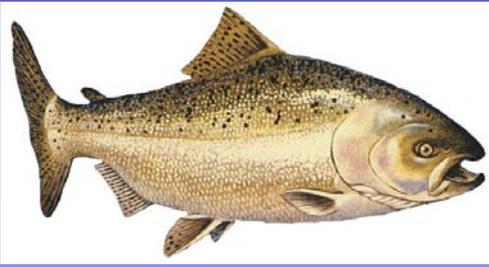


Environmental Windows in the Great Lakes: Progress Toward a Balance Between Dredging Needs and Resource Protection



Dr. Douglas Clarke
US Army Engineer Research and Development
Center, Vicksburg, MS

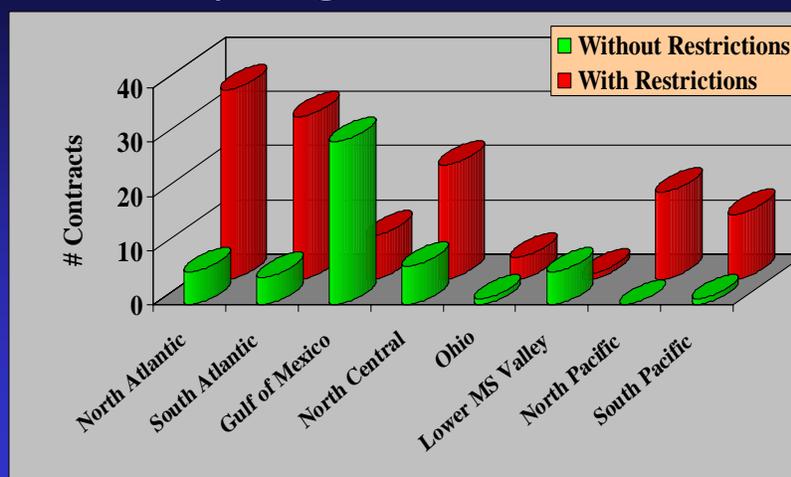
Environmental Windows

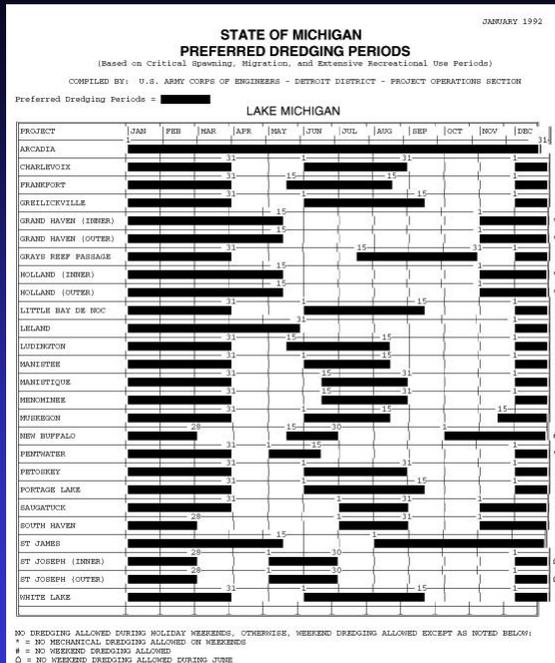
- **Are based on the *Precautionary Principle***
- **Greatly complicate the conduct of dredging**
 - both in terms of coordination and contracting
- **Can inflate the cost of dredging**
- **Have no performance standards**
- **Are a management practice of first rather than last resort**
- **Can only be resolved by**
 - science-based decisions
 - substantial investments in research and training of regulatory personnel

Chronology of Windows

- **First appeared after passage of NEPA in 1969**
- **By 1980 > 80% of all Federal navigation projects complied with at least one window**
- **By 1996 > 90% of Federal projects were restricted, a majority by multiple windows**
- **The %age of restricted projects continues rising to this day in response to new emphasis on environmentally driven mandates, such as the ESA and EFH**

Frequency of Windows by Region (1987-96)





LAKE MICHIGAN WINDOWS

Detroit District

The Problem

Concerns Not Prioritized

| Life History Stage | Suspended Sediments | Turbidity | Entrainment |
|--------------------|---------------------|-----------|-------------|
| Eggs | Moderate | NA | High |
| Larvae | High | Low | Low |
| Juveniles | Moderate | High | Moderate |
| Adults | Low | Moderate | NA |

NRC Recommendations to Improve the Process

Take a Regional Approach

- **Form regional study team**
- **Prioritize technical issues**
- **Identify data gaps**
- **Select appropriate dredging project(s)**
- **Make commitments**
- **Collaborate to plan and execute study**
- **Share and publish results**

Great Lakes Dredging Team

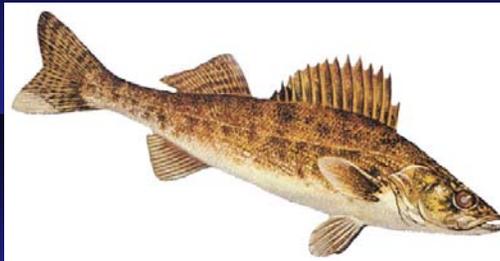
- **Windows Advisory Team**
 - **Great Lakes Commission**
 - **NY, OH, PA, IN, MI, WI, MN
Resource Agencies**
 - **Buffalo, Detroit and Chicago
Districts**
 - **Engineer R&D Center**
 - **EPA, USFWS, NOAA**

Major Technical Issues

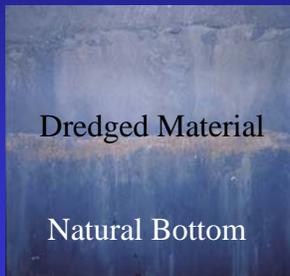
- ★ **Dredging effects on walleye, pike, and bass spawning**
 1. Sedimentation
 2. Developmental effects
- ★ **Dredging effects on salmon and trout**
 1. Spring downstream migrants, including hatchery releases
 2. Fall upstream migrants

Determining Effects on Walleye Spawning Habitat

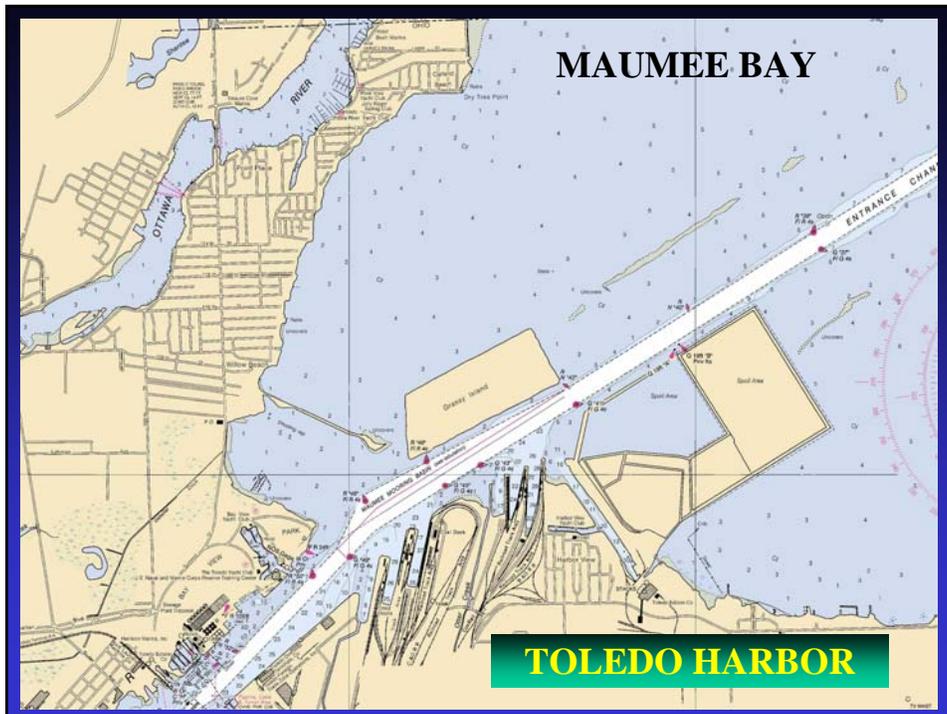
- **Degree of Exposure**
 - Sedimentation
 - Plume Characterization
- **Tolerance**
 - **Threshold of detrimental effects**



Research Task: *Sedimentation Effects*



- **Persistent concerns**
- **Detection in the field exceedingly difficult at appropriate scales (i.e. mm, hours)**
- **No standardized lab protocols analogous to suspended sediment exposures exist**
- **Investigate suitable technologies**
- **Develop testing procedures for tolerance determinations**

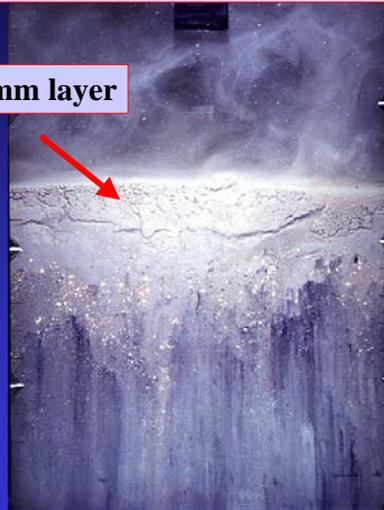


Effects of Sedimentation on Spawning Habitat



Measuring sediment deposition with Sediment Profiling Camera

2 mm layer

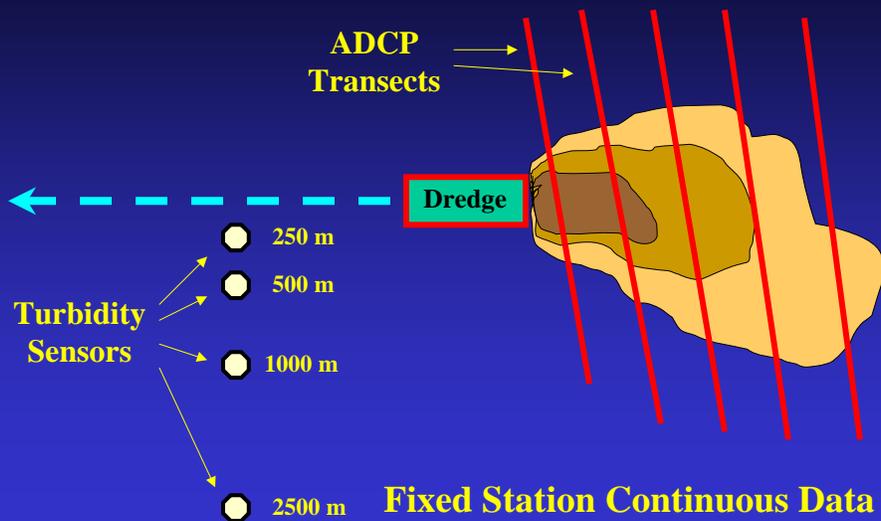


Plume Characterization

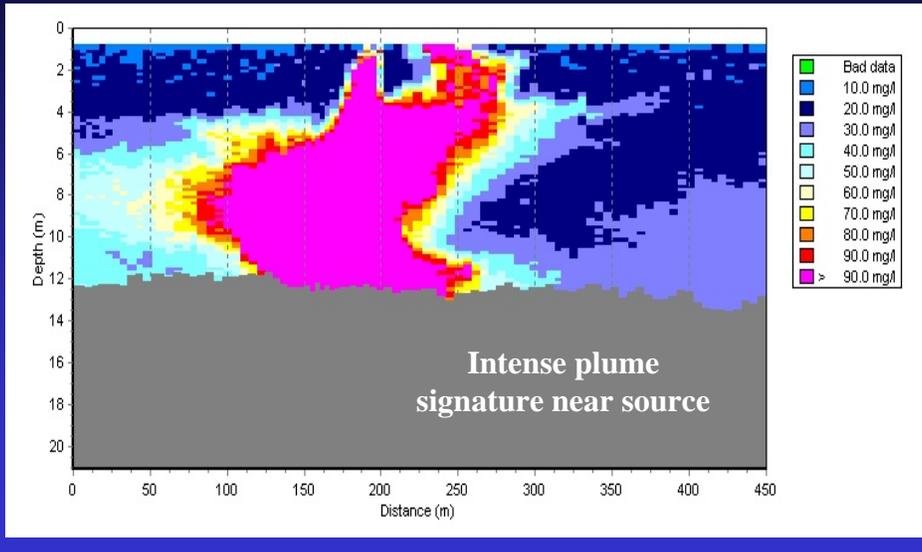
- **Acoustic technologies**
 - ADCP backscatter
 - Sediview backscatter to concentration conversion
- **Optical Backscatter Sensors**
 - Continuous data record

Field Studies

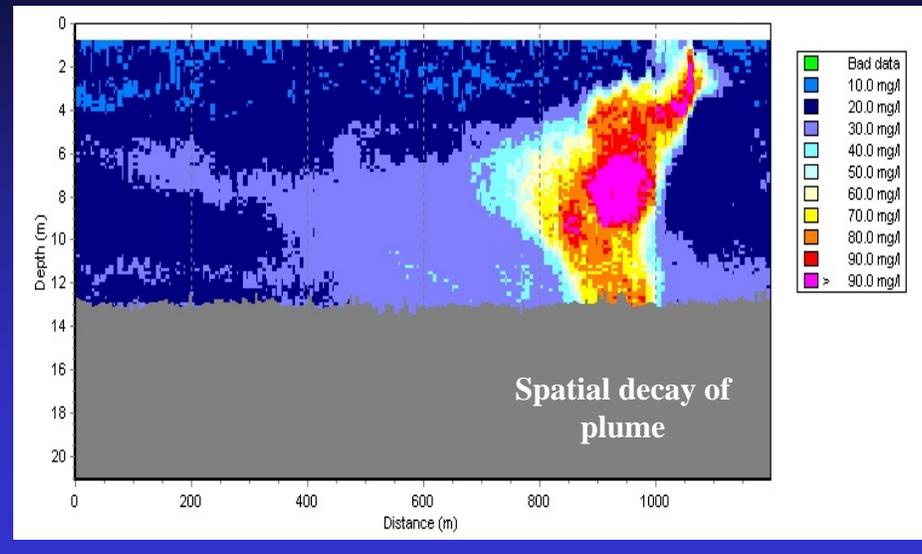
Wide Area Plume Characterizations



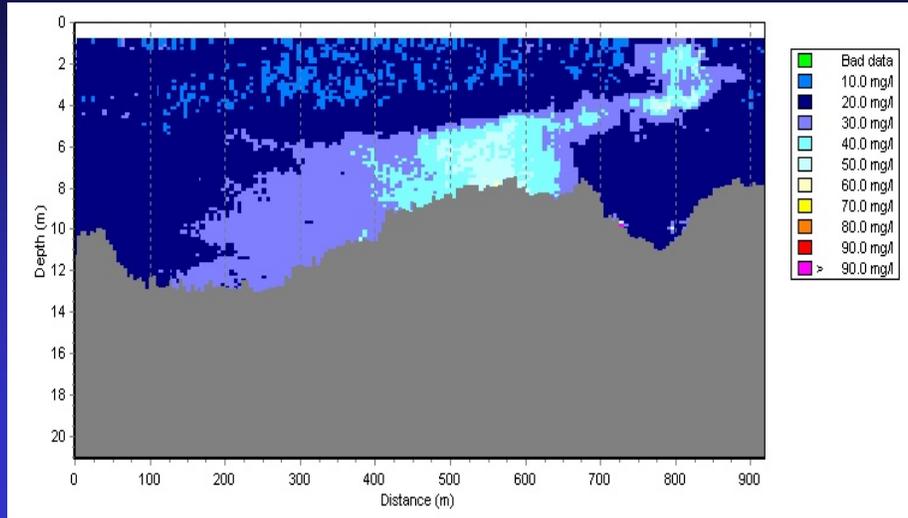
EXAMPLE ADCP PLUME TRANSECT (35 Meters from Bucket Dredge in Chesapeake Bay)



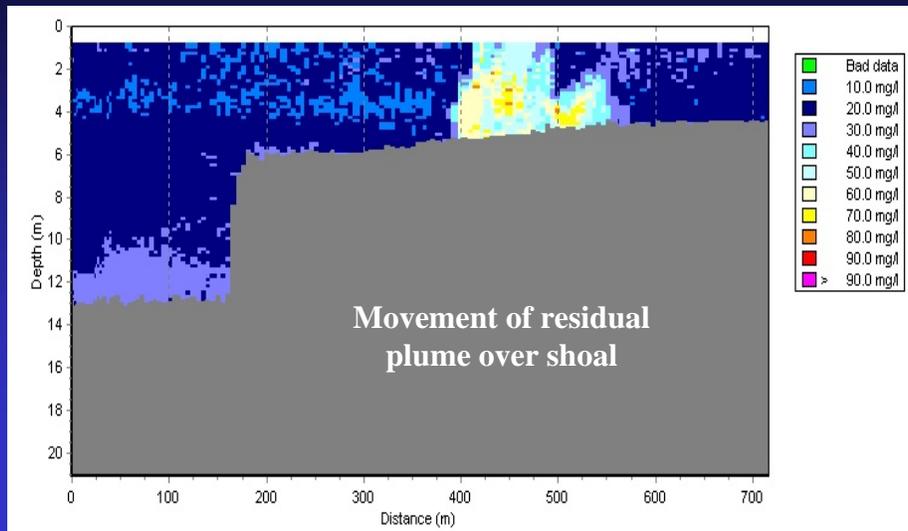
EXAMPLE ADCP PLUME TRANSECT (96 Meters from Bucket Dredge in Chesapeake Bay)



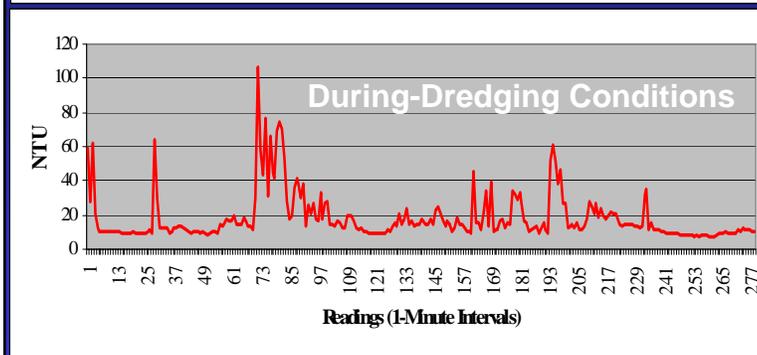
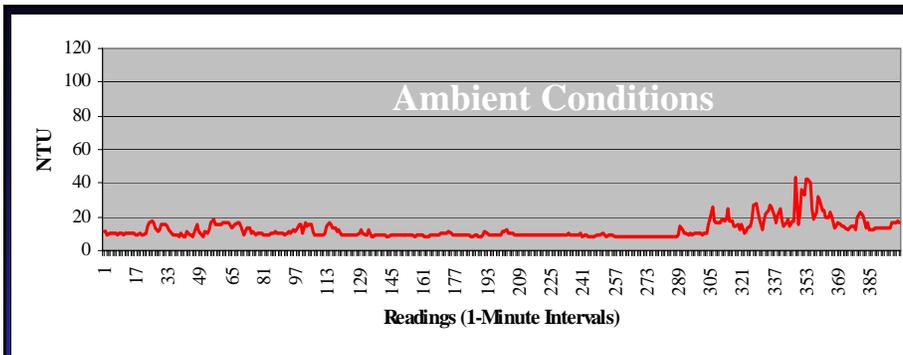
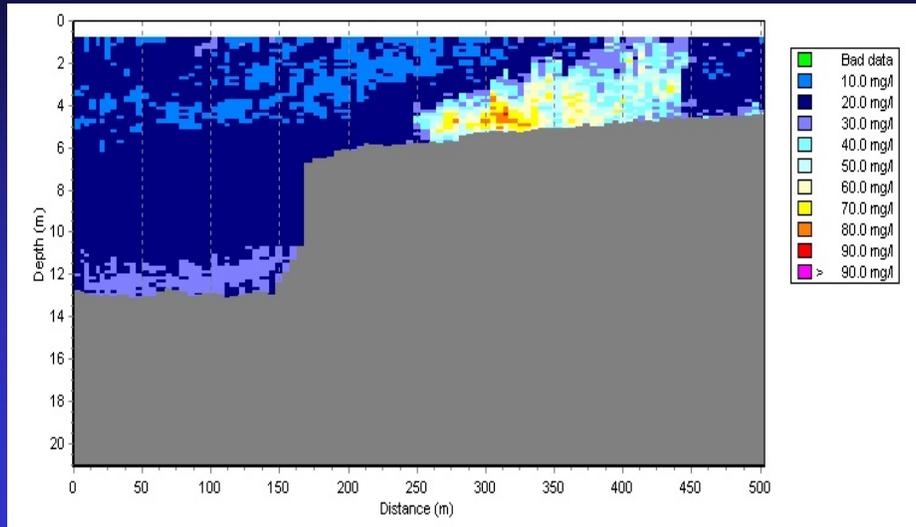
EXAMPLE ADCP PLUME TRANSECT (157 Meters from Bucket Dredge in Chesapeake Bay)



EXAMPLE ADCP PLUME TRANSECT (217 Meters from Bucket Dredge in Chesapeake Bay)



EXAMPLE ADCP PLUME TRANSECT (278 Meters from Bucket Dredge in Chesapeake Bay)

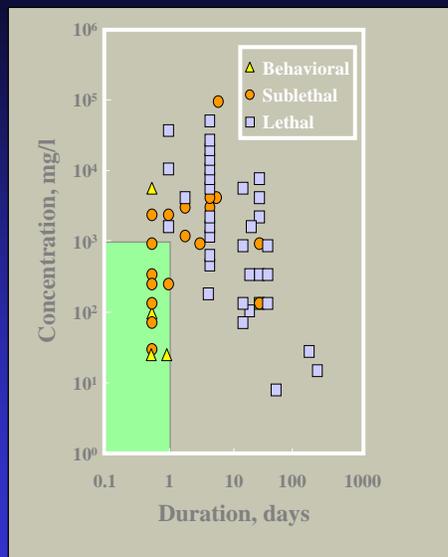


**OBS
TIME
SERIES
DATA**

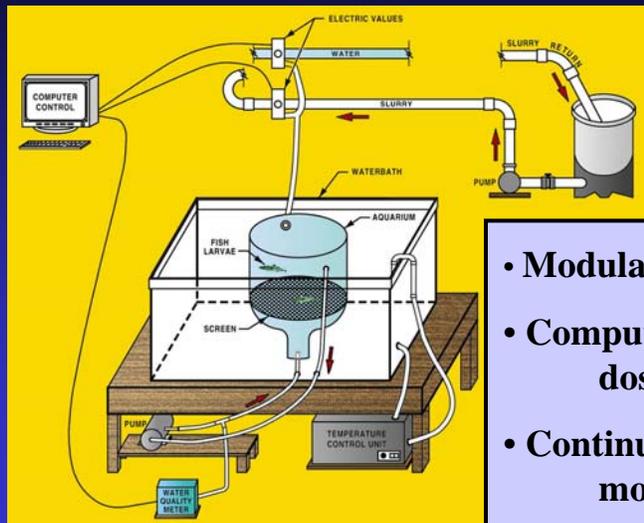
If dispersion to spawning habitat occurs:

- **Plume characterization results could be used to design appropriate experimental exposures of walleye eggs and larvae**
- **Experimental approaches could determine threshold effect levels**
- **Plume characterization results could then be used to determine effective protection measures, e.g., spatial “buffer” zones to avoid exceeding thresholds**

Juvenile Salmonids

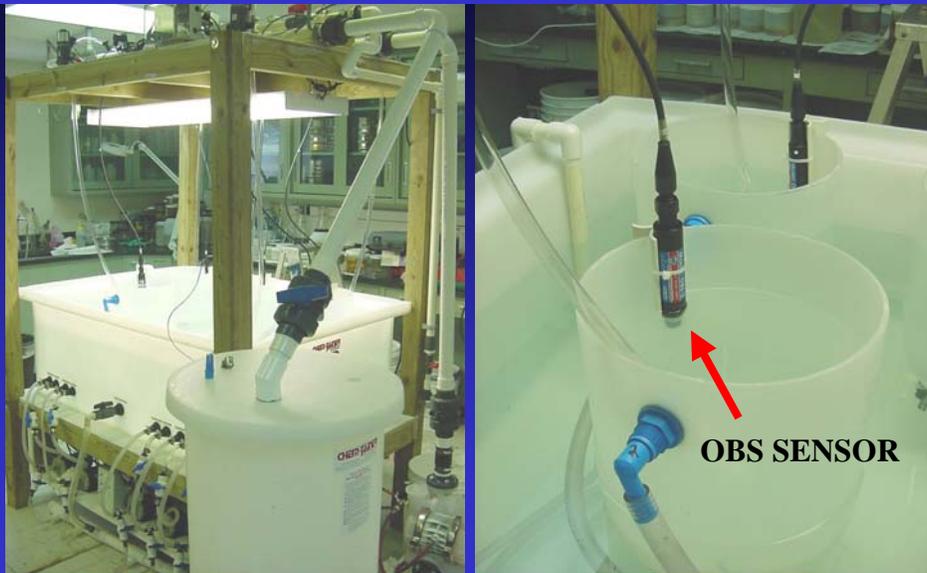


Suspended/Deposited Sediment Exposure System



- Modular
- Computer controlled dose
- Continuous WQ monitoring

SUSPENDED/DEPOSITED SEDIMENT EXPOSURE SYSTEM



Determining Effects on Salmon and Trout

- **Migratory Blockage**
 - **Plume Characterization**
 - **Underwater Sound**
 - **Water Quality**



Research Task: *Salmon Protection*



- **Few definitive studies conducted on navigation dredging effects except for entrainment concerns**
- **Migration impairment remains a major concern**
- **Actual probabilities of species-specific exposures and thresholds of effects need to be determined**
- **Sublethal effects of exposure difficult to ascertain and evaluate**

Monitoring Plume-Fish Interactions

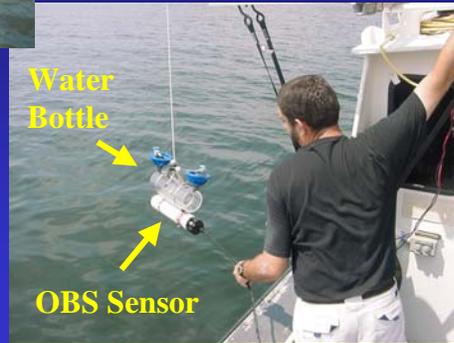


ADCP Transducer
(RDI Workhorse Series)

Fisheries Hydroacoustics
Transducer



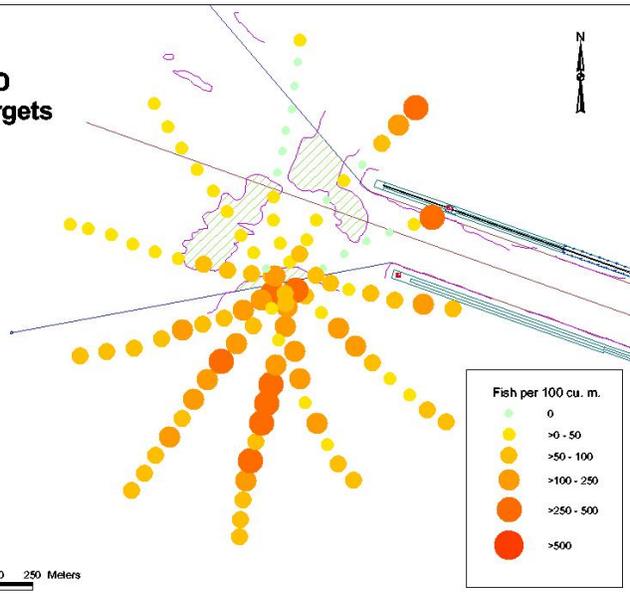
GPS
Unit

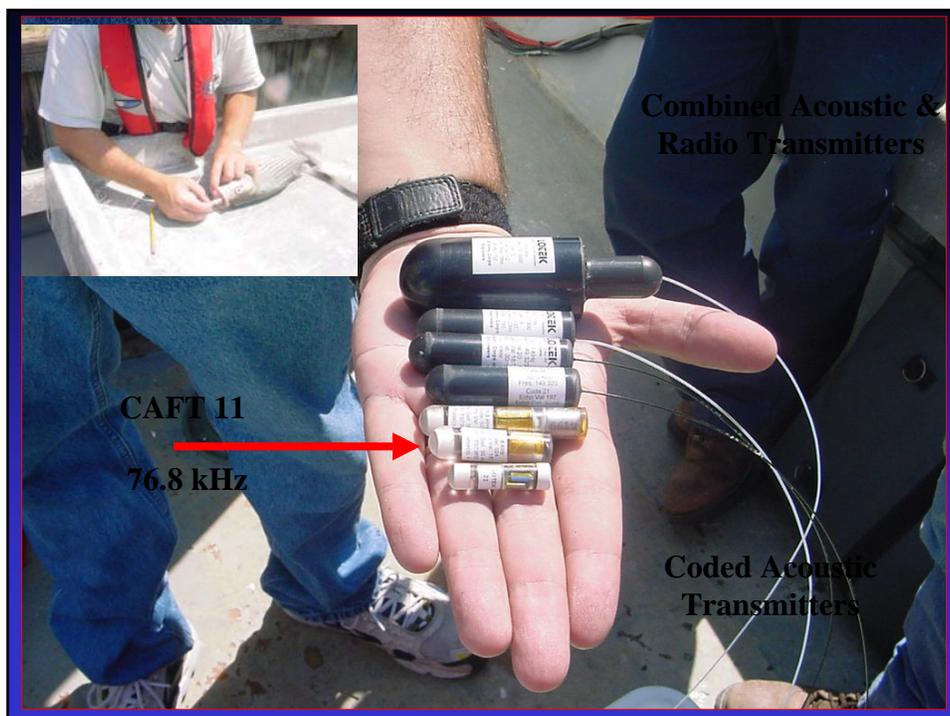
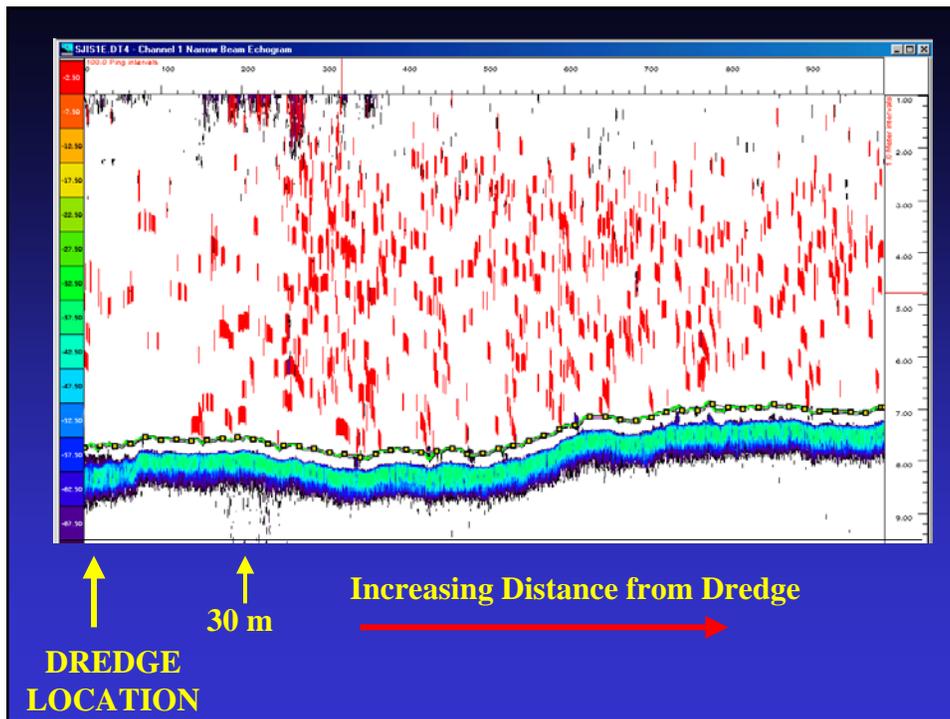


Water
Bottle

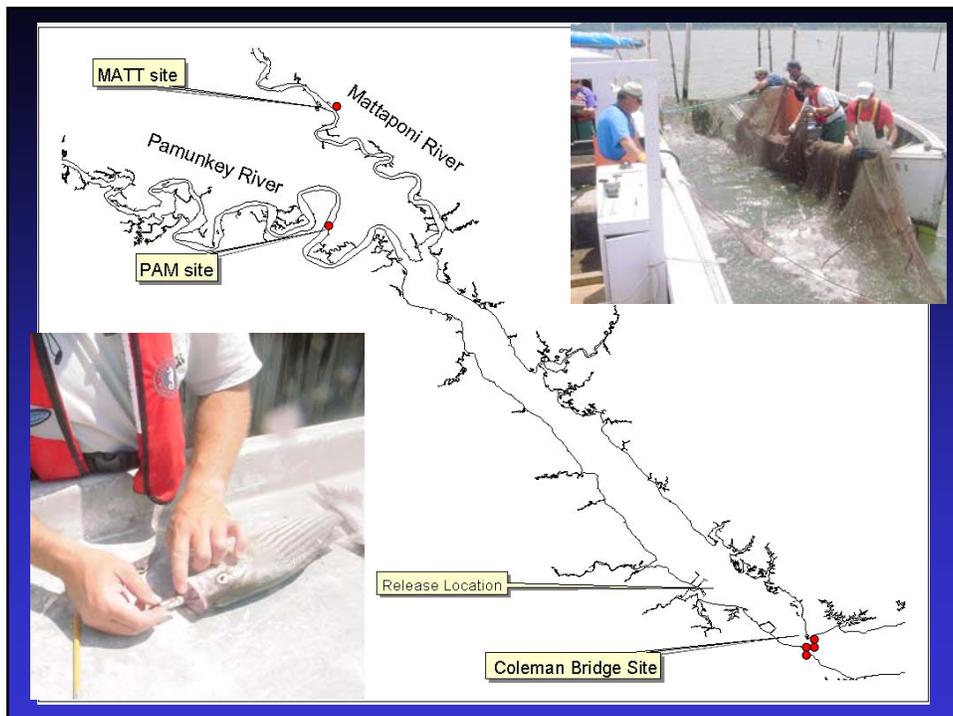
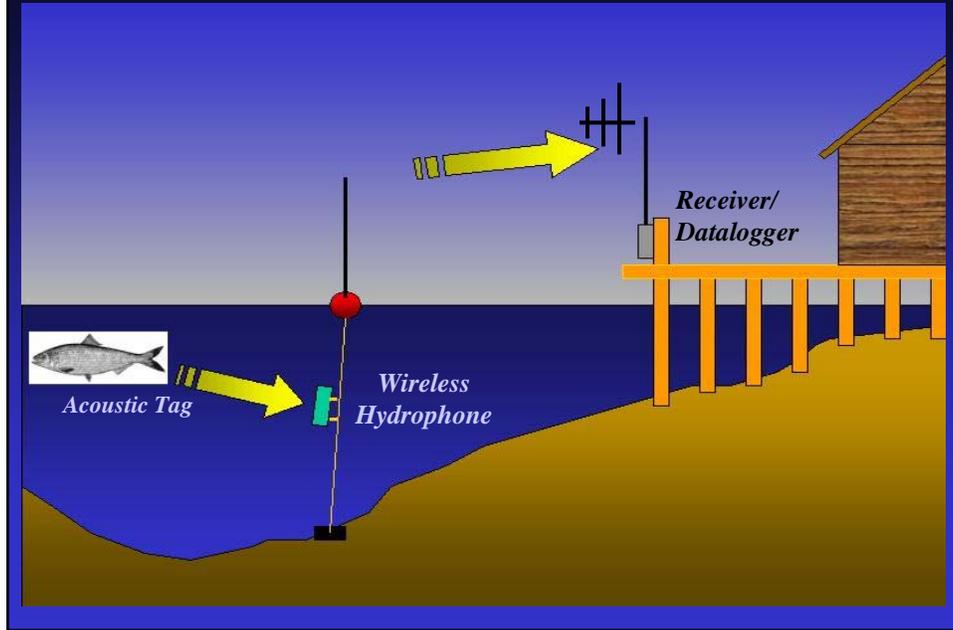
OBS Sensor

St. Joseph, MI
May 1, 1999
Intensive Survey D
Bottom Single Targets
Nighttime
Dredge Active

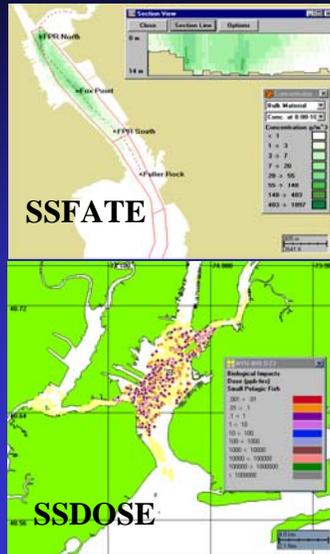




Lotek Biotelemetry System



Research Task: *Modeling Tools for Environmental Windows Determination*



- Modeling tools can facilitate and optimize objectivity in windows determination
- Models must be verified
- Models must adapt, evolve through continual refinement (SMS)
- Link to DMM Focus Area
- Emphasize development, testing and application of tools that address environmental aspects (e.g., support risk assessment)

Pitfalls in the Present System

- Windows must be over-restrictive to ensure effectiveness
- Windows have no performance standards
- Multiple regulatory players involved
- Few resource agencies have staff dedicated to the dredging process
- Resource agencies have no funds for dredging research or training
- Little incentive exists to change the status quo

Recommendations

- **Consider all best management practices on an equal basis with windows**
- **Accept windows as a potentially useful tool based on the merits of a given project and specific sources of risk**
- **Do not institutionalize windows**
- **Seek science-based, adaptive approaches**
- **Obtain commitments to resolve major concerns**



WWW.WES.ARMY.MIL/DOTS

