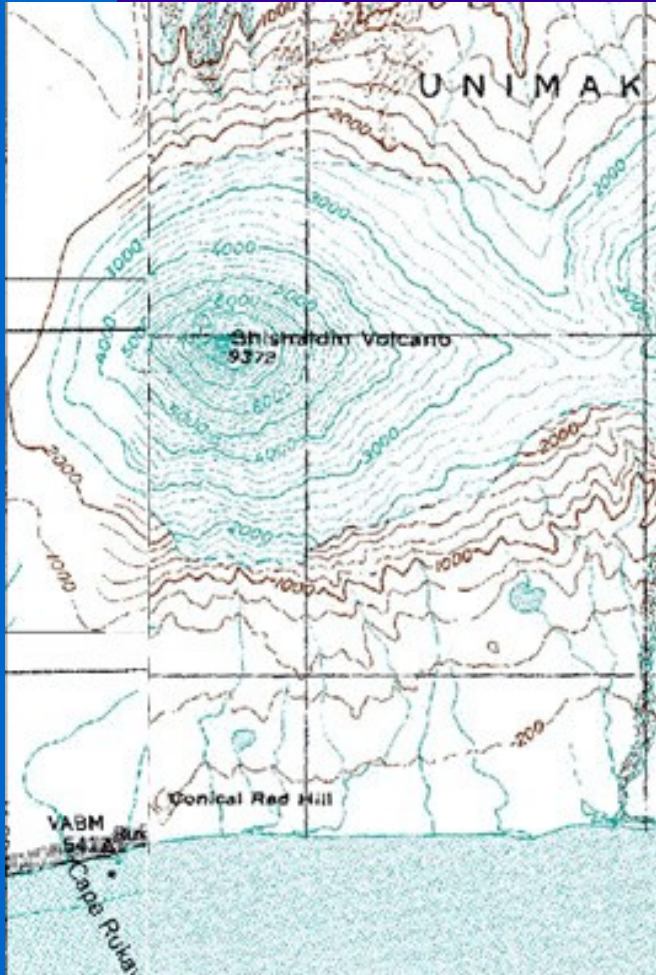


# Other Habitat Measures

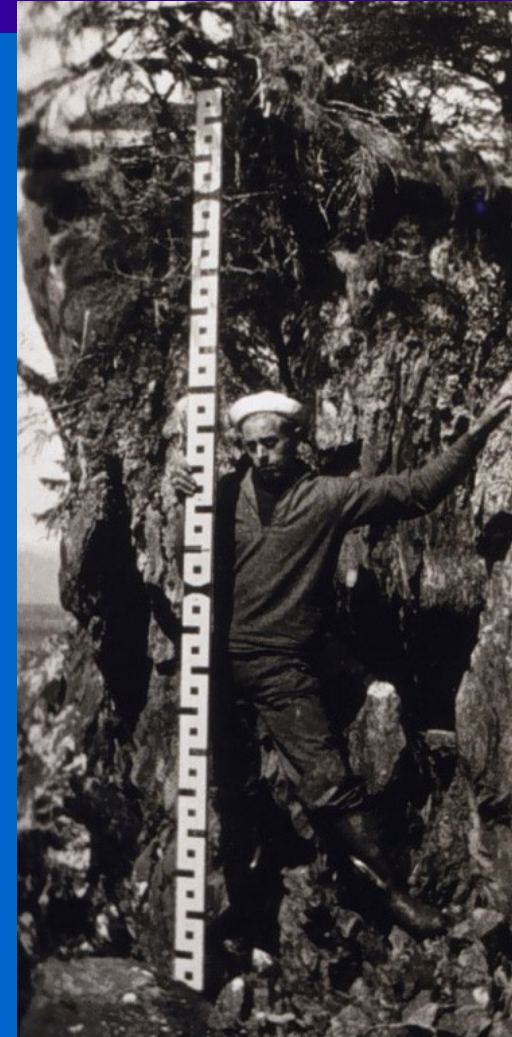
- Channel gradient- Drop in elevation per unit length affects
- Stream velocity
- Habitat types
- Species distribution
- Species abundance



# Gradient Calculated by



- Topographic maps
- Stadia rod measures





# Sinuosity - how curvy?

- **Low sinuosity**
  - Steep gradients
  - Little pool development
- **High sinuosity**
  - Undercut banks
  - Large, deep pools



# Channel classification



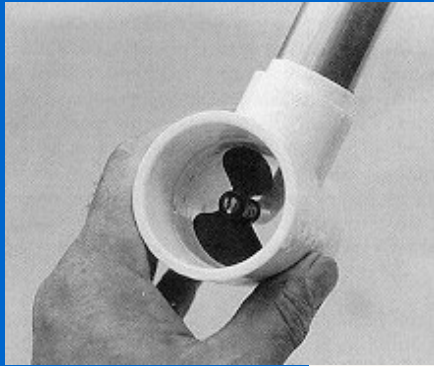
- **Group stream and river channels**
- **Channel type classification**
- **Gradient & channel shape**
- **Defining sampling strata**
- **Rating stream sensitivity**
- **Identifying potential effectiveness**

# Velocity measure



- Floating object
- Movement of dye
- Mechanical current meter
- Electrical current meter

# Velocity meters

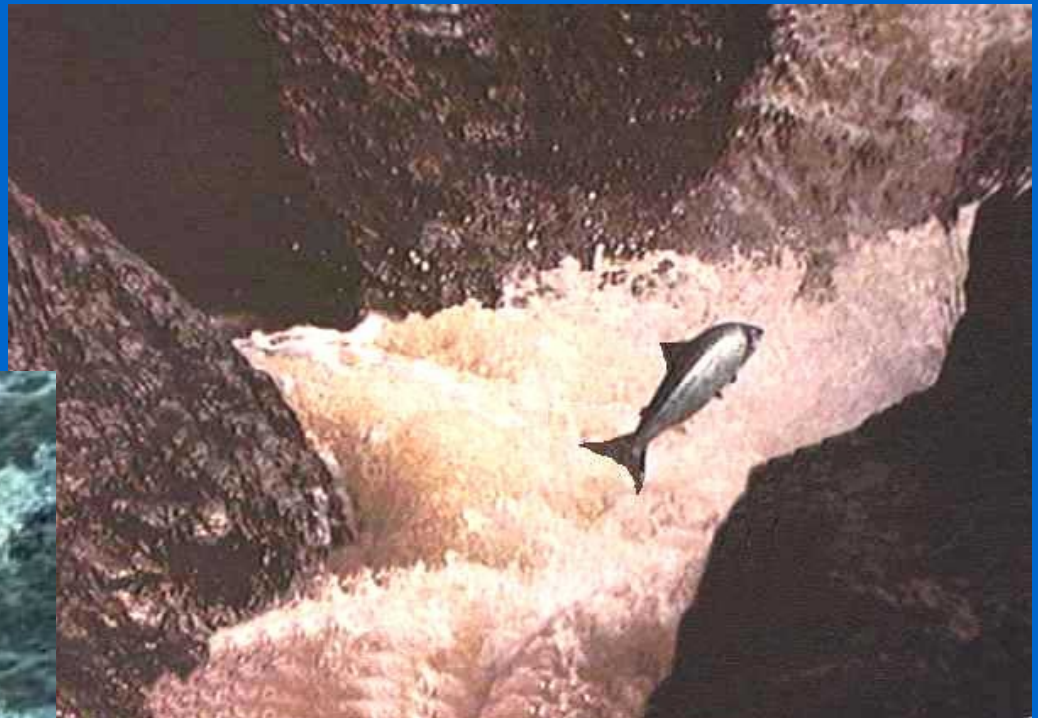


- Propeller
- Cup
- Electromagnetic



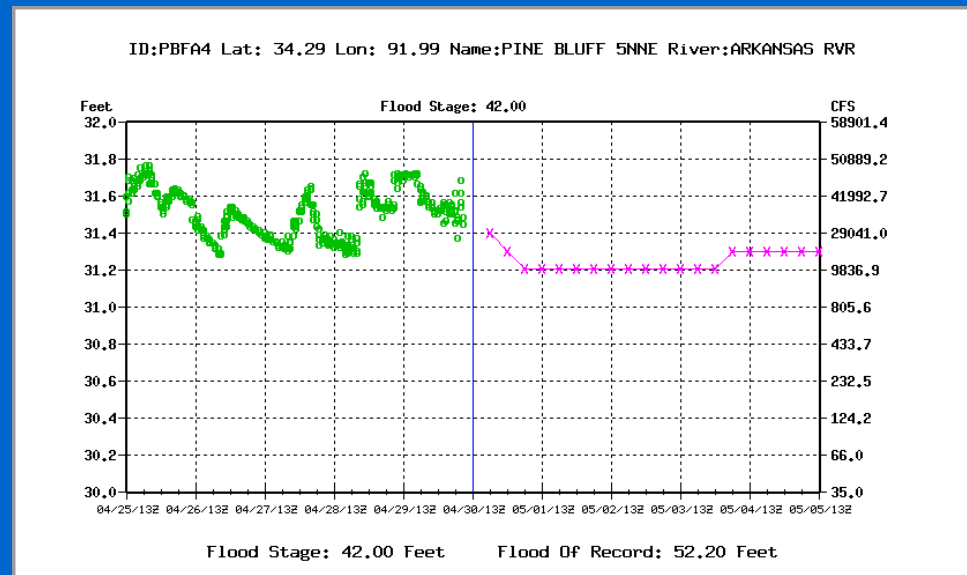
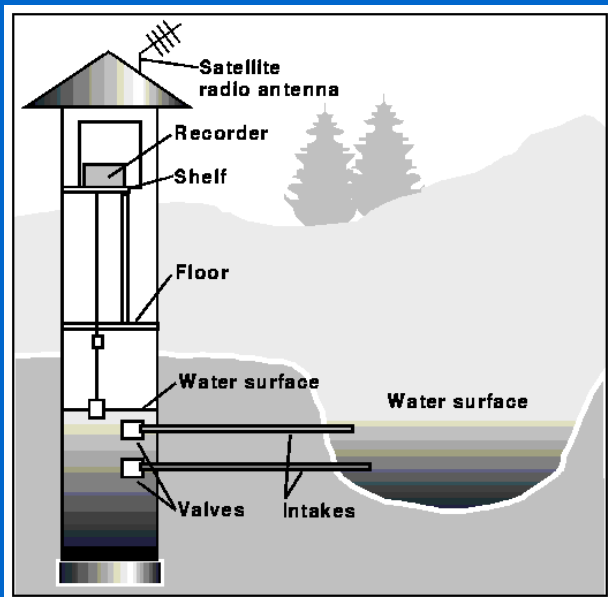
# Discharge, quantity of water through channel/ time

- Quantity and quality of stream habitats
- Water quality
- Fish passage



# Discharge measured

- Gauging stations
- Hydrographs
- Gordon et al (1992)



# Substrate composition



- Quality of spawning habitat
- Fish cover
- Benthic macro invertebrates composition
- Benthic macro invertebrates production

# Substrate



- **Classification by**
  - Visual
  - Wentworth scale (table 4.2 Pg 103)
- **Subsurface substrate composition**
  - Estimate effect on embryo survival

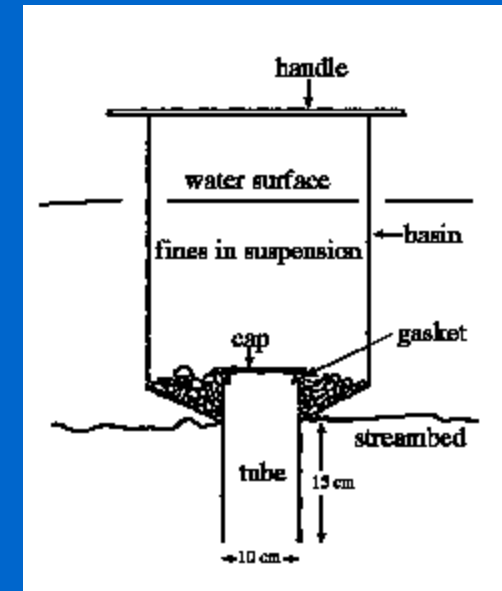


# Core samplers

- **Mc Neil hollow- core sampler (Fig 4.12A Pg. 104)**
- **Freeze core sampler (Fig 4.12B Pg. 104)**

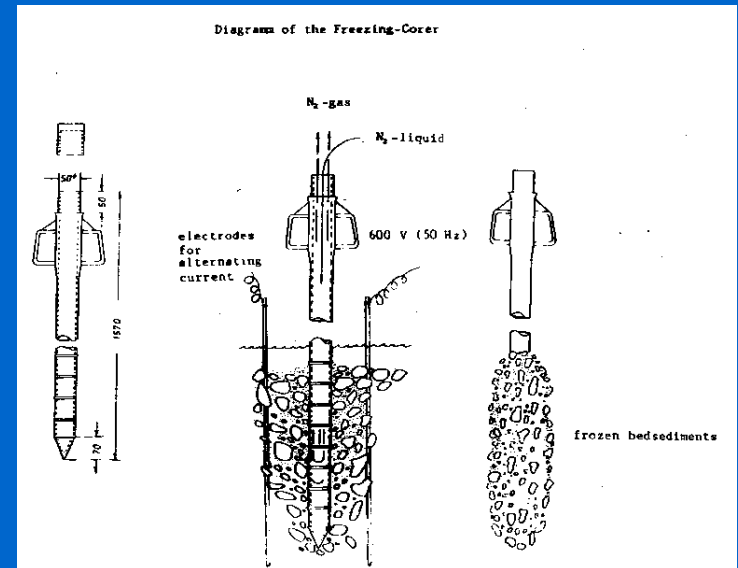
# McNeil sampler

- More portable
- Less costly
- Easy operation



# Freeze core sampler

- Analyze vertical stratification
- More complete collection of fine sediment
- Sample deeper water



# Erosion & sedimentation

- Effects of road building
- Logging
- Grazing



# Items Measured

- Repeated measure of channel cross sections
- Scour chains aggradation and degradation



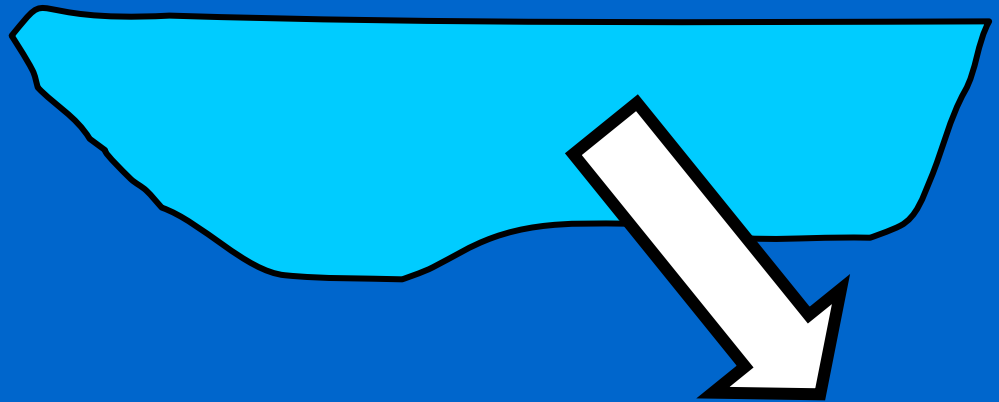
# Censusing habitats provides information on

- Habitat availability
- Identification of limiting factors
- Estimate of fish species abundance



# Habitat types integrate

- Depth
- Velocity
- Substrate
- (refer to Box 4.3 Pg. 107)



# Habitat classification



- Pool (slower water)

- Riffle (fast water)



# Cover- protection



- Aquatic vegetation
- Boulders
- Woody Debris
- Water turbulence and depth
- Riparian features



# Cover requirements vary by

- Species
- Life stage
- Season



# Large woody debris (LWD)

- Stabilizes channels
- Forms pools
- Traps spawning gravel/organic matter



- Habitat for macro invertebrates
- Provides cover for fish

# **Habitat complexity ; measure of habitat diversity**

- **Classification criteria**
- **Shannon-Weaver Diversity index**
- **Travel time of dye**
- **Retention of plastic strips**

# Stream shading measure

- Densimeter
- Sun arc
- Solar radiometer



# Bank stability measure

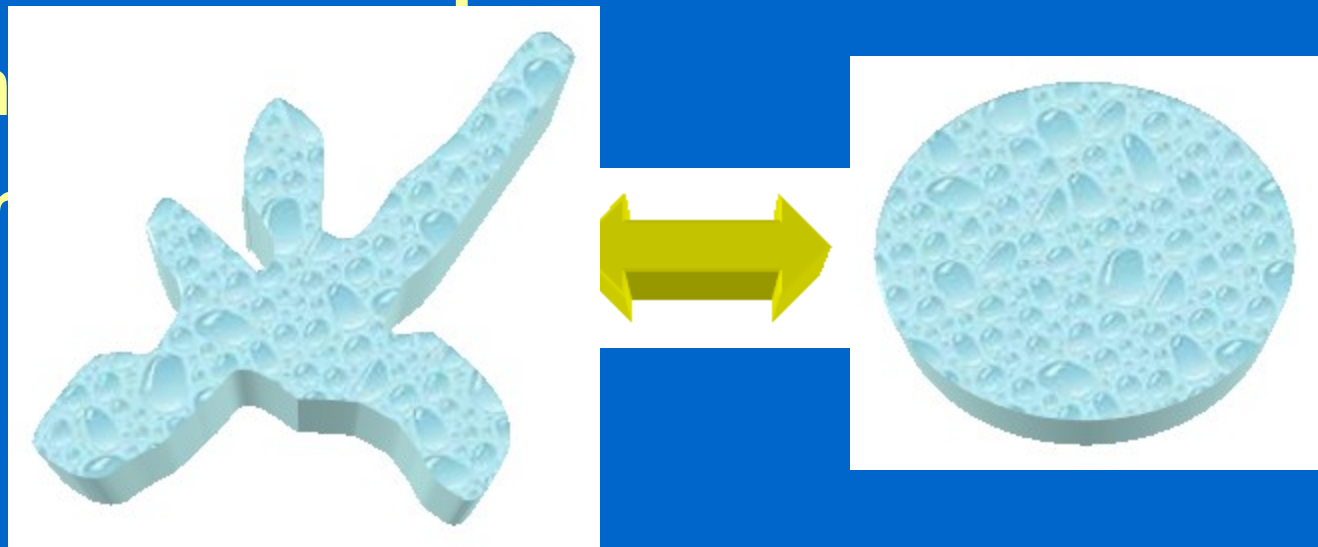
- Proportion of study area with actively eroding banks
- Visual rating system



# 4.5 Lake and Reservoirs

## - Morphometric measures

- Area
- Shoreline length
- Shoreline development index
- Depth
- Volume



# Depth measure



- Electronic echo sounders
- Weighted sounding cables





# Physicochemical attributes

- Temperature
- Dissolved oxygen
- Transparency
- Note: All affect water quality

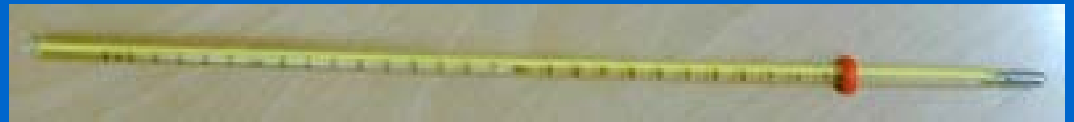


# Temperature measure

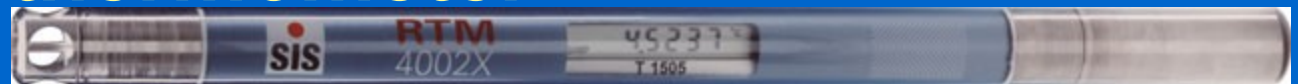
- Electronic thermister



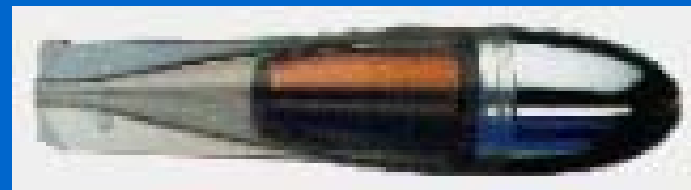
- Mercury thermometer



- Reversing thermometer

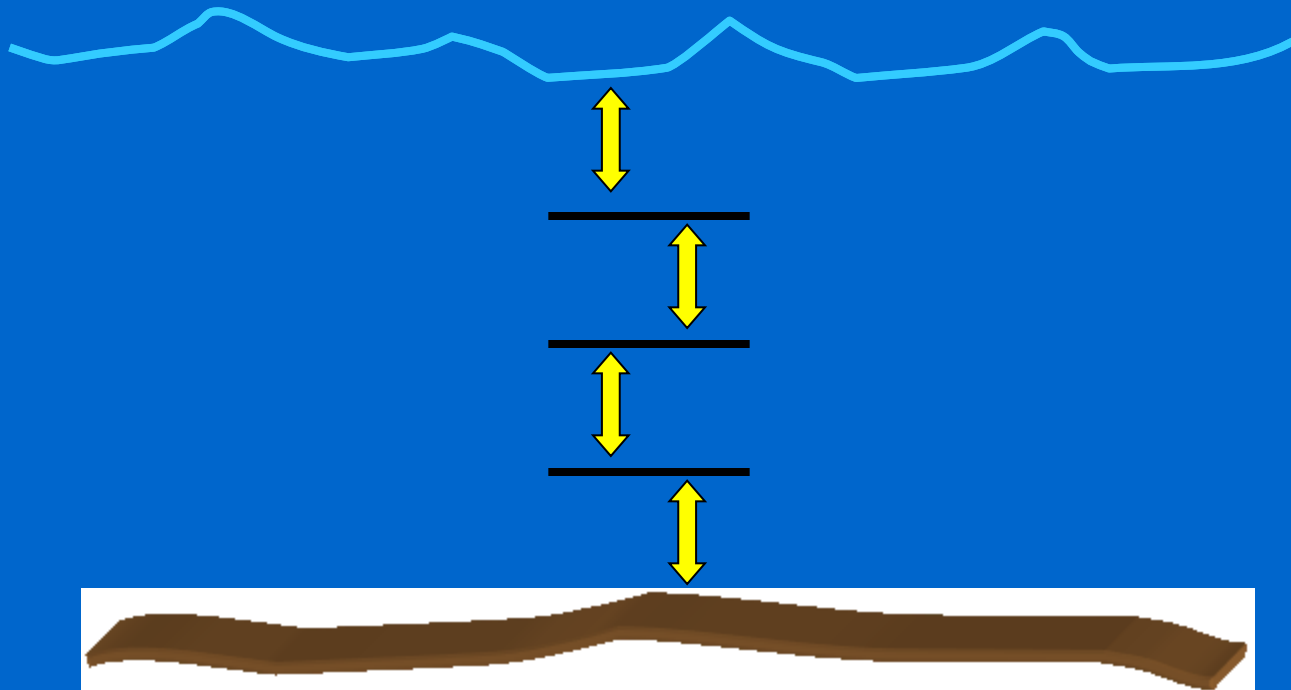


- Bathythermograph



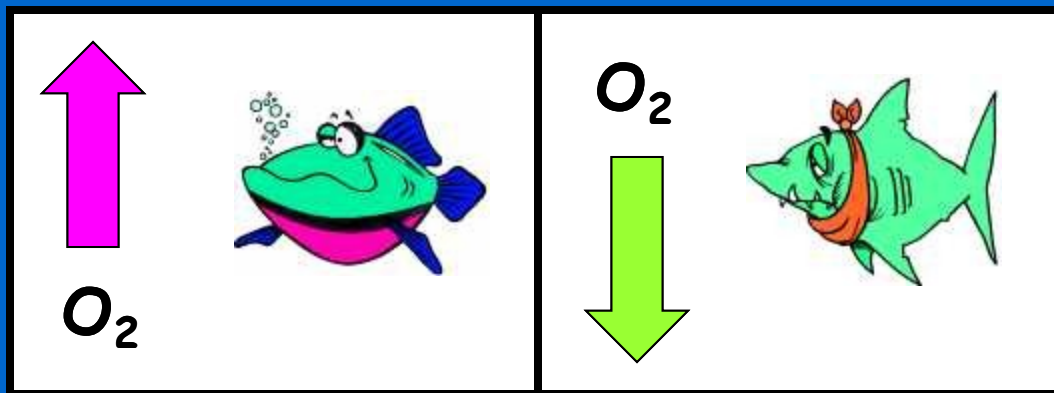
# Measurements

- 1-m intervals
- surface to bottom



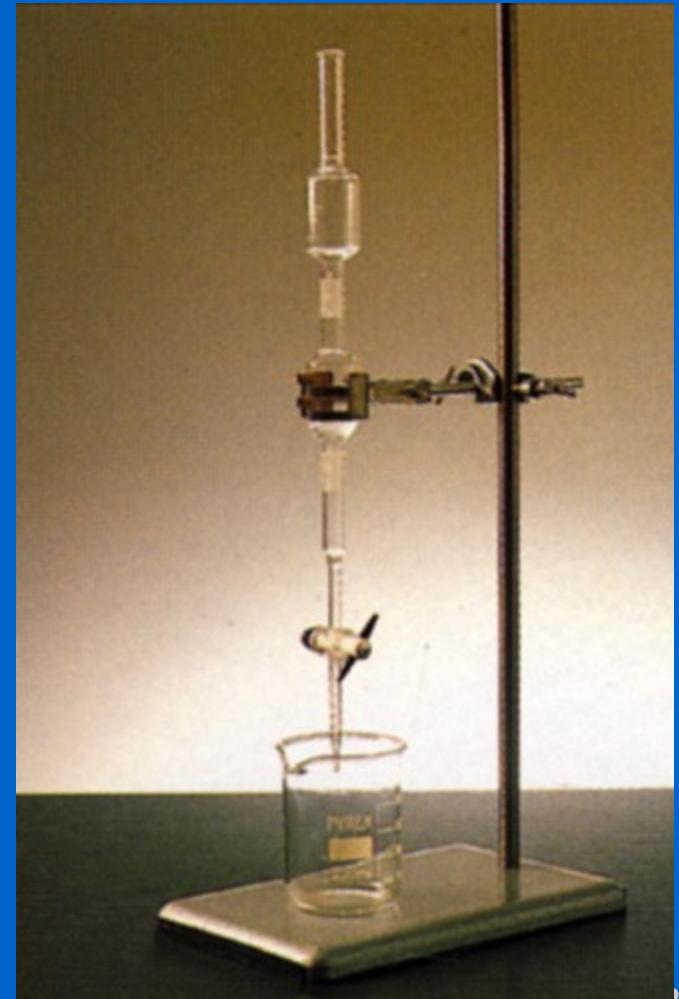
# Dissolved oxygen

- Fish distribution
- Influence on nutrition effects



# Measure

- Dissolved oxygen meter
- Winkler titration



# Transparency affected by



- Suspended particles
- Plankton



- Measure using Secchi disk



# Other Lake and Reservoir Measures

- **Storage ratio-average volume of the body of water to its annual discharge volume**
- **Flushing rate-proportion of the reservoir volume discharged per unit time**
- **Turnover time-No. of days to discharge volume of reservoir (storage / 365)**

# Lake and Reservoir Classifications



- **Oligotrophic-low nutrient levels**
- **Eutrophic -high nutrient concentrations**
- **Mesotrophic-Intermediate nutrient concentration**



# Eutrophic



$PO_4 =$



- High phosphorous
- High chlorophyll a
- Low secchi disk
- Morphoedaphic Index- estimation of yield