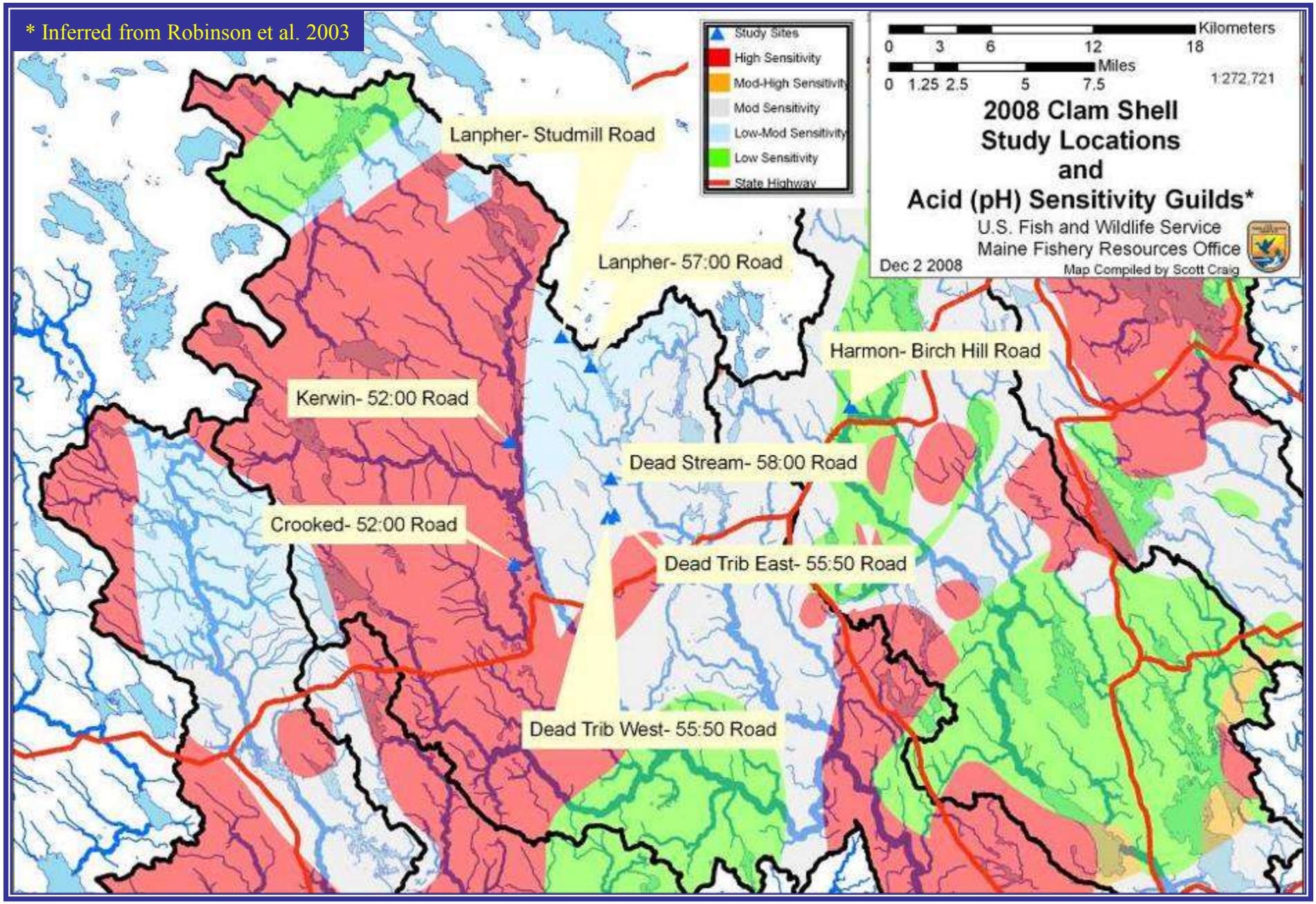
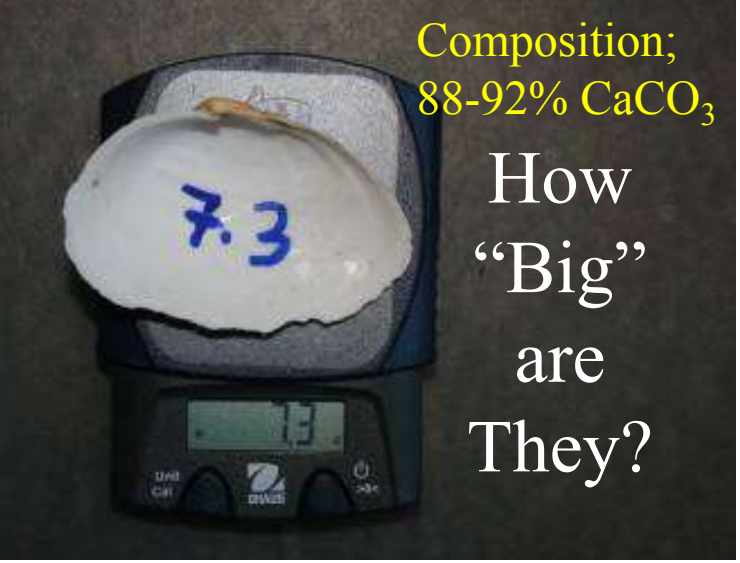
Downeast Maine Rivers

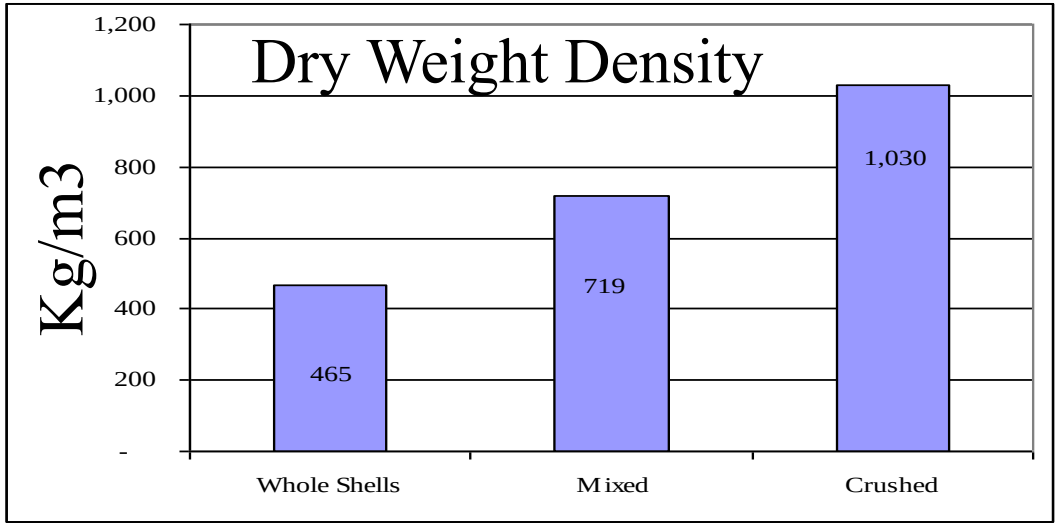
Chronically Low pH and High Organic Aluminum

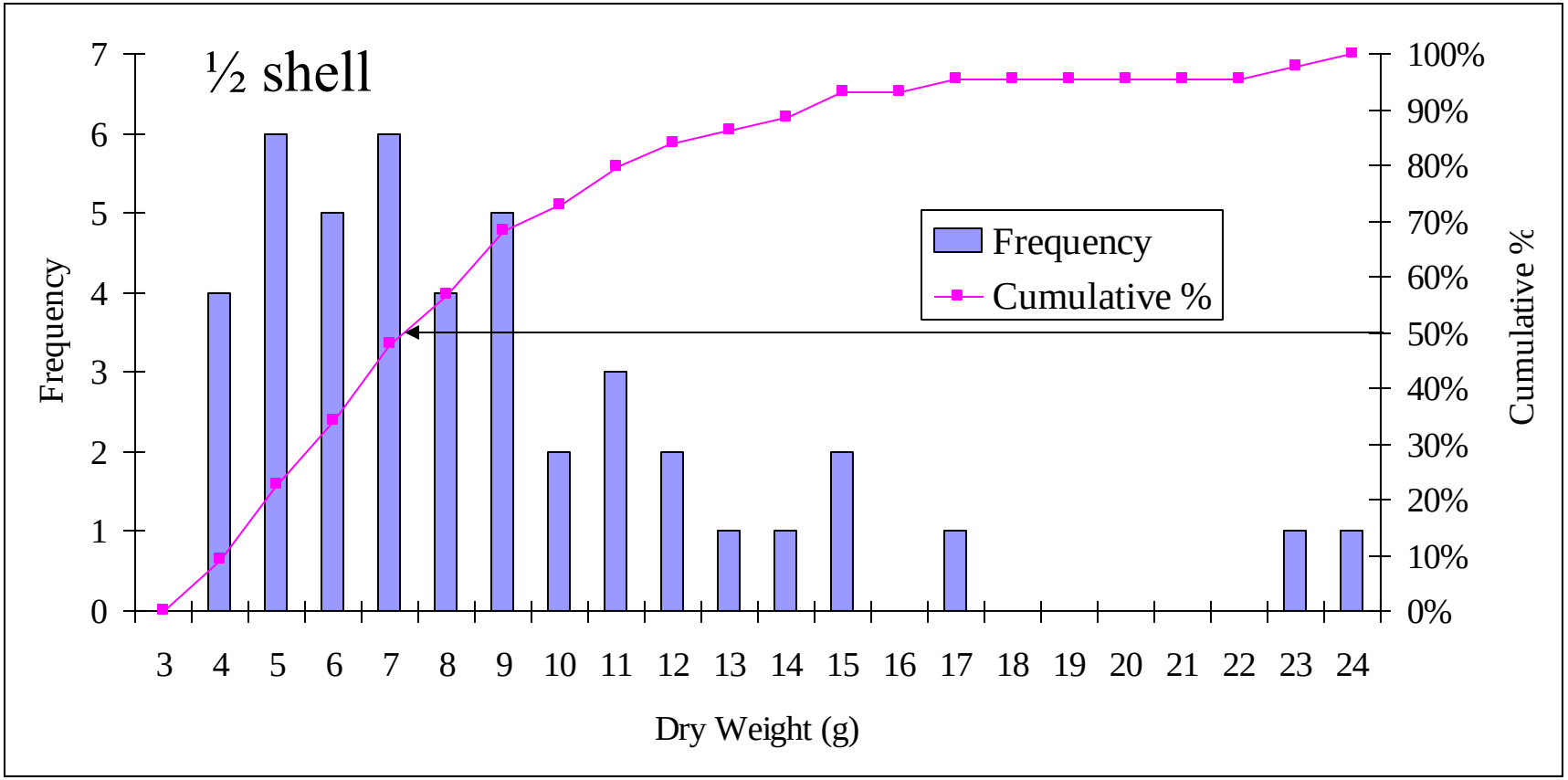
Experimental (Pilot) Clam Shell Addition Project
Assessing shell degradation rates over a range of stream influences

Sample Locations in Machias (7) and East Machias Rivers (1)




Composition;
88-92% $CaCO_3$
How
"Big"
are
They?
7.3

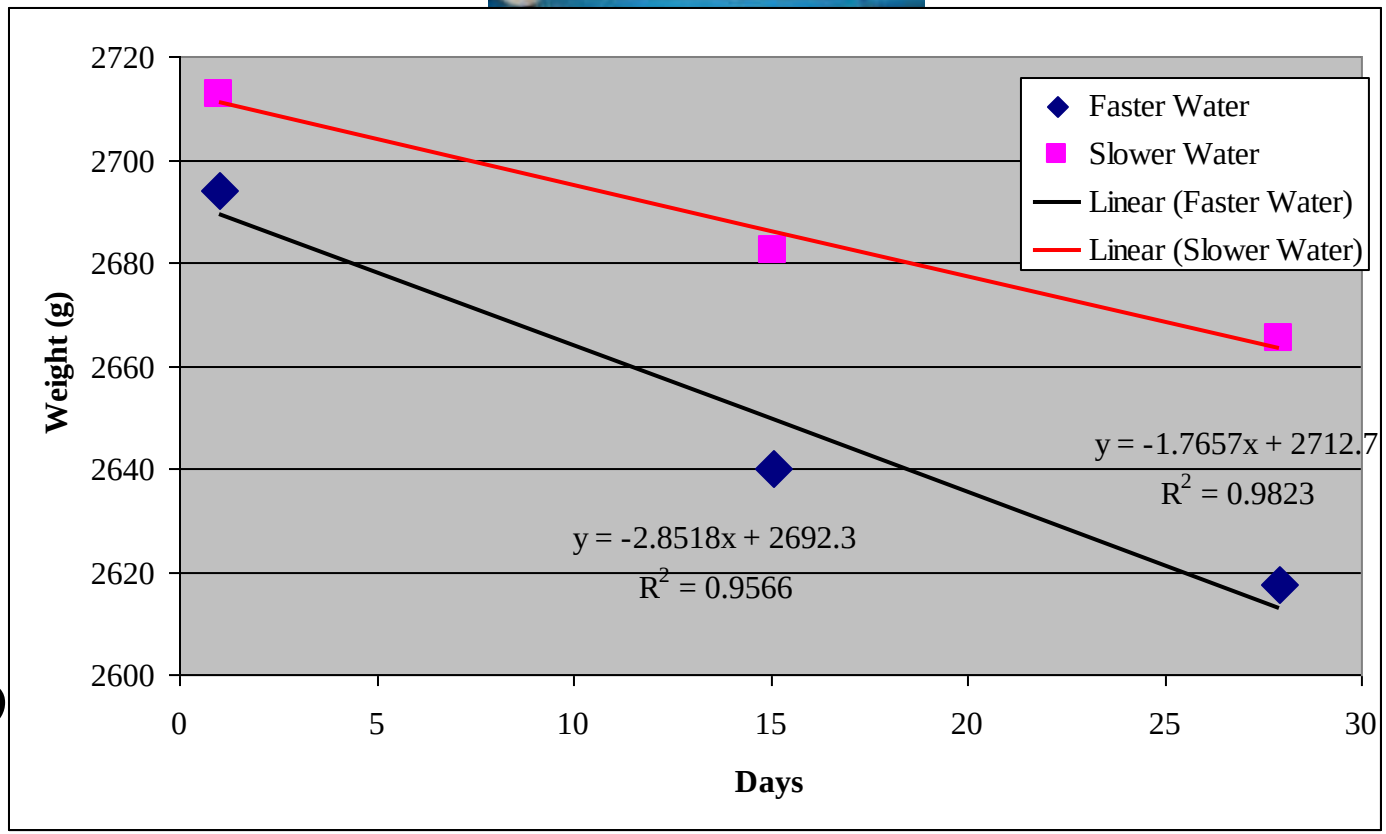

Dry Weight Density
Kg/m3
1,200
1,000
800
600
400
200
-
465
719
1,030
Whole Shells
Mixed
Crushed


½ shell
Frequency
Cumulative %
Frequency
Cumulative %
0
1
2
3
4
5
6
7
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dry Weight (g)

Ongoing Flow-through *In Vitro* experiment at CBNFH

Complete Dissolution: 2.6 to 4.2 years

Note- 28 day experiment With COLD water!



Feb 2009

In Situ Methods

- Placed 5 (5 kg) bags of clam shells per stream
- Duration Sept 2nd through November 21st (80 days)
- Sampled weekly through Oct 21st

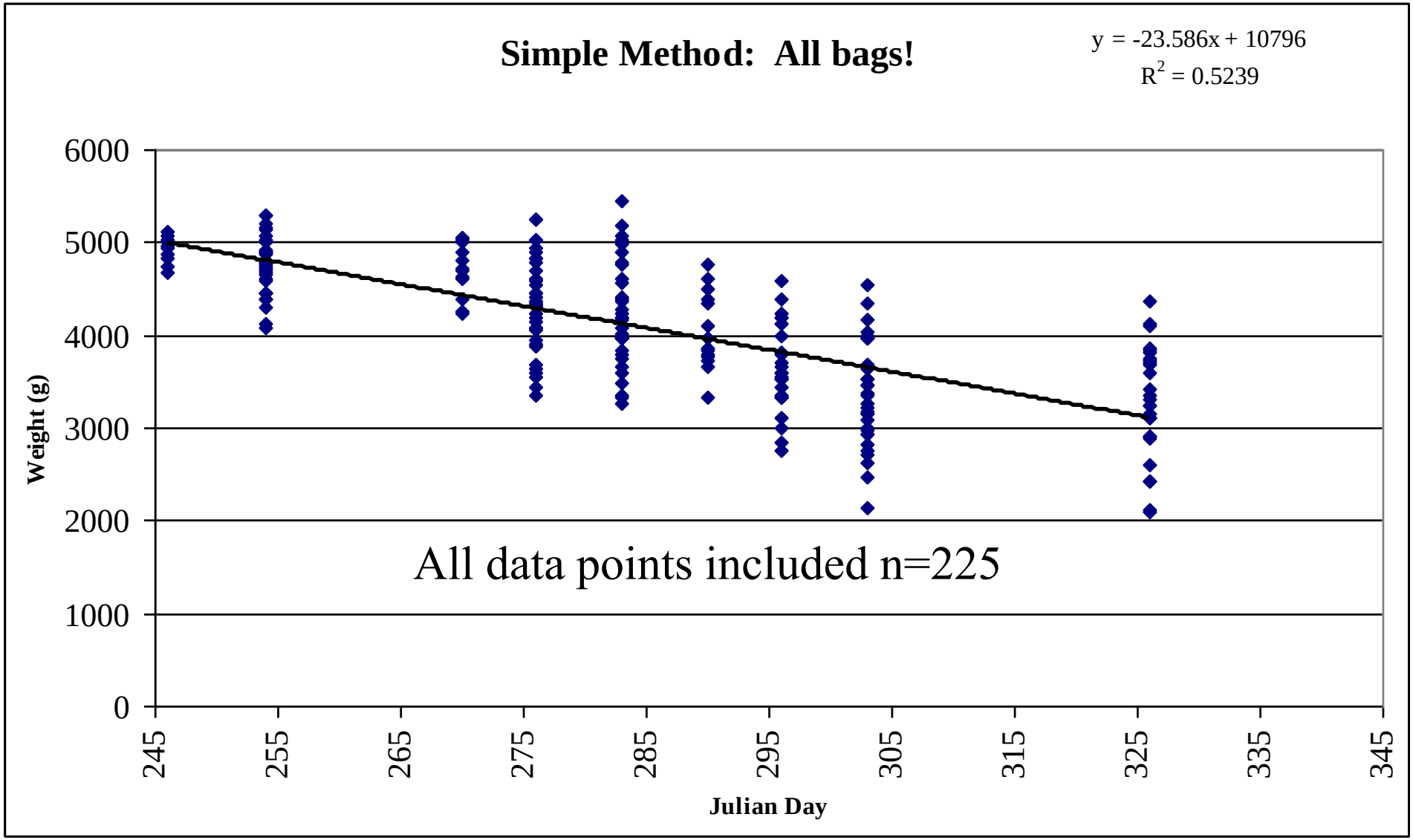
Recorded

-Visual Shell Loss
-Insect Colonization (very few observed)
-pH
-Water Temp
-Water Velocity

Tossed out erroneous data for interaction analysis….

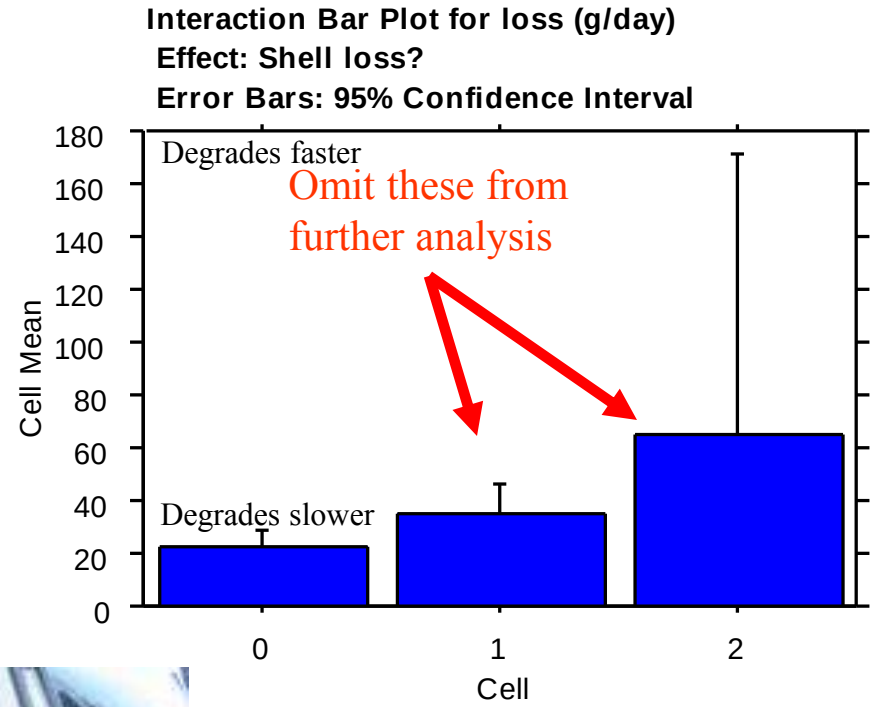
Simple & Easy Method

When y=0 x=456 458-246=212 days or 0.58 years



Means Table for loss (g/day)
Effect: Shell loss?

	Count	Mean	Std. Dev.	Std. Err.
0	194	22.241	48.208	3.461
1	100	34.521	58.691	5.869
2	2	65.000	11.785	8.333



Visual Shell Loss:

Nominal Variables:

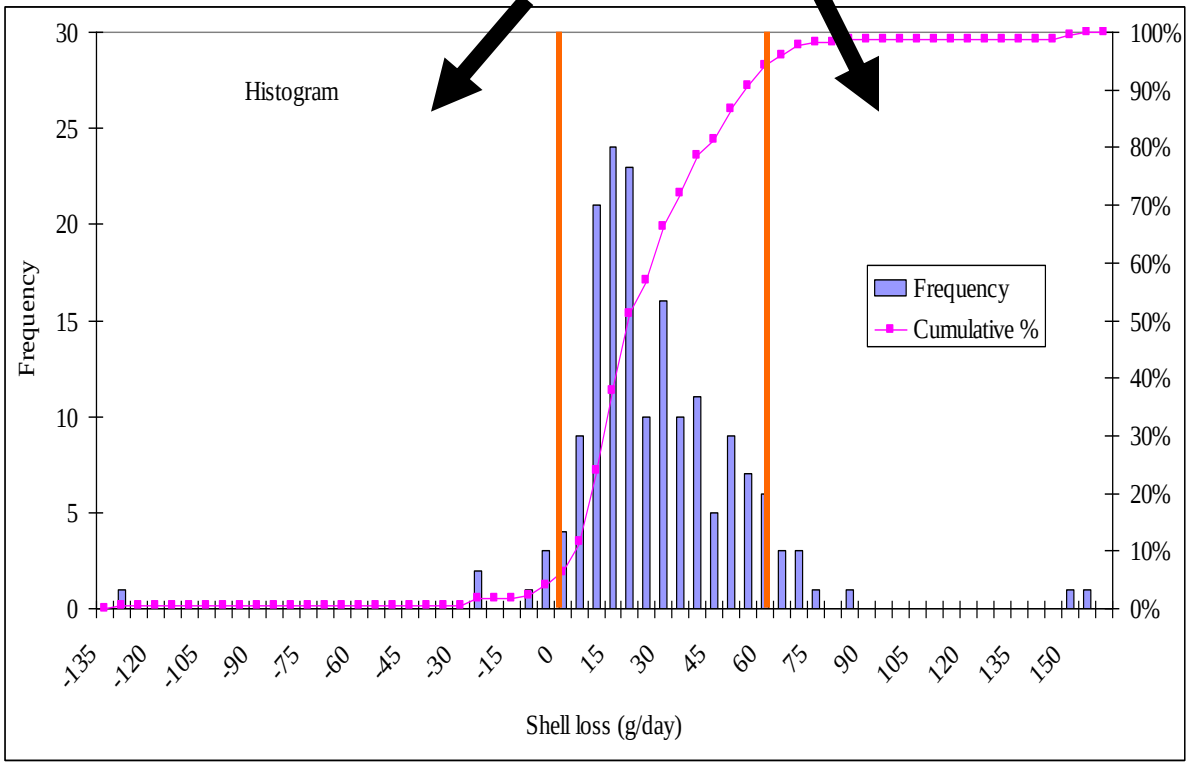
0 No visible loss
1 Small particle loss
2 Medium particle loss
3 Large particle loss

After removing all data where shell loss was observed

and

Omitted
5% on each end

Assessed Degradation With 3 Independent Nominal Variables

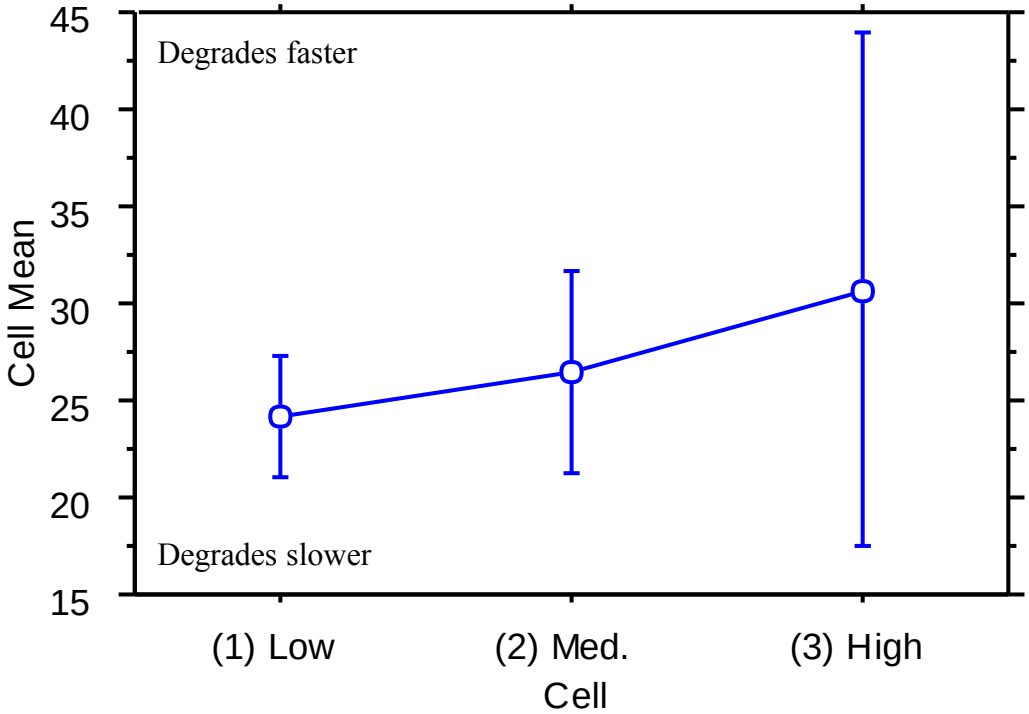


Stream Velocity pH Time-Temperature

Means Table for loss (g/day)
Effect: Flow Nominal

	Count	Mean	Std. Dev.	Std. Err.
(1) Low	96	24.111	15.194	1.551
(2) Med.	47	26.435	17.643	2.574
(3) High	11	30.717	19.727	5.948

Interaction Line Plot for loss (g/day)
Effect: Flow Nominal
Error Bars: 95% Confidence Interval



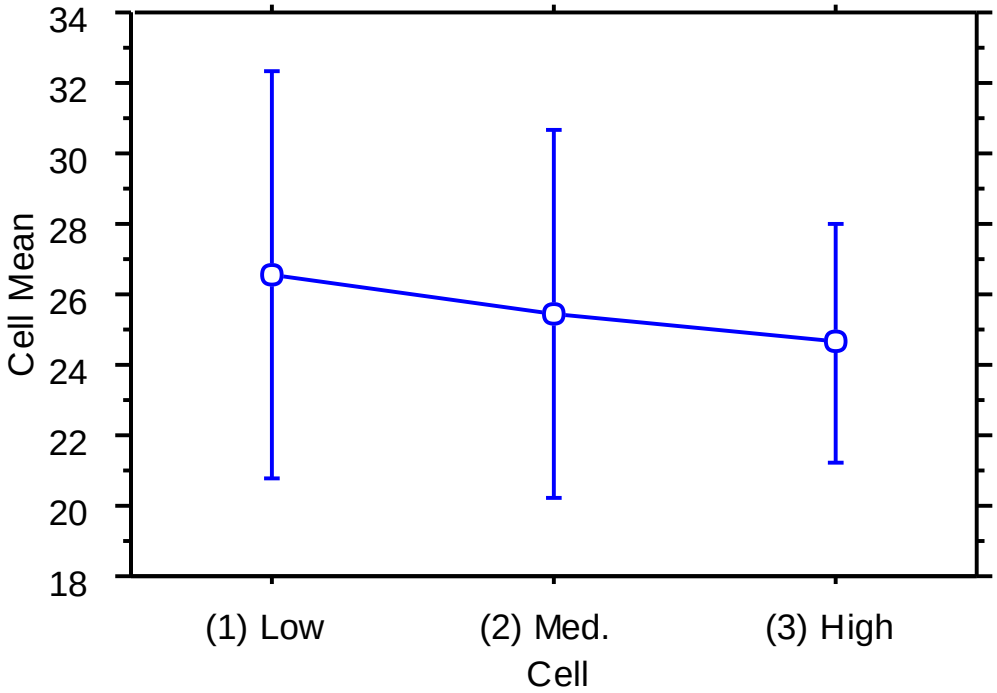
Flow (Velocity)
Nominal Variables:

Low 0 - <0.2 m/s
Med. 0.2 – 0.5 m/s
High >0.5 m/s

Means Table for loss (g/day)
Effect: pH Nominal

	Count	Mean	Std. Dev.	Std. Err.
(1) Low	31	26.523	15.762	2.831
(2) Med.	55	25.433	19.215	2.591
(3) High	68	24.617	14.031	1.701

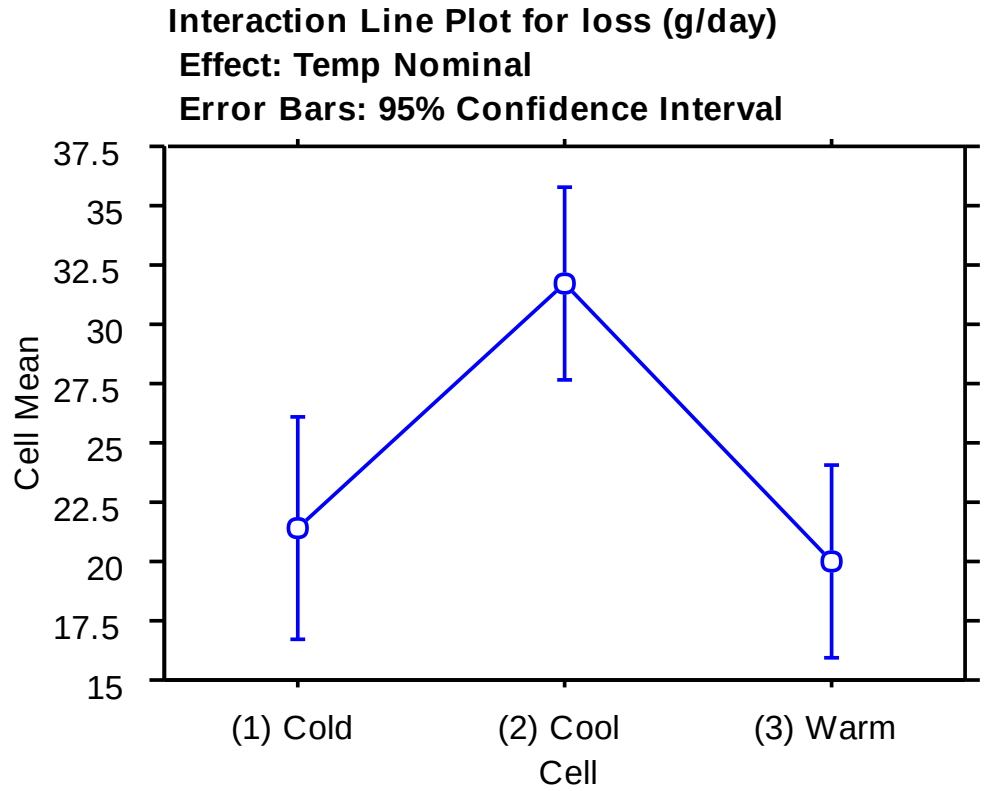
Interaction Line Plot for loss (g/day)
Effect: pH Nominal
Error Bars: 95% Confidence Interval



pH
Nominal Variables:
1) Low <4.8
2) Med. 4.8 - 6
3) High >6

Means Table for loss (g/day)
Effect: Temp Nominal

	Count	Mean	Std. Dev.	Std. Err.
(1) Cold	48	21.363	16.166	2.333
(2) Cool	64	31.704	16.335	2.042
(3) Warm	42	20.012	13.088	2.019



Date-Water Temp.
Nominal Variables:

Cold >22 Oct
Cool 2 Oct – 16 Oct
Warm < Sept 26

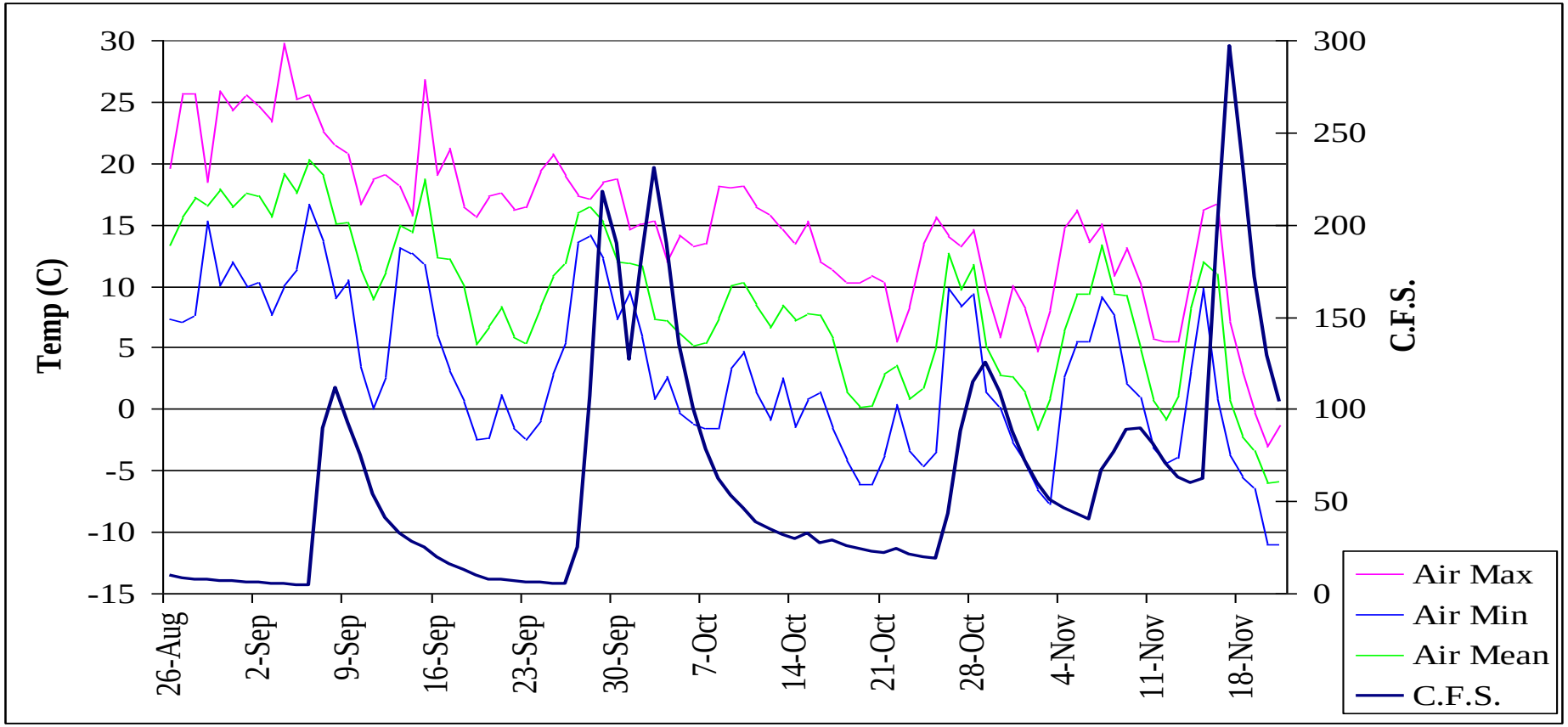
How could this be?

Date-Water Temp. Nominal Variables: & Discharge

Warm: < Sept 26

Cool: 2 Oct – 16 Oct

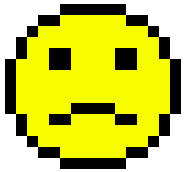
Cold: >22 Oct



Summary:

Degradation ~22 g/day (0.5%/day)

193-206 days to "Disappear"

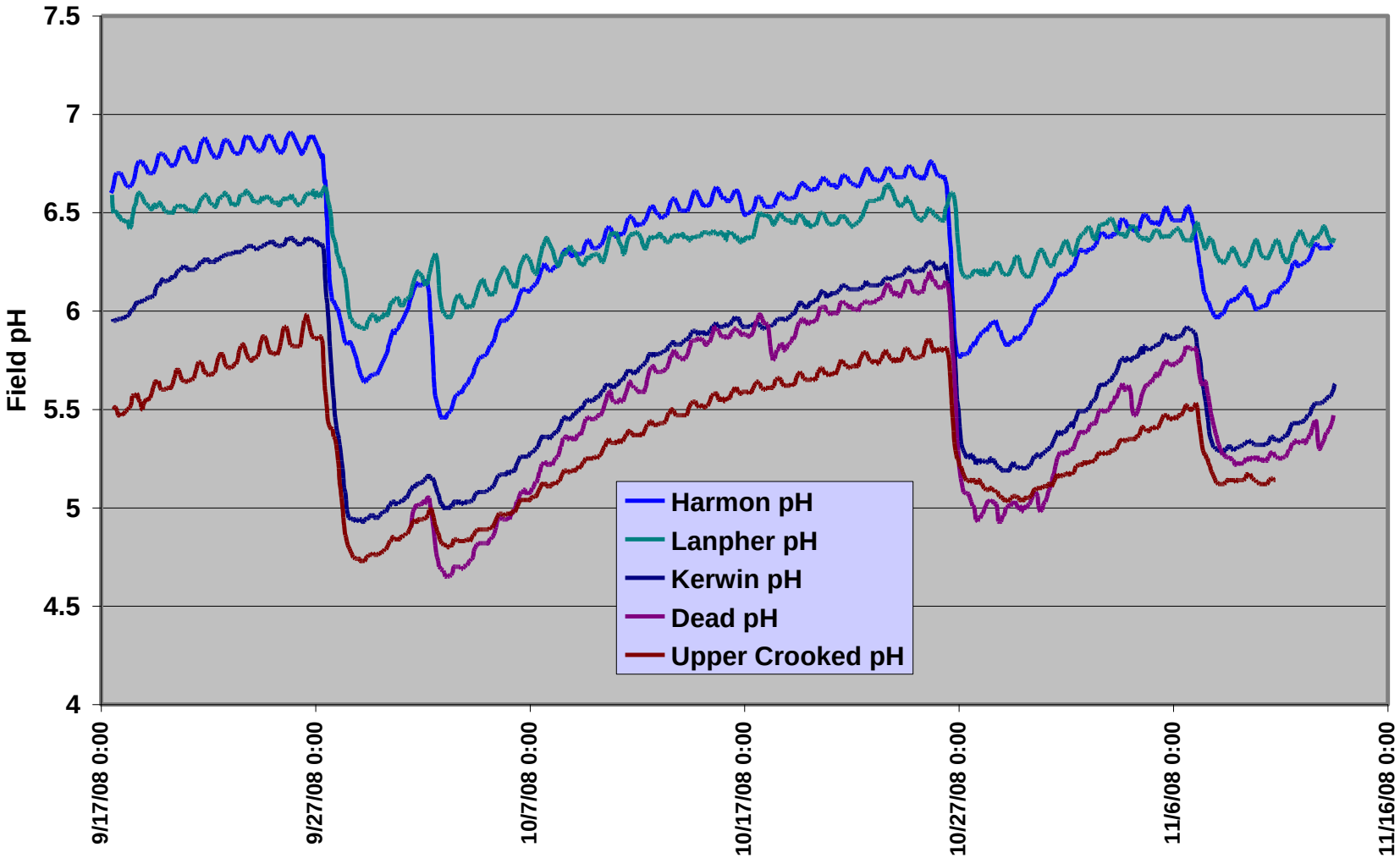


Although not statistically significant

Flow & pH

may effect degradation rates

Maine DEP Sonde “pH” Data



Data courtesy Mark Whiting