FiW 4614 Fish Ecology Spring 2007

Lecture 19: Chemical inputs and effects on fishes – 2

I. Introduction
  A. Analytical framework for studying chemical effects on fish
    - previous discussion of physiology, toxicology focused on individual fish
    - many permutations of lab vs field study design and level of biotic organization being studied

  B. Lab studies examine cell, organ, individual responses
    1. Tissue cultures (in vitro)
      - biochemical, cellular, organ responses

    2. Whole-fish tests (in vivo)
      - growth, behavior, survival responses of individual fish

  C. Field studies examine individual, population, community responses
    1. Controlled-cage tests
      - growth, behavior, survival responses of individuals

    2. Open-environment observations, comparisons, manipulations
      - growth, behavior, survival responses of individuals
      - size, structure responses of populations
      - structure responses of communities

II. Population effects
  A. Poorly understood for vast majority of species
    - lab studies (esp. of sub-lethal effects) do not readily translate into demographic responses
    - difficult to partition multiple sources of M, R, E, I (real world)
    - anthropogenic influences on chemistry rarely carefully controlled, monitored
    - even so, can provide large-scale quasi-experiments

    1. Some well-studied effects of chemicals on fish populations
      - larval lampricide TFM used in the Great Lakes
      - TFM widely applied to spawning streams
      - known to depress populations of walleye, perch, bullheads, suckers but not sunfishes

    2. Some of best examples of chemical effects on populations come from catastrophic spills
      a. August 2003 fish kill in Roanoke River near Salem, VA
        - eventually traced to a manufacturer of windshield-washer fluid, other chemicals
        - chlorine in effluent causes acute respiratory failure (kills gill cells), other sub-lethal effects
        - “call to arms” = dead Roanoke logperch (endangered fish)
        - monitored sites immediately after spill and subsequent year
        - no detectable effect on logperch population but chubs abundance, size declined

III. Effects on communities
  A. Even less well studied than for populations
    - effects highly region- and toxin-specific (no <u>most</u>-sensitive species)

    1. Biological monitoring of sites known to be heavily polluted offer insight into chemical effects
      - biomonitoring typically done by state agencies (eg, VA DEQ)
      - highly toxic waters tend to support ↓benthic species, ↓total species, ↑ individuals with DELT

IV. Managing water chemistry
- A. Legal mandate relevant to fish
  - 1. Water Pollution Control Act Amendment of 1972 (federal)
    - covers wetlands, rivers, lakes, estuaries
    - protects physical, chemical, biological integrity of waters (fishable, swimmable)
    - most implementation rests with individual states
    - aquatic monitoring typically includes data on water/sediment chemistry, bioassays, biosurveys

- B. Status
  - a main application of monitoring is to assess condition (quality) of waters
  - includes chemical and non-chemical problems

  - 1. National percentages of impaired waters (based on USEPA 2000)
    - 35% of river miles
    - 45% of lake acres
    - 44% of estuary miles^2

  - 2. Virginia's percentages of impaired waters (based on VDEQ 2006)
    - 63% of streams/rivers
    - 97% of lakes (reservoirs)
    - 92% of estuaries

- C. Main causes of water impairment
  - 1. Pollutants
    - bacteria, silt, nutrients, metals, organics

  - 2. Sources
    - agriculture, urban runoff, flow regulation, sewage, atmospheric

- D. Chief toxins associated agriculture, coal-mining, urbanization