CRITFC Lab 7 – Potential Toxic Effects of Pesticides, Especially in Lamprey and Salmon

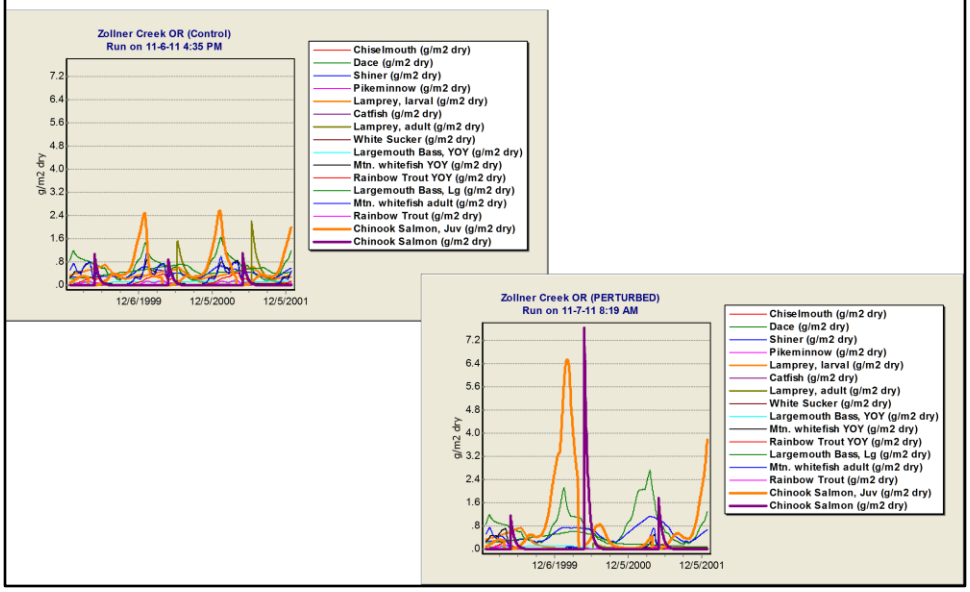
Lab 7 is a continuation of Lab 6 and is also based on simulations of Zollner Creek.

Lab will demonstrate analysis of ecotoxicity at several different levels

- Lethal toxicity
  - Internal or external concentration depending on mode
  - Length of exposure
- Sublethal toxicity, reduction in:
  - Photosynthesis
  - Growth (decrease in feeding, increase in defecation)
  - Reproduction
- Indirect (unique to AQUATOX)
  - Loss of forage base
  - Reduction in predation

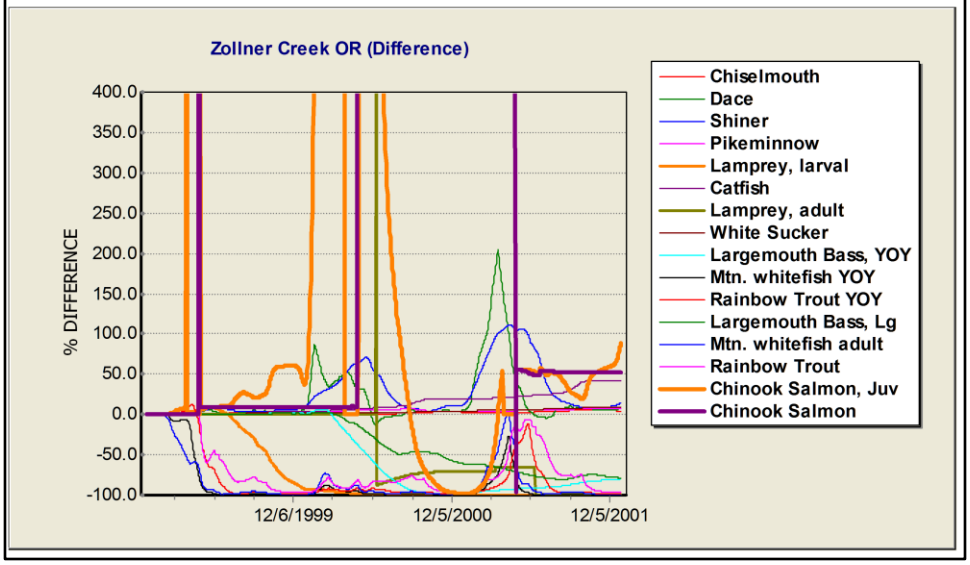
We will see time-dependent lethality, sublethal toxicity exemplified by growth reduction, and indirect effects due to reduction in predation.

Comparison of perturbed and control simulations with and without pesticides reveals large differences



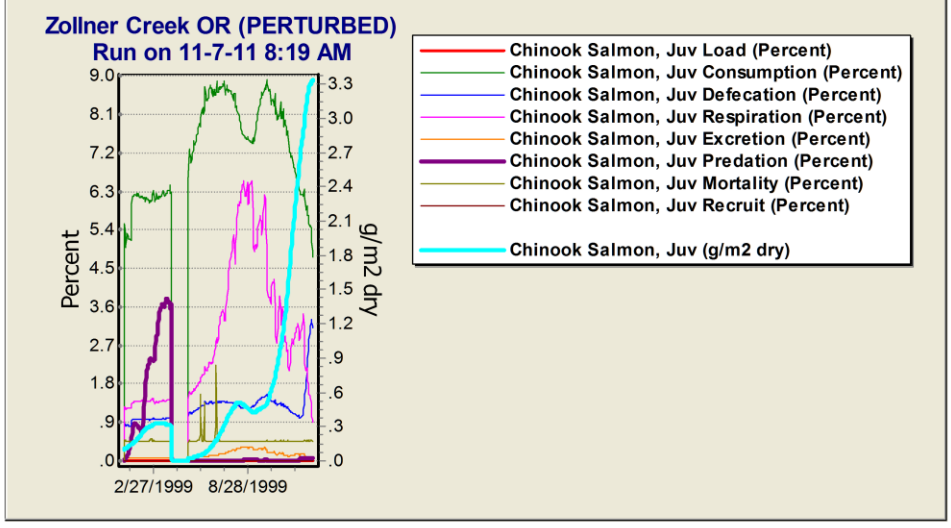
Comparison of the simulated fish community, with and without pesticides, suggests that ecotoxicity is occurring at several different levels. The increase in salmon in the first year is most likely due to removal of predation on juvenile salmon.

Plotting percent difference indicates loss of piscivorous fish early in the perturbed simulation



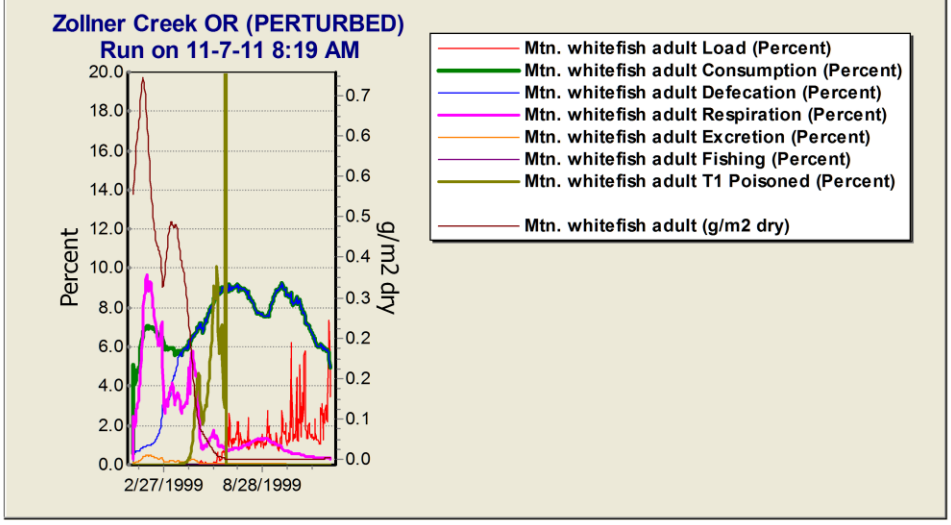
The first fish to become locally extinct at the site is mountain whitefish, followed by trout; bass decline early in year 2. (If you open the "Fish" graph and choose "Difference" you can click on the curves to see the species names, biomass, and date.)

Does the decline of the top predators explain the initial success of juvenile salmon?

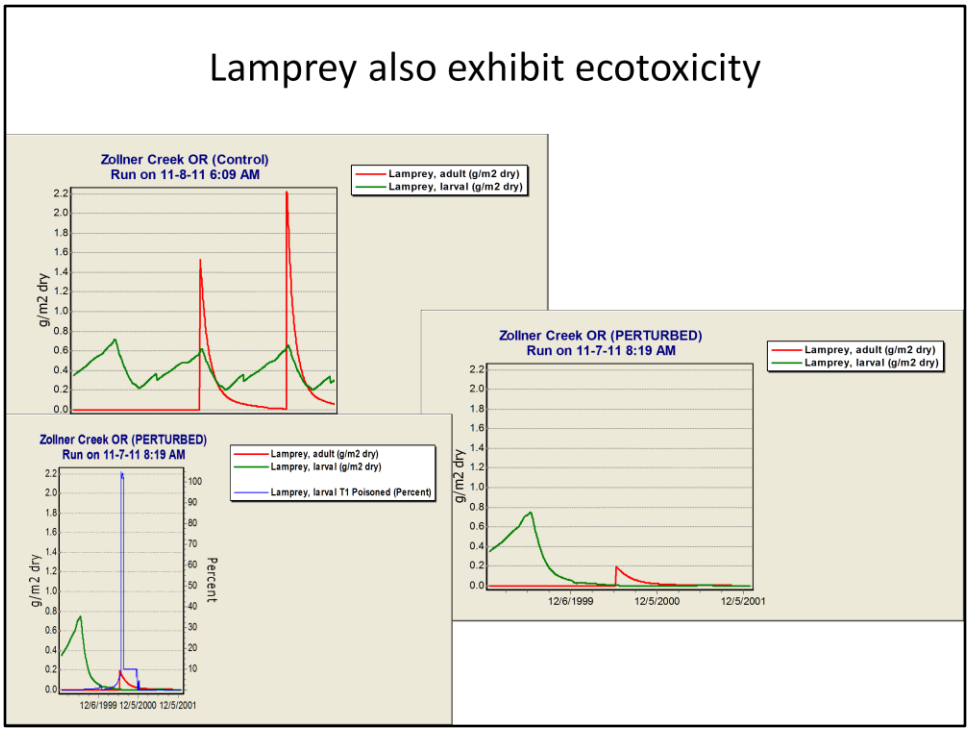


Plot “Juv salmon rates” to see that predation is an important constraint on the initial juvenile salmon, but that there is no predation on the cohorts from the May 2000 spawning.

What accounts for the early decline of mountain whitefish? Sublethal and lethal effects.

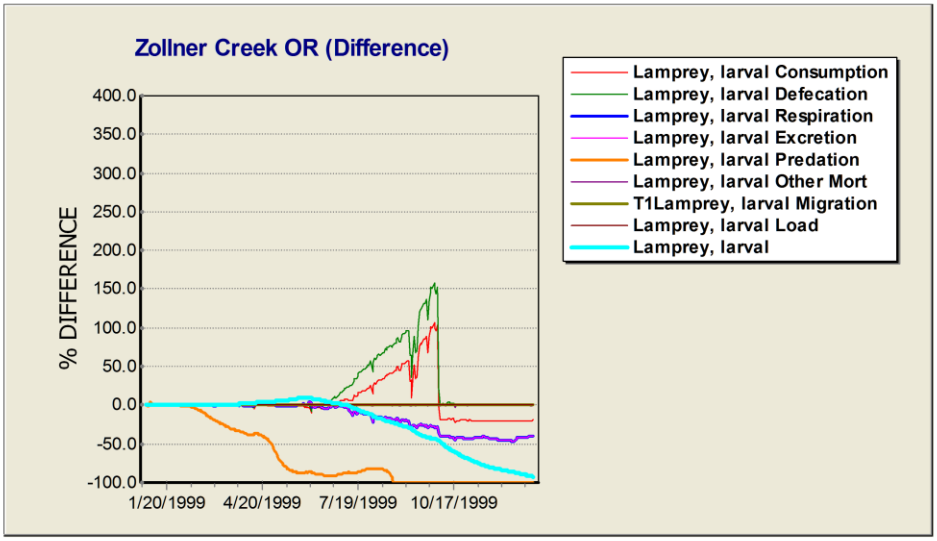


A plot of “Whitefish rates” shows that soon after the beginning of the simulation respiration exceeds consumption, then defecation = consumption; that is followed by acute mortality. Subsequent rates involve very small biomass of whitefish loadings from upstream



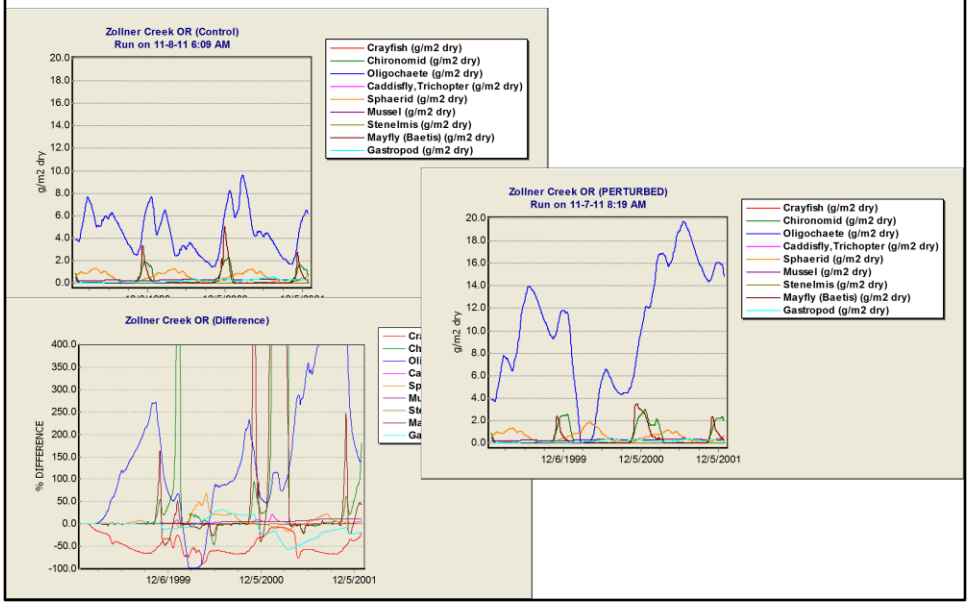
Comparison of control and perturbed lamprey simulations show large differences, some of which are explained by acute toxicity (see inset, lower left). Failure of a year class of juveniles will be reflected by failure of the adult migration. The simplification of the anadromous algorithm is that the response will show up in the next cycle—not three years later.

Release of predation pressure (indirect) is followed by increase in defecation (sublethal)

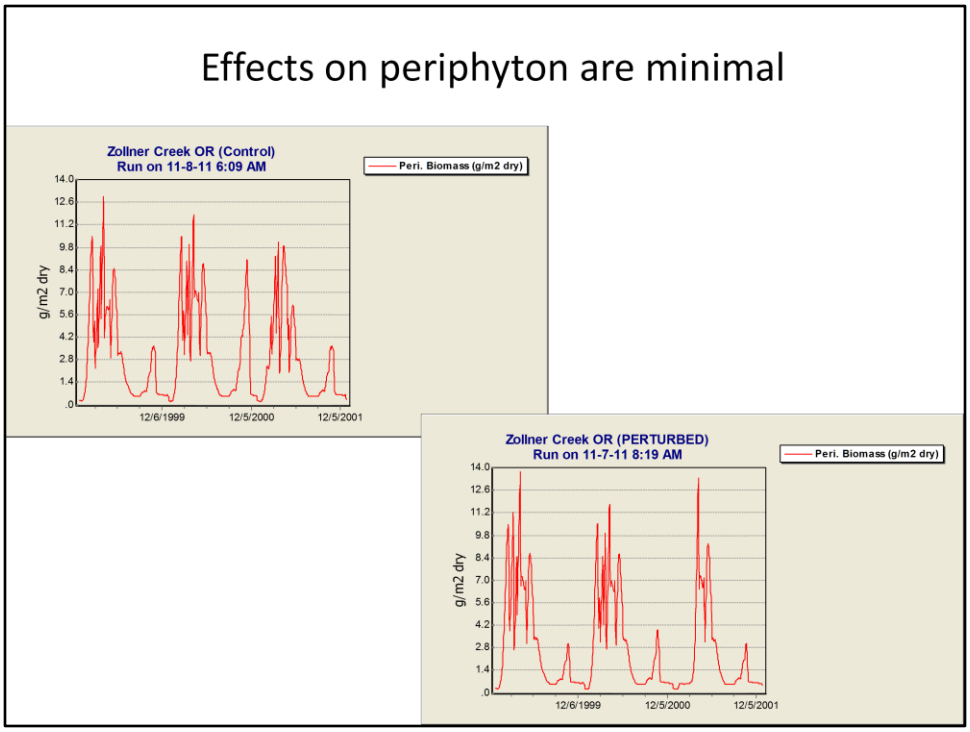


At first larval lamprey are favored by reduction in predation; but then, with continued bioaccumulation, defecation increases and then there is lethality (previous slide).

Pesticides removed predation of oligochaetes by fish and killed crayfish; eventually snails declined

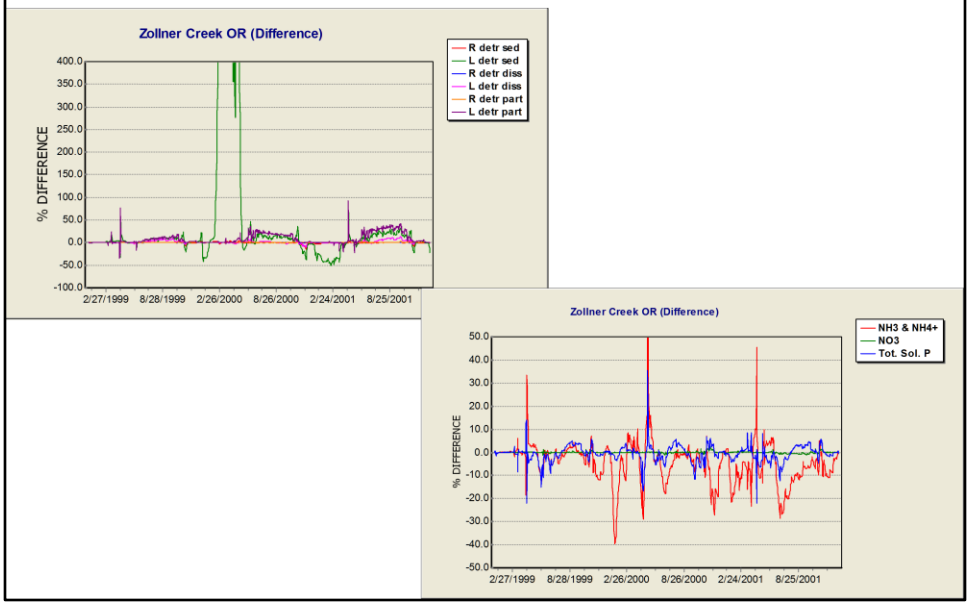


With special attention to the difference graph, oligochaetes are tolerant of the pesticides and favored by removal of predation pressure by fish. Crayfish are subject to sublethal and possibly lethal direct effects. **How could you determine more specifically the effects?**



There is little top-down control exerted on the periphyton. Snails, mayflies, and chiselmouth and sucker fish graze periphyton. **Why isn't there more impact from the pesticides?**

Labile detritus increases considerably with large fish kill, but nutrients do not reflect that



Because we are modeling a stream with short retention time, the nutrients will not show much response to the fish kill.