Chapter 15

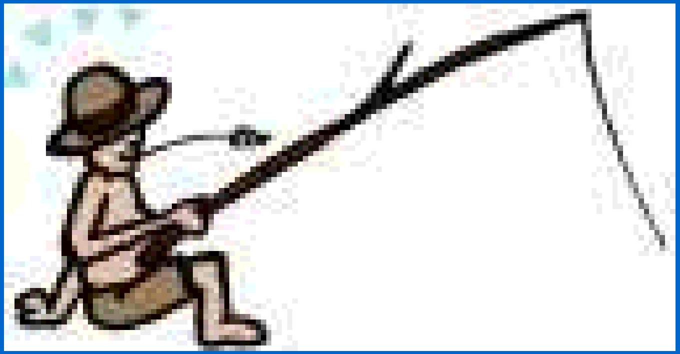
Length, Weight, and Structural Indices

15.1 Introduction

- Methods of measurement of fish structure
- Calculations of indices
- Interpretation of Structural Indices

Length frequency data

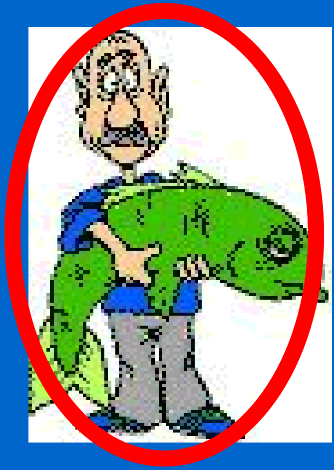
- Estimate benefit to commercial and recreational fisheries



- Basis for estimating growth, standing crop, and production
- Production (kg/ha/year)

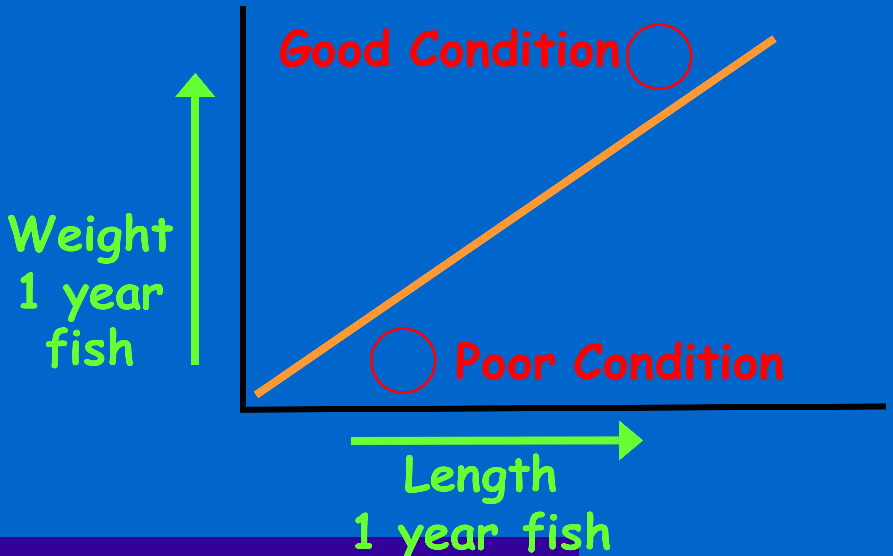
Fish Length & Weight

- Length defines legal size for harvest
- Relative number of fish in certain size categories...measure of management objectives
- Harvest (metric tons) and Standing Stock (kg/ha)



Fish Length & Weight (cont.)

- Growth described by weight at age or weight gain/year
- Weight & Length...condition

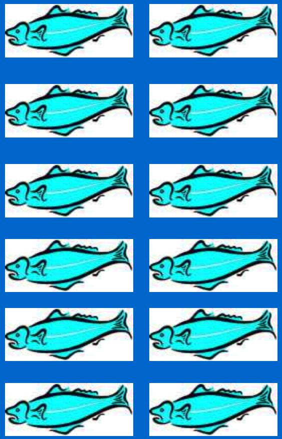


15.2 Considerations

- Does gear bias influence length and weight measures?

Vs.

Vs.



- How many fish measured or subsampled for measurement?

Considerations (cont.)

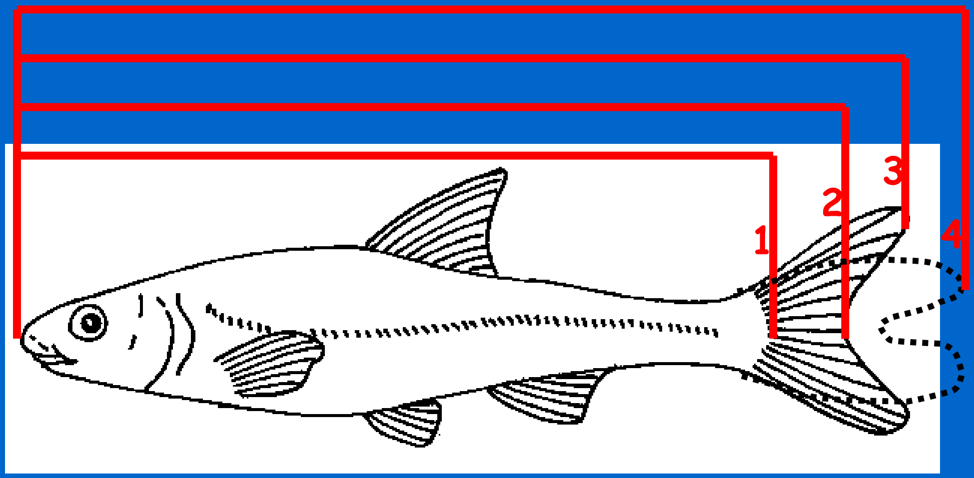
- Does gender influence length & weight measures?

Vs.

- Weight more error-prone than length.

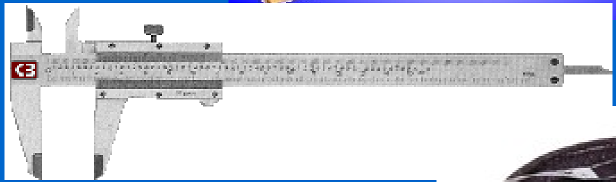
Length groups and bin sizes

- Convention   use 10.0 - 10.99 instead of 9.5 - 10.5
- Whole body measurements:
  - Maximum standard length - least convenient (1)
  - Fork length (2)
  - Natural total length (3)
  - Maximum total length (4)



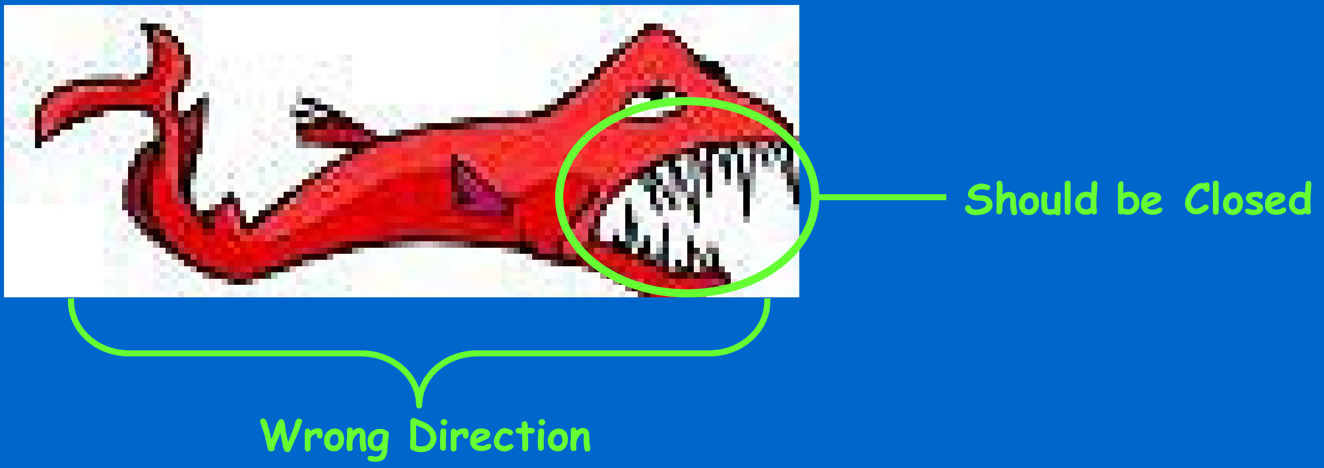
Measuring devices

- Measuring boards -
  1 to measure, 1 to record
- Calipers - small fish
- Measuring tape - large marine species
- Electronic measuring boards - records automatically



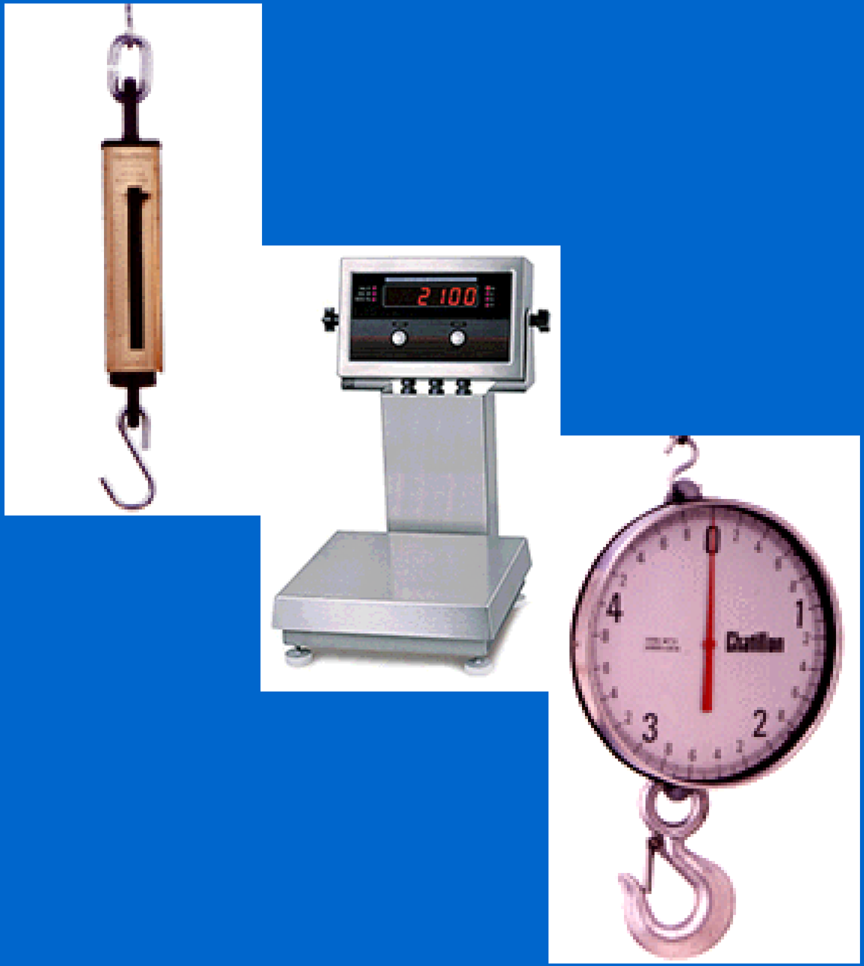
Measuring conventions

- Fish mouth closed
- Head left, tail right



- Measure fresh to avoid shrinkage and rigor mortis

Weighing devices



- Spring loaded scales
- Electronic scales (battery-powered) with digital readout
- Hanging scales measure fish in bulk or large fish

Weighing conventions

- Remove excess moisture on fish
- Periodic calibration of scales
- Remove excess moisture on scale
- Tare often
- Account for wind & fish, boat motion

Preservation

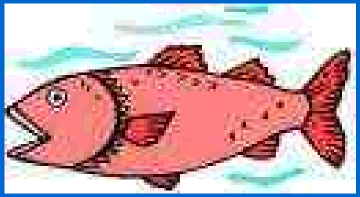
- Weight goes up about 8%
- Length goes down about 2%
- Use fresh specimens if possible

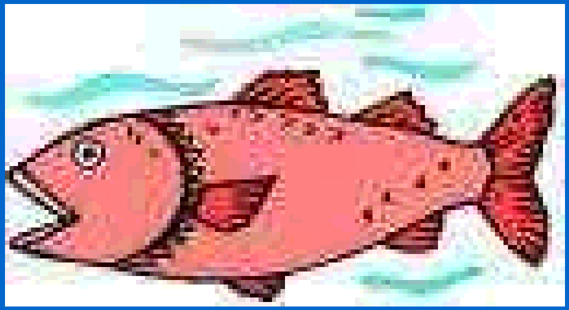
15.3 Weight-Length Relationships

- So length can be converted to weight or vice versa
- Condition - variation from expected weight at a given length

Power function

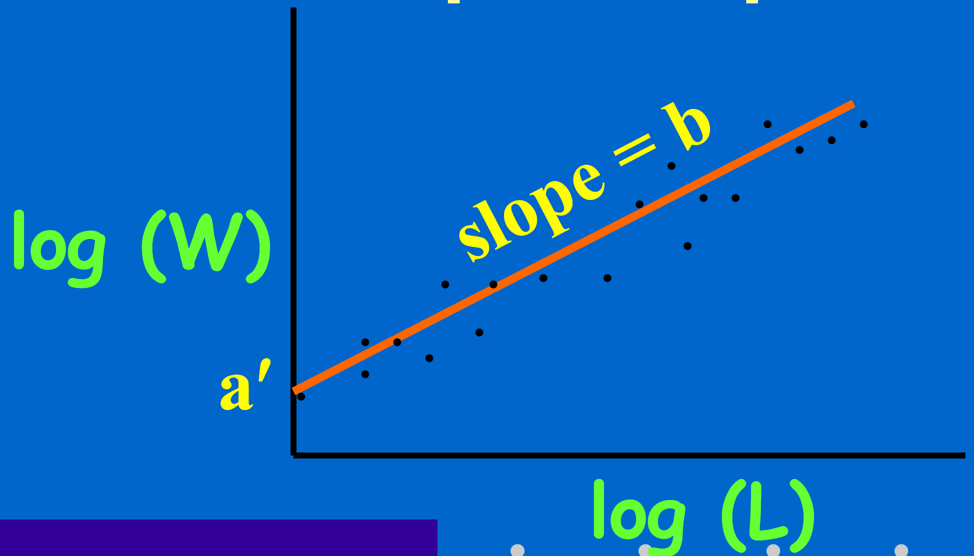
- W = a * L^b
- B > 3...fish get rounder as they grow
- B < 3...fish get less rotund as they grow
- B = 3...fish stay same shape as they grow



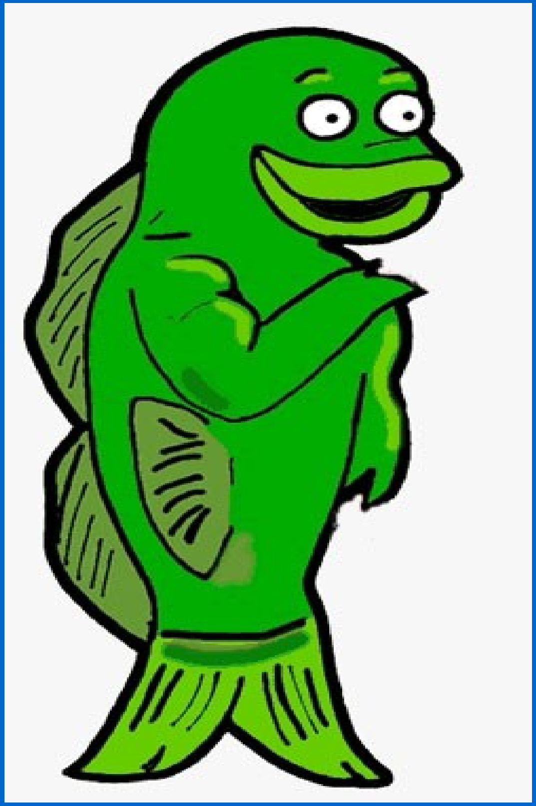


Transformation

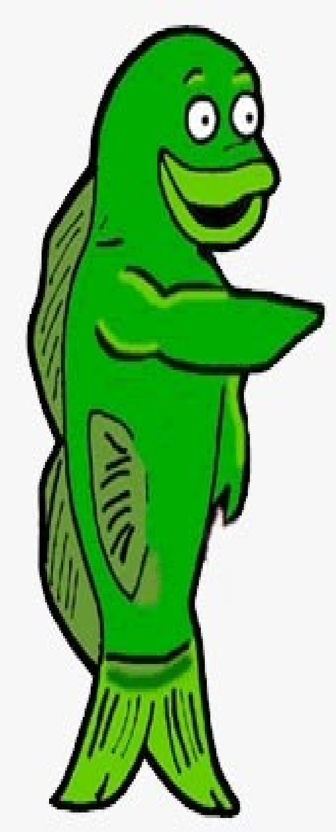
- Estimate a and b using linear regression
- Log10(W) = Log10(a) + b * Log10(L)
-    Y   = intercept + slope * X



15.4 Indices of Condition

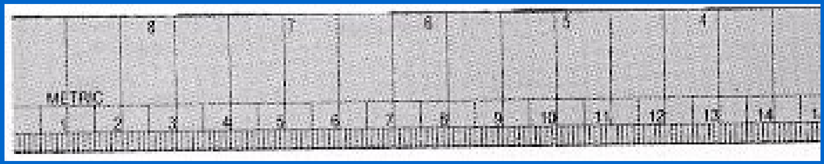


- Fulton condition factor
- Relative condition factor
- Relative weight



Fulton Condition Factor

- K = (W/L^3) * 100,000 (millimeters, grams)

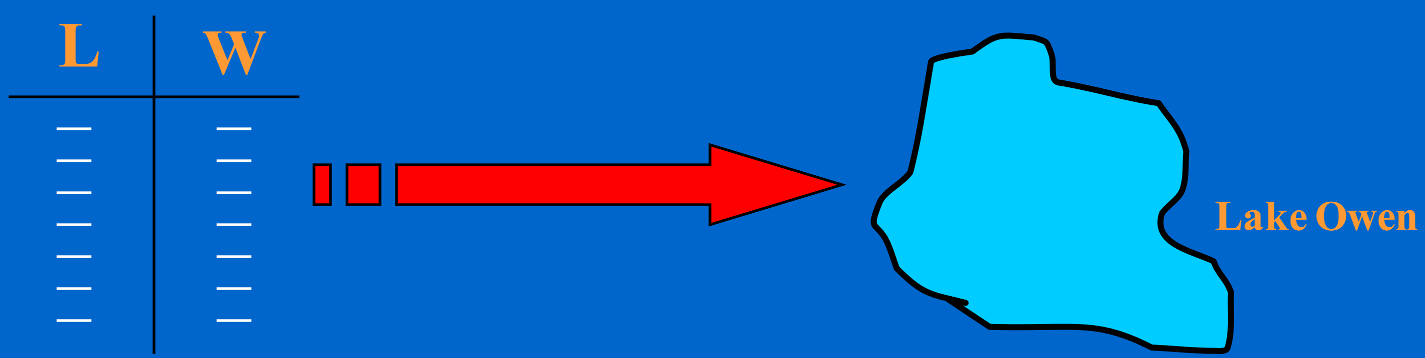


- C = (W/L^3) * 10,000

  (inches, pounds)
- For fish with b > 3, the values of K & C change with length (poor choice)

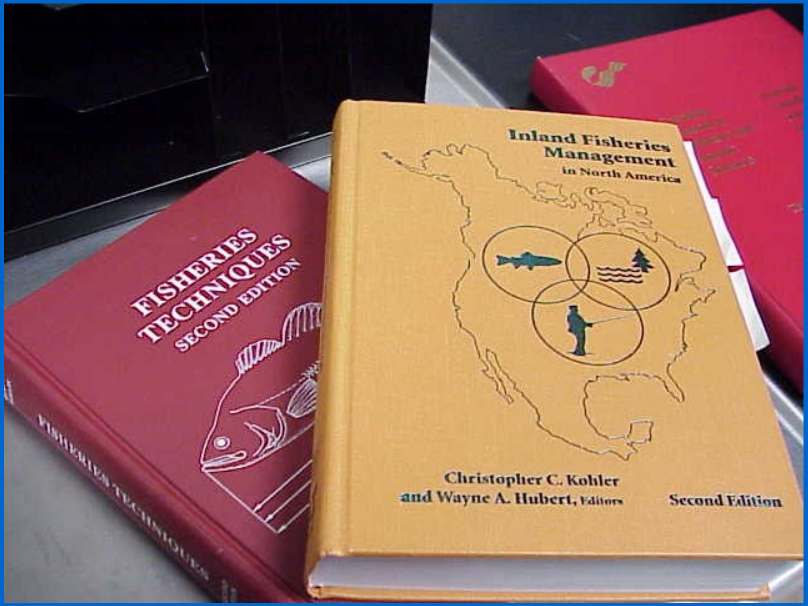
Relative Condition Factor

- Kn = (W/W')
- W' = a * L^b (for study population, use L,W data and linear regression)



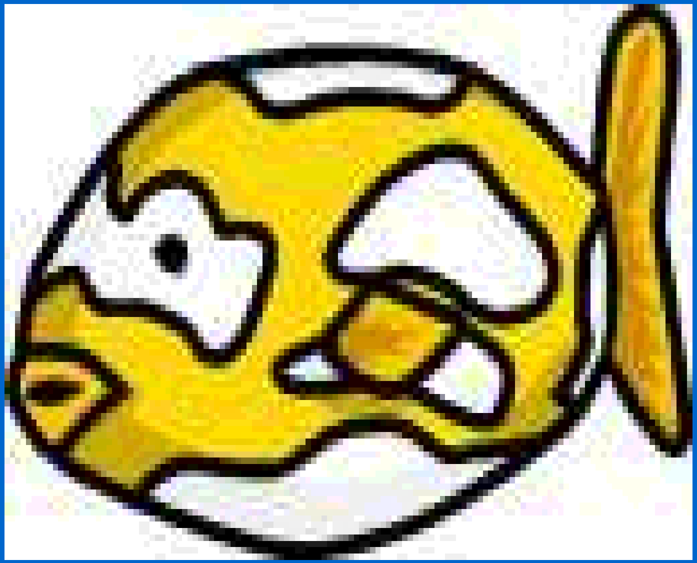
Relative Weight

- Wr = (W/Ws) * 100
- Log10(Ws) = a' + b * Log10(L) (where a' = Log10(a))
- Note: a' and b come from literature
- If Wr << 100 then fish in poor condition



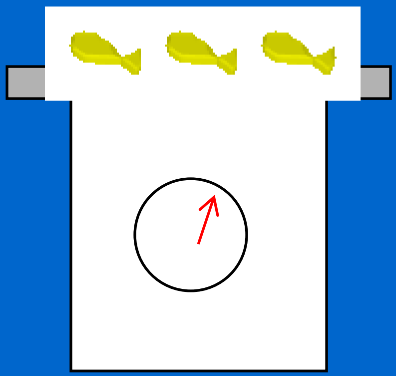
Relative weight (cont.)

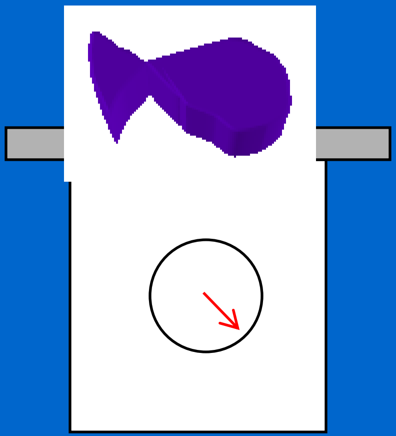
- Varies with length (possible) and time of year
- Related to fat content
- Related to fecundity & egg quality
- Related to growth



15.5 Weight Models

- Swingle's F/C ratio
  - F = weight of forage species
  - C = weight of carnivores
- Desirable range 3-6





Problem...some F are too large to be eaten by C

- Swingle's Y/C ratio
  - Y = wt of fish in F group available to average adult in C group
  - C = weight of carnivores
  - desirable range 1-3

Other Swingle Metrics

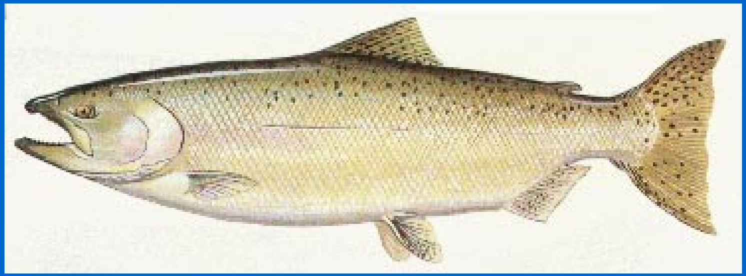
- Swingle's A_t - percentage of total weight of fish population that is harvestable
- Examples: 60-85% for LMB and BG
- Swingle's E - percentage of weight of fish community composed of one species or group
- Example: LMB in small impound...14-25%

Jenkins and Morais metric

- AP/P ratio
- AP = biomass of prey small enough to be eaten by a particular size predator
- P = cumulative biomass of predators of different sizes
- Plotted on a log10 vs log10 scale
- Curve should be above the 1:1 line to have sufficient prey for predators

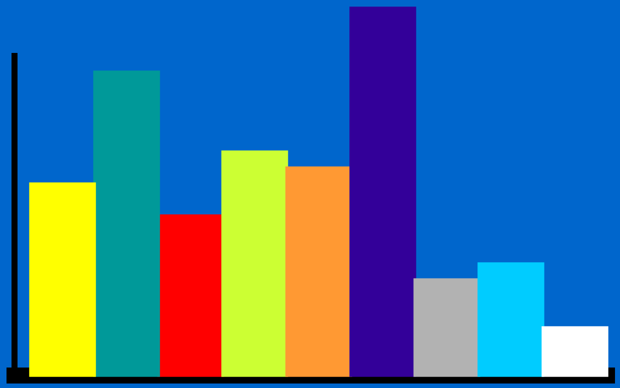
15.6 Length-Frequency Histograms reflect:

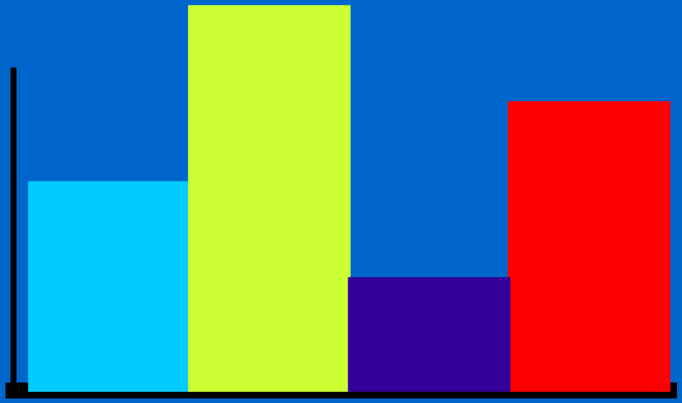
- Reproduction
- Recruitment
- Growth
- Mortality



Guidelines

- Sample 100 fish of at least stock size
- Bin sizes
  - 30-cm fish… 1-cm interval
  - 60-cm fish… 2-cm interval
  - 150-cm fish… 5-cm interval





Guidelines

- Y-axis
  - Absolute number of fish per length group
  - Percentage in each length group
  - Standardized - ex. number per hour electrofishing

15.7 Length-Frequency Indices






- PSD & RSD
- YAR
- Population and Community Models



Stock-Density Indices: PSD

- PSD = # of fish > quality size / # of fish > stock size * 100
- Note: for stock & quality size see Table 15.2, pg 464
- Round to the nearest whole number

Stock-Density Indices: RSD

- RSD = # of fish > specified size / # of fish > stock size * 100
- Round to the nearest whole number
  - Stock size (S)
  - Quality size (Q)
  - Preferred (P)
  - Memorable (M)
  - Trophy (T)
- Traditional RSD vs Incremental RSD

Stock-Density Indices: Young-Adult Ratio

- YAR = # fish < 15 cm / # fish > 30 cm
- Expected range at moderate LMB density 1-10

Stock Density Indices: Community Models

- Balanced Populations have predictable PSD
- Examples
  - Bluegill 20-60
  - Crappie 30-60
  - Largemouth bass 40-70