

Assessing Populations and Communities

- I. We previously talked about density and production of populations - what about sizes and standing crop? And what about potential interactions among species?
- II. Why certain fish species are more abundant than others
 - A. Trophic pyramid - primary producers, primary consumers (herbivores; zooplankton), secondary consumers (planktivorous fish), tertiary consumers (eat planktivores)
 - B. Trophic transfer of energy is inefficient (probably only about 10% [or less] of energy makes it from one trophic level to the next) - this limits the number of trophic levels in ecosystems
 - C. Detritivores - live 'outside' of the traditional trophic pyramid; can become quite abundant; and if omnivorous, wreak havoc on other species with more limited foraging capabilities
 - D. Carrying capacity - as with populations, some factor (e.g., resources) limits the total biomass of fish in a system.
- III. Birth of population and community assessment tools
 - A. Historically - recall that managers widely stocked to supplement populations or communities that did not produce adequate biomass or sizes of fish
 - B. Homer Swingle suggested the opposite problem - overproduction of small fish led to competition for resources and slow growth. First time that fish *size structure* was considered in fish management
 1. High reproductive success
 2. High densities of small fish
 3. Competition for limited resources
 4. Slow growth; chronically small sizes in the community
 5. Total biomass may be close to some carrying capacity, though.
 - C. "Balance" - Swingle's management goal – not based on mechanistic understanding; rather Swingle sampled a very large number of ponds with desirable (balanced) and undesirable (unbalanced) fish size structure
 1. Balance is achieved
 - a. Anthropogenic idea; no ecological basis
 - b. Communities with a substantial proportion of large, harvestable fish
 - c. Many communities may be "unbalanced" due to environmental factors (i.e., naturally); in fact, natural tendency seems to be to reach an unbalanced state.
 - d. Some communities may become unbalanced due to human effects (overharvest, introduced vegetation, etc.)
 2. Assessment statistics
 - a. F/C ratio - Forage biomass/carnivore biomass; goal for balance is 3-6
 - b. Y/C ratio - Biomass of vulnerable forage/carnivore biomass; goal for balance is 1-3
 - c. A_T - (Biomass of harvestable fish/total biomass of fish) x 100; goal for balance is 60-80% of the fish biomass should be at harvestable weight
 3. Problems with the assessment statistics
 - a. Based on weight when length is the measure of "success" in most fisheries
 - b. Need reliable estimate of whole-pond biomass for each species; intractable
 - D. "Proportional Stock Density" - R.O. Anderson developed this in the 70s as an

improvement for assessing communities

1. Benefits
 - a. Length-frequency approach
 - b. Can derive from subsamples
2. PSD -proportional stock density
 - a. $PSD = (\text{number of quality size fish} / \text{number of stock size fish}) \times 100$
 - b. Stock length - 20-26% of world record angling length (e.g., largemouth bass is 8 inches or greater)
 - c. Quality length - 36-41% of world record angling length (e.g., largemouth bass is 12 inches or greater)
 - d. Target PSDs
 - (1) largemouth bass - 40 -70
 - (2) bluegill - 20-40
 - (3) yellow perch - 30-50
 - (4) walleye - 30-60
3. RSD - relative stock density; a user-defined method of assessing stock size structure

IV. Problems with these indices

- A. Assume a stable system; birth and death rates respond in a compensatory fashion
- B. RSD and PSD do not account for the total density of fish in the community
- C. Mechanisms underlying the observed size patterns are speculative - need to do mechanistic research