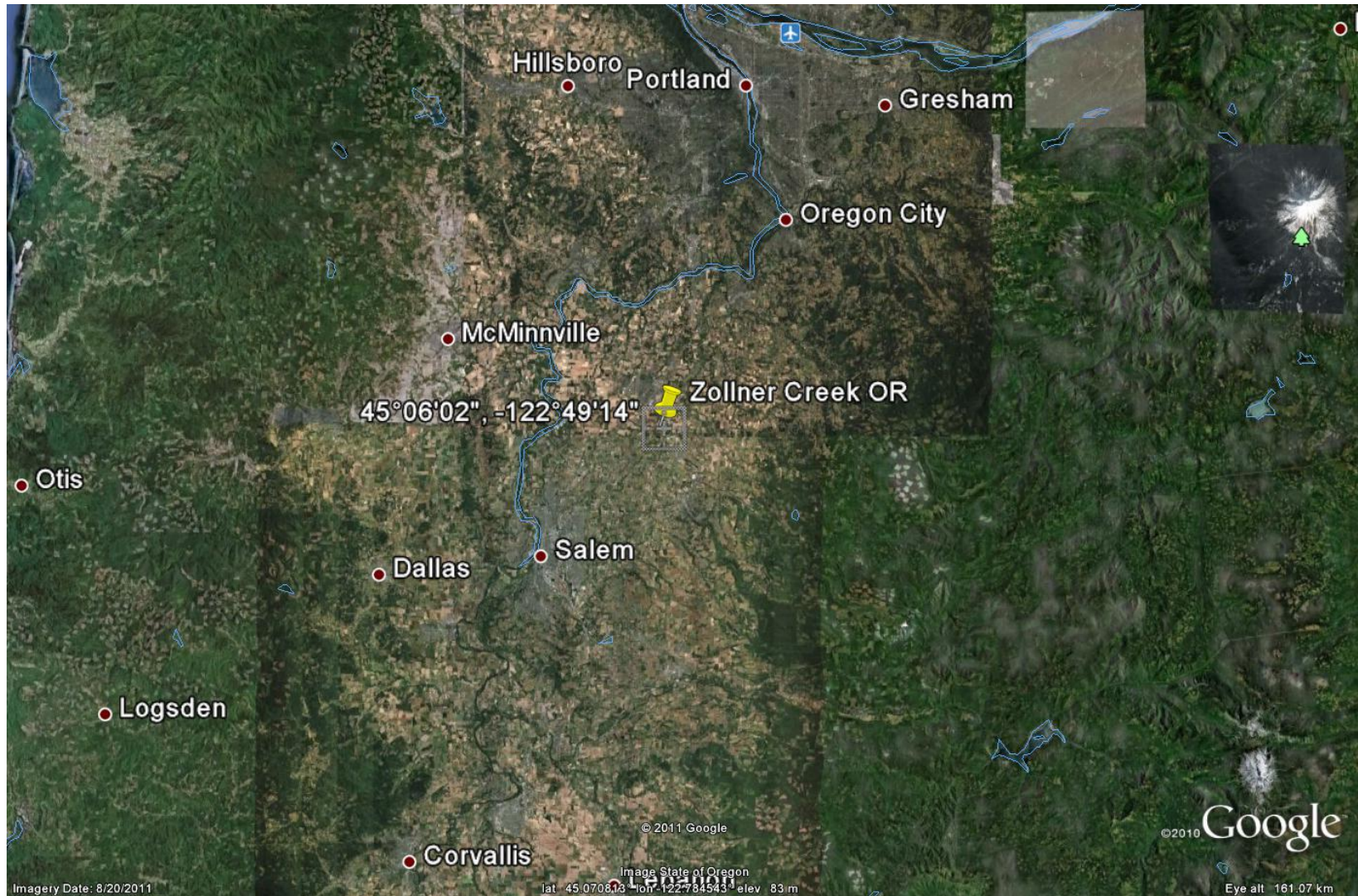


CRITFC Lab 6 – Setup of New Study for Oregon Stream, Anadromous Behavior, and Bioaccumulation of Pesticides in Lamprey and Salmon



Zollner Creek is in the Pudding River Watershed



The Oregon criteria for chlorpyrifos was exceeded

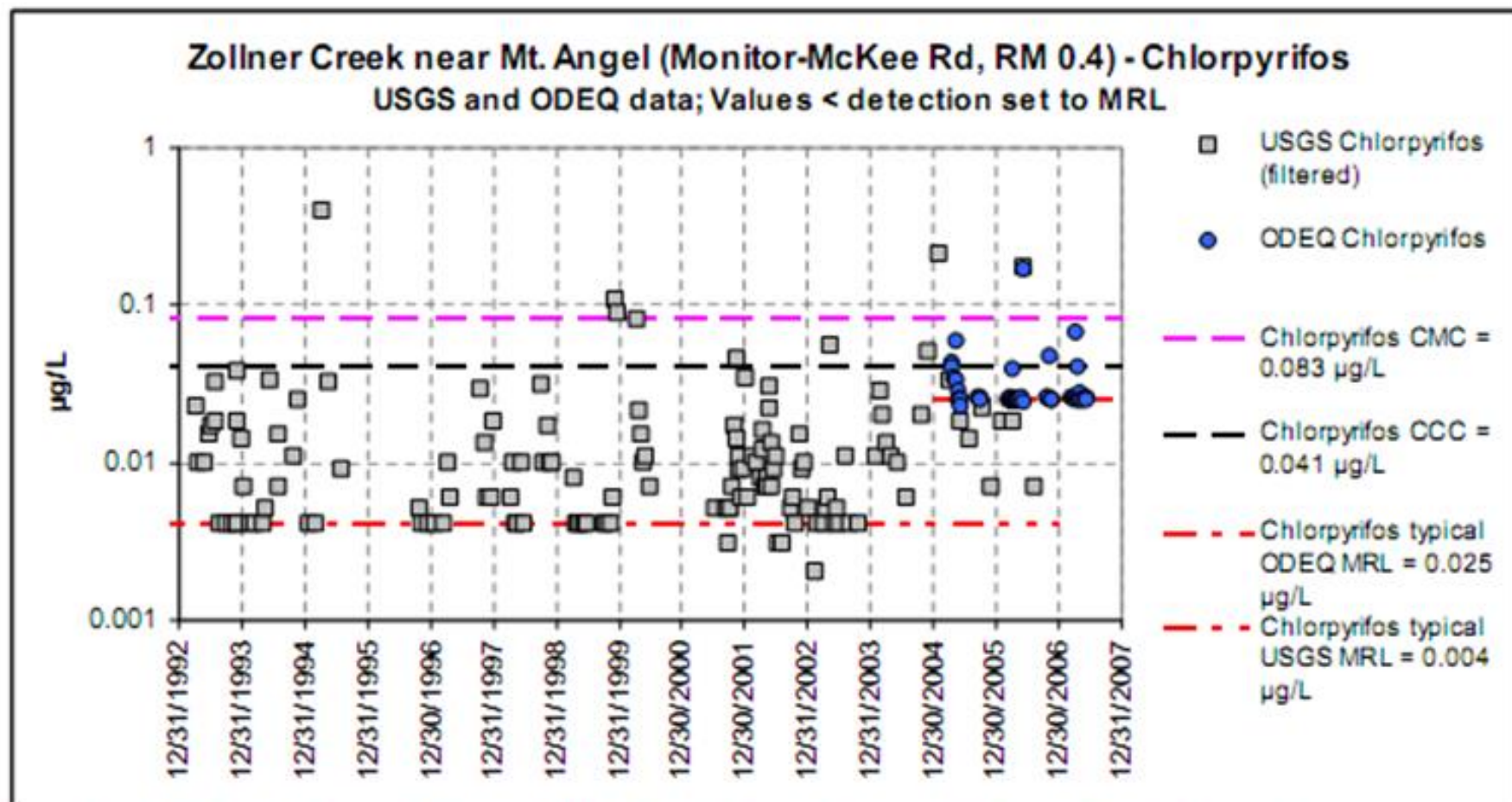


Figure I • 9: Zollner Creek near Mt. Angel (RM 0.4) – Chlorpyrifos concentrations • Logarithmic scale

Legacy pesticides (no longer used) include dieldrin

Table 4 - 4: Water Quality Criteria

Compound	Freshwater				Human Health For Consumption of:				Drinking Water MCLs
	Acute µg/L		Chronic µg/L		Water + Organism ^B µg/L		Organism only ^B µg/L		µg/L
Chlordane	2.4	Table 20	0.0043	Table 20	0.00046	Table 20	0.00048	Table 20	2
Dieldrin	2.5	Table 20	0.0019	Table 20	0.000071	Table 20	0.000076	Table 20	
Chlordane	2.4	Table 33A	0.0043	Table 33A	0.00080	Table 33A	0.00081	Table 33A	
DDT	1.1	Table 20	0.001	Table 20	0.000024	Table 20	0.000024	Table 20	
DDD 4,4'-					0.00031	Table 33A	0.00031	Table 33A	
DDE 4,4'-					0.00022	Table 33A	0.00022	Table 33A	
Dieldrin	0.24	Table 33A			0.000052	Table 33A	0.000054	Table 33A	


MCL - Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

Table 20 and 33A are contained in OAR 340-41-0033

Table 4 - 5. FDA Action levels for fish (edible portion)

Pesticide	FDA Action Level
CHLORDANE	0.3 ppm (300 µg/kg)
DDT, DDE, & TDE	5 ppm (5000 µg/kg)
ALDRIN & DIELDRIN	0.3 ppm (300 µg/kg)

Use calibrated model with chlorpyrifos & dieldrin








 Zollner Creek OR w chlorpyr dieldrin-pulse.apss-- Main Window

AQUATOX: Study Information








EPA Release 3.1 Beta

Study Name:

Model Run Status:
Perturbed Run: 11-5-11 7:53 PM
Control Run: 11-6-11 5:36 AM


Data Operations:
 Initial Conds.
 Chemical
 Site
 Setup
 Notes
 Birds, Mink...
 Sed Layer(s)

There are 0 sediment layers modeled.

Program Operations:
 Perturbed
 Control
 Output
 Export Results
 Export Control
 Use Wizard
 Help

State and Driving Variables In Study
Dissolved org. tox 1: [Chlorpyrifos]
Dissolved org. tox 2: [Dieldrin]
Total Ammonia as N
Nitrate as N
Total Soluble P
Carbon dioxide
Oxygen
Tot. Susp. Solids
Refrac. sed. detritus
Labile sed. detritus
Susp. and dissolved detritus
Buried refrac. detritus
Buried labile detritus
Diatoms1: [Peri Low-Nut Diatom]
Diatoms2: [Peri High-Nut Diatom]
Diatoms3: [Phyt High-Nut DiatJC]
Diatoms4: [Phyt Low-Nut DiatoJC]
Diatoms5: [Phyto, NaviculaJC]
Diatoms6: [Peri, Nitzschia]
Greens1: [Cladophora]
Greens2: [Peri, Green]
Greens4: [Phyto, Green]
Bl-green1: [Phyt, Blue-Greens JC]
Bl-green3: [Peri, Blue-Greens]
OtherAlg1: [Cryptomonas]
Shredder1: [Crayfish]
SedFeeder1: [Chironomid]
SedFeeder2: [Oligochaete]
SuspFeeder1: IC addisfly Trichonteri

Perturbed Run-- Zollner Creek OR w chlor...

Progress: 

81%
(6/11/2001)

☒ Save to Disk upon Completion (overwrite)

Percentage of Maximum Stepsize:
8.4 %

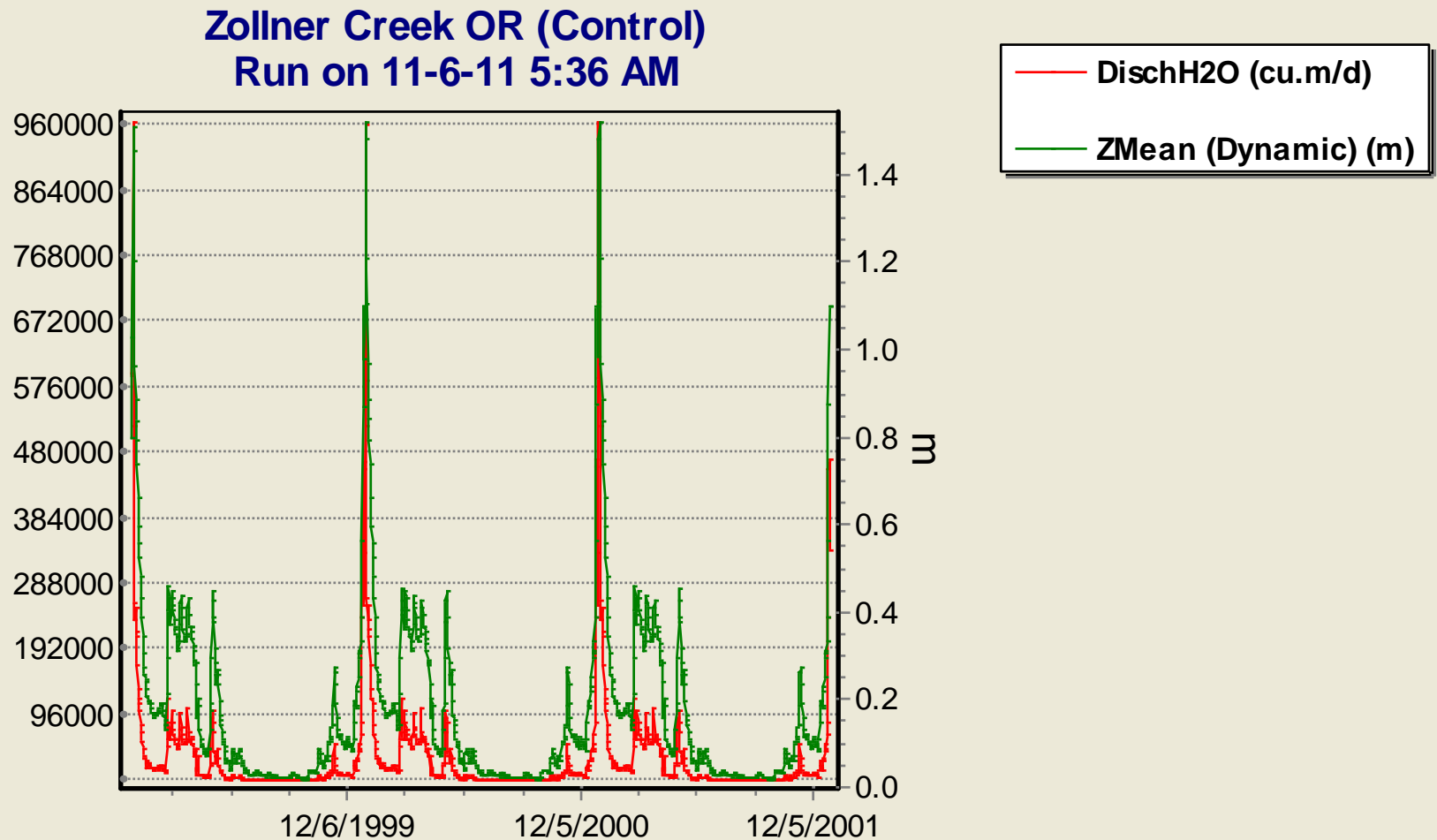
Last Error Overrun: CO2
ErrVal: 0

Largest Rate: AtmosEx

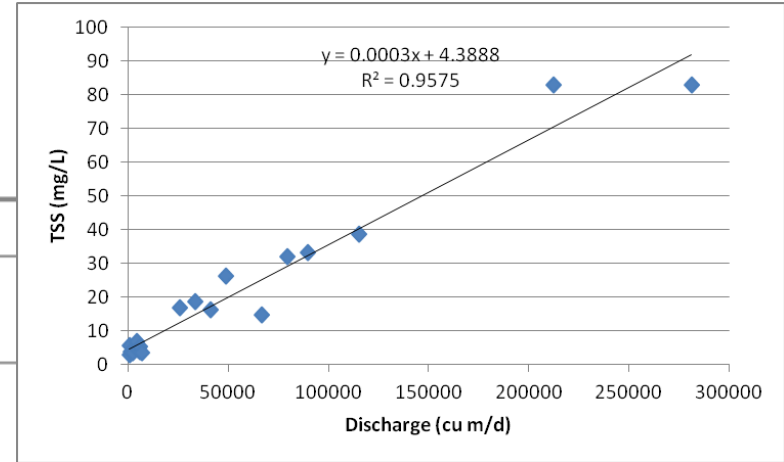
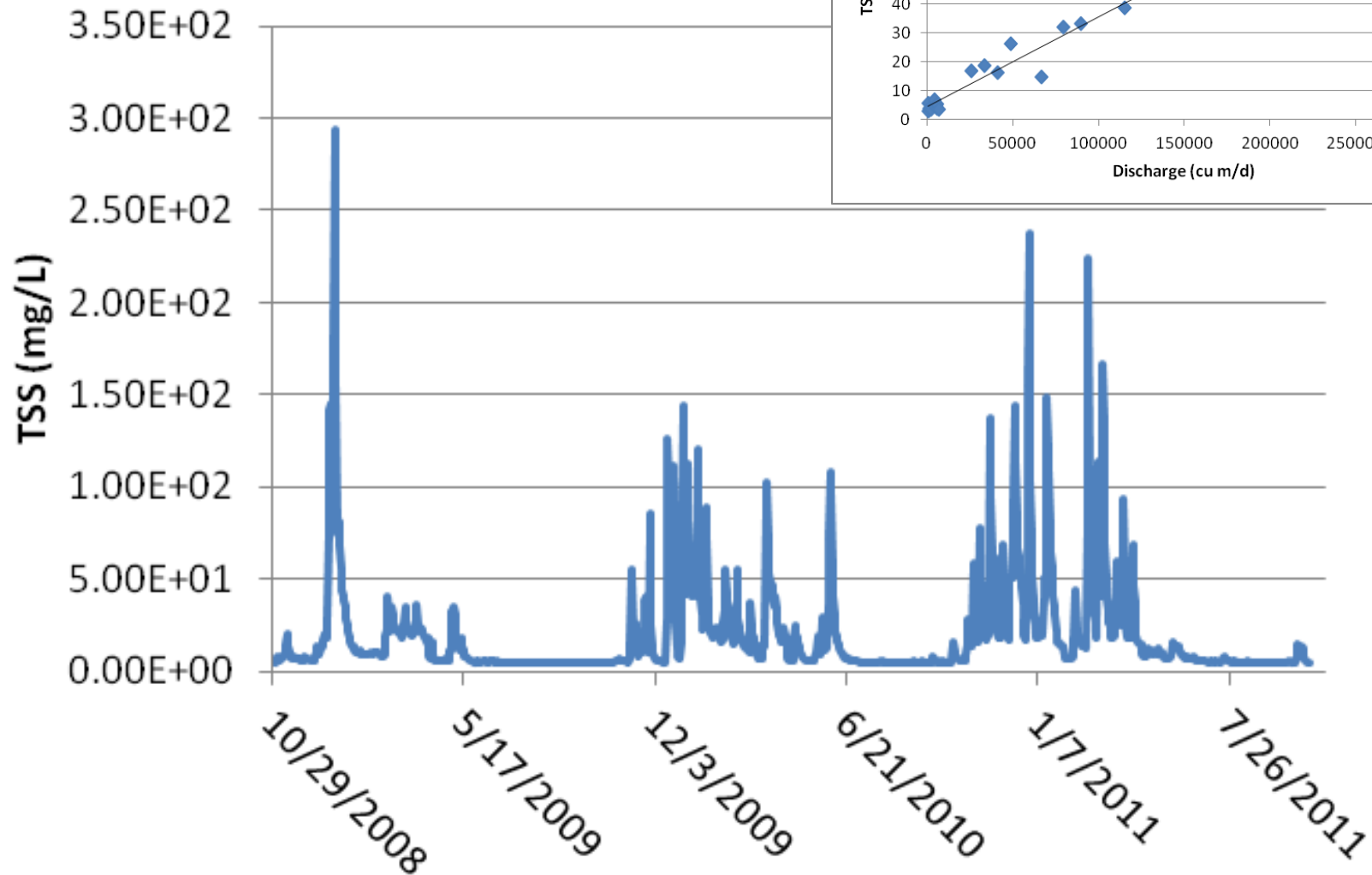
Suggested tasks using Zollner Creek study

- Explore boundary conditions
 - Area, depth, volume
 - Driving variables (discharge, nutrient loadings, TSS)
 - Pesticide loadings
- Parameters for lamprey and salmon, including setup for anadromous behavior
- Simulated bioaccumulation
 - Chlorpyrifos, dieldrin
 - Chinook salmon, lamprey
- Action levels for human consumption
- Lab 7 will examine ecotoxicity as a continuation

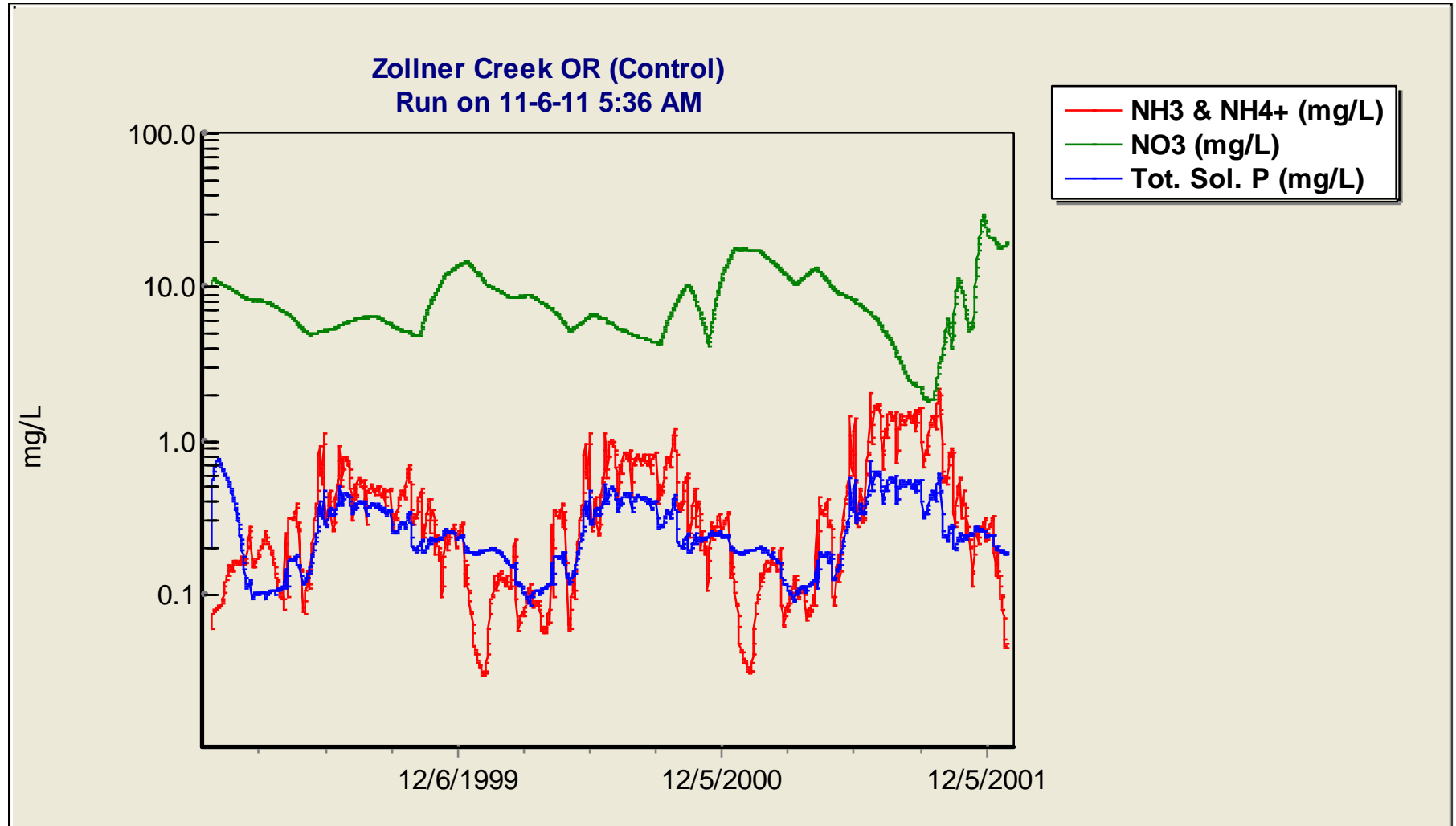
Discharge and water depth are important



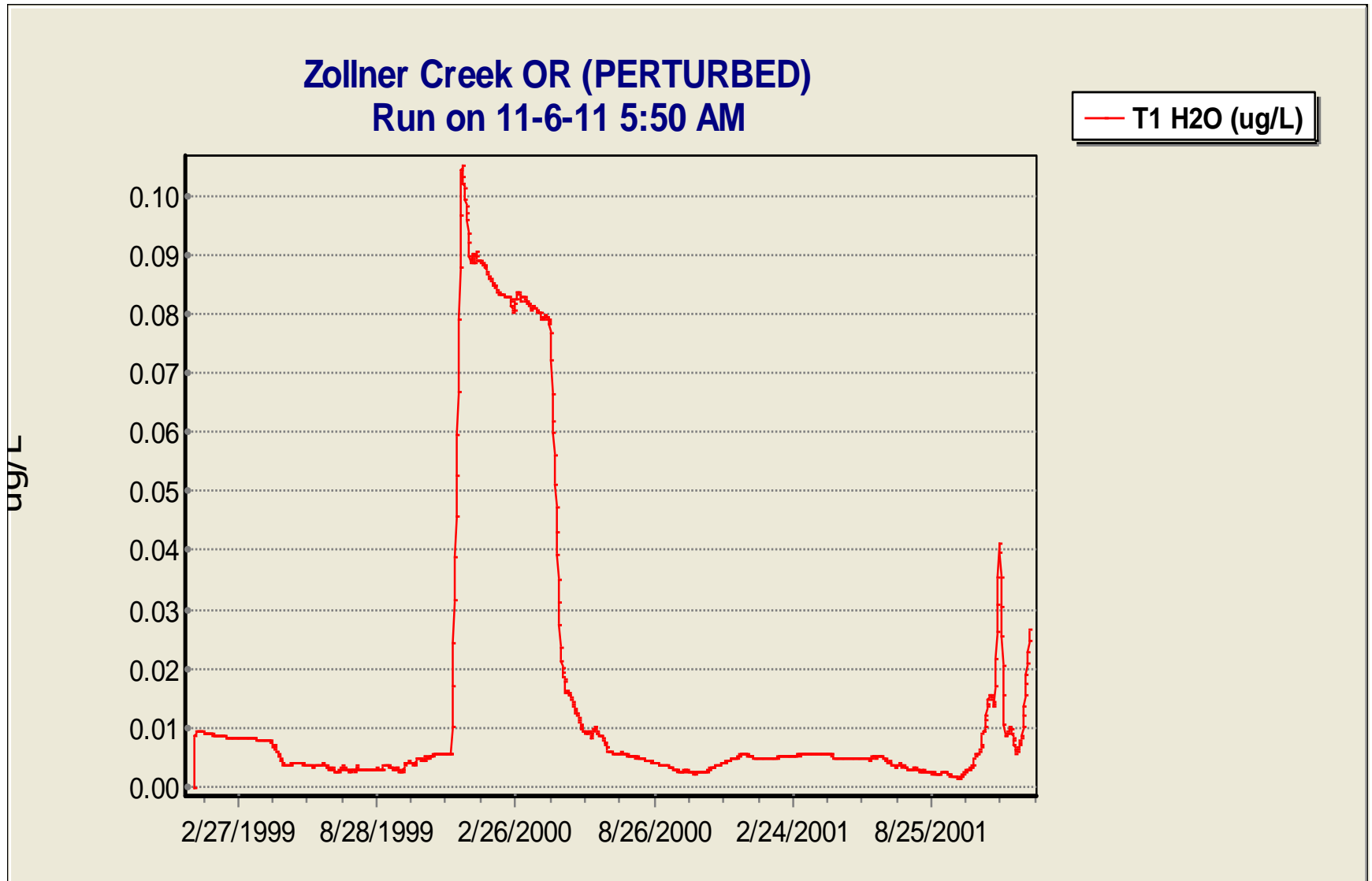
TSS estimated using regression on discharge



Nutrients, especially nitrate, are high due to agricultural runoff

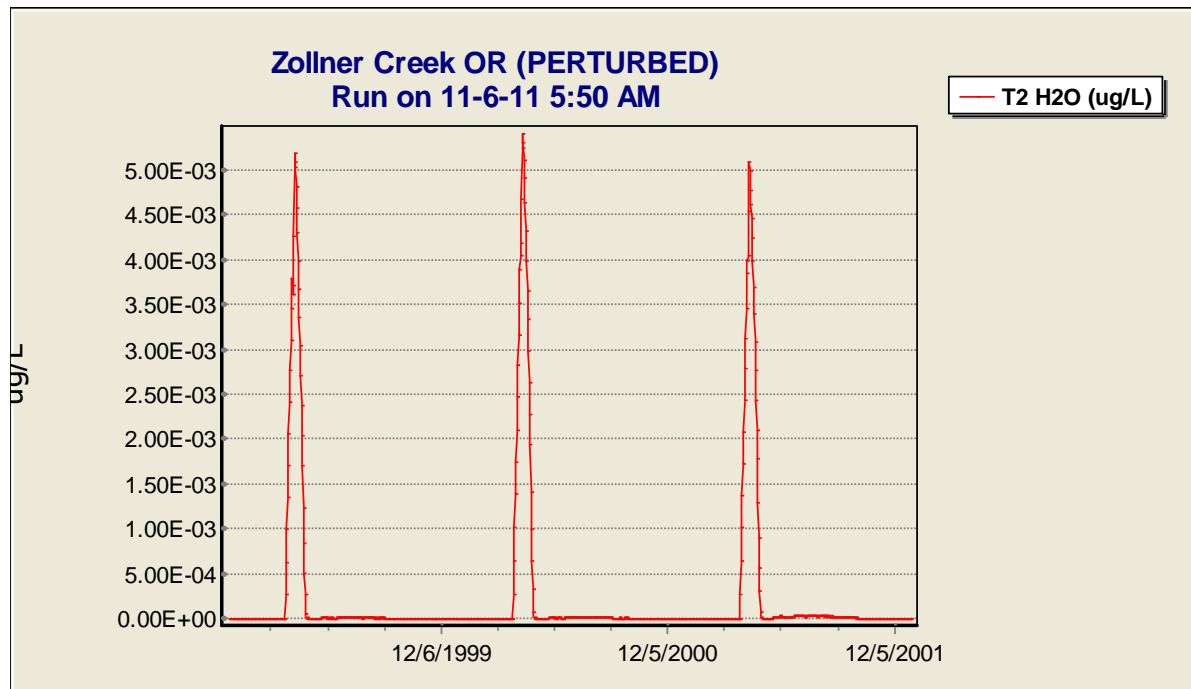


Time-varying chlorpyrifos loading extracted from USGS site record

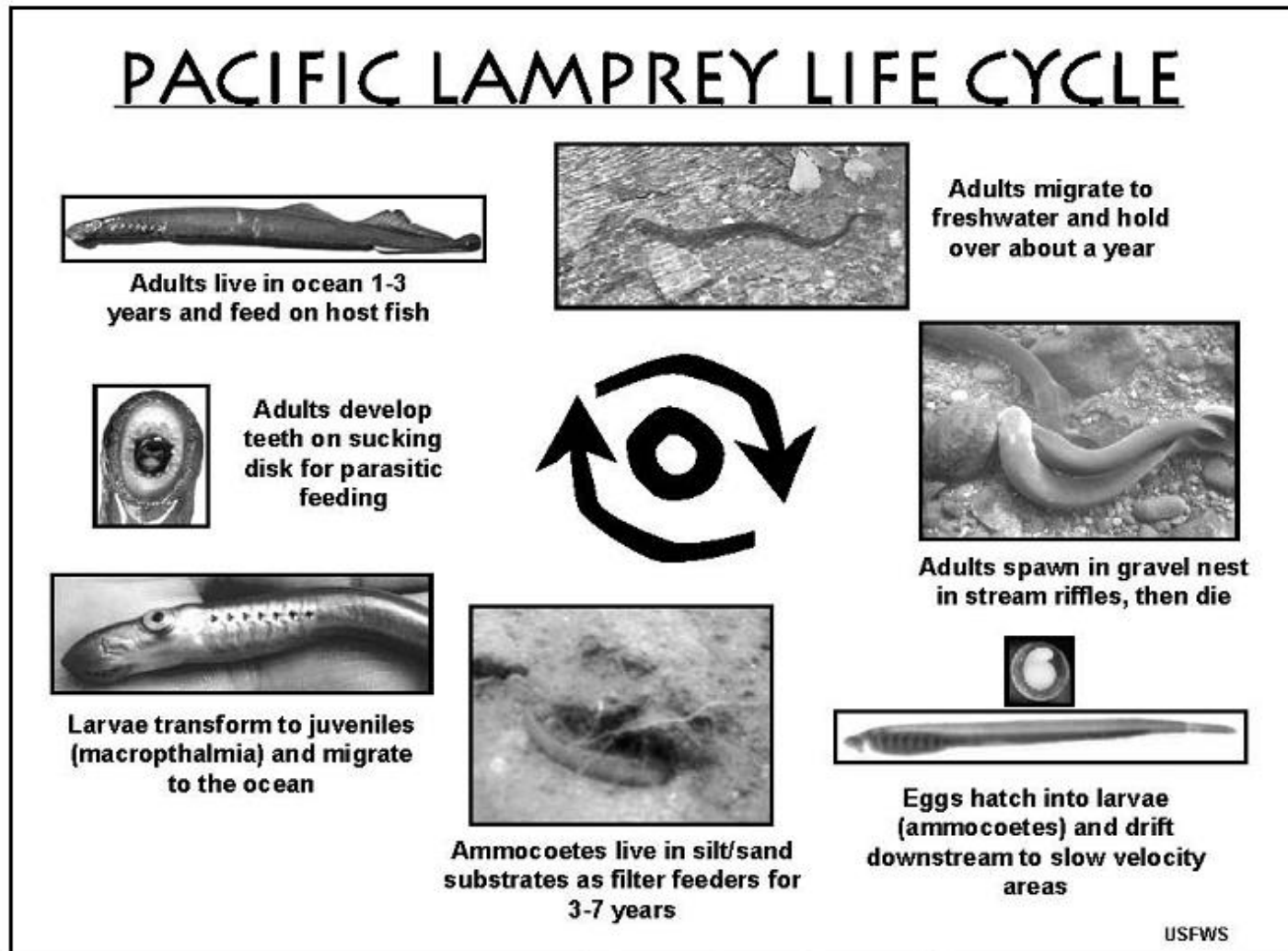


Pulsed loadings of dieldrin in solution provide a compromise between worst-case and best-case

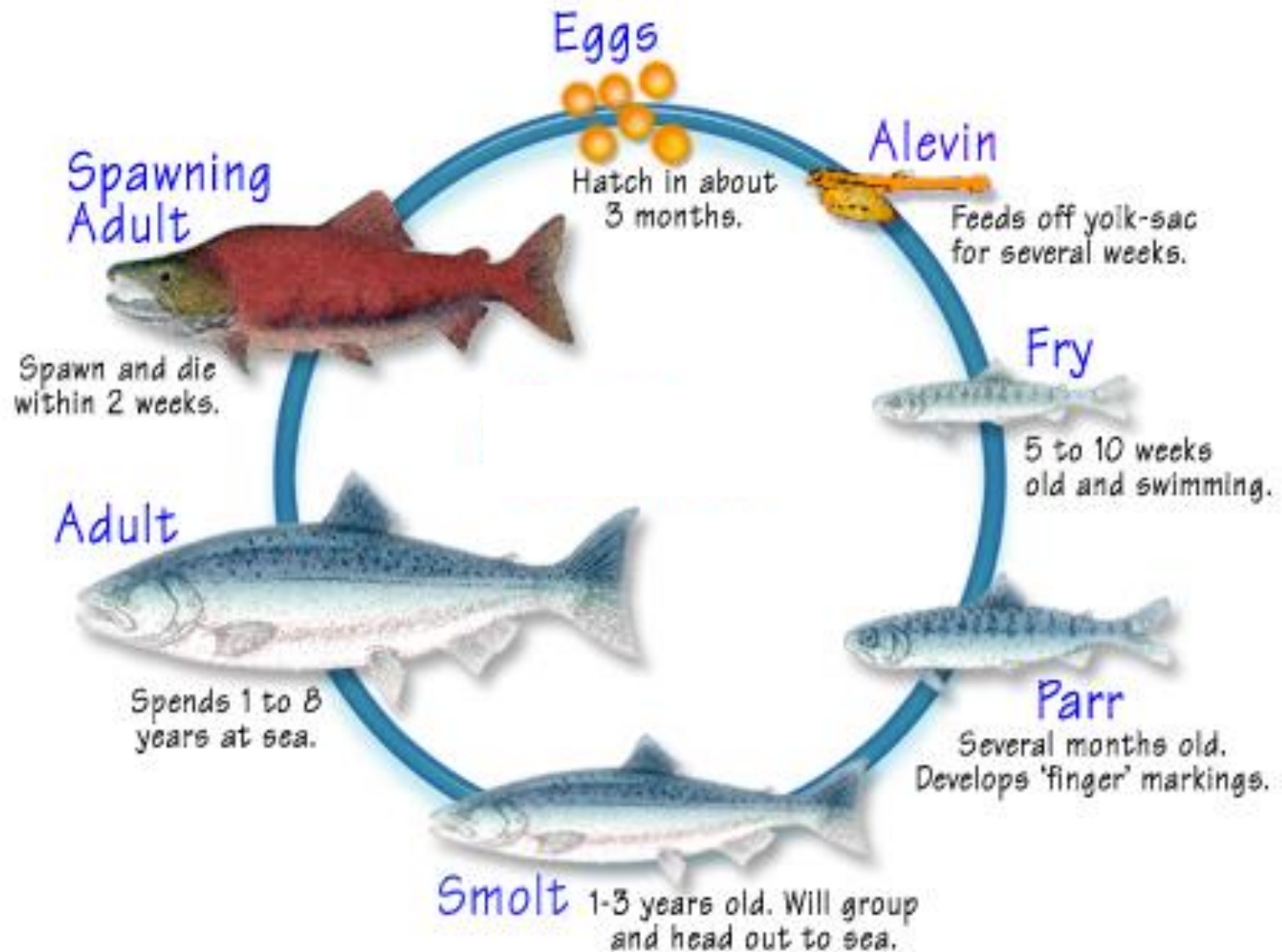
Date	Dieldrin ug/L	or	Date	Dieldrin
4/1/1997	0.006		3/30/1997	0
4/1/2003	0.003		4/15/1997	0.006
4/1/2006	0.002		4/30/1997	0
5/1/2007	0.009			
mean	0.005		triangular distribution	



Pacific lamprey larvae live as filter feeders in sediments for several years



Chinook salmon life cycle



Setup for anadromous fish (lamprey)

AQUATOX- Edit State Variable Data

LgBottomFish1: [Lamprey, adult]

Fish Stocking in grams per day
Use Const. Loading of g / d

Anadromous Fish Setup

☒ Model Size-Class fish as Migrating Off-Site and Returning as Adult

Off-Site Migration Setup

Julian Date of Juvenile Migration (1-365)	<input type="text" value="349"/>	e.g. 12/15/2011
Fraction of Biomass Migrating (0-1)	<input type="text" value="0.2"/>	(fraction)
Julian Date of Adult Return (1-365)	<input type="text" value="166"/>	e.g. 6/15/2011
Years Spent off site	<input type="text" value="3"/>	years
Mortality Fraction (0-1)	<input type="text" value="0.7"/>	(fraction)

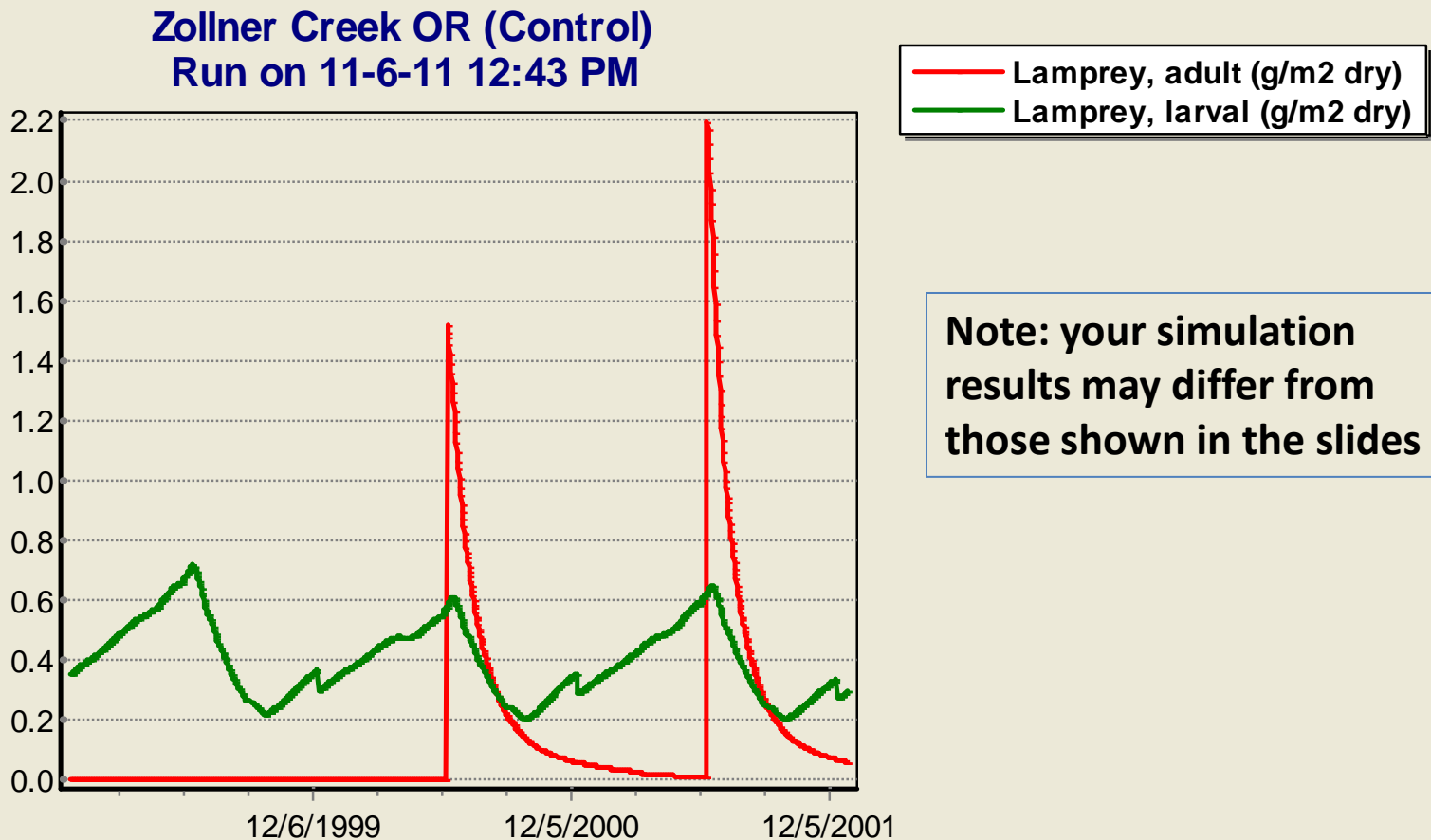
Notes:

Multiply loading by

Spreadsheet for Anadromous Calculations

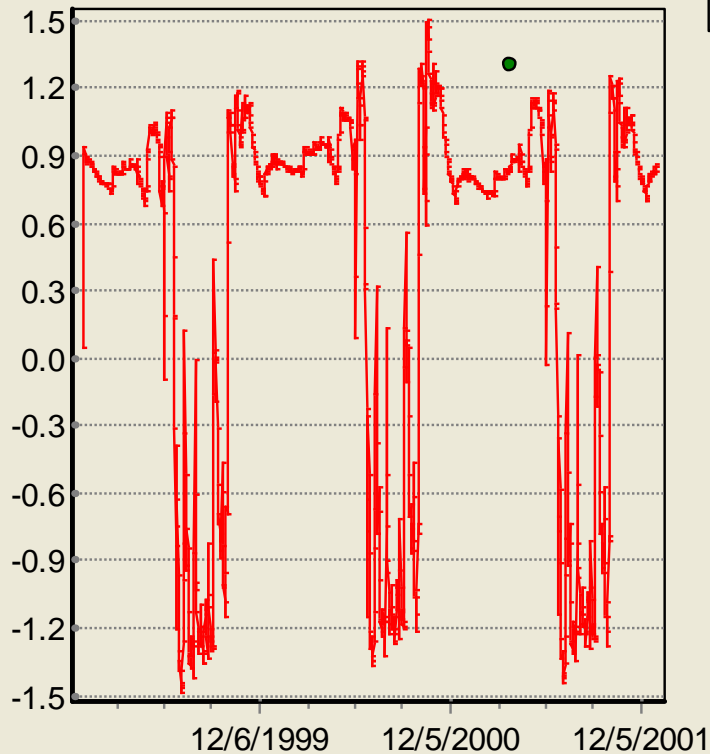
New Interface Inputs		Chinook salmon		Dieldrin	
Date of juvenile migration	2-Apr				
Fraction of biomass migrating	100%				
Date of adult return	2-May				
Years spent off-site	4				
Off-Site Mortality Frac	0.7 frac				
AQUATOX Calculations From Existing Parameters					
Clearance Rate (K2)	0.0026941	1/d			
Growth Multiplier	160.00	frac	Taken from mean weights		
Initial Lipid	20%	g lipid / g ww			
Return Lipid	20%	g lipid / g ww			
Biomass departing	0.05	g/m2			
Conc in Departing Fish	1.60	ppb	ug/kg ww		
"Off-Site Environment" Intermediate Calculations					
Initial Lipid Norm Conc	8.0	ug / kg lipid			
Time off site	1491	days			
Depuration effect	1.8%	multiplier			
Growth effect	0.625%	multiplier			
"Off-Site Environment" Results (passed back to AQUATOX)					
Biomass Returning	2.400	g/m2	fn growth and mortality		
Return Conc	0.000	ug/kg ww	fn depuration and growth effect		
Return Lipid Norm Conc	0.001	mg/kg lipid			
Data Above	0.011195%	pct remains	from original dry weight value.		
	0.011195%	pct remains	from original lipid normalized value.		

In this simulation the larval lamprey are stable over the period of the simulation and the adults exhibit an annual return and slow decline (they do not eat)



The simulated growth rate of larval lamprey is close to the observed rate

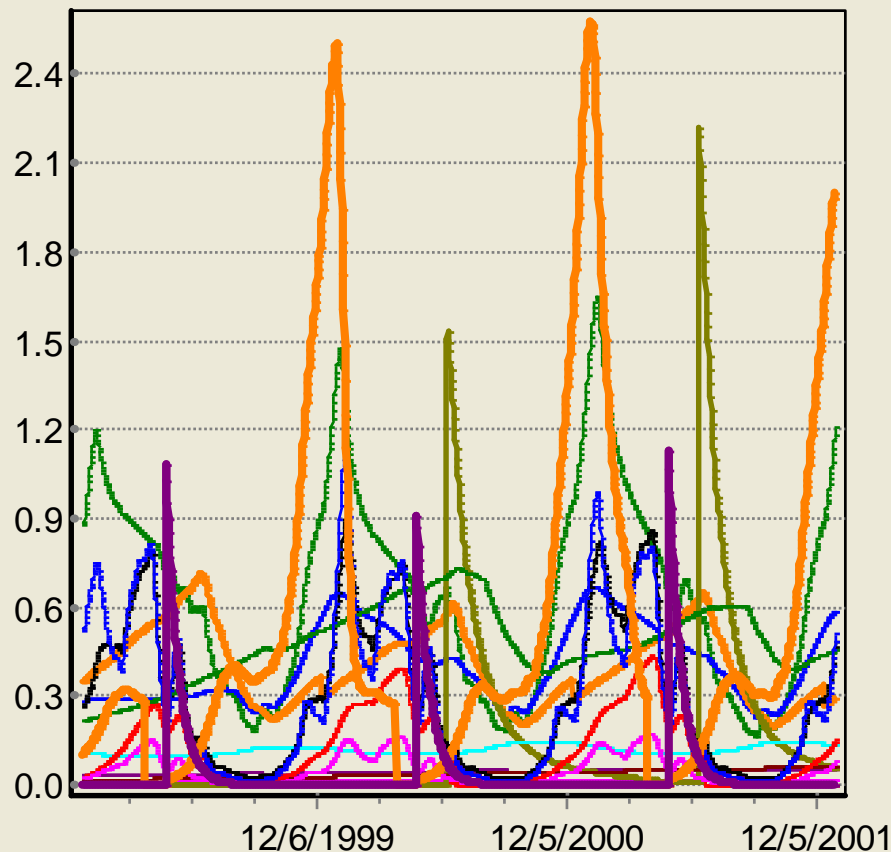
Zollner Creek OR (Control)
Run on 11-6-11 12:43 PM



— Lamprey, larval GrowthRate (Percent)
● Lamprey growth rate (Percent)

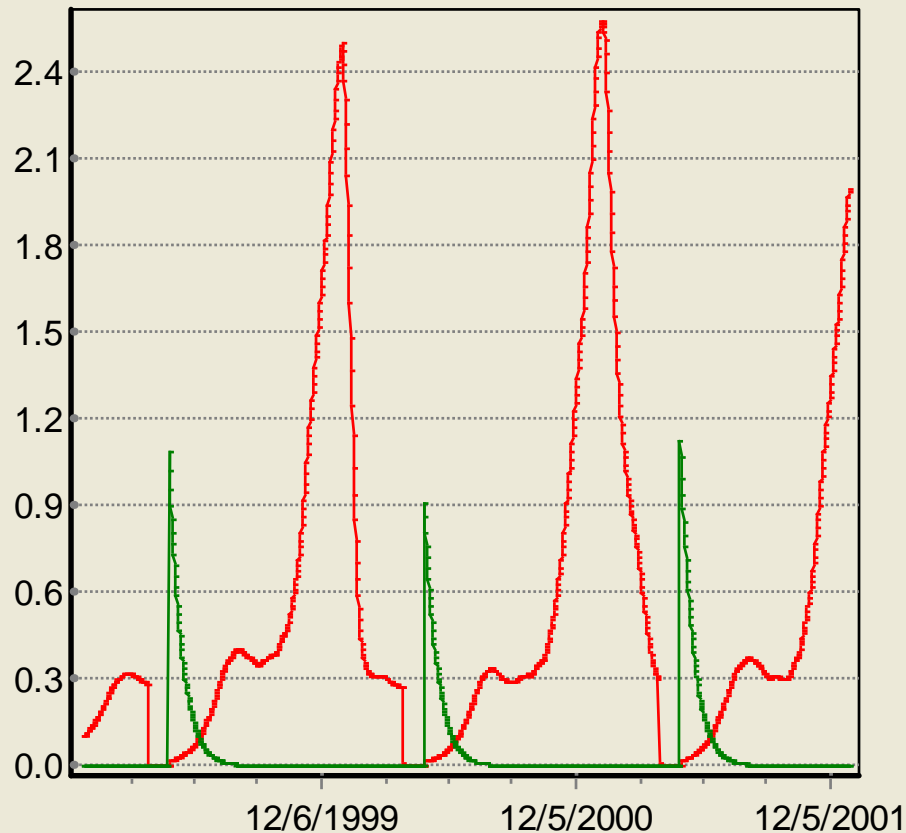
Salmon and lamprey dominate fish community control simulation without pesticides

Zollner Creek OR (Control)
Run on 11-6-11 4:35 PM



In the control simulation the peak juvenile salmon biomass may be too high

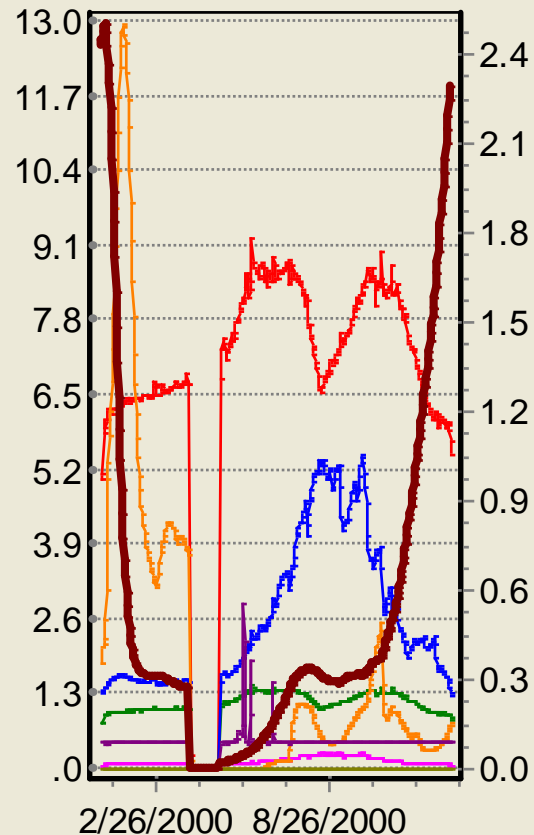
Zollner Creek OR (Control)
Run on 11-6-11 4:35 PM



— Chinook Salmon, Juv (g/m² dry)
— Chinook Salmon (g/m² dry)

Plotting the rates may provide some insights into what is behind the high biomass

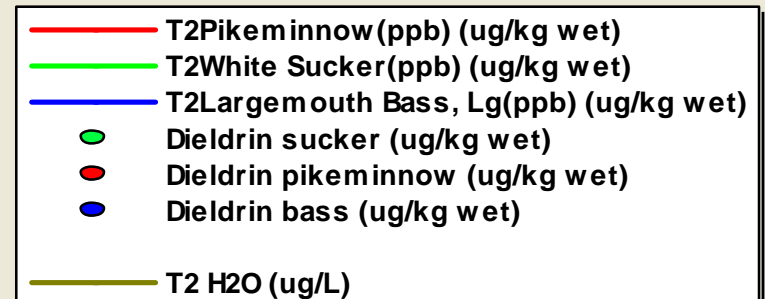
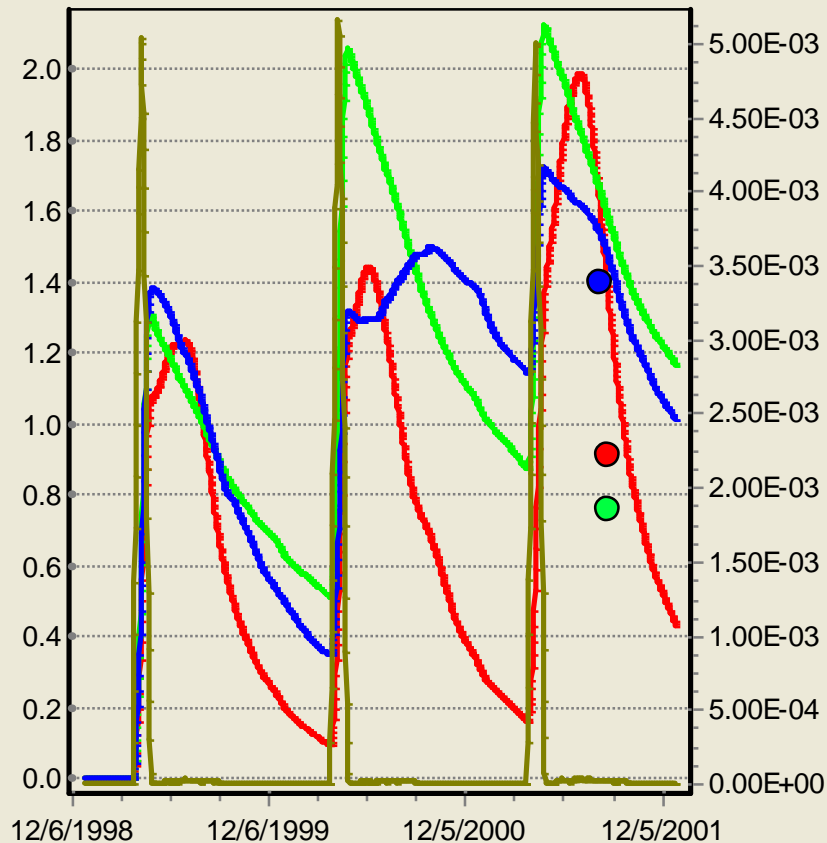
Zollner Creek OR (Control)
Run on 11-6-11 4:35 PM



- Chinook Salmon, Juv Consumption (Percent)
- Chinook Salmon, Juv Defecation (Percent)
- Chinook Salmon, Juv Respiration (Percent)
- Chinook Salmon, Juv Excretion (Percent)
- Chinook Salmon, Juv Predation (Percent)
- Chinook Salmon, Juv Mortality (Percent)
- Chinook Salmon, Juv Recruit (Percent)
- Chinook Salmon, Juv (g/m² dry)

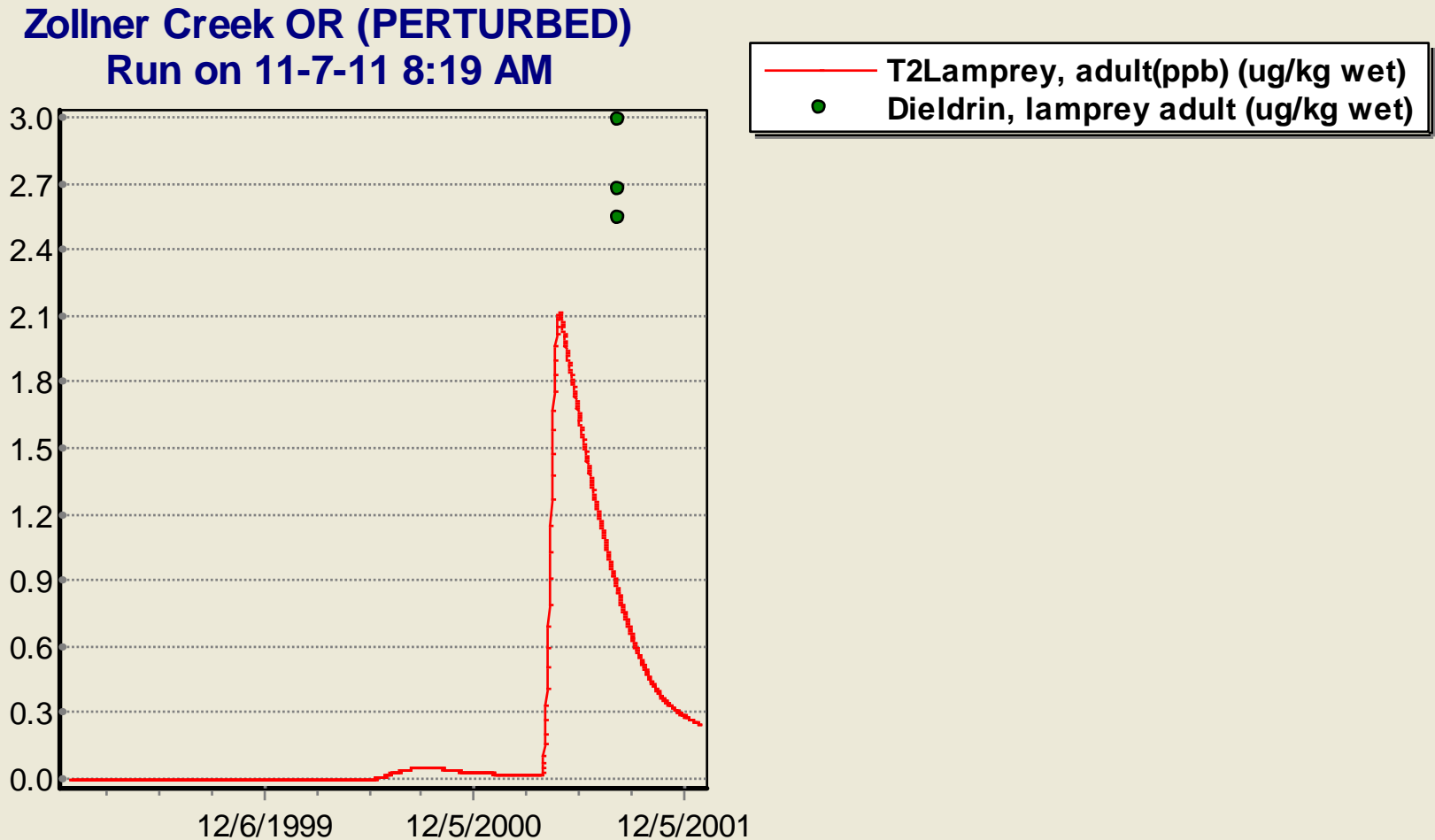
Dieldrin tissue concentrations are verified with limited data for three species

Zollner Creek OR (PERTURBED)
Run on 11-7-11 8:19 AM



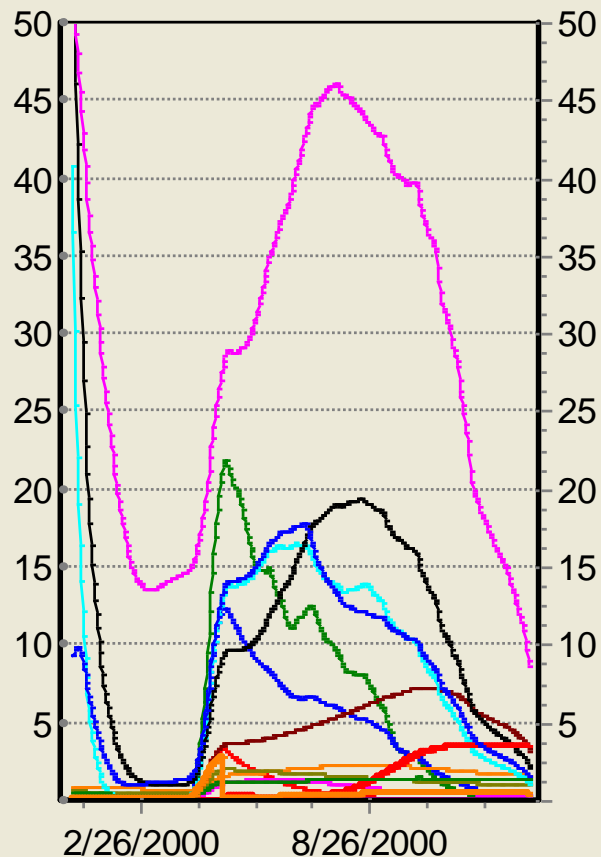
ug/L

Diieldrin in adult lamprey (data from 2009)



Predicted concentration of dieldrin in fish exceeds action level of 2.3 ug/kg

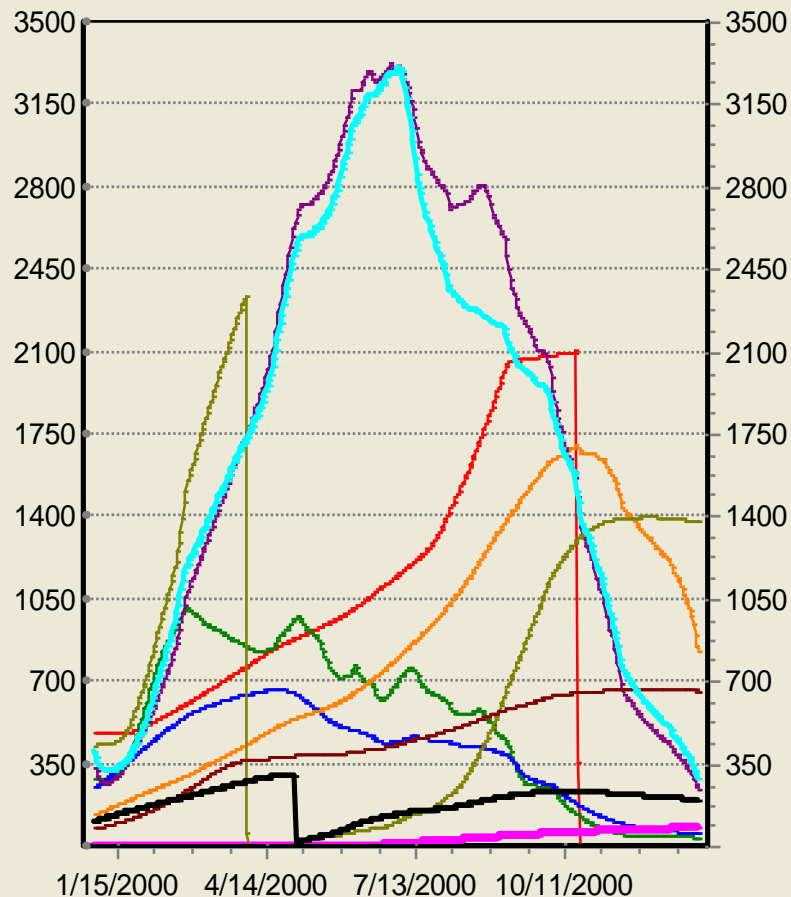
Zollner Creek OR (PERTURBED)
Run on 11-7-11 8:19 AM



- T2Chiselmouth(ppb) (ug/kg wet)
- T2Dace(ppb) (ug/kg wet)
- T2Shiner(ppb) (ug/kg wet)
- T2Pikeminnow(ppb) (ug/kg wet)
- T2Catfish(ppb) (ug/kg wet)
- T2Lamprey, adult(ppb) (ug/kg wet)
- T2White Sucker(ppb) (ug/kg wet)
- T2Largemouth Bass, YOY(ppb) (ug/kg wet)
- T2Mtn. whitefish YOY(ppb) (ug/kg wet)
- T2Rainbow Trout YOY(ppb) (ug/kg wet)
- T2Chinook Salmon, Juv(ppb) (ug/kg wet)
- T2Largemouth Bass, Lg(ppb) (ug/kg wet)
- T2Mtn. whitefish adult(ppb) (ug/kg wet)
- T2Rainbow Trout(ppb) (ug/kg wet)
- T2Chinook Salmon(ppb) (ug/kg wet)

Chlorpyrifos in fish (ug/kg wet)

Zollner Creek OR (PERTURBED)
Run on 11-7-11 8:19 AM

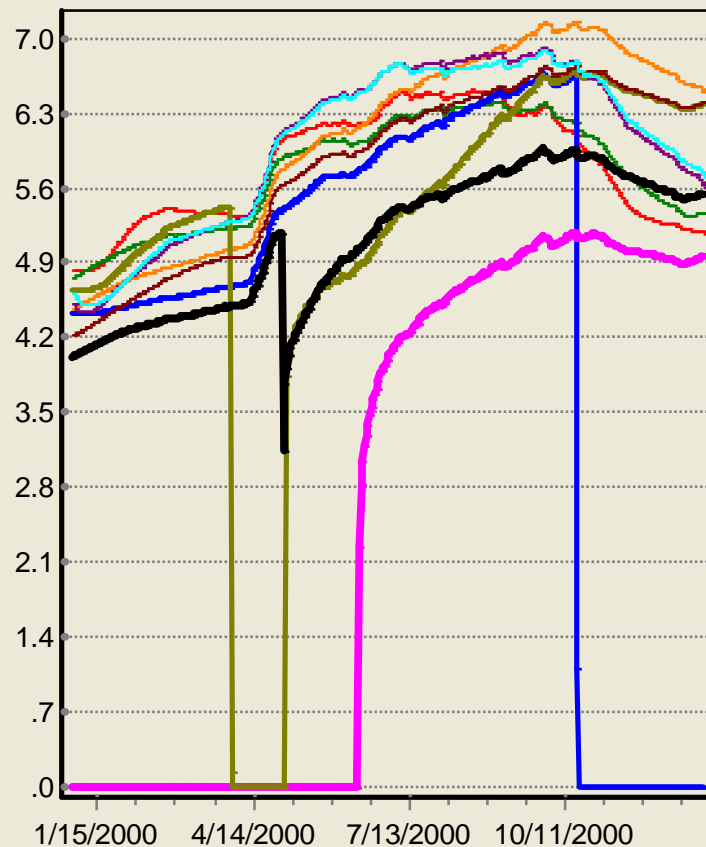


- T1Lamprey, larval(ppb) (ug/kg wet)
- T1Dace(ppb) (ug/kg wet)
- T1Shiner(ppb) (ug/kg wet)
- T1Lamprey, adult(ppb) (ug/kg wet)
- T1Largemouth Bass, YOY(ppb) (ug/kg wet)
- T1Mtn. whitefish YOY(ppb) (ug/kg wet)
- T1Chinook Salmon, Juv(ppb) (ug/kg wet)
- T1Largemouth Bass, Lg(ppb) (ug/kg wet)
- T1Mtn. whitefish adult(ppb) (ug/kg wet)
- T1Chinook Salmon(ppb) (ug/kg wet)

ug/kg wet

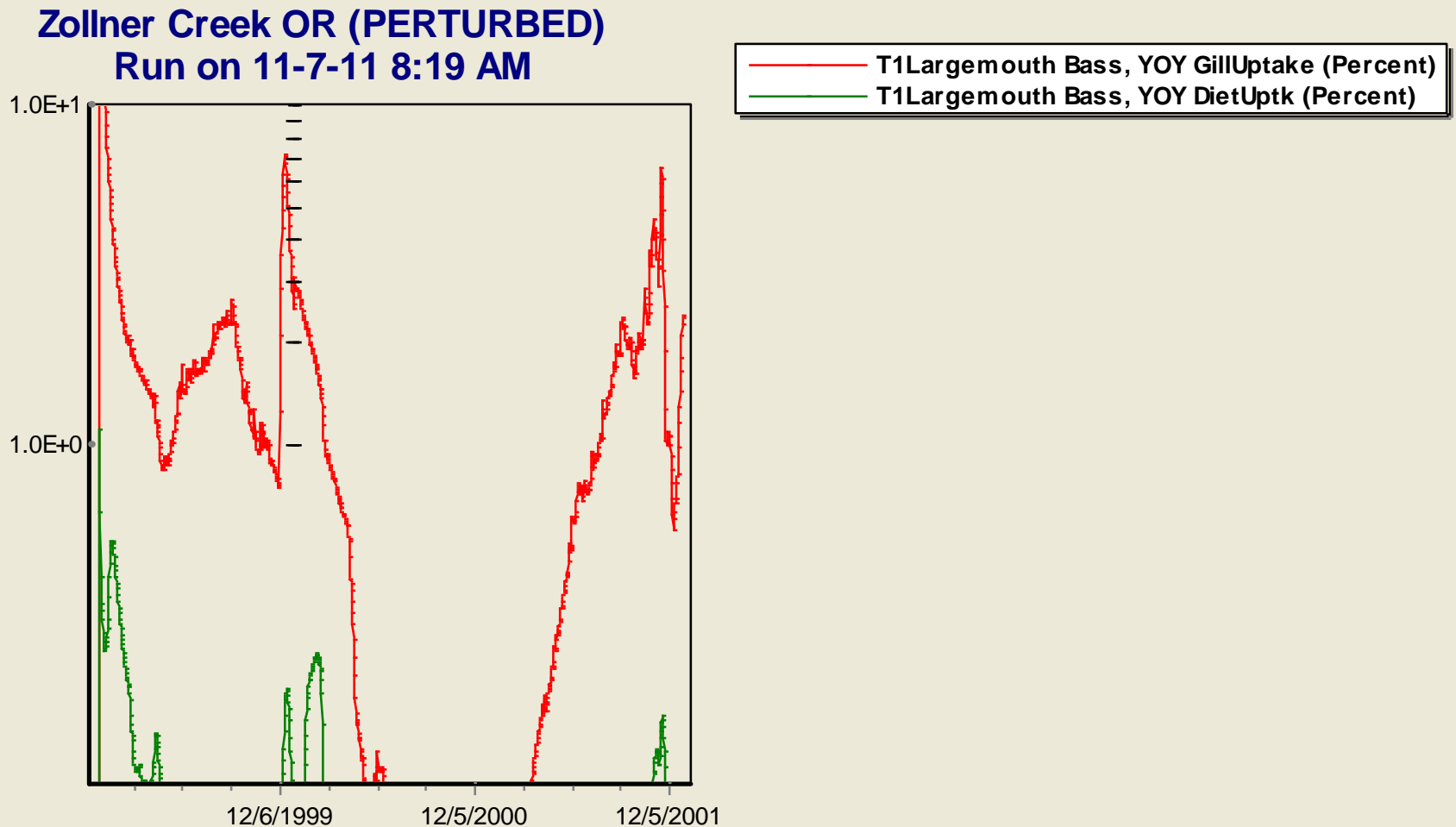
Lipid-normalized Log BAF for chlorpyrifos in fish

Zollner Creek OR (PERTURBED)
Run on 11-7-11 8:19 AM



- BAF Lipid T1Dace (log10BAF lipid)
- BAF Lipid T1Shiner (log10BAF lipid)
- BAF Lipid T1Lamprey, larval (log10BAF lipid)
- BAF Lipid T1Lamprey, adult (log10BAF lipid)
- BAF Lipid T1Largemouth Bass, YOY (log10BAF lipid)
- BAF Lipid T1Mtn. whitefish YOY (log10BAF lipid)
- BAF Lipid T1Chinook Salmon, Juv (log10BAF lipid)
- BAF Lipid T1Largemouth Bass, Lg (log10BAF lipid)
- BAF Lipid T1Mtn. whitefish adult (log10BAF lipid)
- BAF Lipid T1Chinook Salmon (log10BAF lipid)

AQUATOX enables one to “drill down” and determine what accounts for results



Clearance rate is a fn of lipid, weight, and KOW
Clearance calculator.xlsx can be used off-line

Depuration as fn lipid, wt, and KOW							
Dieldrin							
Clearance Rate Calculator							
WetWt	4000 g	(also try 25 g for juvenile)					
LipidFrac	20% g lipid / g wet						
LogKow	5						
Nondissoc	1 fraction						
Clearance Rate Calculator Output							
K2 or Clearance	0.00269						
$LogK2 := -0.536 * LogKOW - Log10(Nondissoc) + 0.116 * POWER(WetWt, RB) / LFrac;$							

Closure?

- You may wish to examine other aspects of the results or even make changes and re-run the model
- However, Lab 7 is a logical continuation