

# Multiple Stressors in Saginaw Bay: Navigating the Issues

## Workshop 2



Ann Arbor, Michigan  
NOAA Great Lakes Environmental Research Laboratory  
*April 9, 2009*

Craig Stow

Introduction, Synopsis of Some 08 Activities

# AIF Resource Professionals and Managers Workshop – Bay City, MI April 2, 2008



## Workshop Objectives:

- Provide update on 2008 accomplishments
  - Share proposed activities resulting from Workshop 1
  - Obtain feedback, input from on proposed activities for 2009
  - Discuss how findings will be used by decision-makers
- 
- Introduce you to our Acting Director
  - Introduce you to some Special Guests
  - Introduce you to our new building

# Welcome to Our New Building!



# Workshop Agenda

10:00 am Welcome and Introductions: Project overview and update - C. Stow

10:20 am Welcome from NOAA Headquarters – R. Magnien

10:30 am Economic metrics for assessing the impacts of water quality - F. Lupi

10:45 am Update on MDNR fish studies in Saginaw Bay - D. Fielder

11:00 am Impacts of multiple stressors on fisheries production in Saginaw Bay- T. Hook

11:15 am Fish population surveys and lower trophic level sampling - S. Pothoven

11:30 am Panel Discussion: Fish sampling and experimentation

12:00 pm *Lunch*

1:00 pm Plans for monitoring and experimentation to assess water quality - J. Bressie

1:15 pm Factors impacting benthic algal growth and muck production - S. Peacor

1:30 pm Update on DEQ water quality studies in Saginaw Bay - B. Walker

1:45 pm Role of dreissenids and sediment nutrient flux in P availability - D. Kashian

2:00 pm Deployment of buoys and sensors for water quality monitoring - N. Hawley

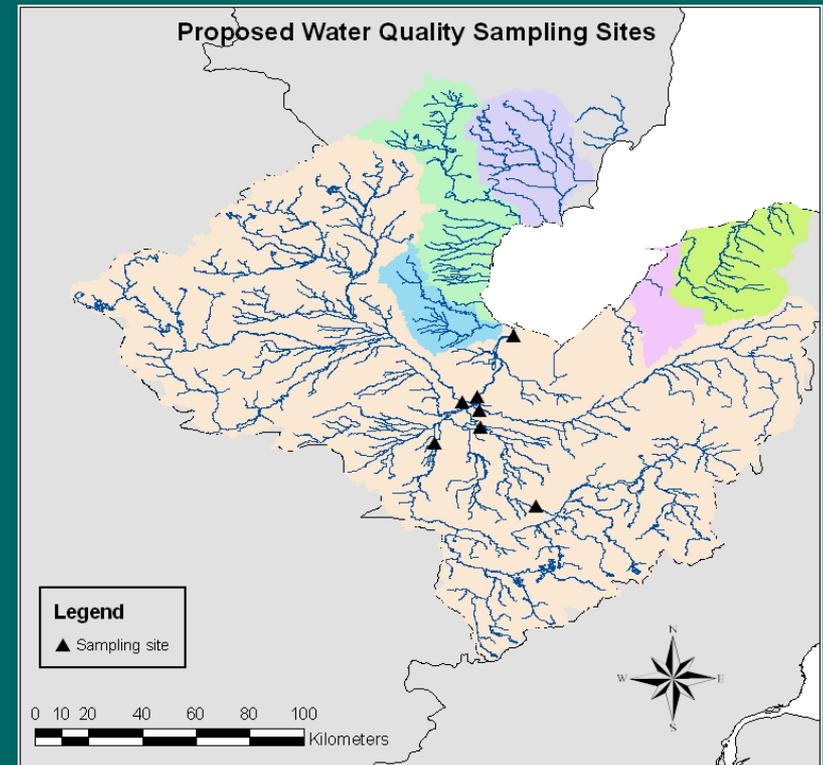
2:15 pm Panel Discussion: Water quality sampling and experimentation

3:00 pm Concluding remarks – C. Stow

# 2008 Watershed Sampling Activities

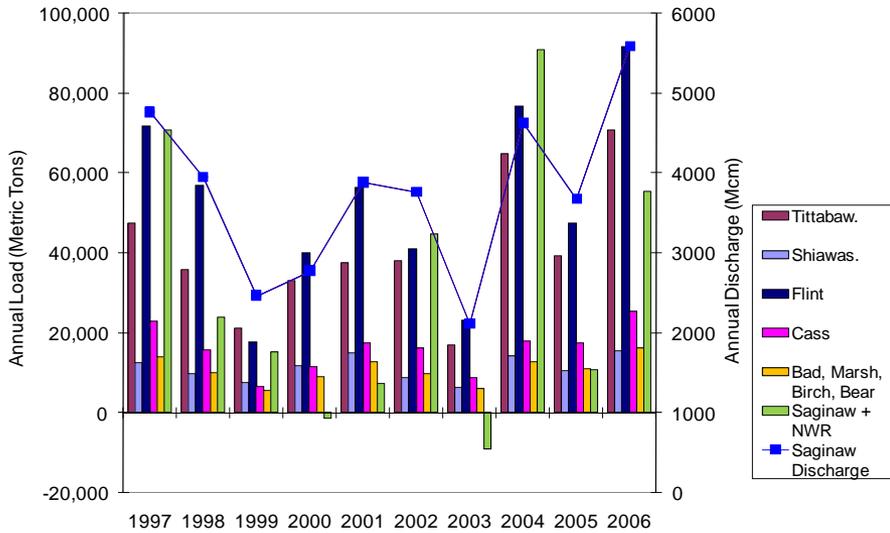
Tom Johengen

- Two main stem Saginaw River sites sampled 33 times Jan – Dec 2008.
- The 4 main Tributaries sampled 8 times.
- Longitudinal transects sampled 3 times.

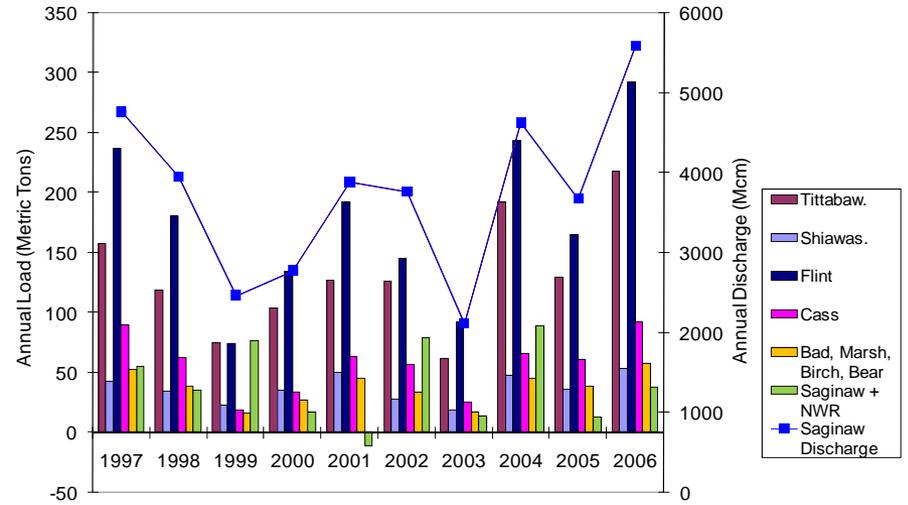


- Samples have been analyzed - in the process of estimating loads

Saginaw River Tributaries' Annual TSS Load Estimates (Q(t), Q(t-1), Q(t-1,...,t-10))

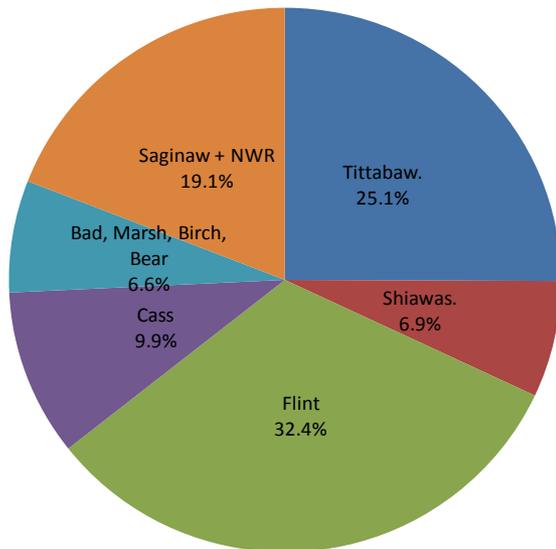


Saginaw River Tributaries' Annual TP Load Estimates (Q(t), Q(t-1), Q(t-1,...,t-10))

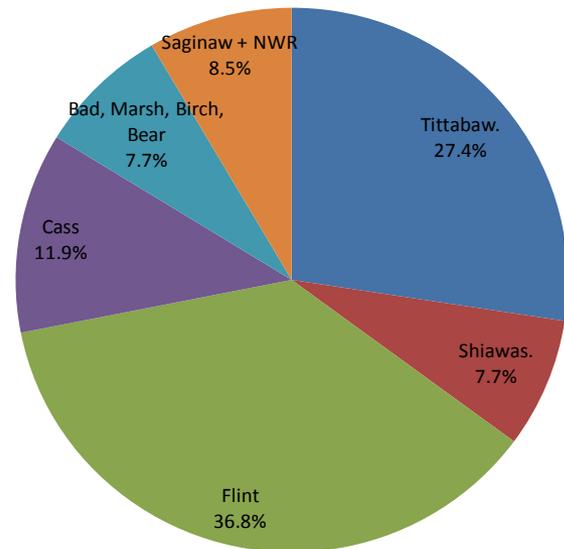


## Estimates by Carlo DeMarchi

Estimated Contributions to the 1997-2006 Saginaw River TSS Load  
(161,380 Metric Tons/Year)



Estimated Contributions to the 1997-2006 Saginaw River TP Load  
(477 Metric Tons/Year)



# Watershed Sampling Activities Planned for 2009

Continue to analyze multiple load estimation approaches

Need to generate estimates of Loads from Unmonitored Tributaries

- account for about 15% of load
- conduct bi-weekly sampling of 3-4 of the unmonitored tribs Apr - Aug
- supplement with for historical conc data from DEQ reports
- use DLBRM for flow estimates, or USGS model estimates?

Complete 2-3 storm-sampling events

- sample at 4-6 hr frequency over 2-3 day period
- try to capture rise and fall of hydrograph

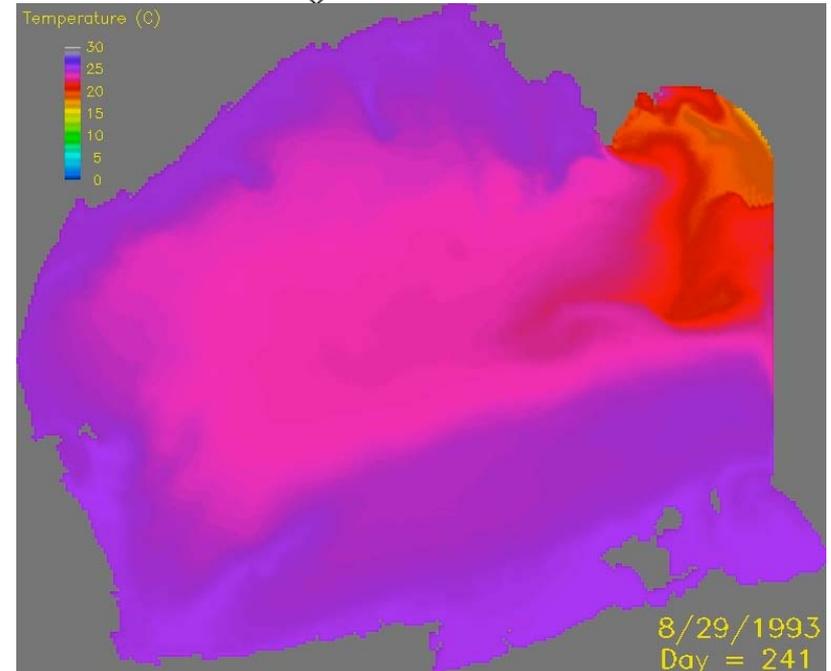
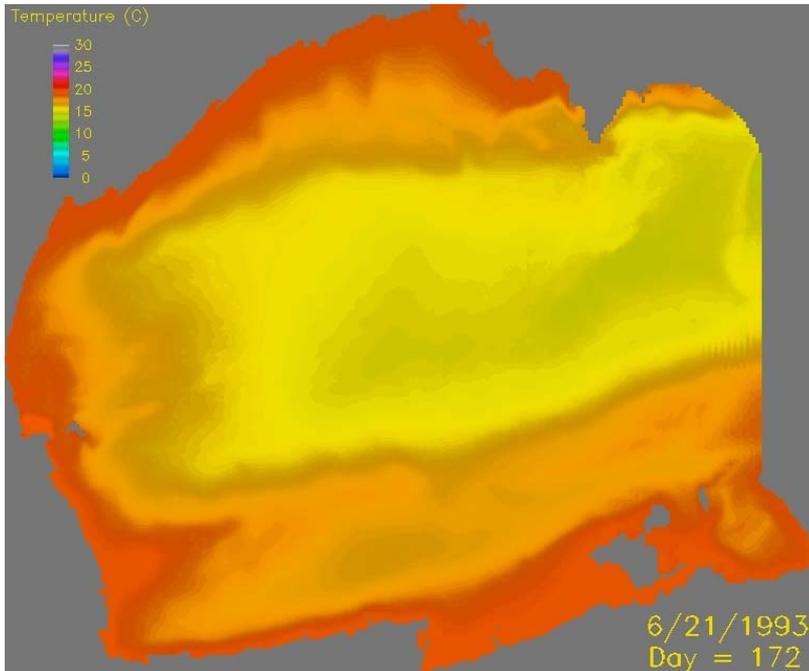
# Lake Huron-Inner Saginaw Bay Nested Grid Model

Summer currents (from the 2 km grid) →



Prepared by Dima Beletsky

Summer surface temperatures (from the 200 m grid)



Mean ( $X \pm SE$ ) annual density (no. per m<sup>2</sup>) of *Dreissena* at sites in inner and outer Saginaw Bay in 1991-1996 and 2008. Samples collected in the fall of each year by divers using SCUBA.

Station	Year						
	1991	1992	1993	1994	1995	1996	2008
Inner Bay							
5	28,244 $\pm$ 2,457	75,296 $\pm$ 29,280	237 $\pm$ 48	2,959 $\pm$ 422	1,018 $\pm$ 348	3,067 $\pm$ 431	832 $\pm$ 148
6	4,453 $\pm$ 1,387	3,620 $\pm$ 2,444	3,557 $\pm$ 1,616	10,724 $\pm$ 4,862	2,291 $\pm$ 774	61 $\pm$ 23	1,063 $\pm$ 163
13	---	8,956 $\pm$ 6,720	376 $\pm$ 60	855 $\pm$ 449	211 $\pm$ 79	150 $\pm$ 71	133 $\pm$ 7
14	209 $\pm$ 115	63,242 $\pm$ 18,999	7,506 $\pm$ 3,459	3,900 $\pm$ 880	2,564 $\pm$ 425	5,426 $\pm$ 809	395 $\pm$ 67
15	43,117 $\pm$ 1,050	5,556 $\pm$ 2,492	7,341 $\pm$ 2,828	9,725 $\pm$ 2,336	6,728 $\pm$ 742	17,600 $\pm$ 186	267 $\pm$ 92
16	27 $\pm$ 27	46,360 $\pm$ 7,780	4,831 $\pm$ 1,768	1,727 $\pm$ 614	60 $\pm$ 19	6,981 $\pm$ 947	---
Mean	15,210 $\pm$ 8,718	33,838 $\pm$ 13,003	3,975 $\pm$ 1,312	4,982 $\pm$ 1,716	2,145 $\pm$ 1,009	5,548 $\pm$ 2,663	538 $\pm$ 103
Outer Bay							
19	2,480 $\pm$ 1,219	57,640 $\pm$ 19,985	3,328 $\pm$ 900	21,669 $\pm$ 7,773	17,776 $\pm$ 1,912	19,349 $\pm$ 2,116	---
27	3,408 $\pm$ 2,772	4,695 $\pm$ 2,542	5,813 $\pm$ 2,384	9,925 $\pm$ 1,590	3,824 $\pm$ 525	6,981 $\pm$ 1,670	596 $\pm$ 54
Mean	2,944 $\pm$ 464	31,168 $\pm$ 26,473	4,570 $\pm$ 1,243	15,797 $\pm$ 5,872	10,800 $\pm$ 6,976	13,165 $\pm$ 6,184	

2008 69% Quagga (shallow morph)

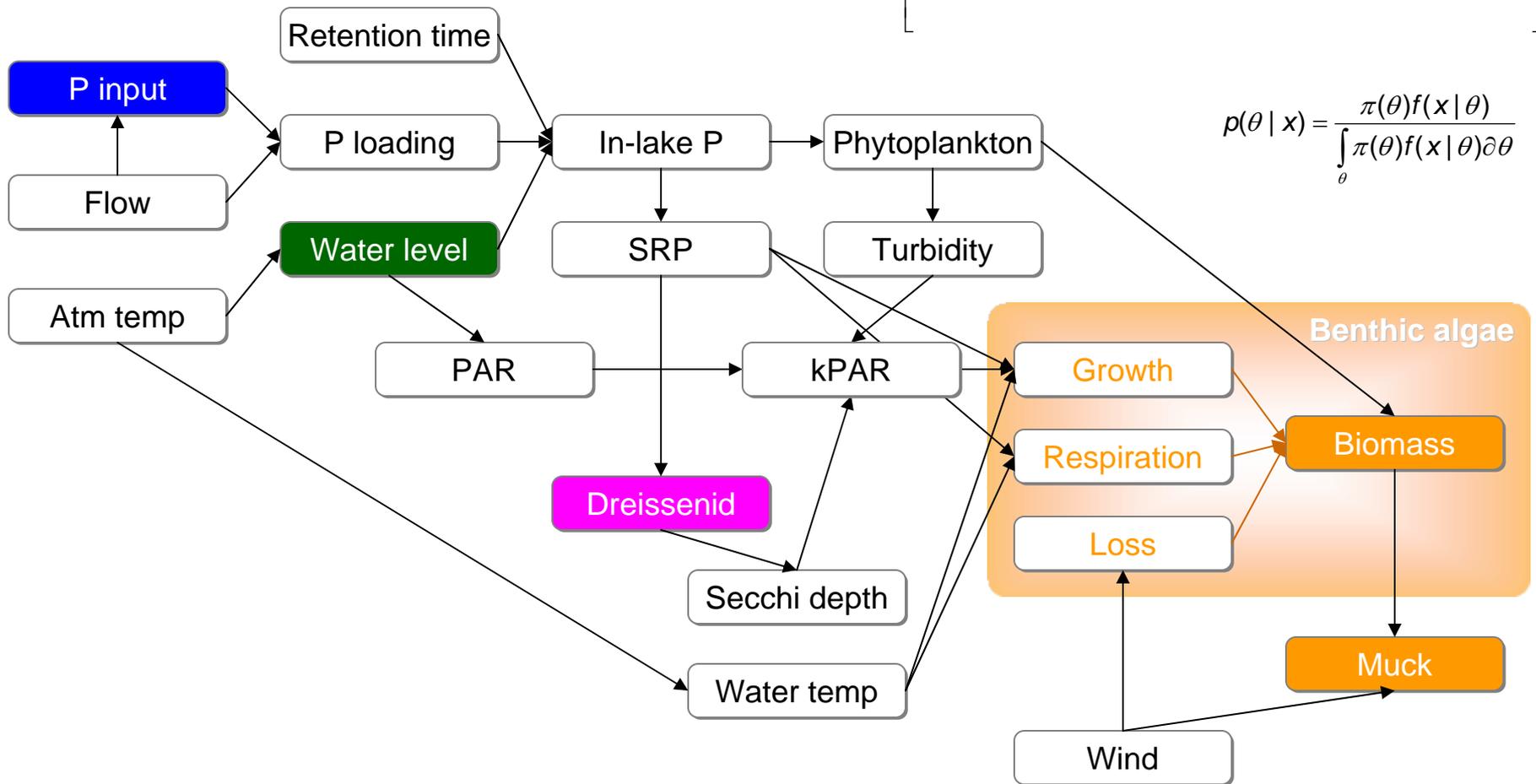
Data provided by Tom Nalepa

# Mathematical Modeling

$$\hat{\beta} = X'X^{-1}X'Y$$

$$\prod_{g=1}^{29} \prod_{h=1}^{137} \frac{1}{\sqrt{2\pi\sigma^2}} \exp \left[ \frac{\left( DO_{gh} - DO_s + \frac{k_1 \times F \times BOD_u}{k_2 - k_1} \left( e^{-k_1 \frac{x_{gh}}{v}} - e^{-k_2 \frac{x_{gh}}{v}} \right) + D_i e^{-k_2 \frac{x_{gh}}{v}} \right)^2}{-2\sigma^2} \right]$$

$$p(\theta | x) = \frac{\pi(\theta)f(x|\theta)}{\int_{\theta} \pi(\theta)f(x|\theta)d\theta}$$



International Joint Commission  
Re-eutrophication Workshop

February 17-18, 2009

Windsor, Ontario

Current problem around the Great Lakes

A particular THANK YOU to Donna Kashian



Questions?