A Scientific Basis for Restoring Fish Spawning Habitat in the St. Clair and Detroit Rivers of the Laurentian Great Lakes

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Bruce A. Manny[1], Edward F. Roseman[1], Gregory Kennedy[1], **James C. Boase[2]**, Jaquelyn M. Craig[1], David H. Bennion[1], Jennifer Read[3], Lynn Vacarro[3], Justin Chiotti[2], Richard Drouin[4], Mike Thomas[5], Mary Bohling[6], and Rosanne Ellison[7]

[1] U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI

[2] U.S. Fish and Wildlife Service, Waterford, MI

[3]University of Michigan Water Center, Ann Arbor, MI

[4]Ontario Ministry of Natural Resources, London, Ontario

[5] Michigan Department of Natural Resources, Mt Clemens, MI

[6] Michigan Sea Grant, Ann Arbor, MI

[7] U.S. Environmental Protection Agency, Grosse Ile, MI

The Reef Restoration Team

Scientists
USGS, FWS, MDNR, OMNR,U-M

Team Facilitators
UM Water Center and Michigan Sea Grant

Design Engineers
SmithGroup JJR, Faust LLC

Fishery Managers
MDNR, OMNR, FWS

Outreach Specialists
Michigan Sea Grant

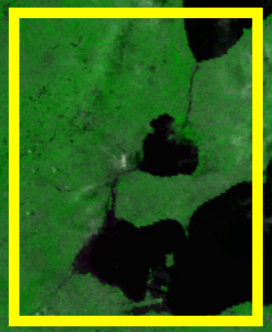
Local Champions & Partners
Sturgeon for Tomorrow, DTE Energy, AOC Council

Grant Managers
UM Water Center and Michigan Sea Grant

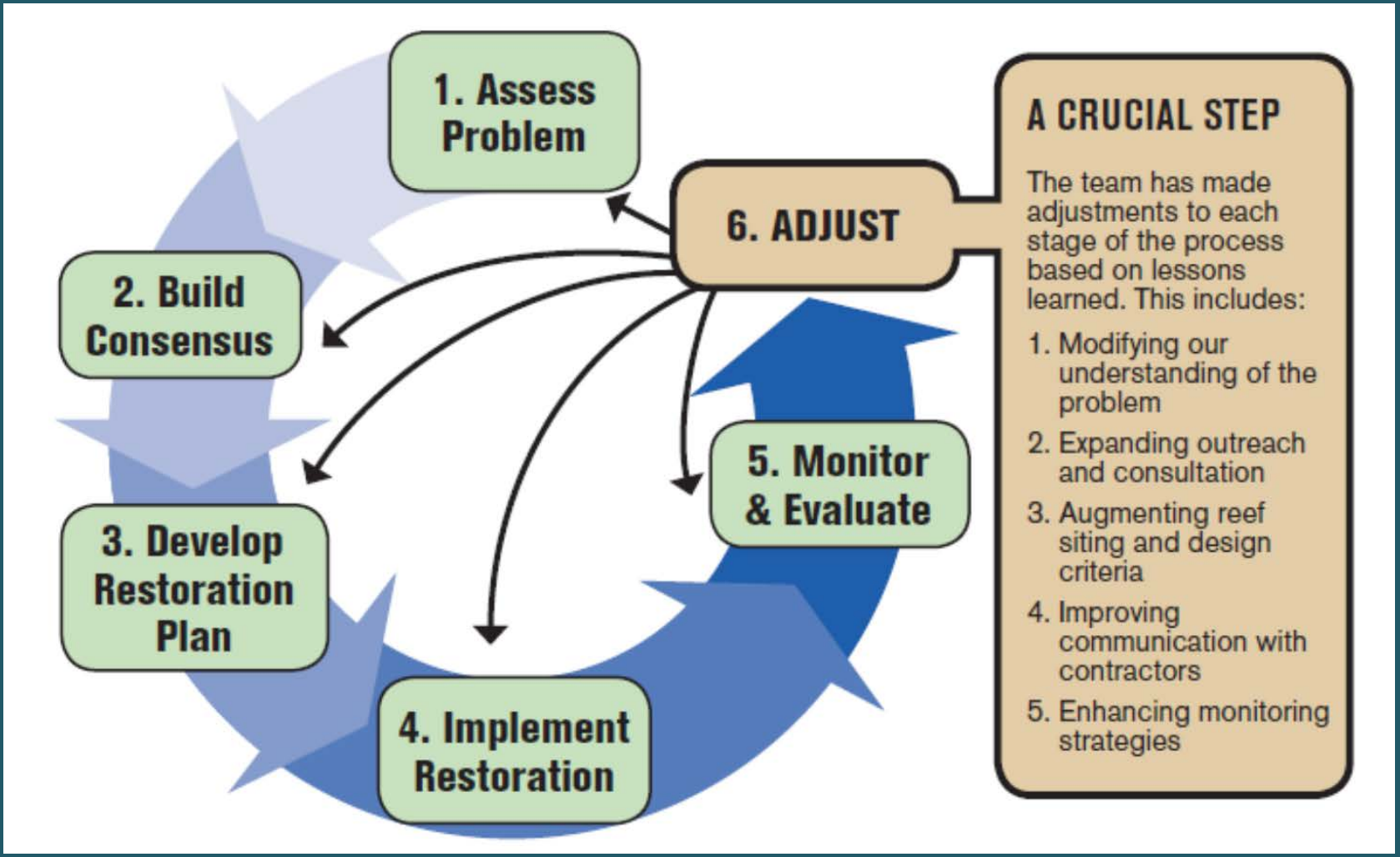
Advisors
Fluvial Geomorphologists, Lake Carriers Association

The St. Clair – Detroit River System

- Connects the Upper and Lower Great Lakes
- Open system
- Historically had some of the most concentrated spawning habitat in the GL



An Adaptive Management Process



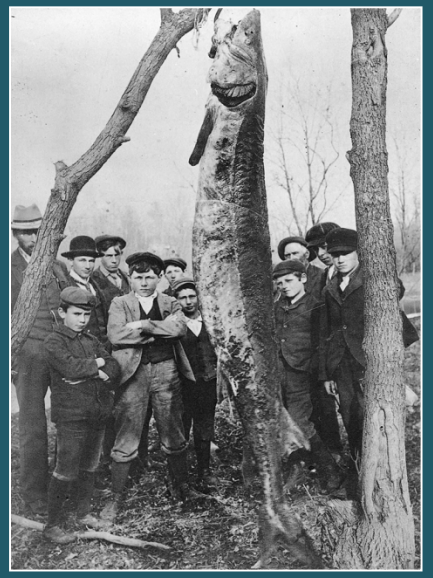
1. Assess Problem

- Define problem
- Evaluate current status
- Develop hypotheses to guide action

Historic State of the SCDRS

"These lakes abound also with fish, some of the most delicious kinds. Among these are the sturgeon, the Mackinaw Trout, the Mosquenonge (muskellunge), the white fish, and other of smaller size peculiar to fresh water. The Sturgeon advances up the stream from the lake during the early part of spring to spawn, and are caught there in large quantities by the Indians"

Lanman (1839) in his book *History of Michigan*



St. Clair – Detroit River System

Historically

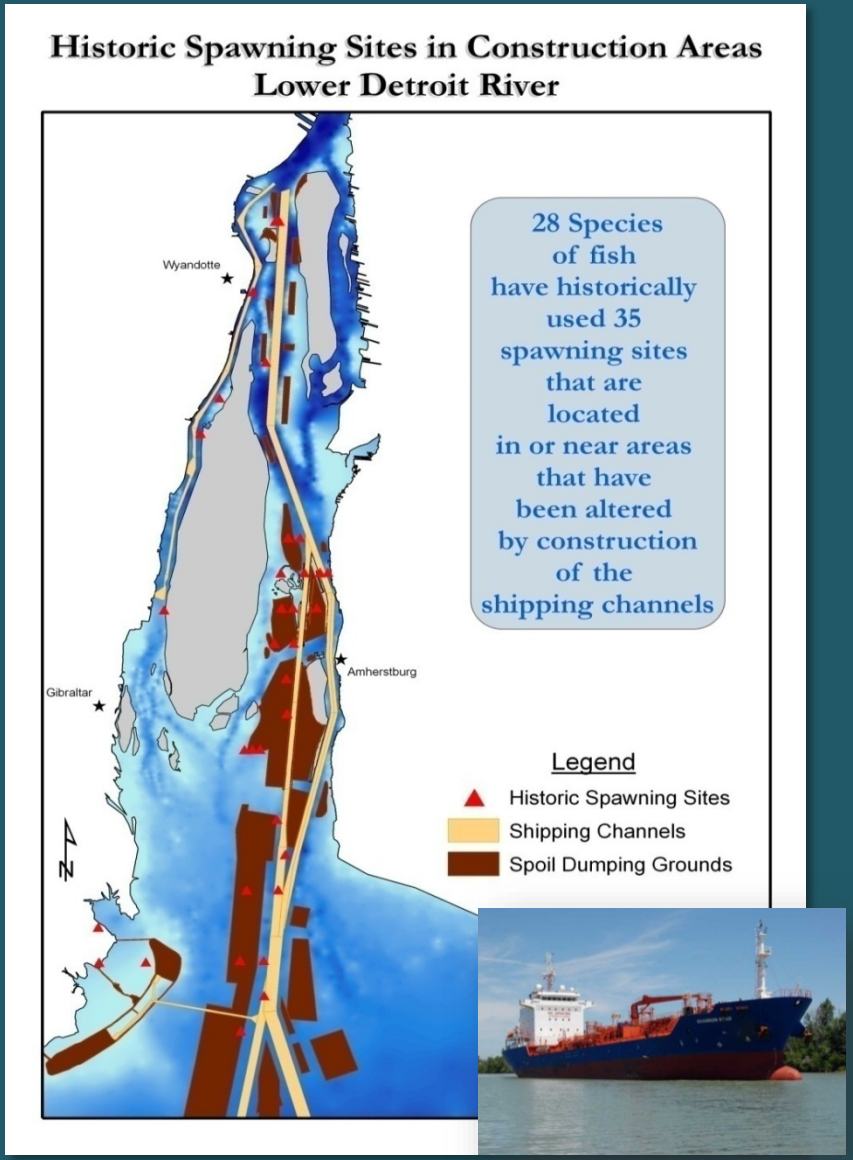
- Huge runs of fish spawned here.
- Largest commercial GL fishery in late 1800s.

Today

- Origin of much of Lake Erie's commercial catch, $2 billion/yr.
- More than 65 species of fish.
  - 16 are threatened or endangered.
- Largest remaining population of lake sturgeon in the Great Lakes.

Construction of the Livingstone Channel

Analysis of Historical Changes to Habitat



The Development of Navigation Channels

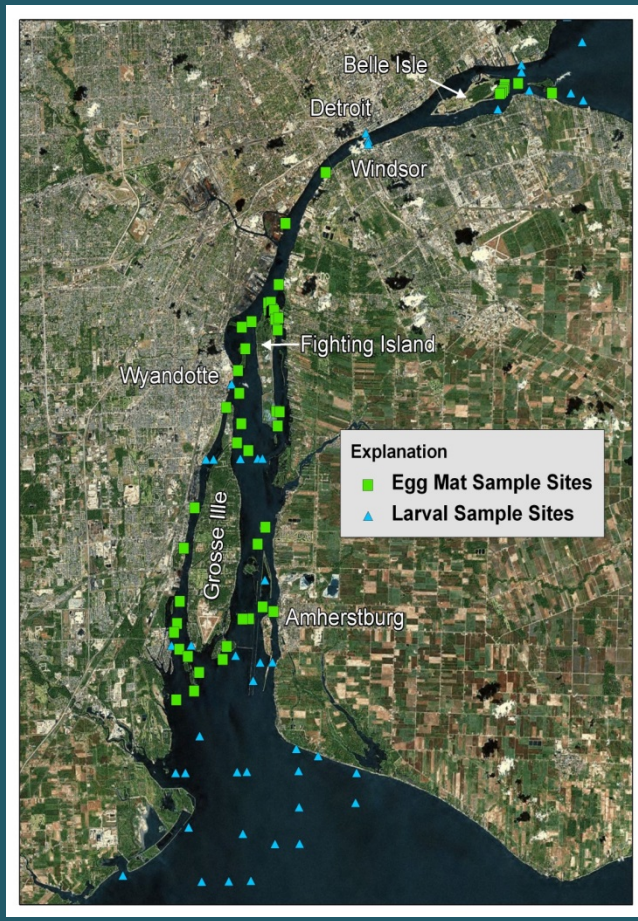
Detroit River, 1874 - 1968:

- Created 60 miles of shipping channels
- Removed more than 30 million cubic yards of material
- Covered 15.5 square miles of river bottom

Bennion and Manny 2011

Evaluate Current Status

- Studies of historical and current spawning habitat
- On-going agency monitoring programs:
  - fish community inventories
  - species-specific fish population monitoring
  - telemetry studies
  - physical habitat assessments
- Pre-restoration biological assessment of candidate restoration sites



Develop Hypotheses to Guide Action: Lack of Spawning Habitat Limits Fish Production

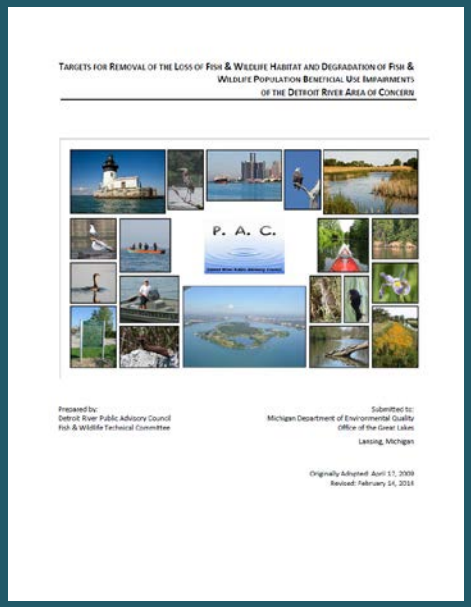
- Restoration projects focus on restoration of native broadcast spawning fish populations and their reproductive habitats

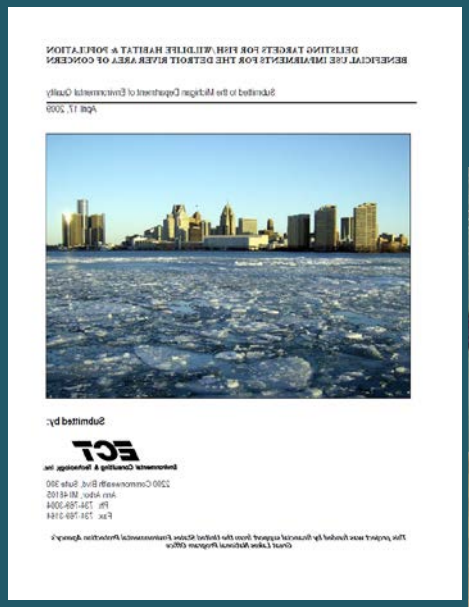
- Designed to benefit recreationally and commercially important fishes
  - Walleye
  - Lake whitefish

- Recover and sustain State of Michigan and Province of Ontario's threatened and endangered species
  - Lake sturgeon
  - Northern madtom

2. Build Consensus

- Scientific workshops
  - Collective Impact Model
- Outreach and engagement
- Integration into larger restoration and management plans





Science and Coordination Team

Mike Thomas,
Todd Wills, Jim Francis,
Jeff Braunscheidel

Bruce Manny, Ed Roseman,
Greg Kennedy, Jaquie Craig,
Dave Bennion, Jason Fischer

Jim Boase,
Justin Chiotti
Andrew Briggs

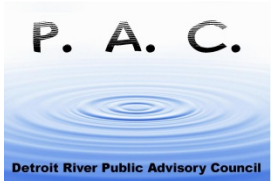
Paul Evanoff, Rachel Echtinaw

Jim Diana,
Mary Bohling

Jen Read, Lynn Vaccaro

Aline Cotel, Laura Alford

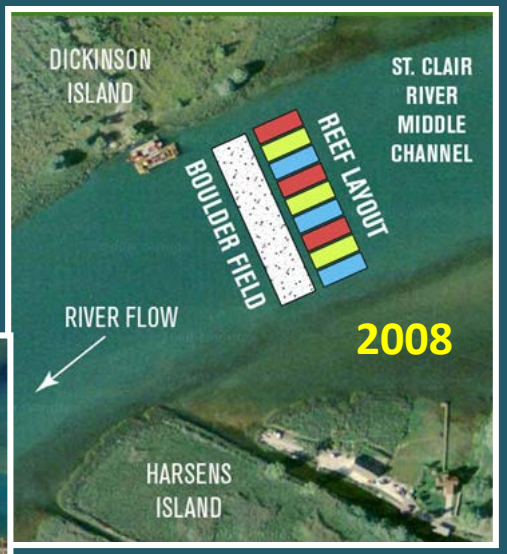
Partners, Sponsors and Funders



Michigan Coastal Management Program

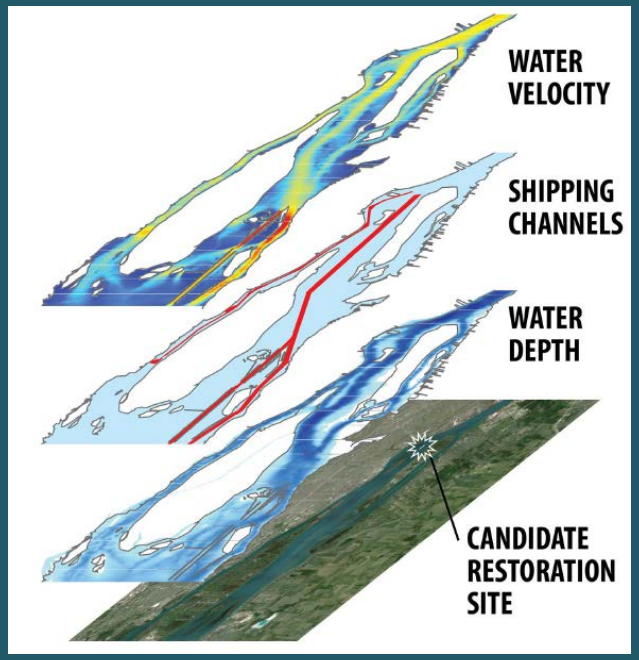
3. Develop Restoration Plan

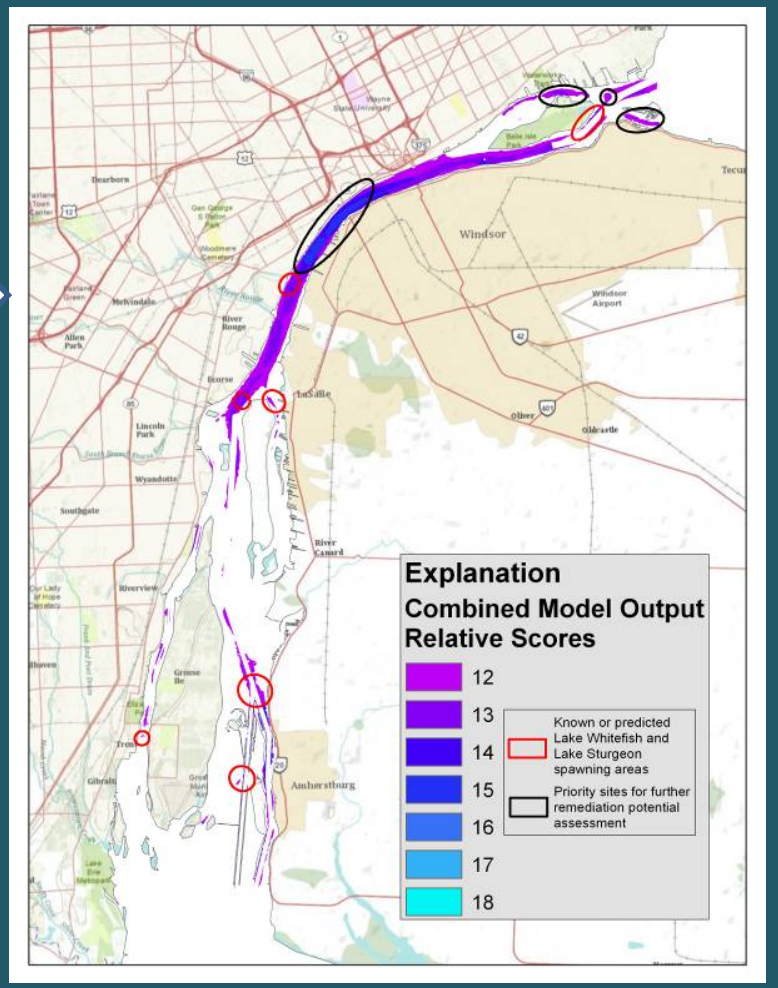
- Early projects were experimental
  - Multiple rock types
  - Across channel layout
- Recent projects have incorporated the lessons learned
  - Single rock type
  - Long narrow design placed in high flow velocity reaches



Phase 1: Prioritizing Restoration Locations

GIS Model





Additional Considerations:

- Proximity to Historic or Existing Spawning Locations
- Known Contamination
- Sediment Transport

Bennion and Manny 2014, Journal of Great Lakes Research 40: 43-51

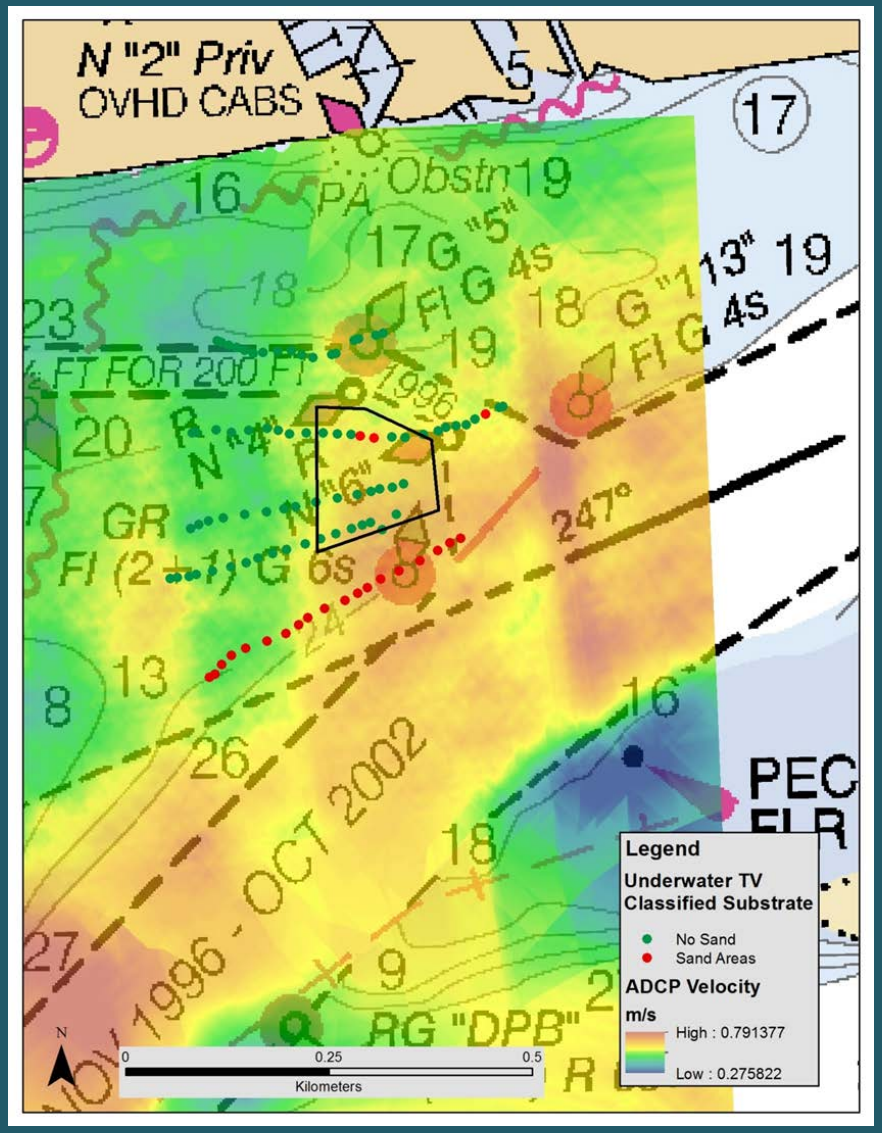
Phase 2: Narrowing Down the Restoration Location

Field Investigations:

- Water Velocity – ADCP Data
- Bathymetry and Sediment Characteristics
  - Side Scan Sonar
  - Underwater Video
  - Scuba Diving
- Biological Activity
  - Egg Collection
  - Adult Fish Surveys

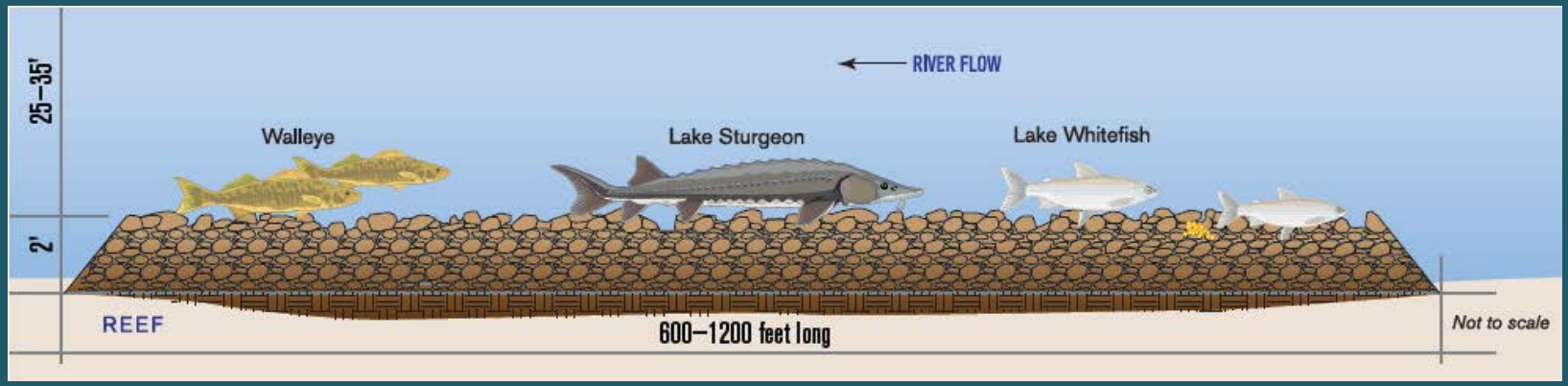
Hydrodynamic Modeling:

- USGS Geomorphology and Sediment Transport Laboratory

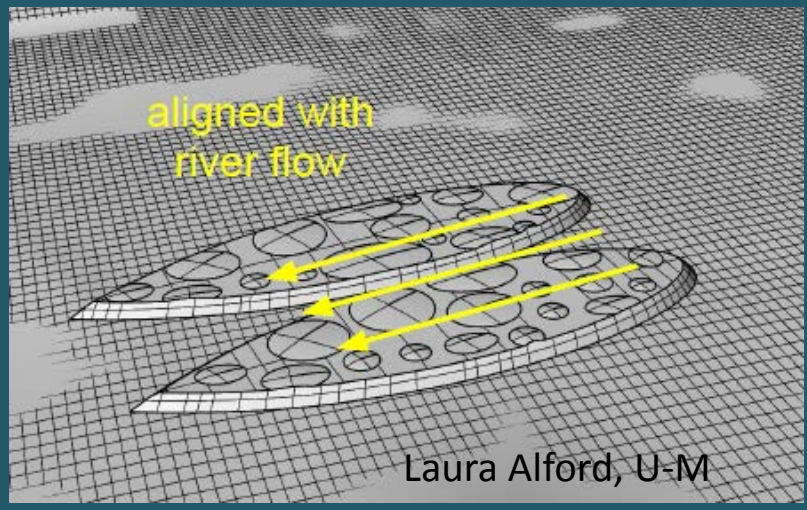


Reef Shape

Current Design – Flat Surface



Computer Model of Alternative Shapes →



4. Implementation – Construction of Fish Spawning Habitat

Crane and Clamshell Bucket

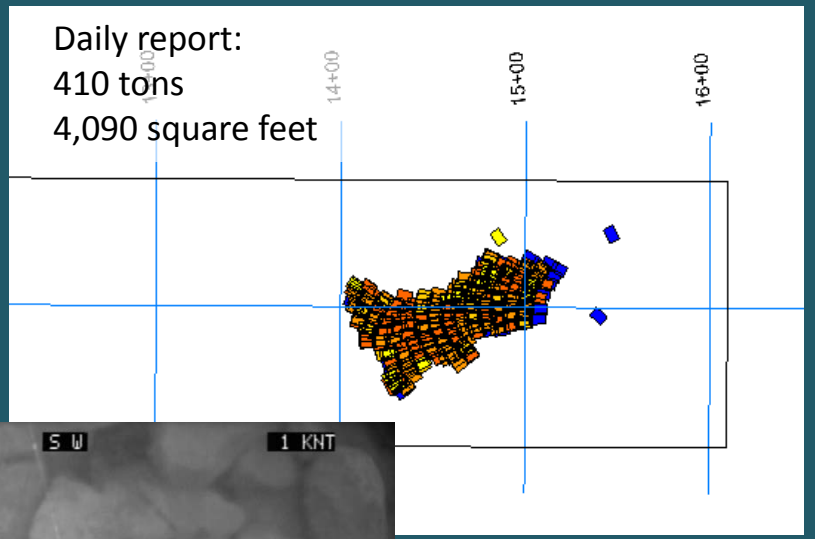
Dump Barge

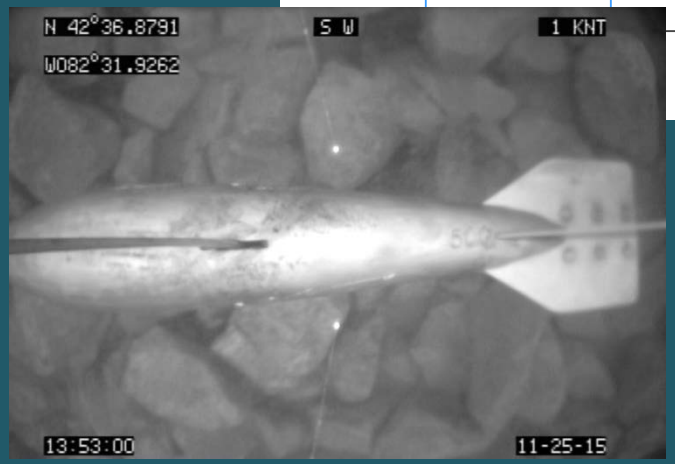
Reef Material

- Materials Tested:
  - Coal Cinders
  - Rounded Field Stone
  - Rock Mixture
- Invasive Species Considerations
  - Sea Lamprey
  - Round Goby
- 4-8” Diameter Angular Limestone
- Locally Quarried, Inspected and Transported to Site

Construction Oversight

- Competitive Bidding (U-M)
- On-Going Communication with Contractor
- Final Construction Verification
  - Bathymetric Survey
  - Underwater Video
- Continued Monitoring



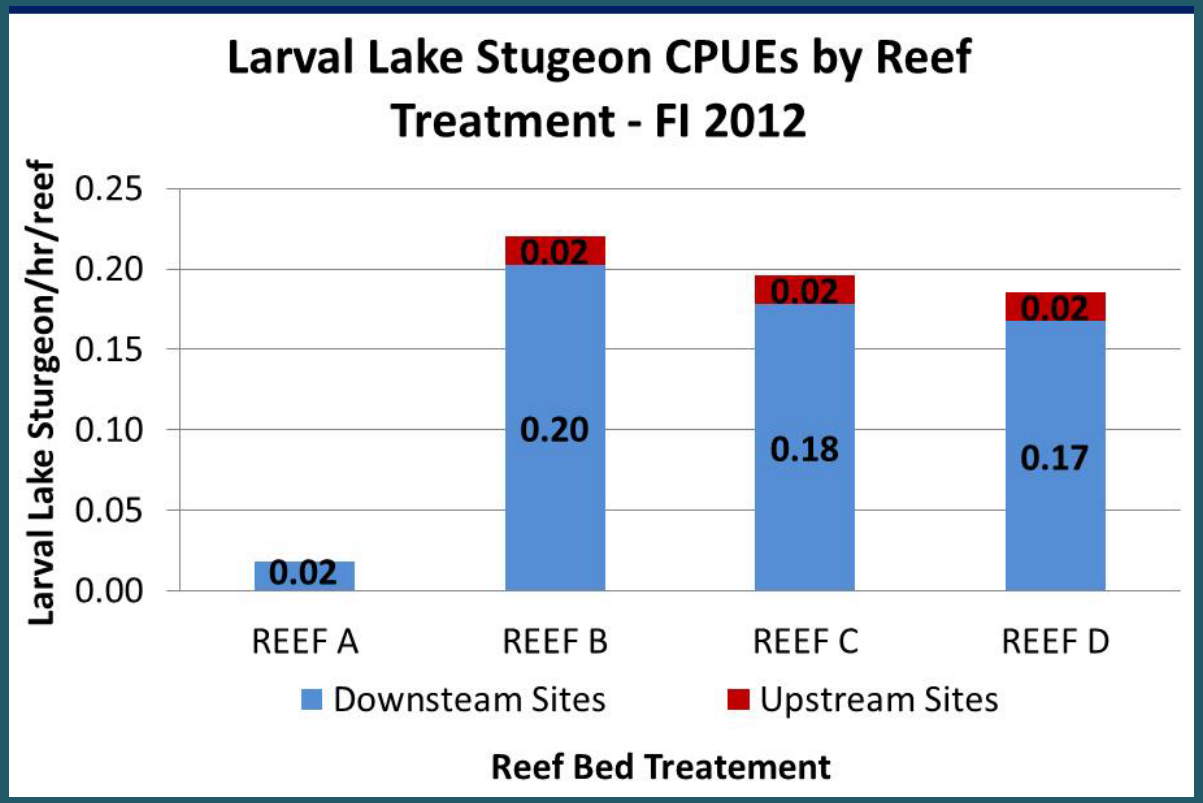


Six Completed Reef Projects

5. Monitor and Evaluate - Biological Assessment

Robust Evaluation of Changes

- Before After Control Impact
- Upstream/downstream comparisons for fish larvae

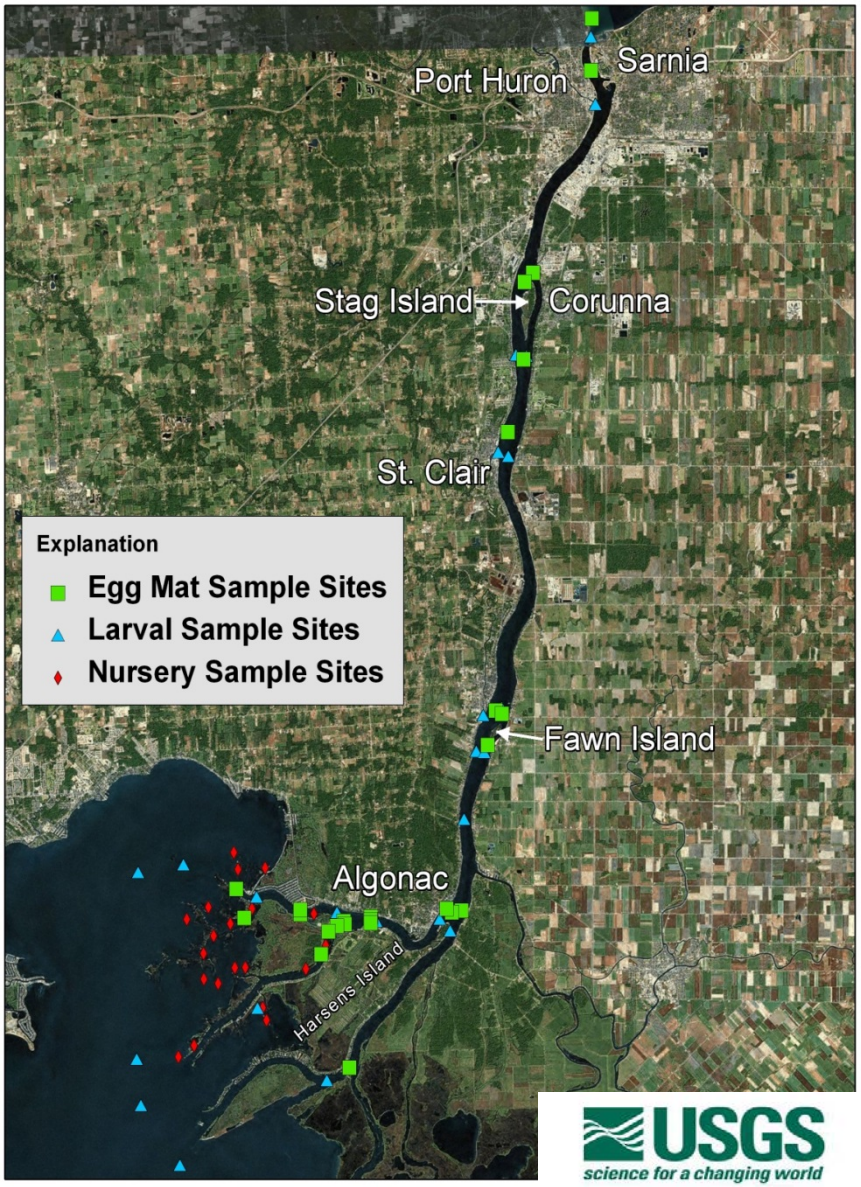


Bouckaert et al. 2014

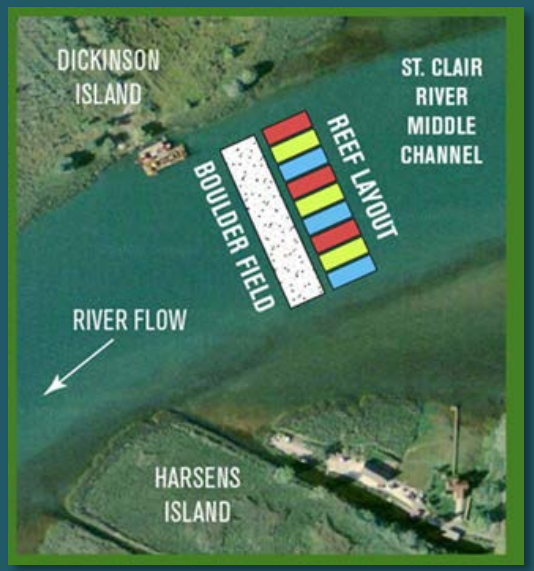
General Recommendations for Monitoring

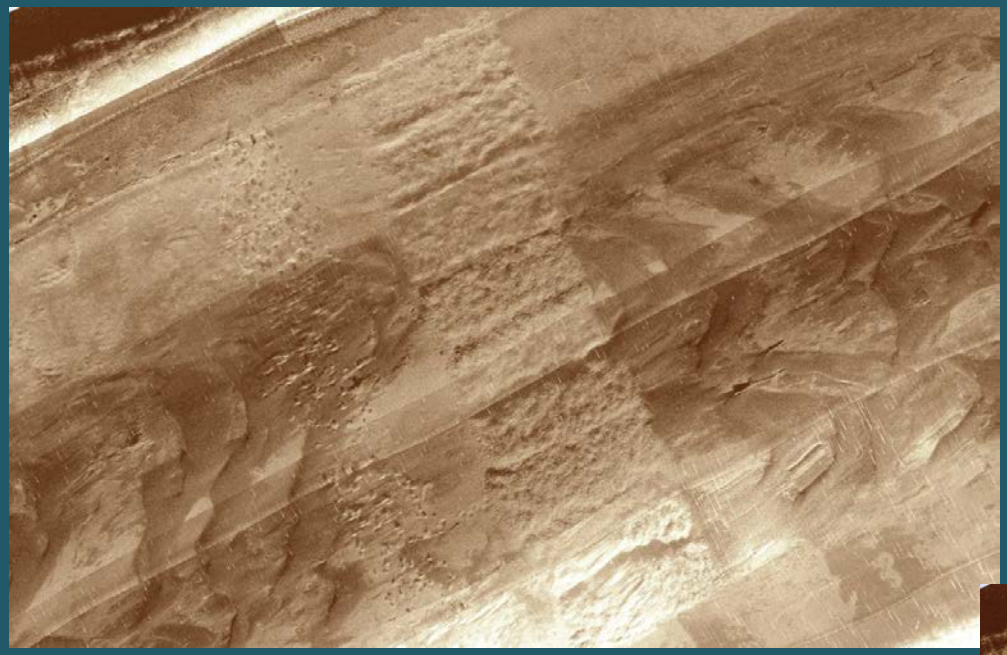
1. Match the spatial and temporal extent of the biological responses and physical stressors
2. Monitor the physical and biological changes
3. Use consistent methods over time
4. Measure quantitative response variables

From McLean et al. 2015



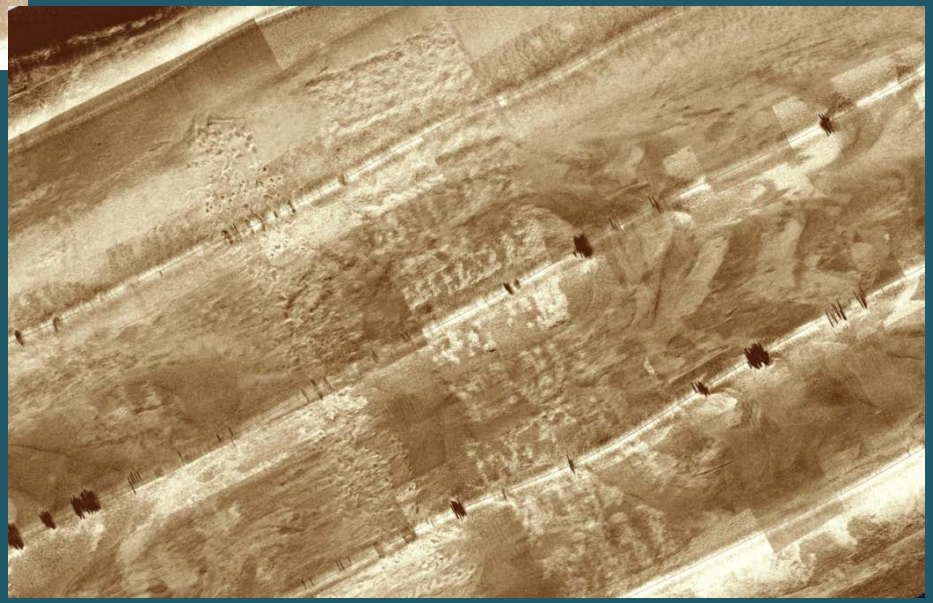
Physical Assessment



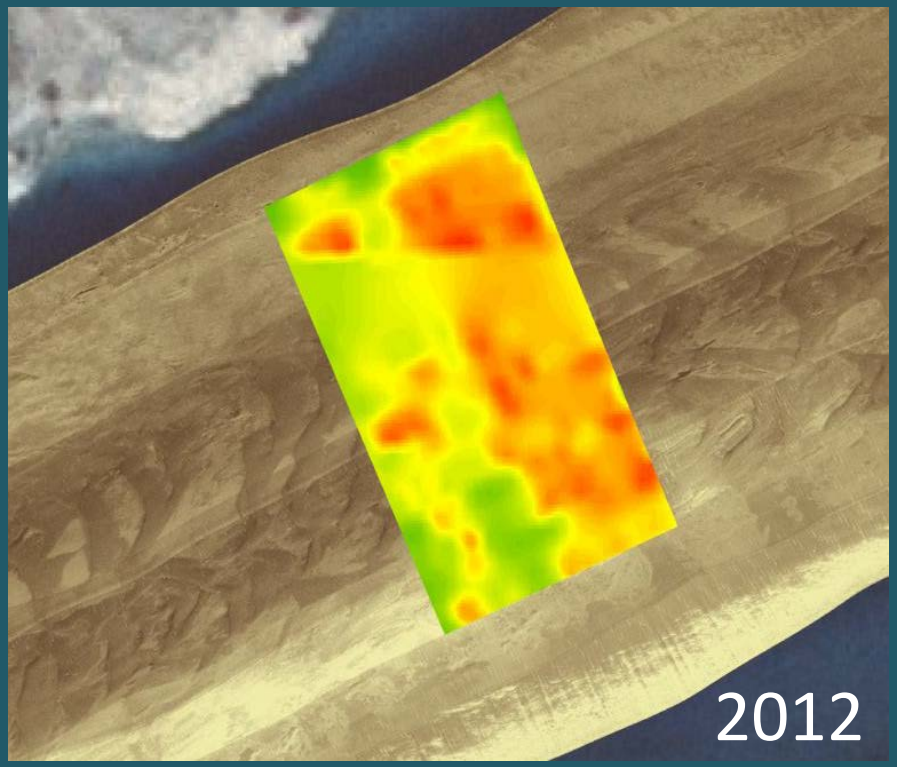


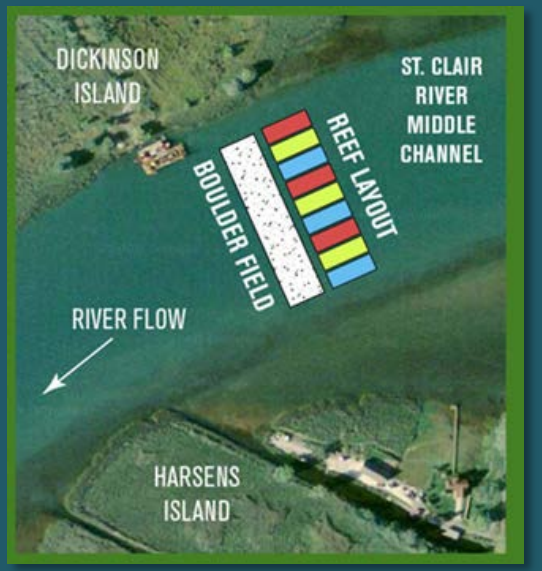
2012

2013



Sonar Imagery - MDNR

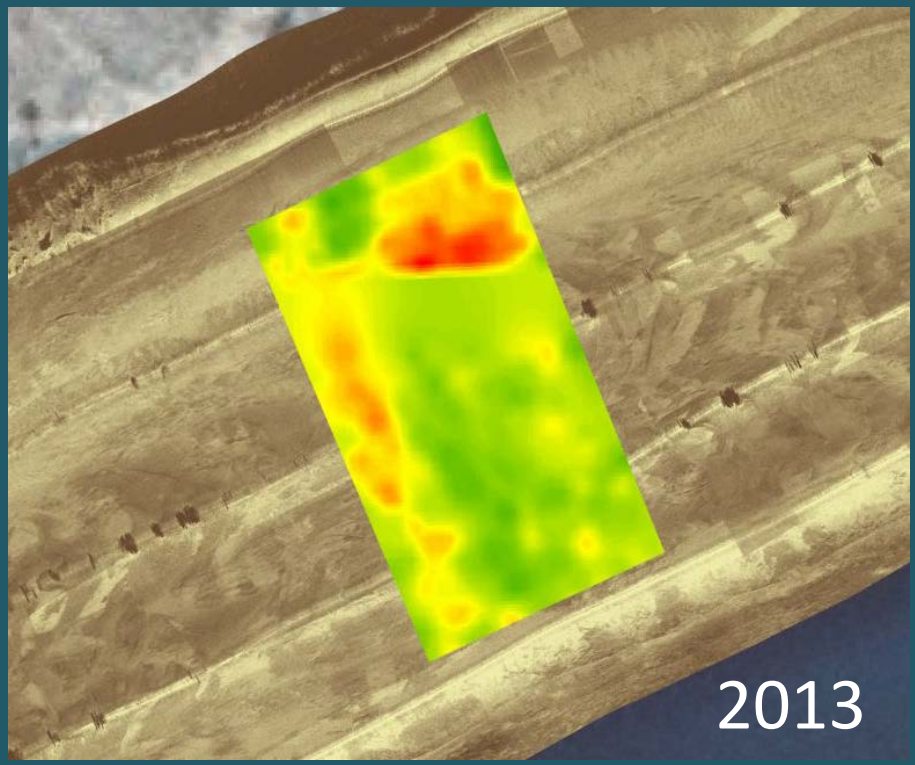




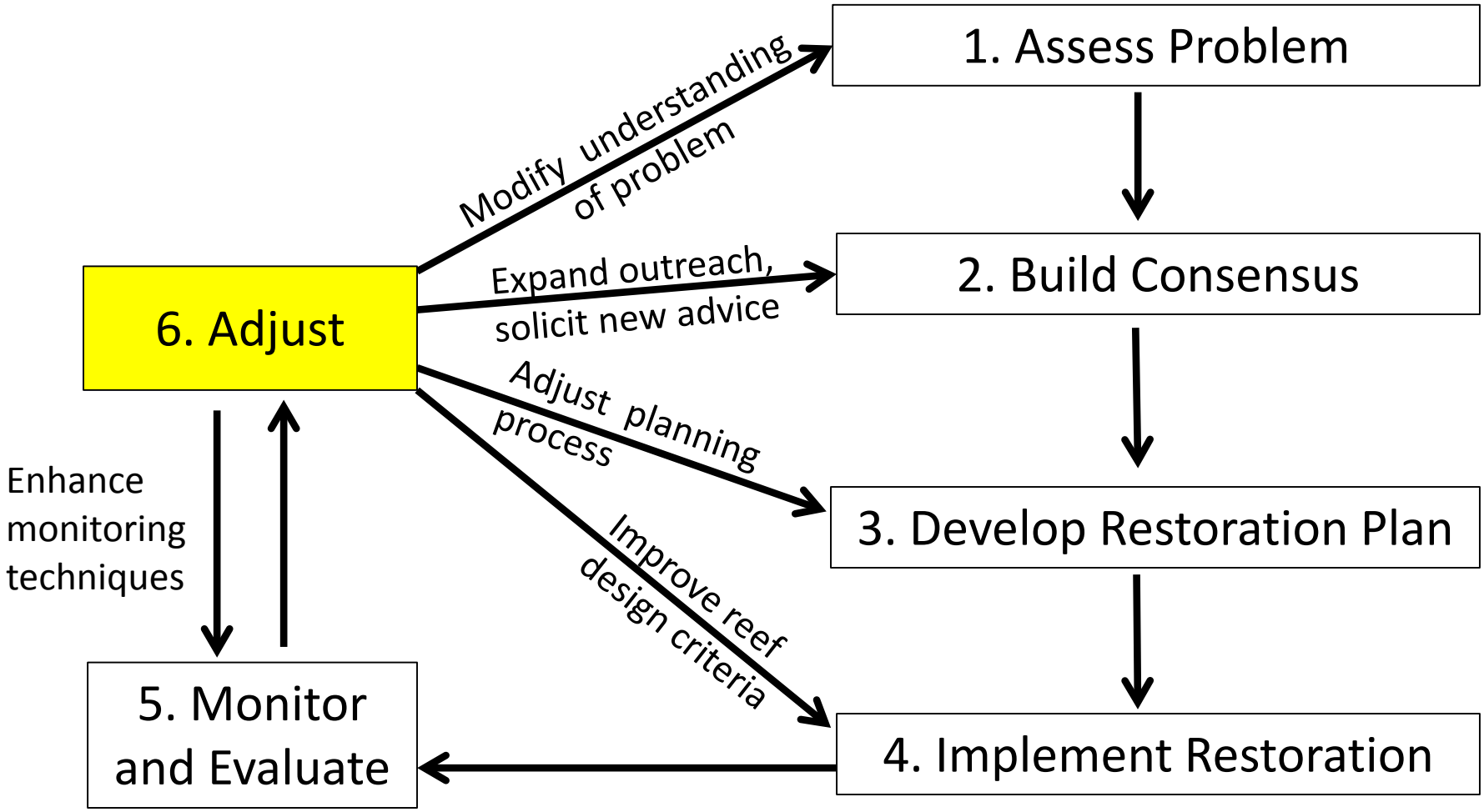
Hardness Index

(Todd Wills, MDNR)

Red – most hard
Green – least hard
1 meter^2 resolution



6. Make Adjustments



Other Adjustments

- Belle Isle Reef (04)
  - Discontinued use of “anchor stones” at the head of the reef beds due to adverse effects on sedimentation
- Fighting Island (08) and Middle Channel Reefs (12)
  - No longer use a mix of rock types
  - No longer use the across channel “no miss” reef layout
  - Siting in highest flow velocities available
- Hart’s Light Reef (14) and Grassy Island Reef (15)
  - Modified reef shape and location to accommodate navigation

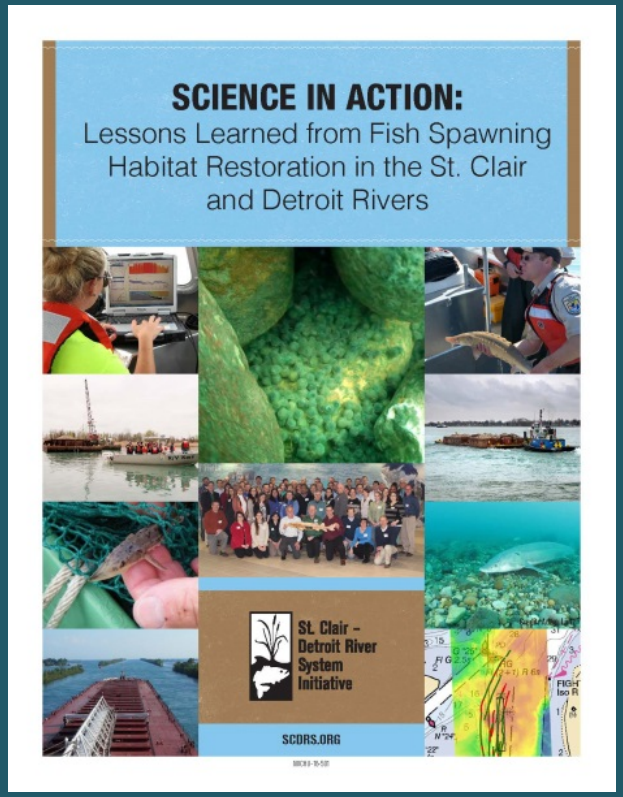
Lessons Learned

- Follow the adaptive management framework
- Use project case studies to help guide
- Restoration planning and implementation techniques
- Building and facilitating a successful team
- Avoiding issues with sedimentation and navigation

St. Clair - Detroit River System Initiative

www.miseagrant.umich.edu/restoration

For More Information



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www.scdrs.org
James_Boase@fws.gov