COASTAL SCIENCE FUELING COASTAL ECONOMIES

Using Geoscience Research to Accelerate Innovation and the Coastal Economy

Sponsored by Senator Bill Nelson | Presented by the National Association of Marine Laboratories

November 20, 2015

Noon — 1:30 p.m.

Capitol Visitor Center, Room SVC 202

PAMELA YOCHEM

Aquaculture Reinvigorates the Coastal Community

Executive Vice President, Hubbs-SeaWorld Research Institute

San Diego, California

MEGAN DAVIS

Community Involvement for the Indian River Lagoon Leads to Water Project Investments

Interim Executive Director, FAU Harbor Branch

Fort Pierce, Florida

LISA AUERMULLER

Coastal Resilience—Reducing the Cost and Vulnerability To Future Storms and Flooding

Director, Coastal Training Program

Rutgers University

New Brunswick, New Jersey

ALAN D. STEINMAN

Ecosystem Restoration in the Great Lakes Yields Significant Return on Investment

Director, Annis Water Resources Institute

Grand Valley State University

Muskegon, Michigan

Copies of each presentation used at this briefing can be found at www.naml.org

Aquaculture Reinvigorates the Coastal Community

Coastal Science Fueling Coastal Economies

Capitol Visitor Center, Washington, D.C.

November 20, 2015

Pamela Yochem, D.V.M., Ph.D.
Executive Vice President
Hubbs-SeaWorld Research Institute

U.S. Economy Depends on a Healthy Coast

- 14% of coastal counties produce 45% of the GDP with 3 million jobs (one in 50)
- In 2011, the ocean economy's 6 economic sectors contributed more than $282 billion to the GDP and over 2.8 million jobs.
- Examples (major sectors):
  - Tourism and Recreation:
    - 70% of ocean employment
    - 34% of ocean GDP
  - Offshore Mineral Extraction:
    - 37% of ocean GDP

Source: NOAA/NOS - *http://oceanservice.noaa.gov/facts/oceaneconomy.html*

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Key Industry Diagnostics for the San Diego Maritime Industry

September 2011

Total employment	**45.8K**
Traditional maritime exclusive industries	8.2
Maritime technology industries	18.9
Other maritime	18.6
Total estimated revenue	**$14 Billion**
Traditional maritime exclusive industries	$1.4
Maritime technology industries	$6.2
Other maritime	$6.5

San Diego Maritime Industry Report 2012 (Table 1, p. 19). Report sponsored by: San Diego Workforce Partnership, San Diego Regional Economic Development Corporation & The Maritime Alliance. Prepared by ERISS Corporation/www.eriss.com

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The Economic Impact of San Diego's Research Institutions

The Economic Impact of
San Diego's Research Institutions
Driving San Diego's Innovation Economy

San Diego Regional Economic Development Corporation

FALL 2015

RESEARCH INSTITUTIONS
have a $4.6B ECONOMIC IMPACT and are at the center of
SAN DIEGO'S $14.4B SCIENTIFIC R&D CLUSTER

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$4.6 Billion equals the impact of:

33-U.S. Open Golf Championships

6-Aircraft carriers stationed in S.D.

34-Comic-Con Conventions

4-San Diego Convention Centers

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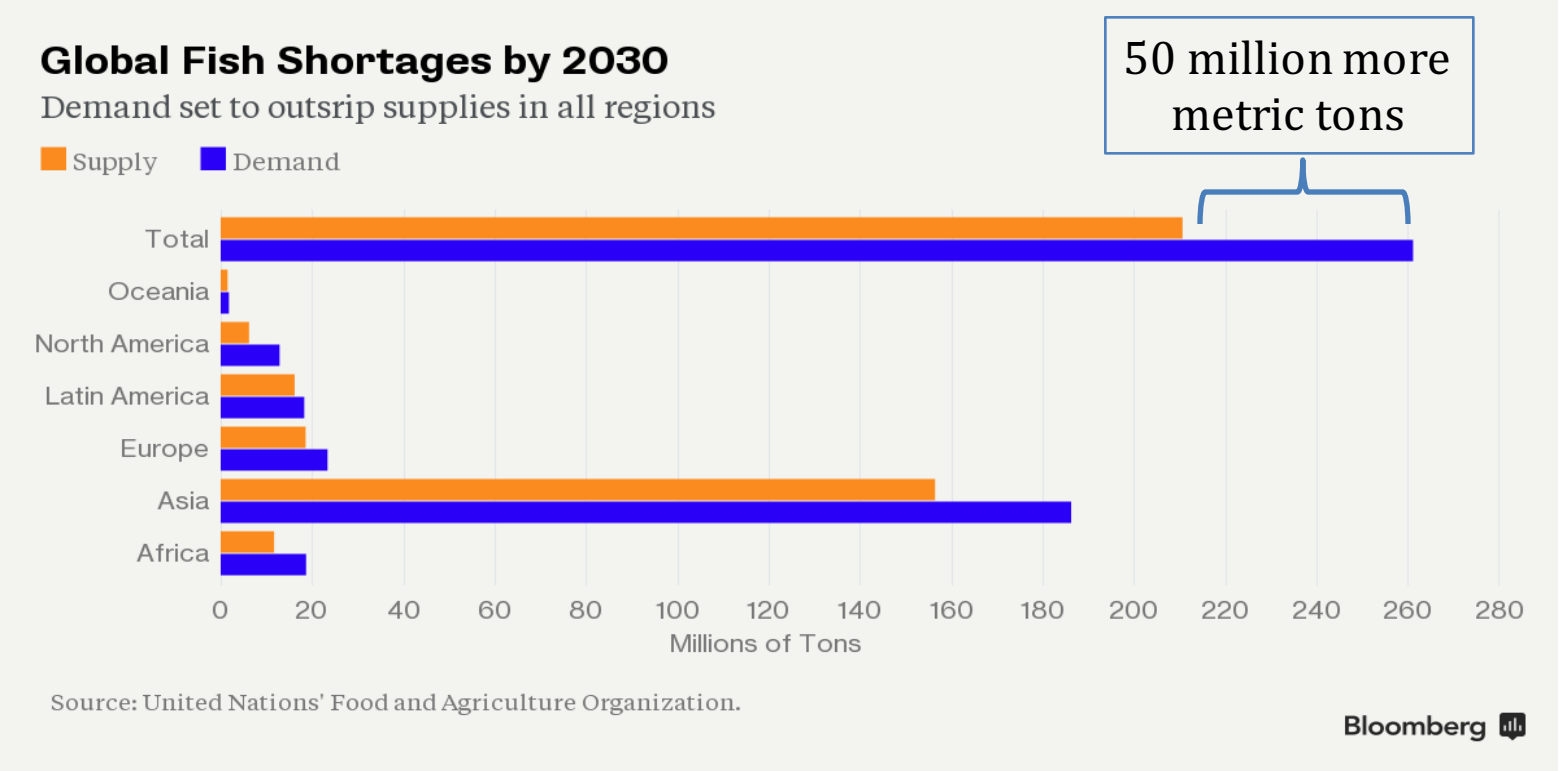
Worldwide Seafood Supply Shortfall



U.S. needs increased domestic supply of safe & sustainable seafood

- 91% of U.S. seafood is imported
- Annual seafood imports total over $16 billion
- 50% of global supply of seafood is farmed (80% in Asia)
- Domestic supply is 6.5% harvest and 2.5% farmed

For California Agriculture, Seafood Production is a Novelty

- 81,500 farms
- Over 400 commodities
- $43.5 billion total revenue
- #1 state with 11.3% of U.S. farm cash receipts
  - 11% for crops
  - 7.1% for livestock
- $12 billion in livestock sales
- <0.5% is aquaculture

Source of Income	Sales
Aquaculture	$54
Chickens, All	$720
Cattle and Calves	$3,299
Eggs, Chicken	$393
Hogs and Pigs	$39
Honey	$23
Milk and Cream	$6,900
Turkeys	$311
Wool and Mohair	$5
Other Livestock	$412
Total	$12,155

cdfa
CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

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Reinvigorating a Coastal Community

Southern California's history:

- By 1975 tuna fishing supported 16 canneries and employed 40,000 people.
- Southern California was known as the Tuna Capital of the World.

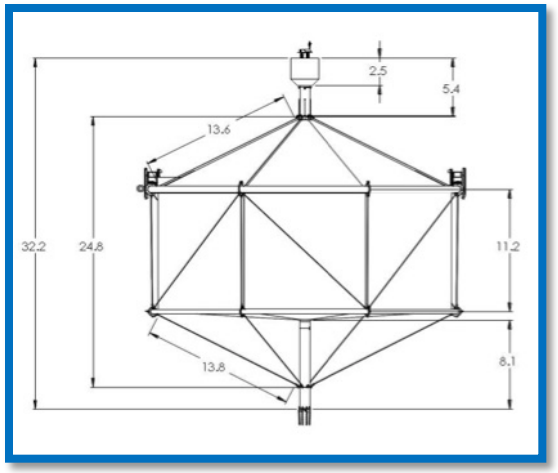
More recently:

- In 2013, California fisheries caught only 165K MT (worth $256 million)
- San Diego caught only 1K MT (worth $6 million)

Reinvigorating a Coastal Community

Southern California's future?

- Proposed project: Rose Canyon Fisheries
- A commercial, state-of-the-art, aquaculture project off the coast of Southern California
  - Evaluate both economic and environmental sustainability
  - Scale up to 5,000 MT annual production
  - Annual sales in excess of $50 million with estimated 2:1 economic benefit to the region (Source: San Diego Regional Economic Development Corporation)



Potential Economic Benefits

- **Region**
  - Sales from $50 million annually
  - Supporting over 300 seafood jobs (wages ~ 2x regional average)
  - New spending in excess of $100 million annually (2:1 economic benefit)
- **State**
  - Represent a 31% increase in seafood ex-vessel sales
- **Nation**
  - Help to reduce the growing trade deficit in seafood imports

Source: San Diego Regional Economic Development Corporation

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New Industry Precipitates the Need for Research

*NATIONAL STRATEGIC PLAN FOR FEDERAL AQUACULTURE RESEARCH (2014-2019)**

Strategic Research Goals:

1. Advance Understanding of the Interactions of Aquaculture and the Environment
2. Employ Genetics to Increase Productivity and Protect Natural Populations
3. Counter Disease in Aquatic Organisms and Improve Biosecurity
4. Improve Production Efficiency and Well-being
5. Improve Nutrition and Develop Novel Feeds
6. Increase Supply of Nutritious, Safe, High-quality Seafood and Aquatic Products
7. Improve Performance of Production Systems
8. Create a Skilled Workforce and Enhance Technology Transfer
9. Develop and Use Socioeconomic and Business Research to Advance Domestic Aquaculture

* National Science and Technology Council Committee on Science; Interagency Working Group on Aquaculture, 2014

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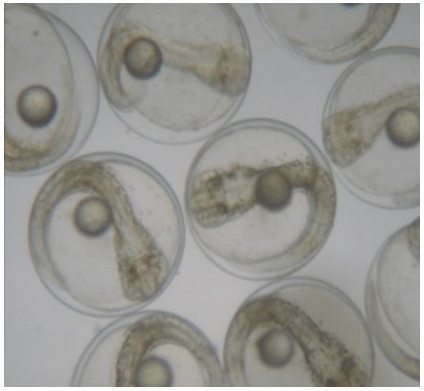
Hubbs-SeaWorld Research Institute

50+ years experience in marine research

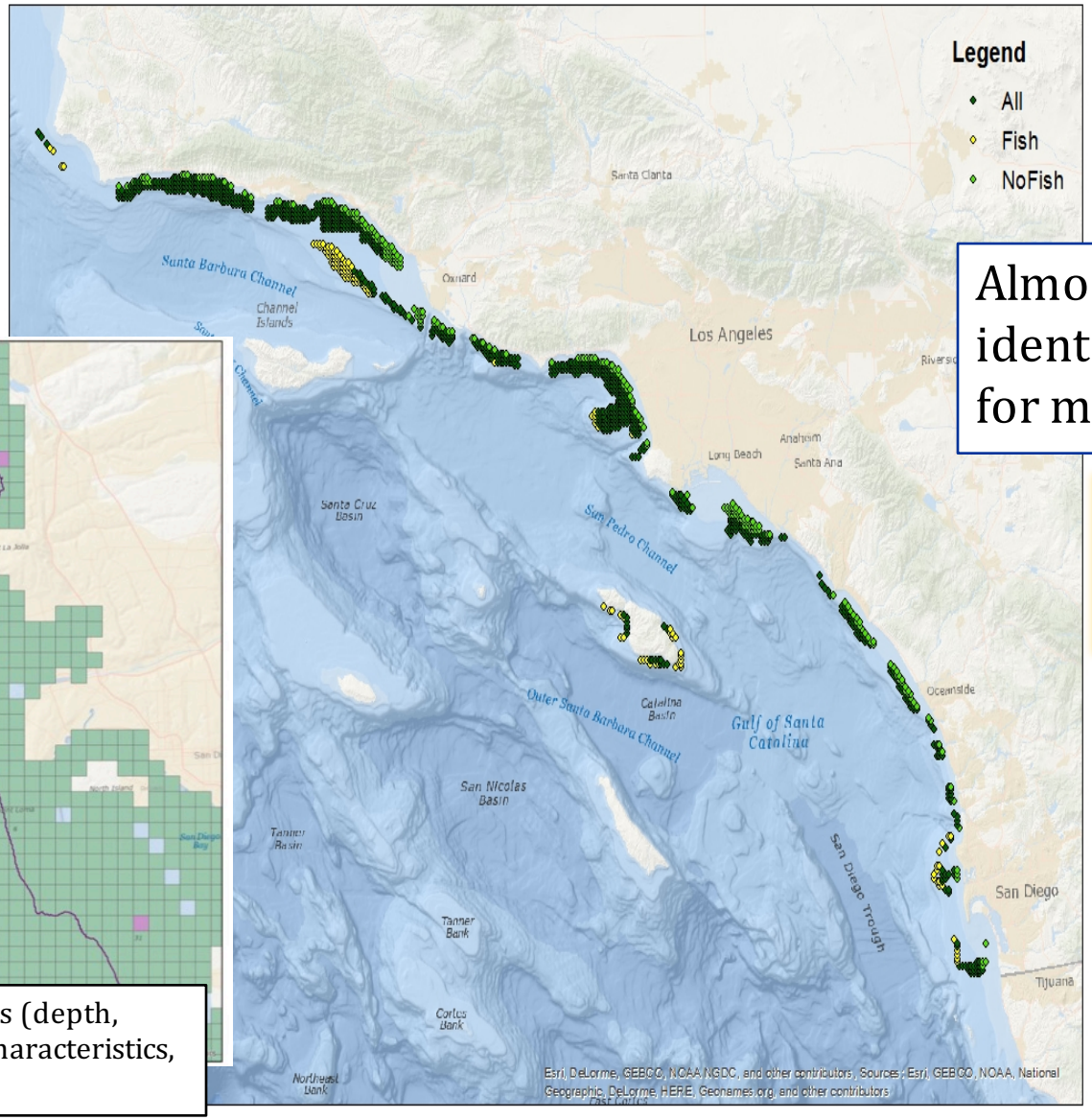
30+ years in aquaculture research (replenishment of depleted stocks, sustainable seafood)

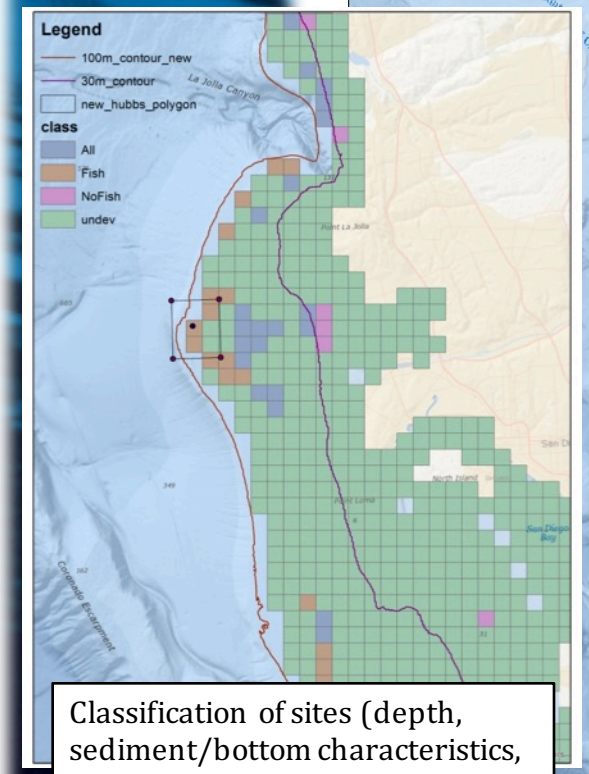


Collaborators

Universities and research institutes, industry groups, eNGOs, community organizations

Sites Potentially Developable for Aquaculture





Classification of sites (depth, sediment/bottom characteristics, fishing conflicts)

Almost 2K km^2 identified as suitable for marine farming

Source:
Bren School of Environmental Science & Management, U.C. Santa Barbara
(Funded by Sea Grant)

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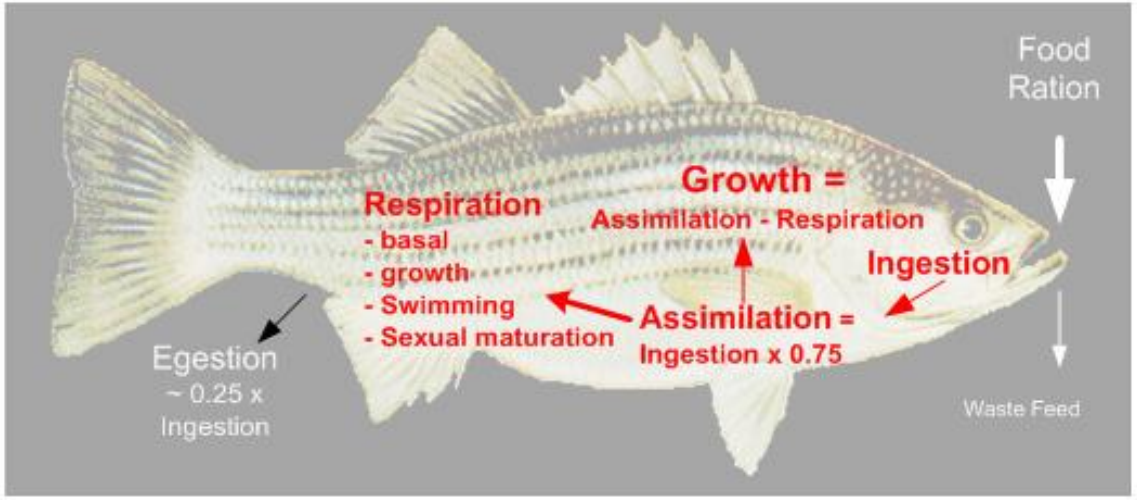
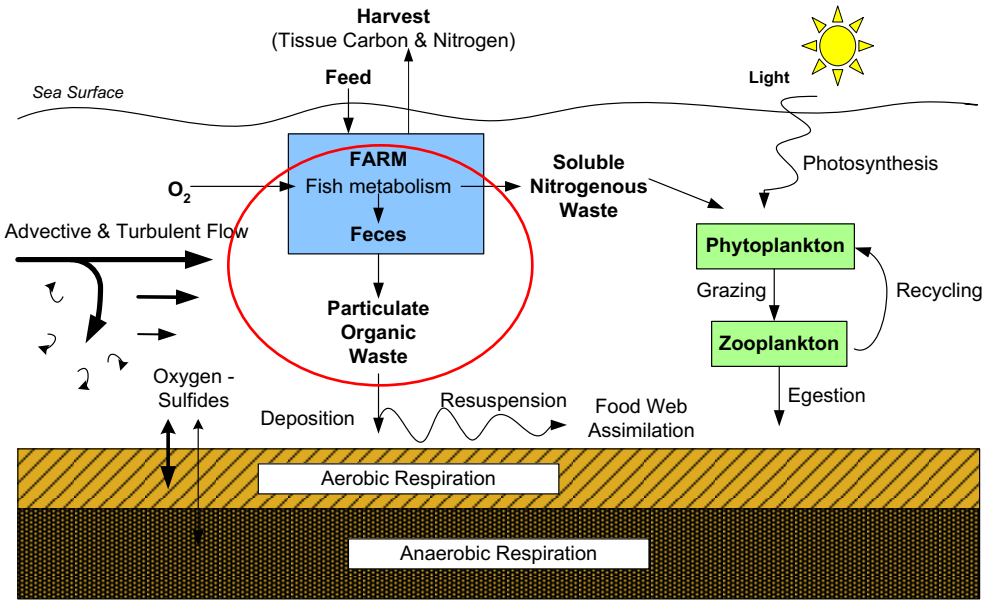
Modeling Potential Impacts





Aquaculture (and Science!) Reinvigorate the Coastal Community

With Earth's burgeoning populations to feed, we must turn to the sea with new understanding and new technology. We must learn to farm the sea as we have farmed the land.

Capt. Jacques Cousteau

- *Aquaculture **provides year-round, living wage jobs** centered in coastal and rural communities.*
- *Marine aquaculture operations **support working waterfronts** (docks, boat yards, and processing plants).*
- *We export advanced technology, feed, equipment, and other investments to producers around the world.*
- ***Let's start using more of this U.S.-developed technology and expertise here**, and stop exporting jobs to other countries.*

Dr. Kathryn Sullivan, NOAA Administrator
SeaWeb Seafood Summit; New Orleans, LA; February 9, 2015

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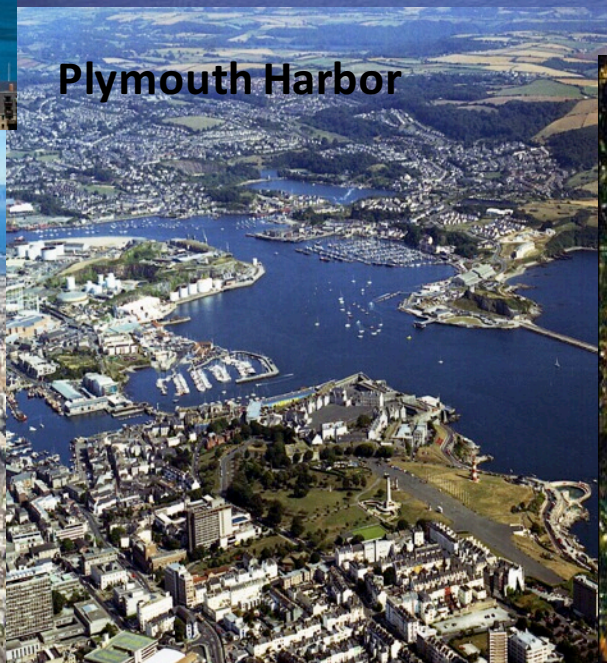
Community Involvement for the Indian River Lagoon Leads to Water Project Investments

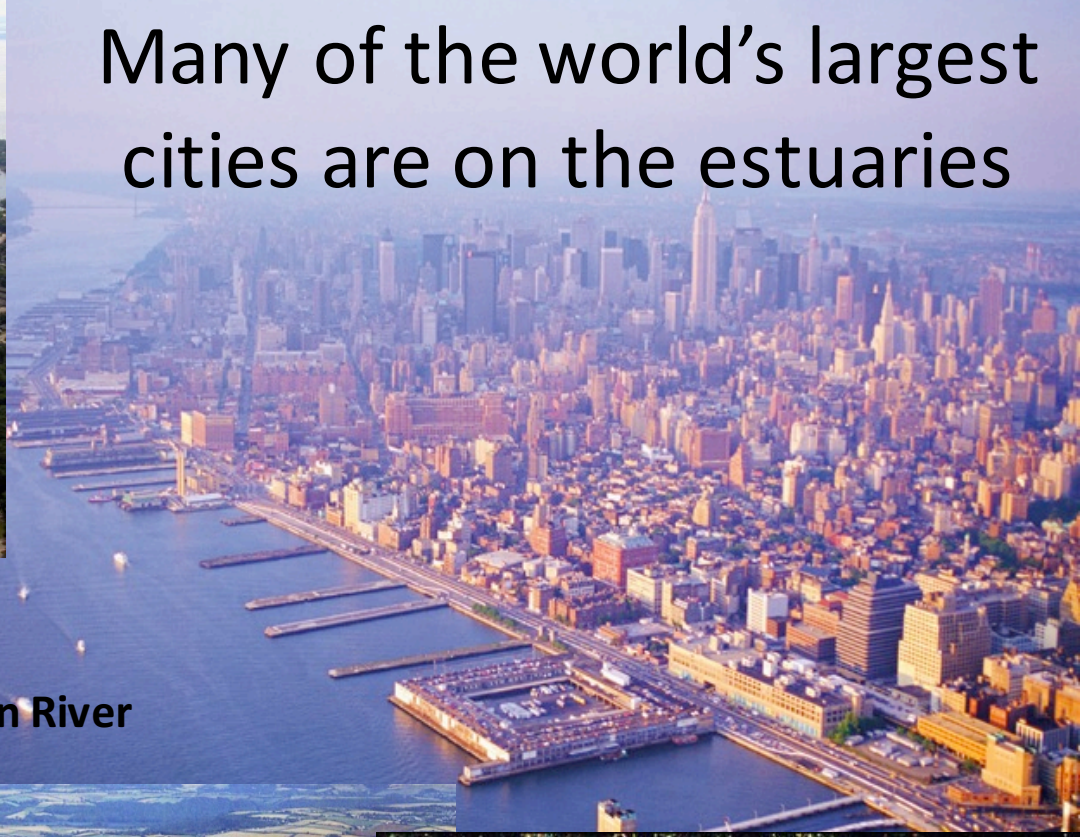
MEGAN DAVIS, Ph.D.
INTERIM EXECUTIVE DIRECTOR

HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY®

Photo courtesy of Indian River by Air

Many of the world's largest cities are on the estuaries





Land Connections to the Ocean

What percentage of the Earth's land surface is connected to the ocean by rivers?

a. 35%

b. 73%

c. 87%

d. 100%

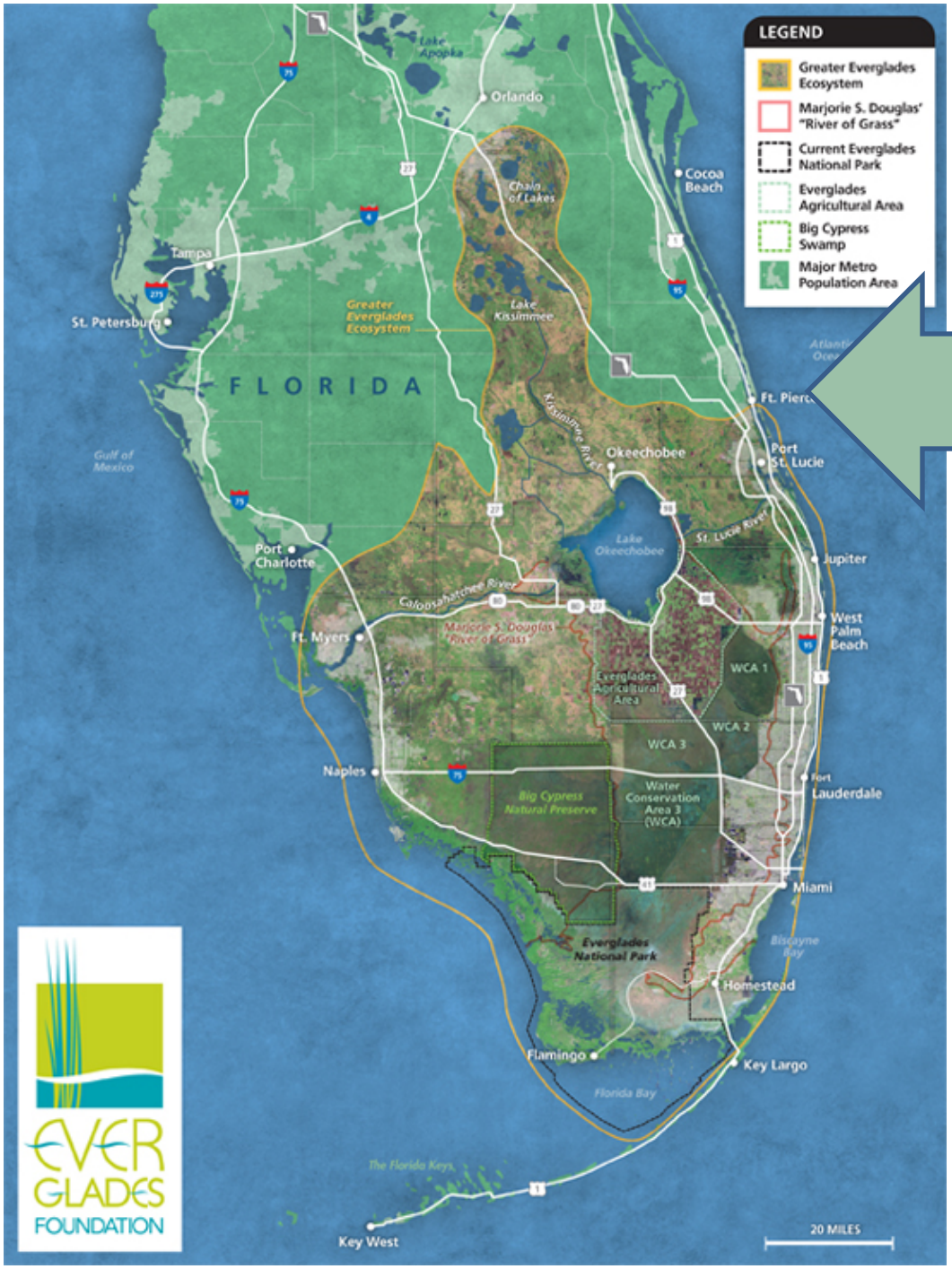
Mississippi River Drainage Basin

Estuaries are……

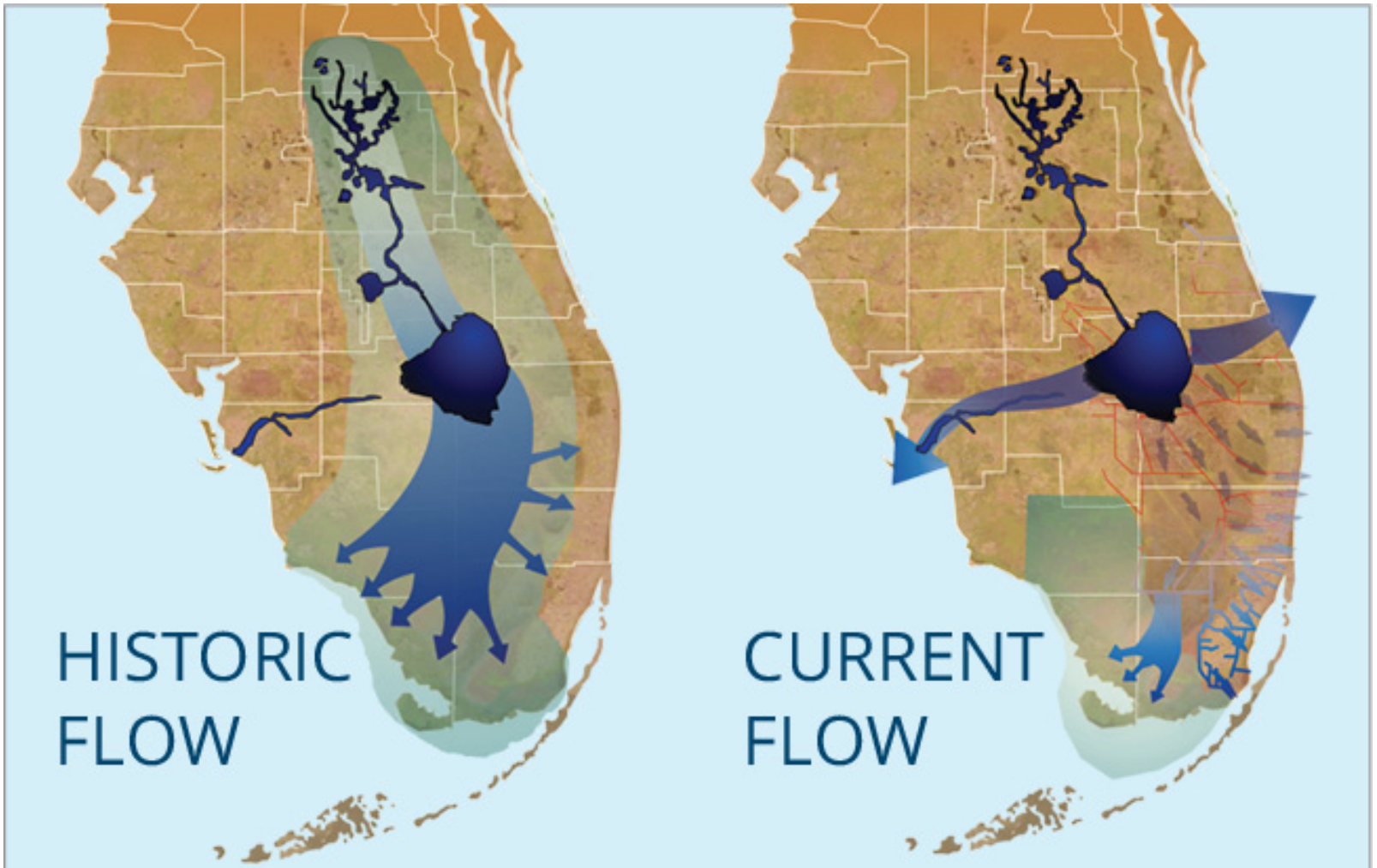
…..where rivers meet the sea

Photo courtesy of Indian River by Air


Enormous filter –
most fertile ecosystems on earth
Fisheries nurseries and migration corridors
Stabilize shorelines & protect coastal areas
© indianriverbyair.com


LEGEND
Greater Everglades Ecosystem
Marjorie S. Douglas' "River of Grass"
Current Everglades National Park
Everglades Agricultural Area
Big Cypress Swamp
Major Metro Population Area
FLORIDA
Lake Apopka
Orlando
Cocoa Beach
Chain of Lakes
Tampa
St. Petersburg
Greater Everglades Ecosystem
Lake Kissimmee
Kissimmee River
Okeechobee
Port St. Lucie
Gulf of Mexico
Port Charlotte
Lake Okeechobee
St. Lucie River
Jupiter
Caloosahatchee River
Ft. Myers
Marjorie S. Douglas' River of Grass
West Palm Beach
Everglades Agricultural Area
WCA 1
WCA 2
WCA 3
Naples
Big Cypress Natural Preserve
Water Conservation Area 3 (WCA)
Fort Lauderdale
Miami
Everglades National Park
Biscayne Bay
Homestead
Flamingo
Key Largo
Florida Bay
The Florida Keys
Key West
20 MILES
EVERGLADES FOUNDATION

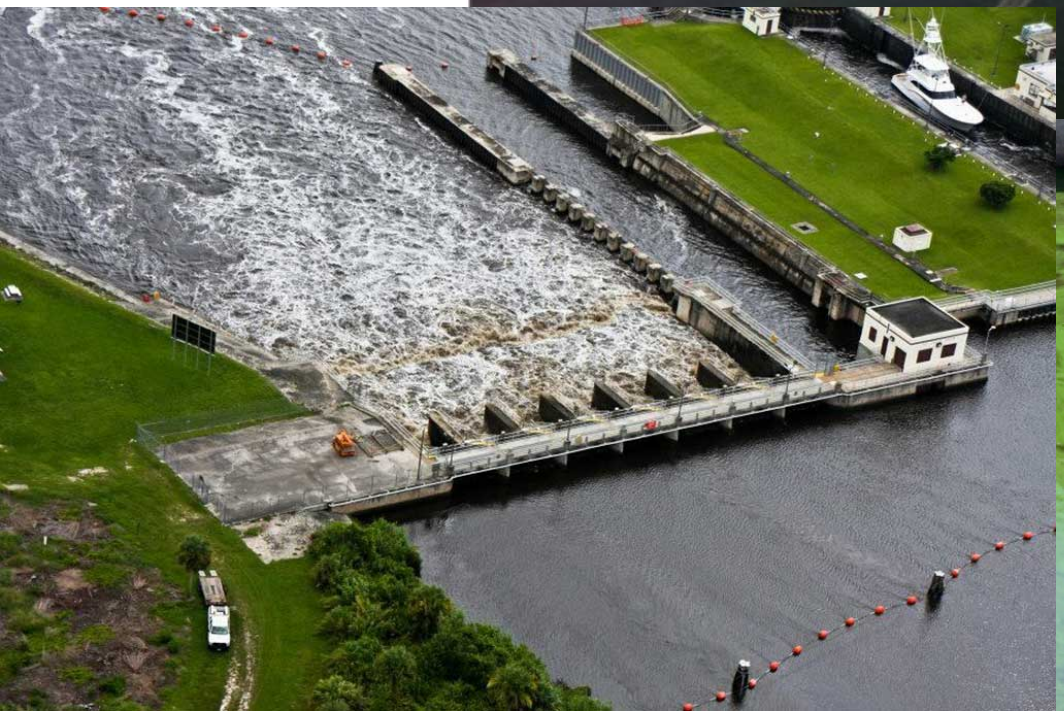

FLA.
Area of detail
Cape Canaveral
Indian River Lagoon
N
BREVARD
Atlantic Ocean
INDIAN RIVER
Vero Beach
OKEECHOBEE
ST. LUCIE
Stuart
MARTIN
Lake O.
Jupiter
PALM BEACH

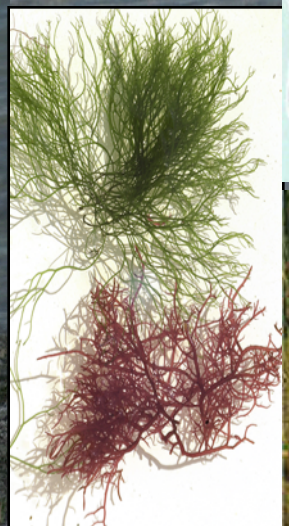


Historic and current flow of the Kissimmee, Okeechobee, Everglades watershed.

Graphic: U.S. Army Corps of Engineers, Jacksonville District

In the summer, 2013






(A)


(B)






“The Lost Summer”

Treasure Coast Photos

PHOTO BY ERIC HASERT

ERIC HASERT/TREASURE COAST NEWSPAPERS
The Derrenbacker family (from left) Stacey, Kyle, 9, Jenna, 14, Dave and Emily, 12, stand on their empty dock on the St. Lucie River behind their home on North Carolina Drive in Stuart. “If you can’t go in the water, then there’s no reason to have a boat. We look at this as a lost summer,” Dave Derrenbacker said.

Community Involvement Caught the Attention of Lawmakers

RESULT: State Investment

$220+ million awarded

17 projects

- Infrastructure
- Water Quality Monitoring
- Water Studies
- Restoration

FAU Harbor Branch's Real Time Water Quality Network the Indian River Lagoon & St. Lucie Estuary

fau.loboviz.com

The importance of estuaries to local economies is the most effective lever for change

Jacques Cousteau National Estuarine Research Reserve

RUTGERS THE STATE UNIVERSITY OF NEW JERSEY

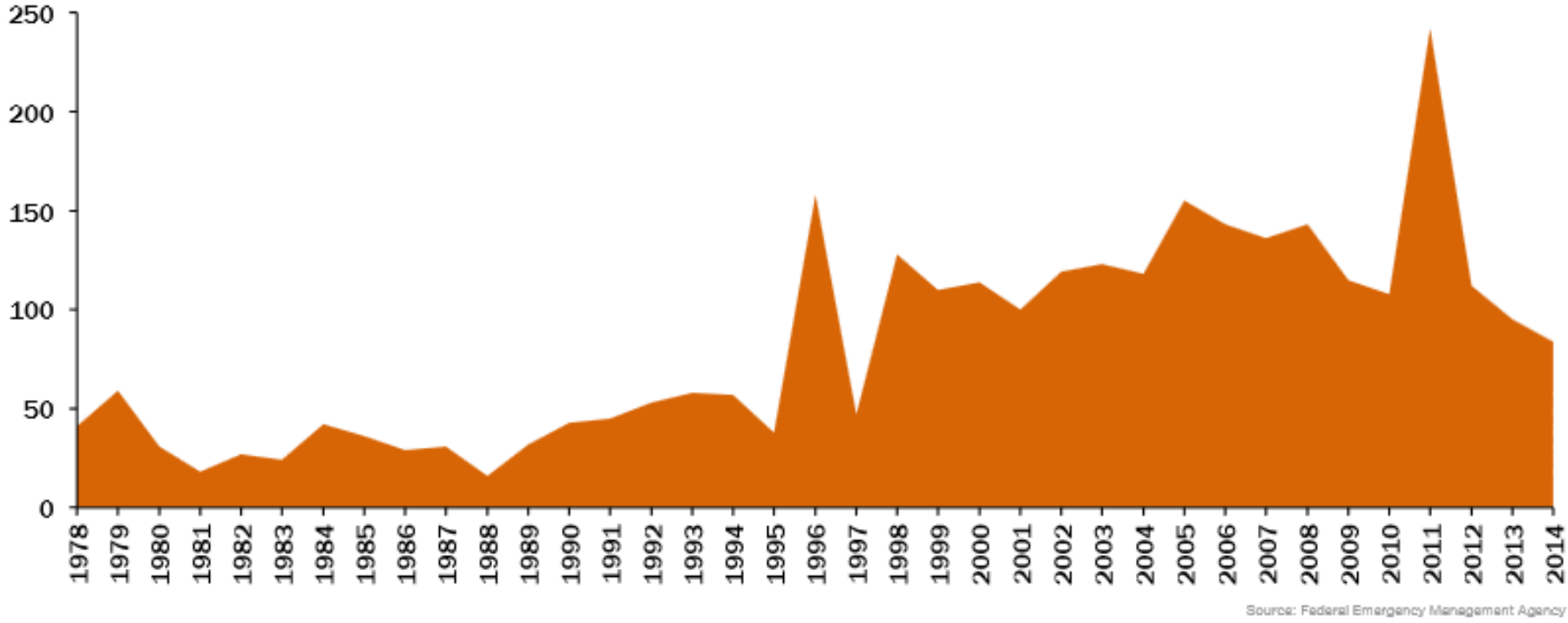
Coastal Resilience - Reducing the Cost and Vulnerability for Future Storms and Flooding


Katrina
2005
$108 billion


Ike
2008
$29.5 billion

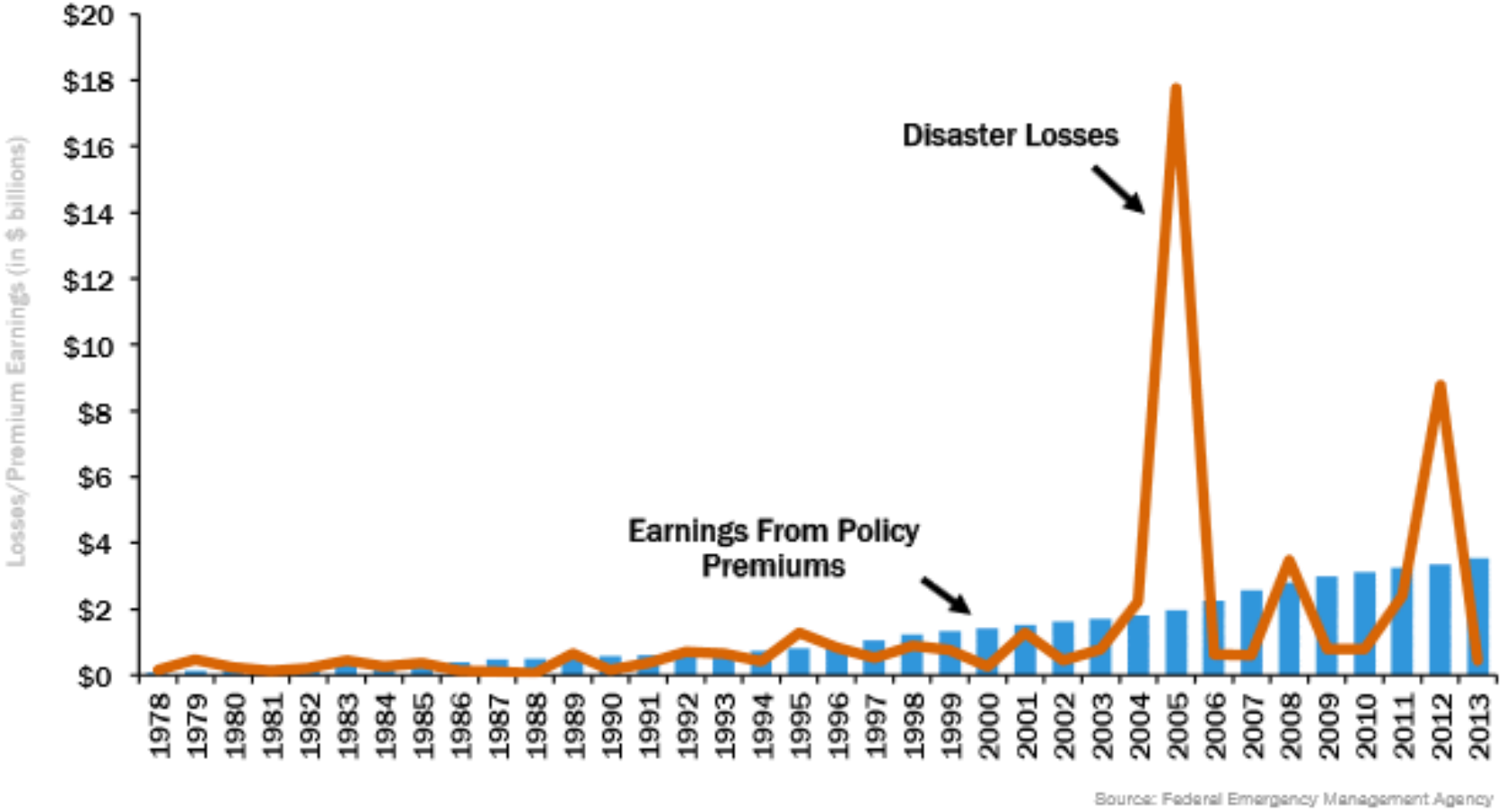

Sandy
2012
$50 billion

FEMA Disaster Declarations



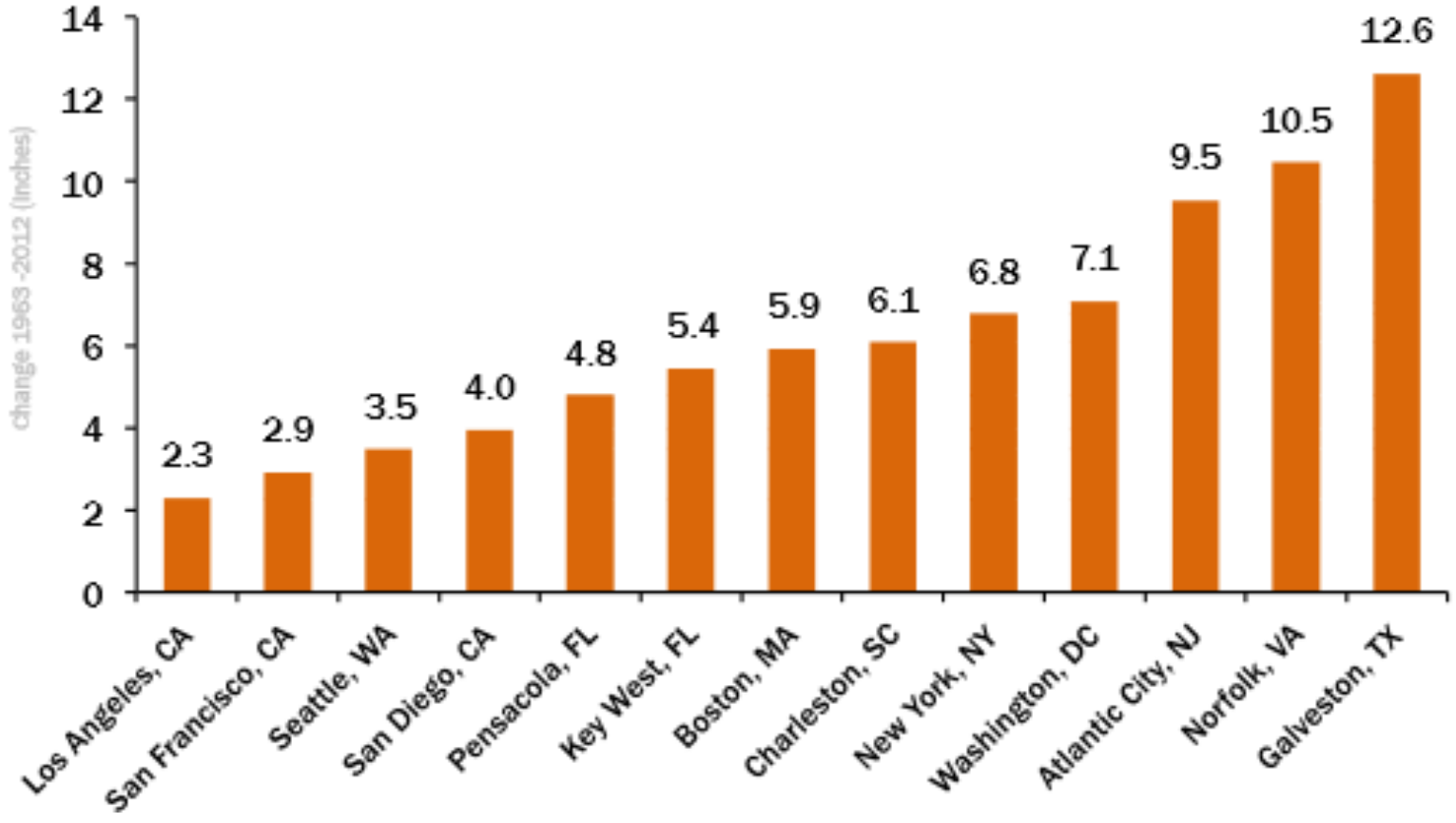
Source: FEMA

National Flood Insurance Program Losses Exceed Revenues



Source: FEMA

Highest Increases in Sea Level Rise



Source: Union of Concerned Scientists & NOAA

Spending on Disaster Recovery vs. Mitigation

(in $ millions)	FY11	FY12	FY13	Total
Disaster Recovery	$21,376	$32,412	$14,321	$68,109
Mitigation	$243	$197	$71	$510

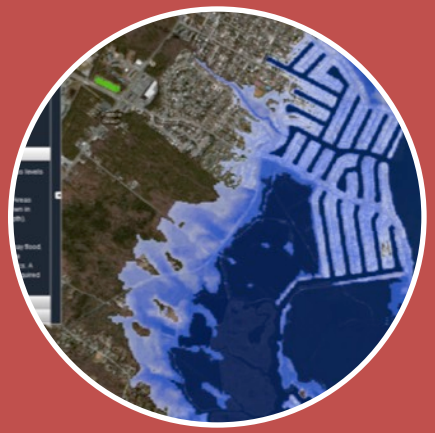
Source: Center for American Progress (excludes supplemental appropriations)

$1.00 spent by FEMA on hazard mitigation provides the nation about $4.00 in future benefits.

Sandy: The Change in the Coastal Conversation

Getting to Resilience

www.PrepareYourCommunityNJ.org



Assess

Evaluate Your Municipal Risks and Vulnerabilities

Plan

Utilize Getting to Resilience to Plan for the Future

Implement

Take Actions to Increase Municipal Preparedness

www.NJFloodMapper.org

Getting to Resilience

www.PrepareYourCommunityNJ.org

ASSESS

Use the online map visualize your comm current and future

PLAN

Complete an online municipal prepared public outreach act hazards.

IMPLEMENT

Utilize the resilienc to prioritize next st municipal actions. (http://www.prepar g/linkages/)

Plan

Utilize Getting to Resilience to Plan for the Future

www.PrepareYourCommunityNJ.org

Getting to Resilience

www.PrepareYourCommunityNJ.org

Municipal Plans

Master Plan

All-Hazards Mitigation Plan

Floodplain Management Plan

Evacuation Plan

Emergency Response Plan

Continuity of Operations Plan

Disaster Recovery Plan

Open Space Plan

Stormwater Management Plan

Getting to Resilience

www.PrepareYourCommunityNJ.org

Municipal Members

Land use Planners

Hazard Mitigation Planners

Floodplain Managers

Emergency Managers

Stormwater Managers

Natural Resource Managers

Municipal Engineers

Town Administrators

Construction Code Official

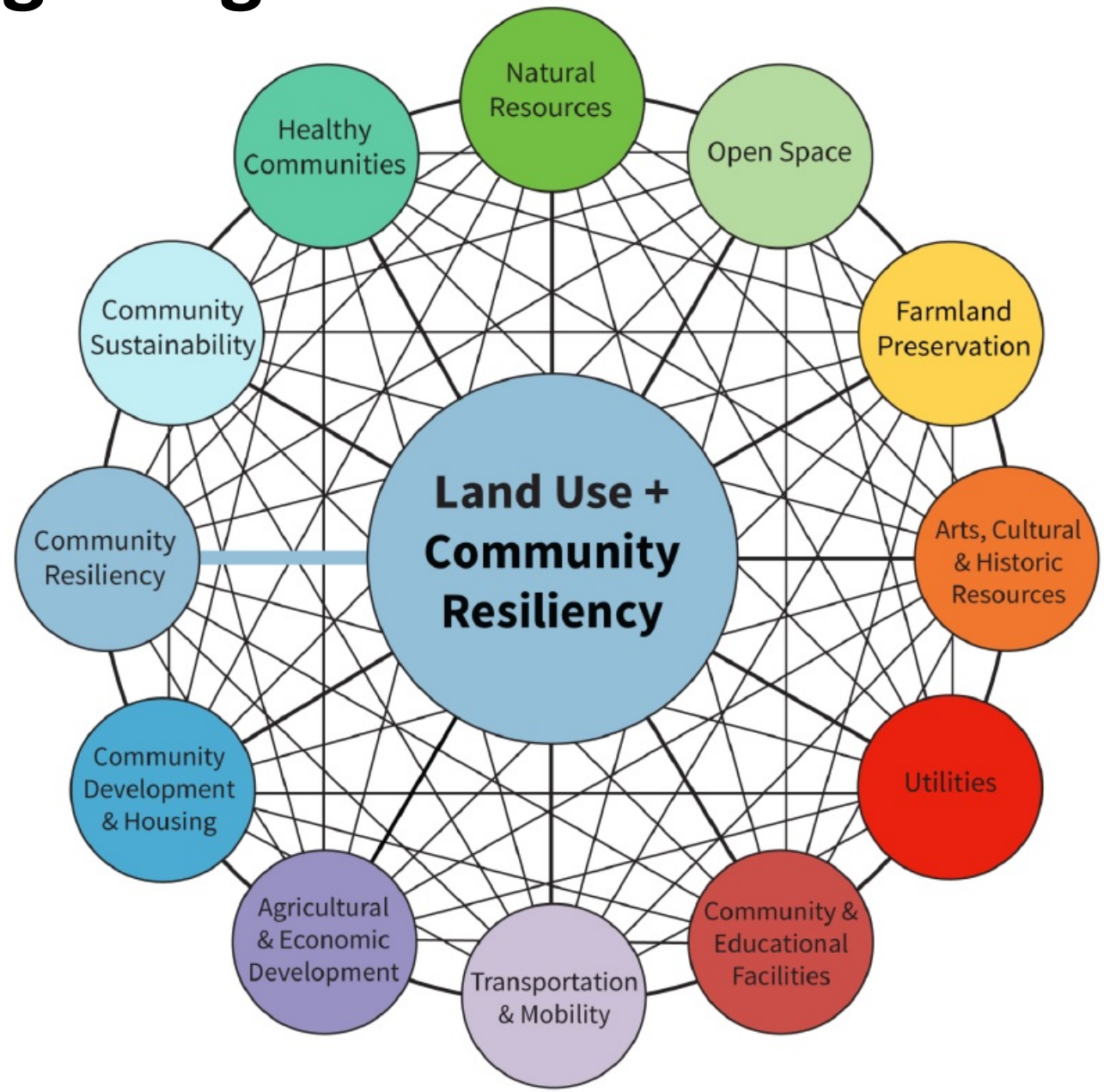
Environmental Commissioners

Clerks

Risk and Vulnerability Assessments

Public Engagement

Planning Integration



Disaster Preparedness and Recovery

Hazard Mitigation Implementation

Getting to Resilience

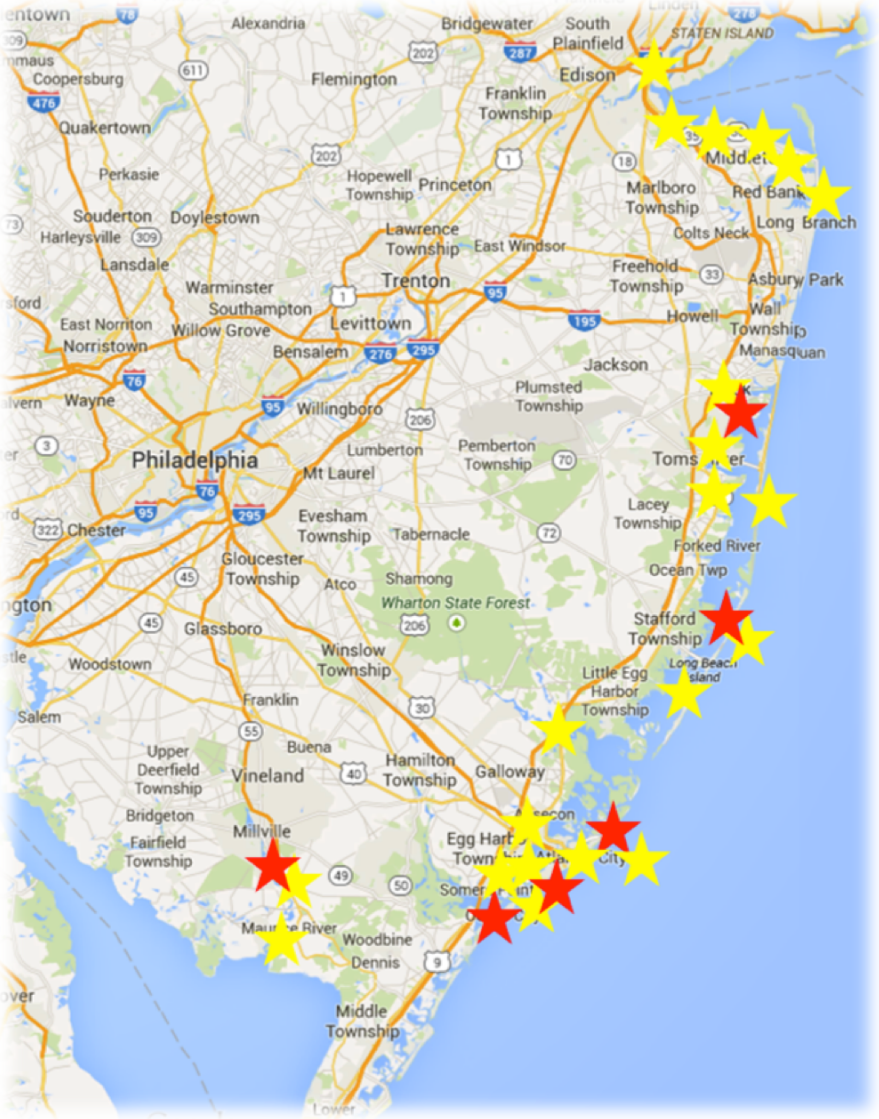
www.PrepareYourCommunityNJ.org

- Community Rating System
- Hazard Mitigation Planning Actions
- Municipal Certification

Outcomes

★ New Jersey Success Stories

★ GTR Communities: recommendations report finalized, writing completed or in process



34 Communities have participated in “Getting to Resilience”.

Success

Brigantine: CRS Class 6 to 5

Getting to Resilience

www.PrepareYourCommunityNJ.org

Assess

Evaluate Your Municipal Risks and Vulnerabilities

Plan

Utilize Getting to Resilience to Plan for the Future

Implement

Take Actions to Increase Municipal Preparedness

Where are we going…

Jacques Cousteau National Estuarine Research Reserve

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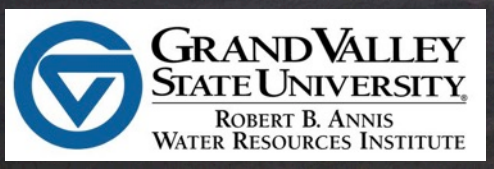
$1.00 spent to prevent damages provides the nation about $4.00 in future benefits.

Ecosystem Restoration in the Great Lakes Yields Significant Return on Investment

Alan Steinman
Annis Water Resources Institute,
Grand Valley State University



Great Lakes

- ~ 90% of US surface fresh water
- ~ 35 million people reside in the Great Lakes basin
- Source of drinking water, transportation, recreation, manufacturing, aesthetics, wildlife habitat

Improvement	Present Value Benefit (relative to baseline)
Increased fish	$1.2-$6.0 billion
Reduced water pathogens	$2-$3 billion
Improved water clarity	$4.5 billion
Improved habitat: birds and waterfowl	$100-$300 million
Clean up AOCs	$12-$19 billion
Housing Values	$29-41billion
Total Specific Benefits	**$69-$81 billion**

www.healthylakes.org/site_upload/upload/America_s_North_Coast_Report_07.pdf

Great Lakes


Jackfish Bay
Peninsu Harbor
Nipigon Bay
Thunder Bay
Torch Lake
Deer Lake - Carp Creek/River
St. Louis Bay/River
Manistique River
Menominee River
Fox River/ Lower Green Bay
Sheboygan River
Milwaukee Estuary
White Lake
Waukegan Harbor
Muskegon Lake
Kalamazoo River
Saginaw Bay
Grand Calumet River/ Indiana Harbor Canal
Maumee River
River Raisin
Rouge River
Detroit River
Black River
Ashtabula River
Cuyahoga River
Presque Isle Bay
Hamilton Harbour
Buffalo River
Niagara River
Eighteen Mile Creek
Oswego River
River (Cornwall/ Massena)

Muskegon Lake

Photo: From the Collection of the Muskegon County Museum

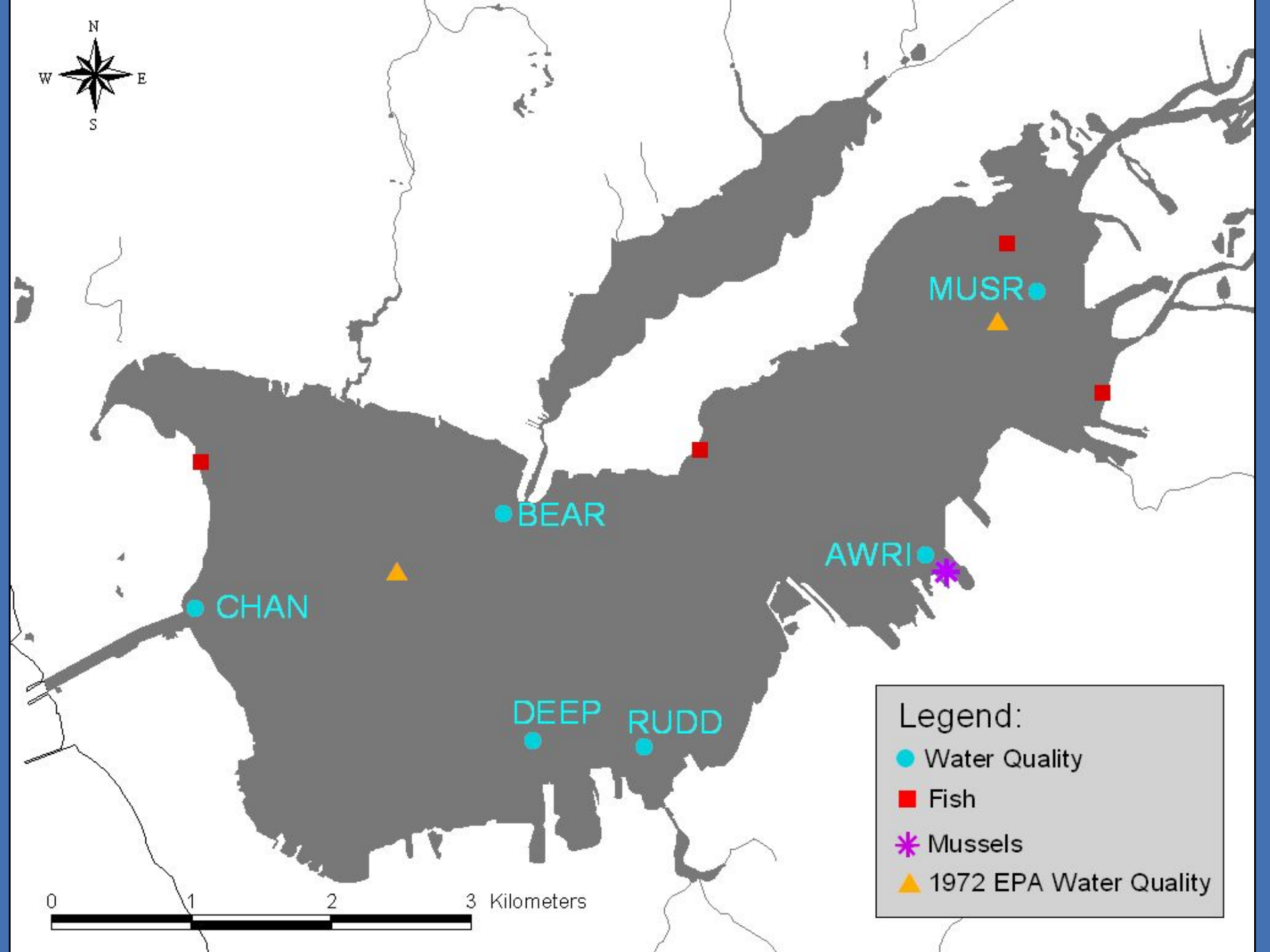
Photo: Marge Beaver

- 17 km^2 drowned river mouth lake
- Direct connection to Lake Michigan
- Historical industrial activities caused habitat degradation
- 315 ha of nearshore habitat filled

Muskegon 1889

Muskegon Lake, MI: 1900-1960

- Over 16% of open water filled in
- 65% of the shoreline had been hardened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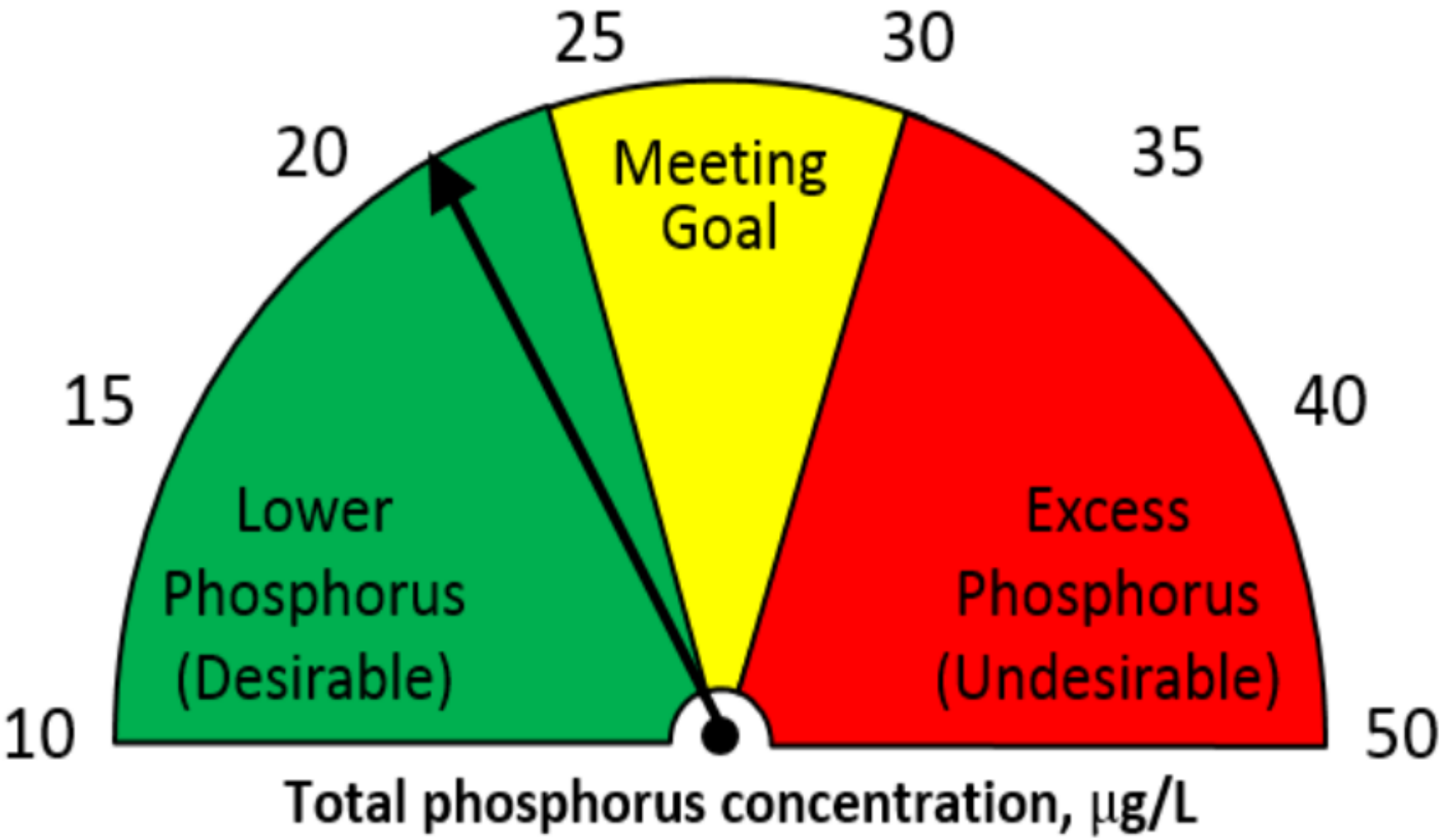
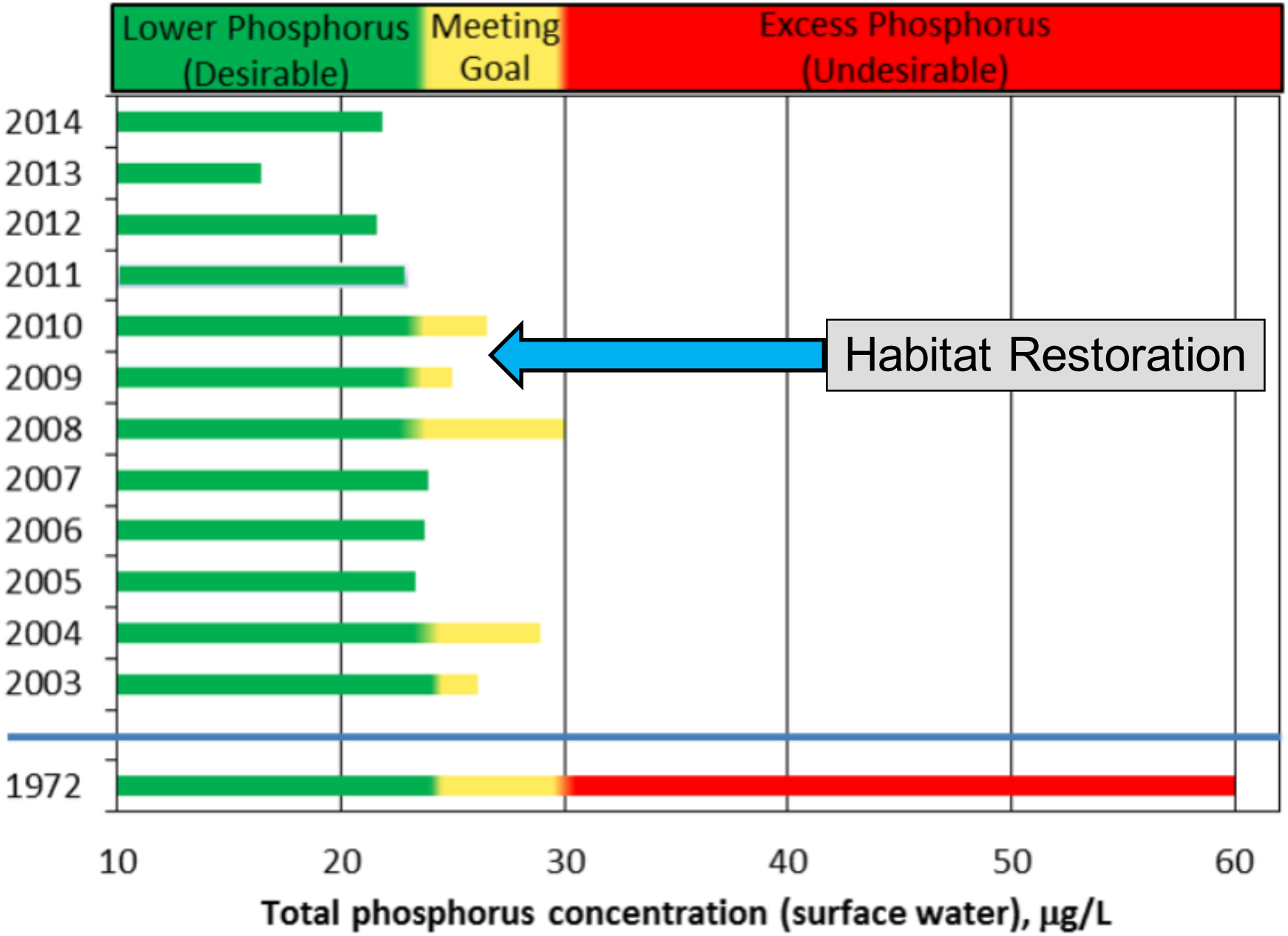
BEAR
AWRI
CHAN
DEEP
RUDD
Legend:
Water Quality
Fish
Mussels
1972 EPA Water Quality
0
1
2
3 Kilometers

Muskegon Lake Water Quality Dashboard : 2014

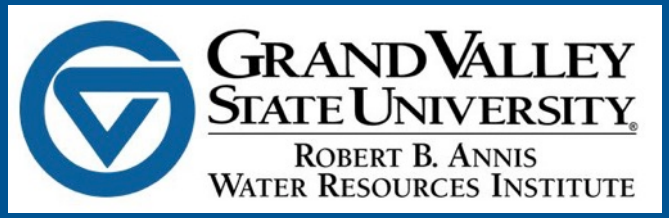


http://www.gvsu.edu/wri/director/muskegon-lake-water-quality-dashboard-78.htm

Historical Status (1972, 2003-2014)



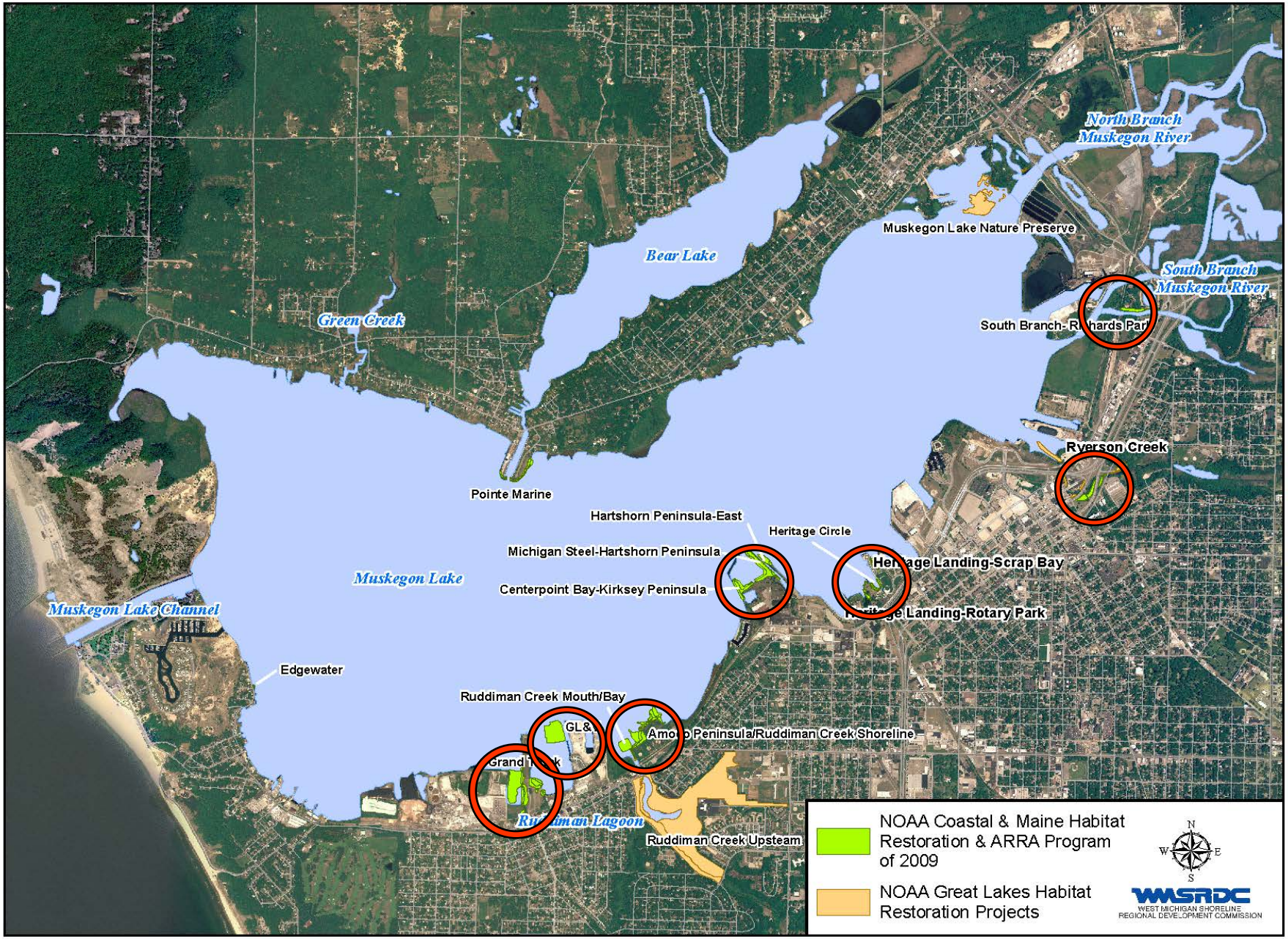
Muskegon Lake Area of Concern Habitat Restoration Project Partners



- $10 million project: American Recovery and Reinvestment Act (NOAA)

Muskegon Lake Habitat Restoration Project

- Restoration goals:
  - Soften ~3,050 m of hardened shoreline
  - Create or restore wetlands (11 ha)
  - Remove unnatural fill (10 ha): 135,000 yd^3
- Restoration design, construction, and monitoring


North Branch
Muskegon River
Muskegon Lake Nature Preserve
Bear Lake
South Branch
Muskegon River
Green Creek
South Branch- Richards Park
Ryerson Creek
Pointe Marine
Hartshorn Peninsula-East
Heritage Circle
Michigan Steel-Hartshorn Peninsula
Heritage Landing-Scrap Bay
Muskegon Lake
Centerpoint Bay-Kirksey Peninsula
Heritage Landing-Rotary Park
Muskegon Lake Channel
Edgewater
Ruddiman Creek Mouth/Bay
GL&
Amoco Peninsula/Ruddiman Creek Shoreline
Grand
Ruddiman Lagoon
Ruddiman Creek Upsteam
NOAA Coastal & Maine Habitat Restoration & ARRA Program of 2009
NOAA Great Lakes Habitat Restoration Projects
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WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Shoreline Restoration

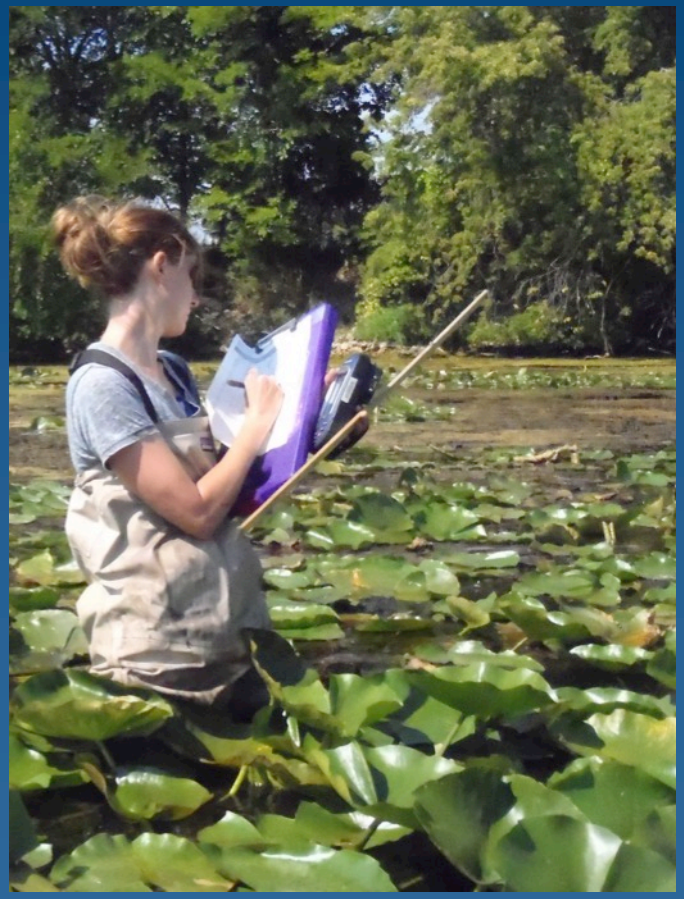
Before

After

Images: Kathy Evans

Monitoring

- 3 monitoring elements
  - Macrophytes
  - Fish
  - Socio-economics
- Used science to assess success and inform restoration design



Valuation of Remediation and Restoration in Muskegon L.

- Housing values
- Recreation values (CV)
- Use and non-use values

Results

- Housing value prediction: $11.9 million
- Contingent value prediction: $3.1 million
- Travel cost prediction: $6.06 million/yr
- Actual spending in Muskegon: $9.5 million

Return on Investment

Add hedonic value (real estate) to actual spending and the present value of travel cost predictions over 10 years:

$66.9 Million
($59.7 – $81.7 million)

Conservative estimate:

- No health benefits
- No effects counted outside Muskegon
- No multiplier effect
- Accounted for decreasing returns

Summary

- Created 80 jobs
- Retained 45 jobs
- Equal to 35,933 labor hours
- Economic impact: 6.6 ROI ($10 million investment resulted in $66 million)
- Enhanced civic pride

WATCH MUSKEGON