

Fish in an Ecosystem Context

- I. Review of ecosystem concepts
 - A. Ecosystem - biotic interactions in the context of the abiotic environment; includes energy flow through the component organisms.
 - B. Food web - interacting biotic components of the community or ecosystem.
 - C. Trophic levels - Somewhat arbitrary groupings of organisms in an ecosystem, based on their energy production or consumption.
 1. Primary producers - autotrophs
 2. Primary consumers - herbivores
 3. Secondary consumers - consume herbivores
 4. Tertiary consumers - consume the secondary consumers
 - D. Structure versus function - ecosystems have a structure...such as the relative biomass and production of the component trophic levels; ecosystems have a function ... such as the ability to remove CO₂ from the environment.
- II. What controls the flow of energy through an ecosystem?
 - A. Bottom-up control - Energy and matter enters the ecosystem through the base of the food web. System productivity drives the total biomass and structure of the ecosystem.
 - B. Top-down control - Consumers might alter biomass, productivity, and structure of lower trophic levels, thereby altering ecosystem structure and function.
- III. Is it bottom-up or top-down and what is the relevance of fish?
 - A. Fish can alter the structure of lower trophic levels
 1. Planktivory can shift size structure of zooplankton from large to small
 2. Small zooplankton are inefficient grazers of zooplankton, and phytoplankton may increase
 - B. Bottom-up control (i.e., nutrient loading) can only explain about 50% of variance in algal abundance in lakes.
 - C. Under certain circumstances, top-down control might “cascade” through lower trophic levels
 1. Increase in tertiary consumers - piscivores
 2. Decline in secondary consumers - planktivorous fish
 3. Increase in primary consumers - herbivorous zooplankton
 4. Decline in primary producers - phytoplankton
 - D. How can this occur if upper trophic level is driving down biomass of lower trophic level? Might the consumer starve? Recall the influence of compensatory responses of populations to increased mortality - biomass declines but production increases.
 - E. When does top-down apply?
 1. Relatively oligotrophic conditions with “simple” food webs
 2. Trophic cascade probably does not apply under these conditions:
 - a. Lots of omnivory
 - b. Species with predatory refuges
 - c. Small, inefficient herbivores
 - d. Inedible phytoplankton
 - F. Applied relevance of top-down control - Biomanipulation – stocking tertiary piscivores (i.e., sportfish) to control algal blooms.
- IV. Other ecosystem effects of fish
 - A. Engineering - actual physical alteration of the environment
 1. Nest building fish
 2. Carp and vegetation removal and increased turbidity

3. Coral reef fish and alteration of coral
- B. Nutrient recycling, transport, and pumping
1. Daily movement of bluegill from open water to littoral zone
 2. Salmon transport of nutrients from ocean to natal streams
 3. Gizzard shad pumping nutrients from detritus to open water