CAPE COASTAL CONFERENCE

Linking Science with Local Solutions and Decision-Making

State of the Cape's Bays and Estuaries: Threats and Impacts to Ecosystem Health

Christopher Neill
Marine Biological Laboratory

MBL

Cape Cod has a Water Problem

Causes

Nitrogen limits growth of algae in salt water

Coastal populations growing fast

Nitrogen comes from multiple sources

Nitrogen not removed by most wastewater treatment

Problem not limited to Cape Cod or Massachusetts

Consequences

Increased growth of phytoplankton, attached and free-living algae

Loss of eelgrass habitat

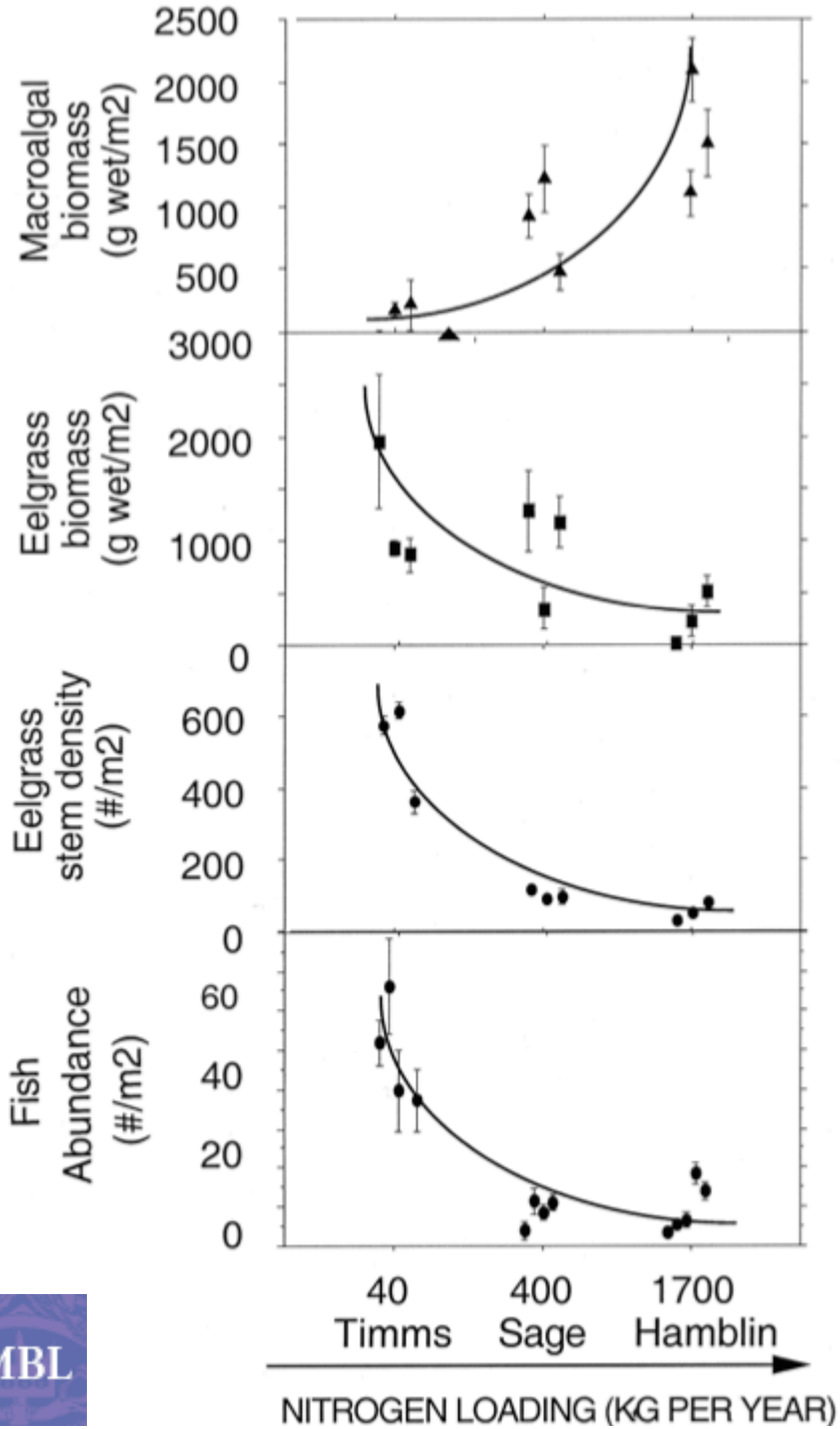
Loss of eelgrass nursery functions for fish and shellfish

More frequent hypoxia and fish/shellfish kills

Increased odors, lower quality of life and economic value

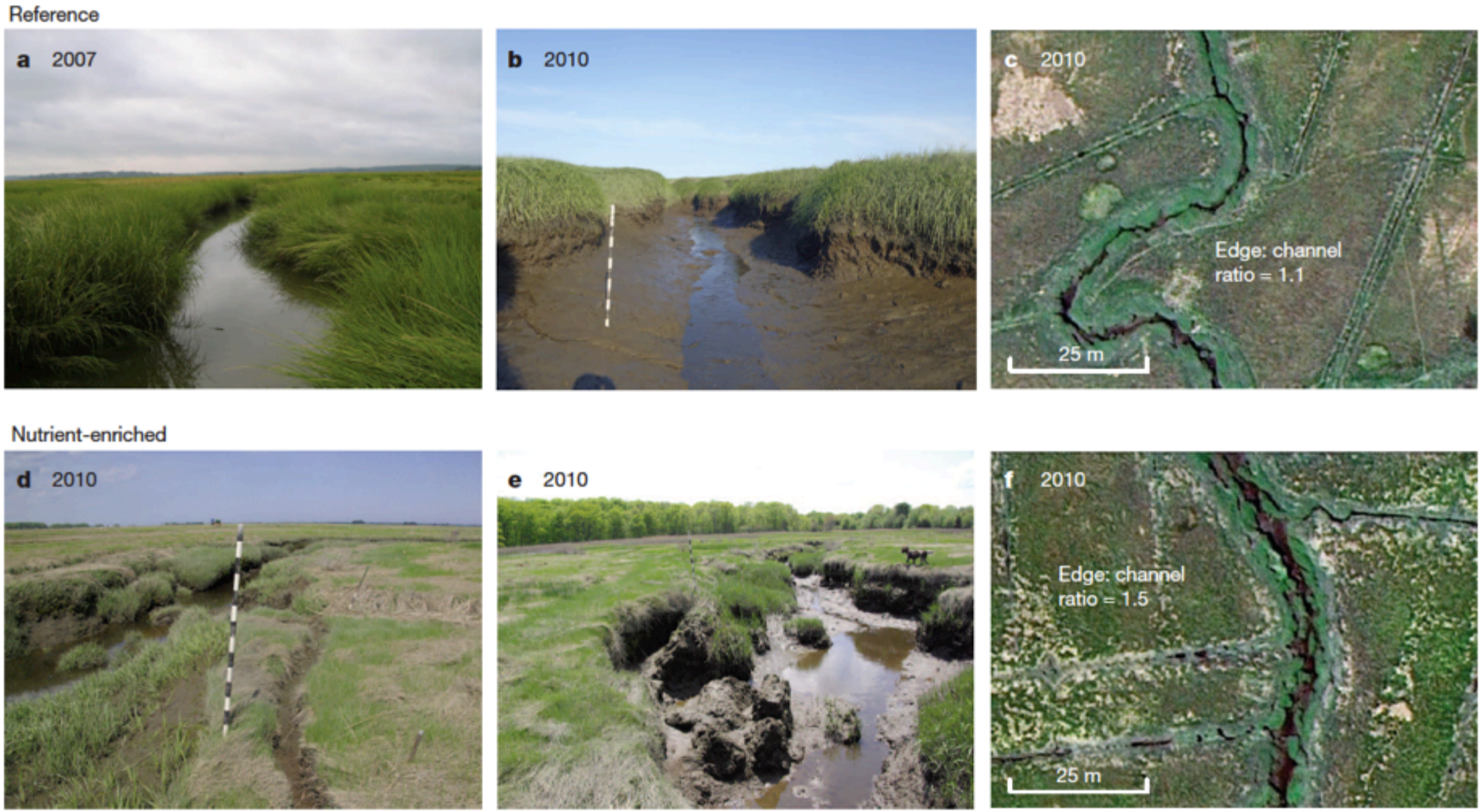
Photo Janice Welenc

Large Body of Science



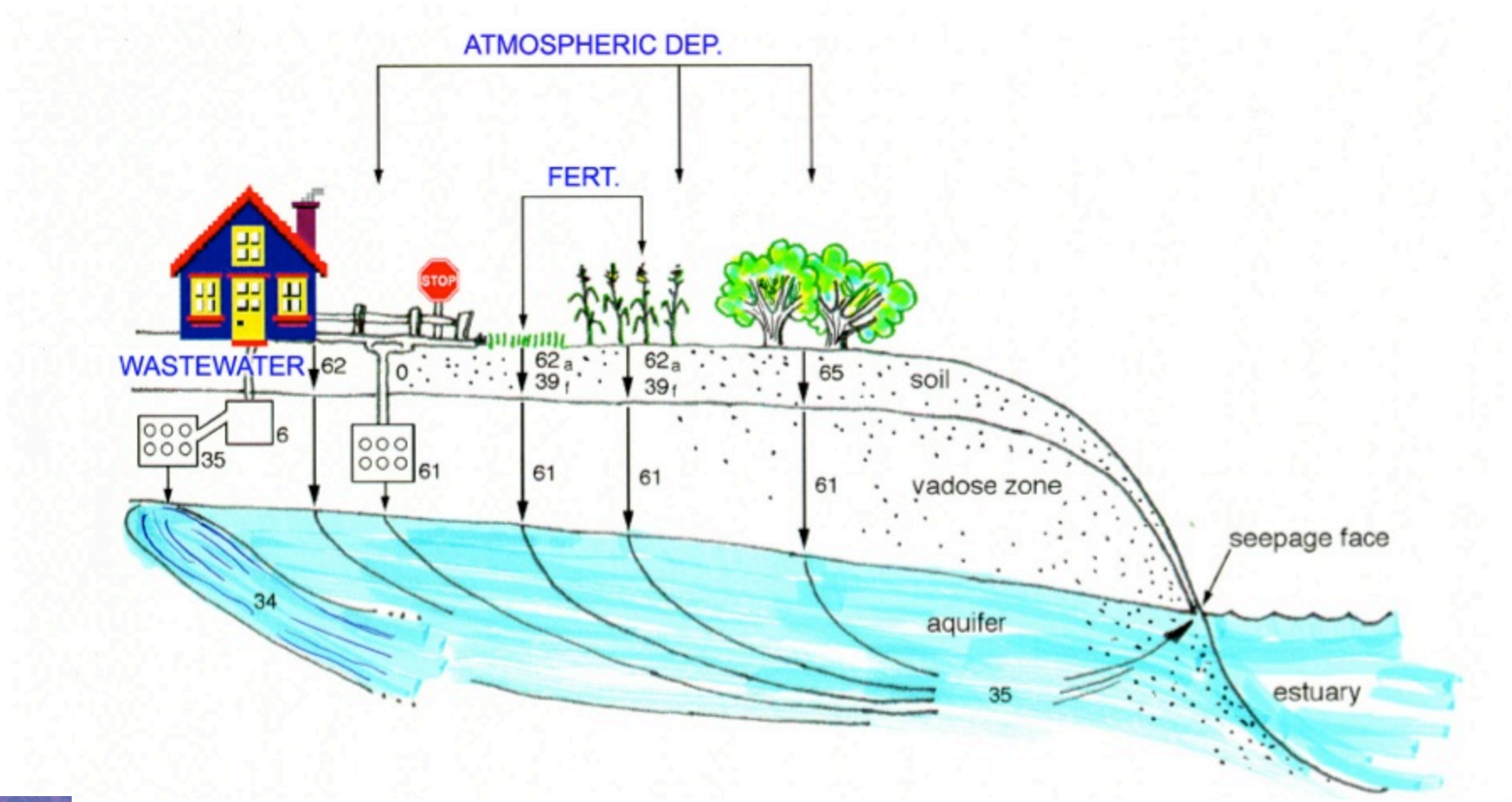
Deegan et al. 2002

Large Body of Science



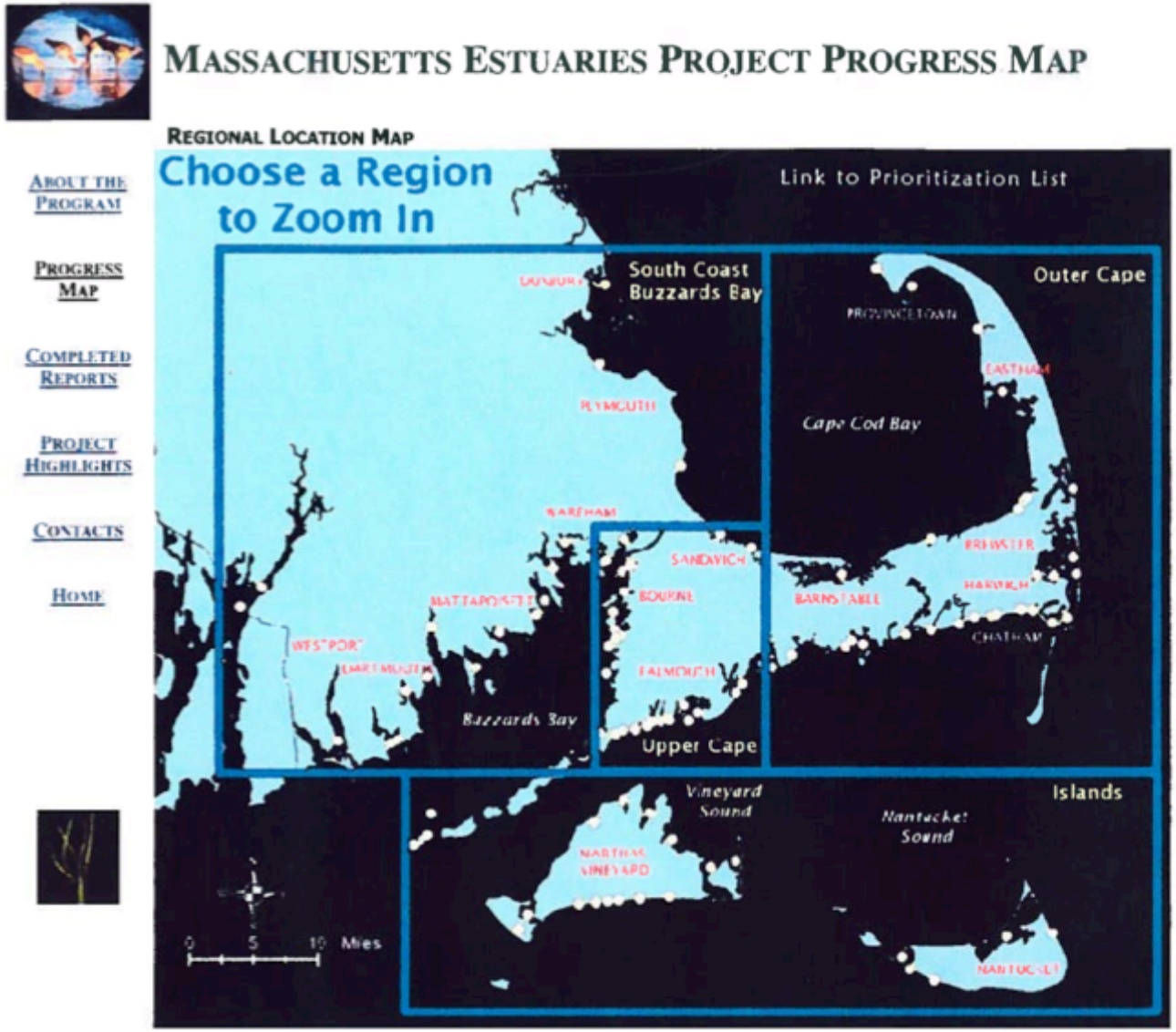
Deegan et al. 2012

Large Body of Science



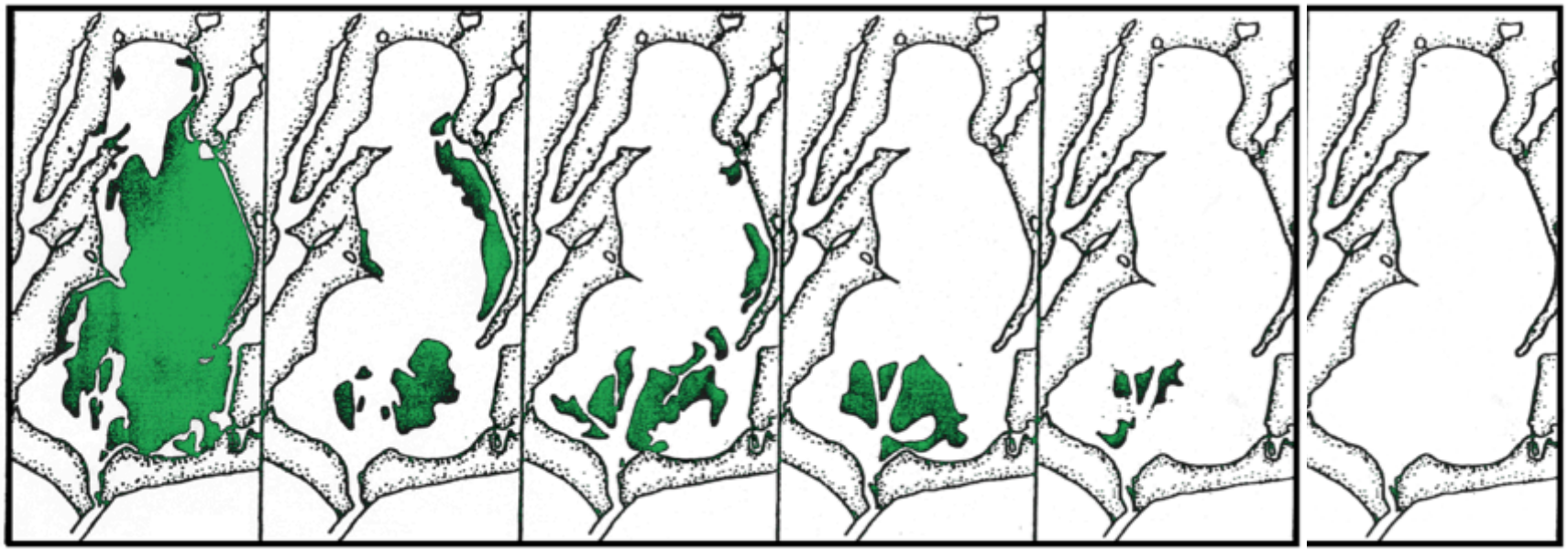
Valiela et al. 1997

Large Body of Science



Mass Estuaries Project

Monitoring Documents Decline

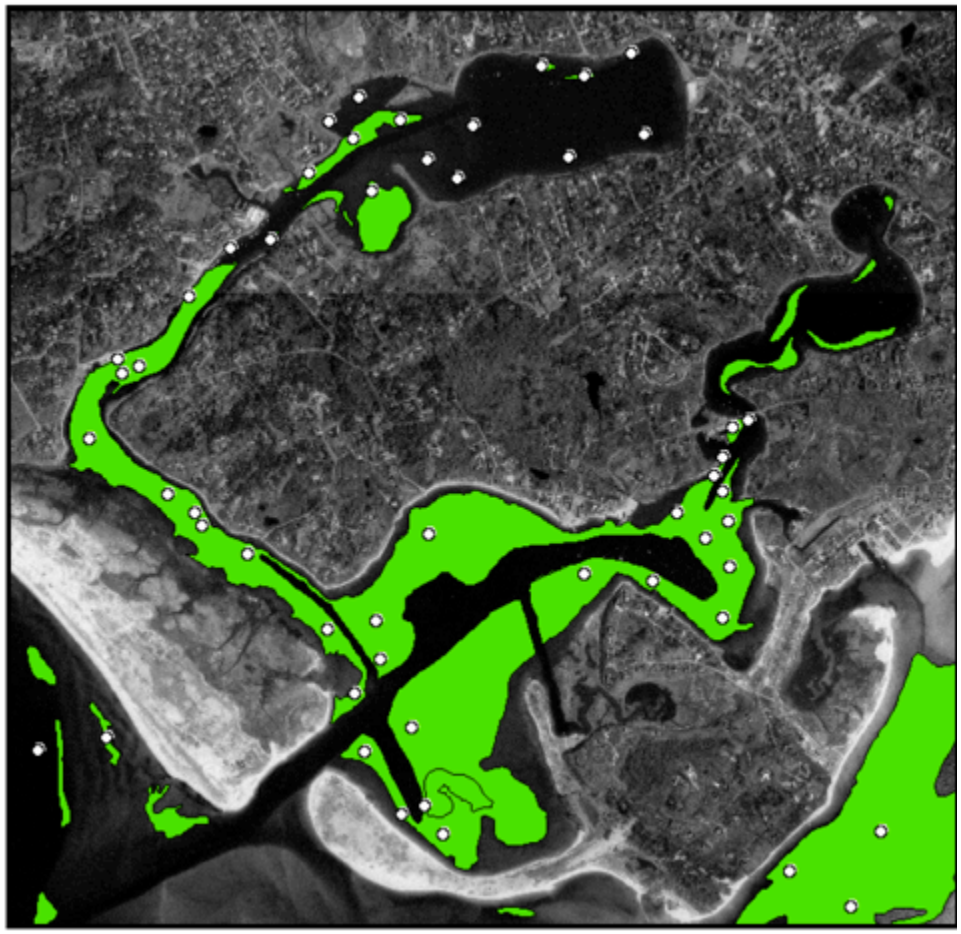


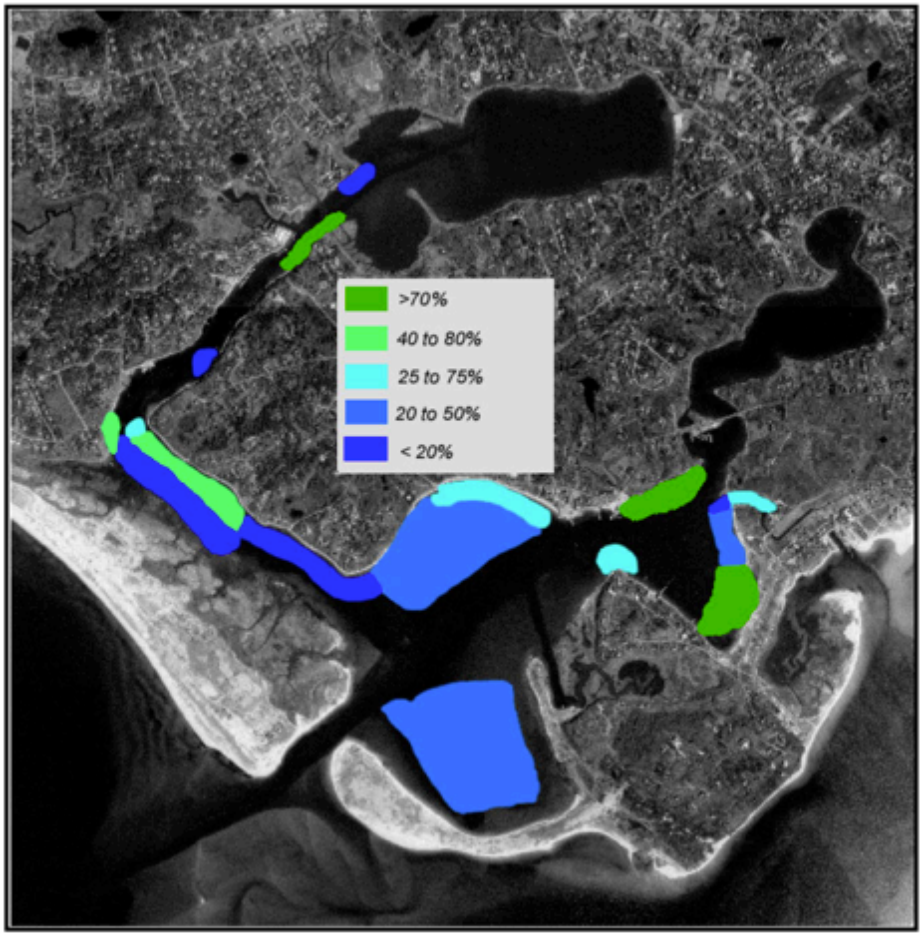
1951 1971 1978 1987 1992 2002

Waquoit Bay, Falmouth

Costa et al. 1992 and updates

Monitoring Documents Decline



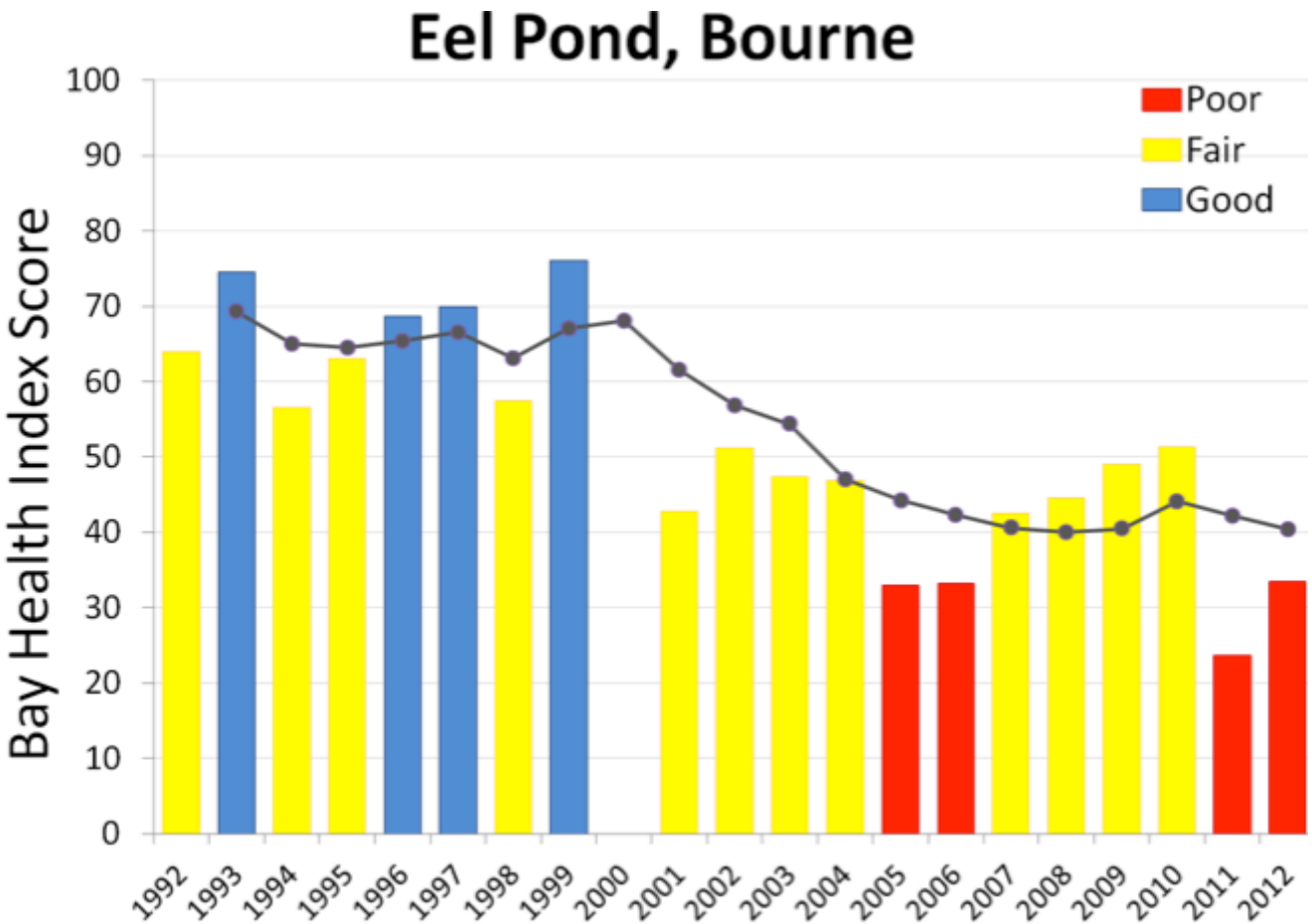


1994 2000

Stage Harbor, Chatham

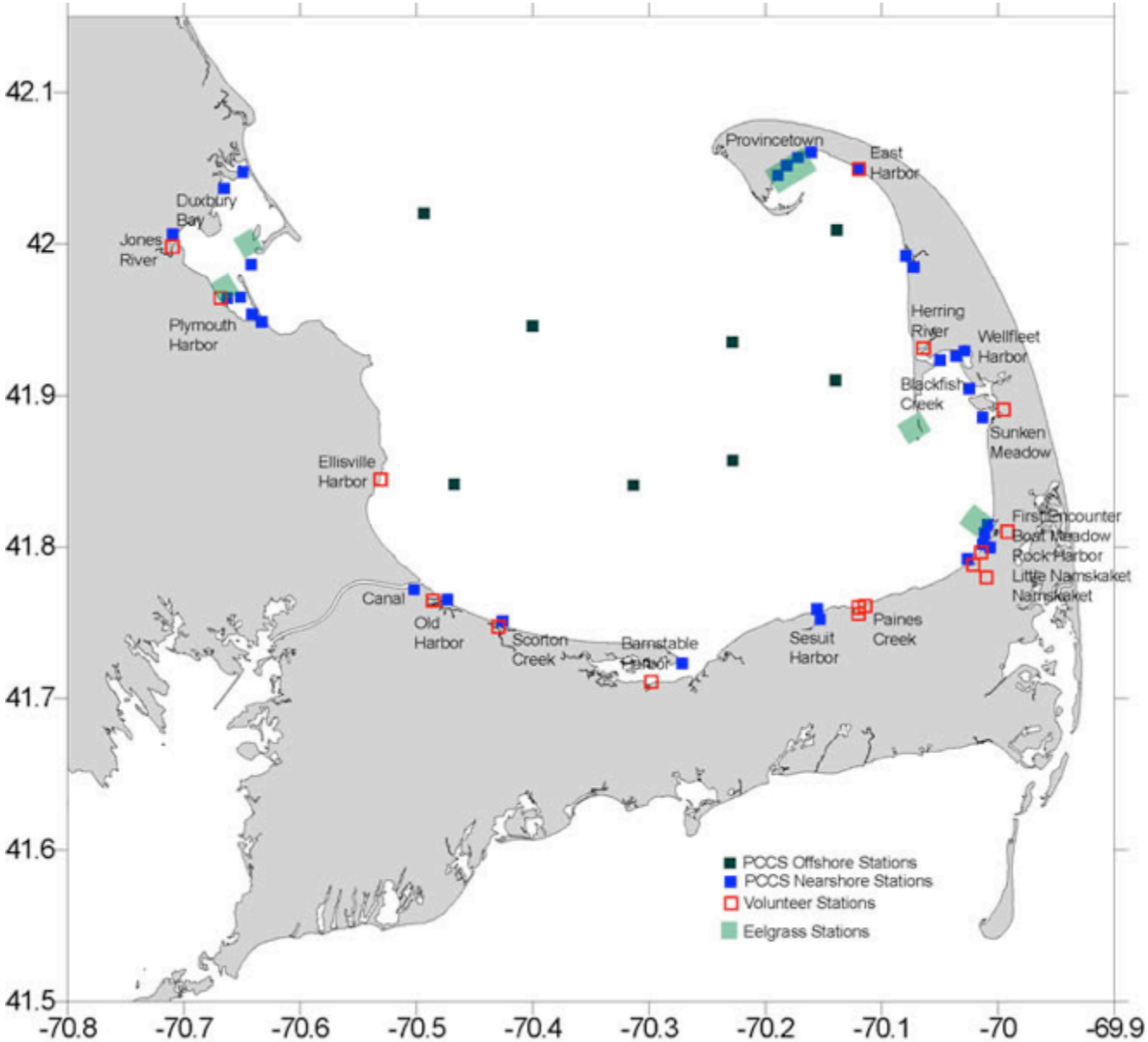
Mass Estuaries Project 2003

Monitoring Documents Decline



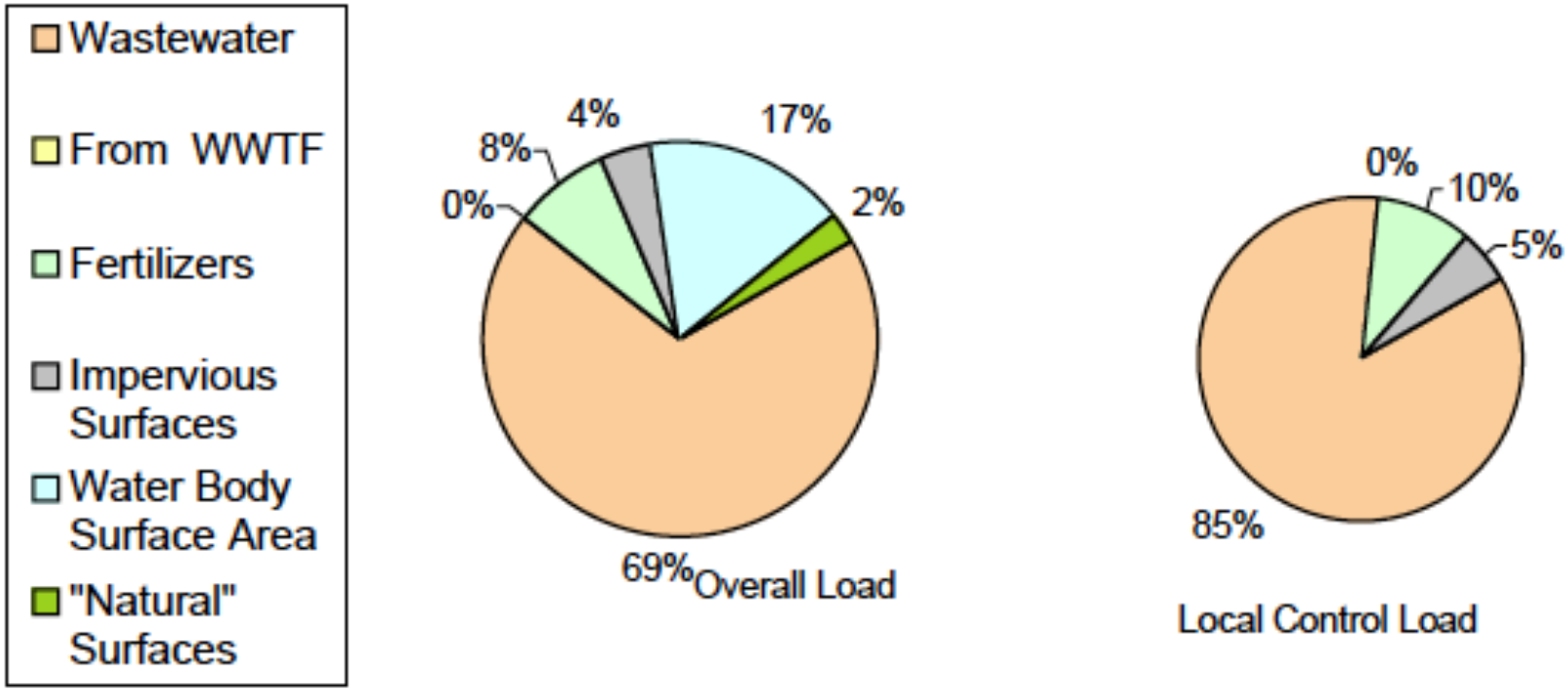
Buzzards Bay Coalition 2013

Monitoring Documents Decline



Provincetown Center for Coastal Studies 2013

Modeling Provides Path Forward



a. Three Bays System Overall

MBL

Mass Estuaries Project 2006

Modeling Provides Path Forward

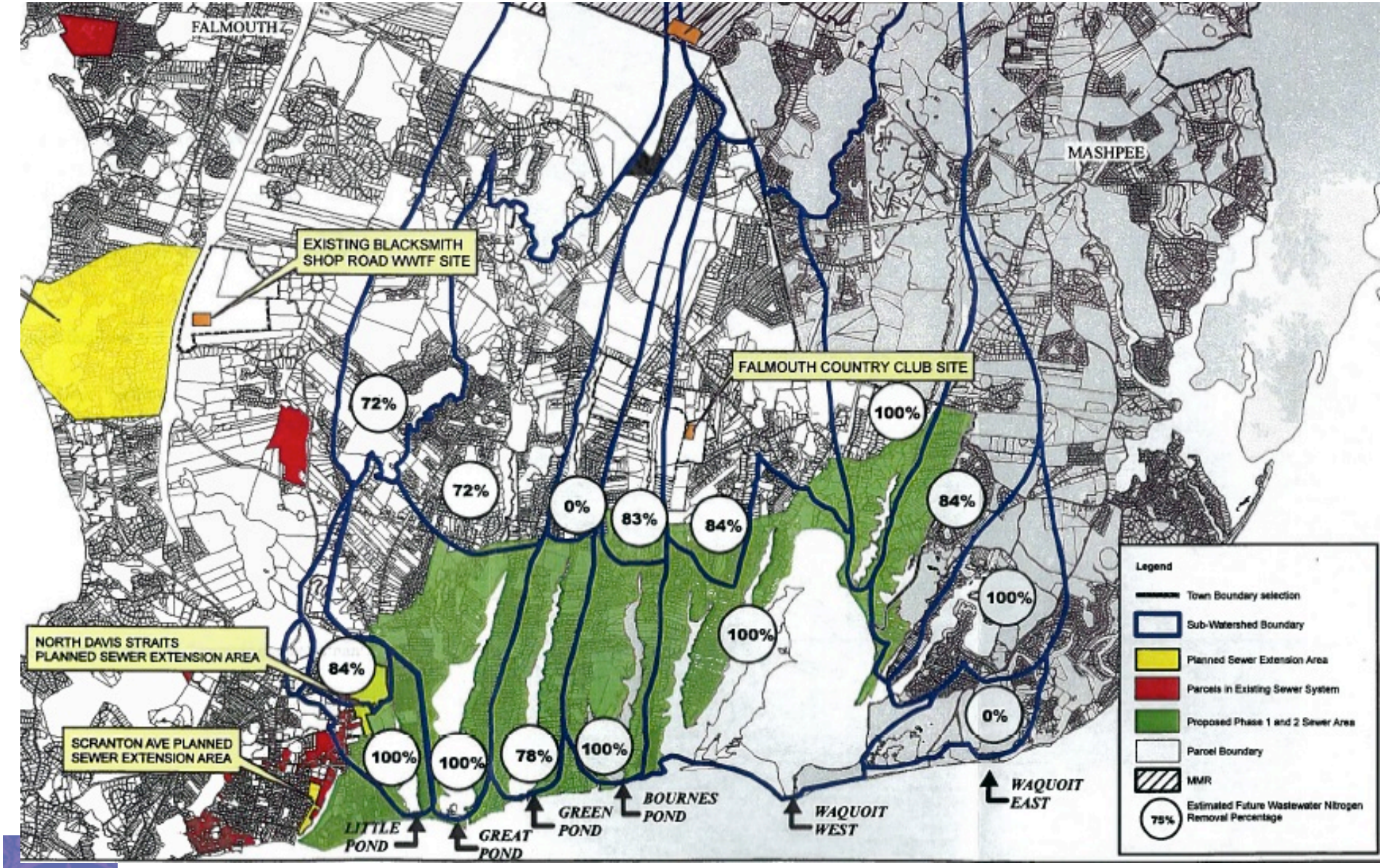
Table VIII-2. Comparison of sub-embayment watershed septic loads used for modeling of present and threshold loading scenarios of the South Coastal embayments and Stage Harbor systems. These loads represent groundwater load contribution from septic systems only, and do not include runoff, fertilizer, atmospheric deposition and benthic flux loading terms.

Sub-embayment	Present Septic Load (kg/day)	New Septic Load (kg/day)	Threshold % Change
Stage Harbor			
Oyster Pond	11.16	0.11	-99%
Oyster River	9.69	0.79	-92%
Stage Harbor	2.32	0.00	-100%
Mitchell River	5.57	2.66	-52%
Mill Pond	1.55	0.59	-62%
Little Mill Pond	1.35	0.65	-52%
Sulphur Springs			
Sulphur Springs	13.74	6.67	-52%
Bucks Creek	3.51	1.62	-54%
Cockle Cove Creek	2.72	2.72	0%
Waste Water TF	3.03	3.03	0%
Taylors Pond			
Mill Creek	5.33	2.14	-60%
Taylors Pond	7.11	2.91	-59%

MBL

Mass Estuaries Project 2007

Modeling Provides Path Forward



MBL

Mass Estuaries Project 2005

Between a Rock and a Hard Place

Cannot achieve goals without treating wastewater

Very high level treatment required to meet N removal goals

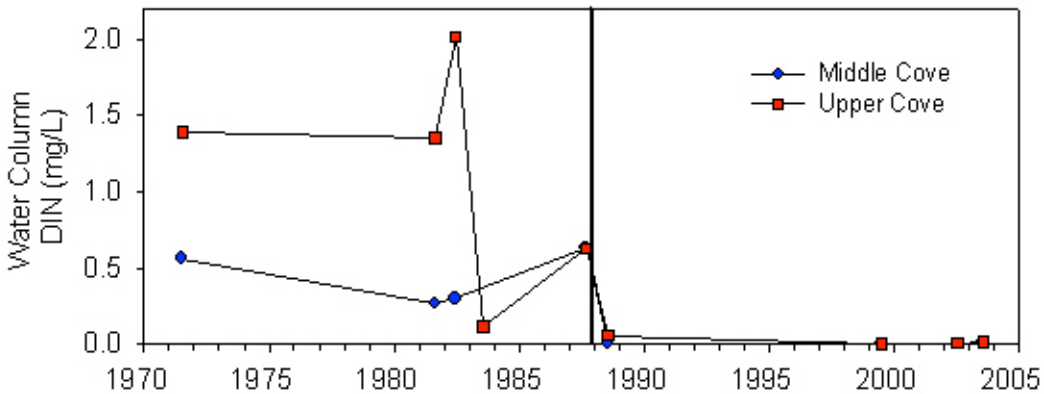
High level of treatment expensive and energy intensive

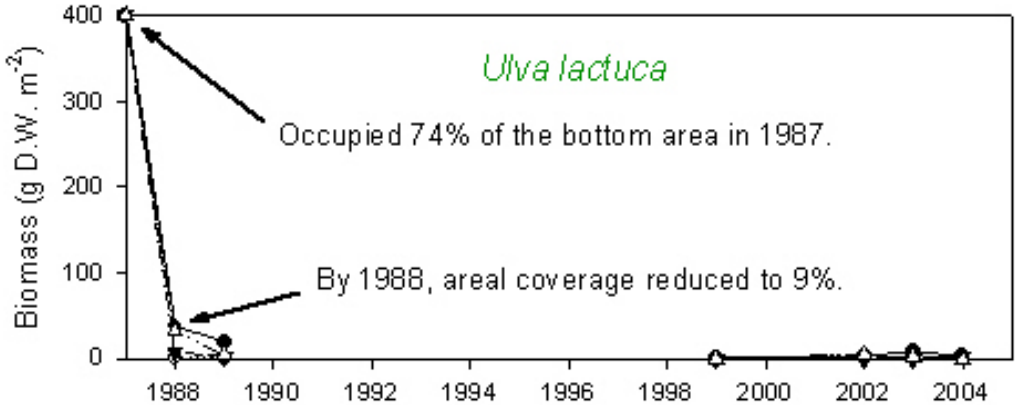
State encourages return of water to same watershed

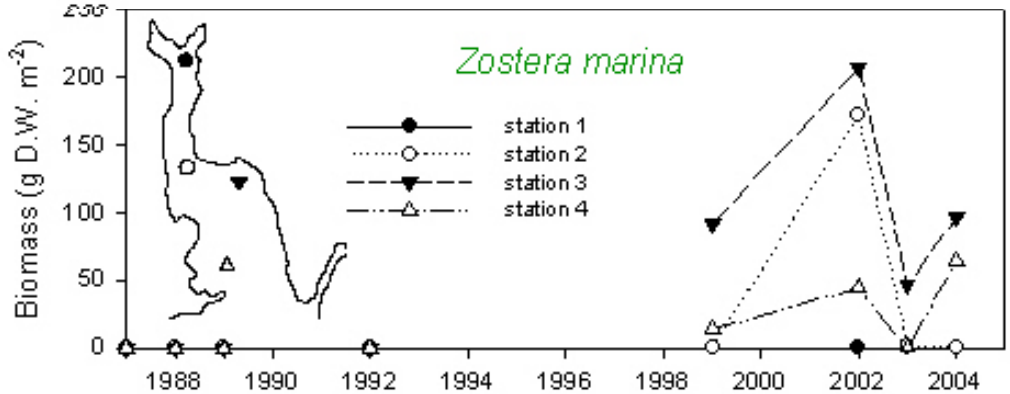
Backyard denitrification systems not reliable

Cheapest alternatives less palatable and hard to mandate

Mumford Cove, Connecticut Case Study



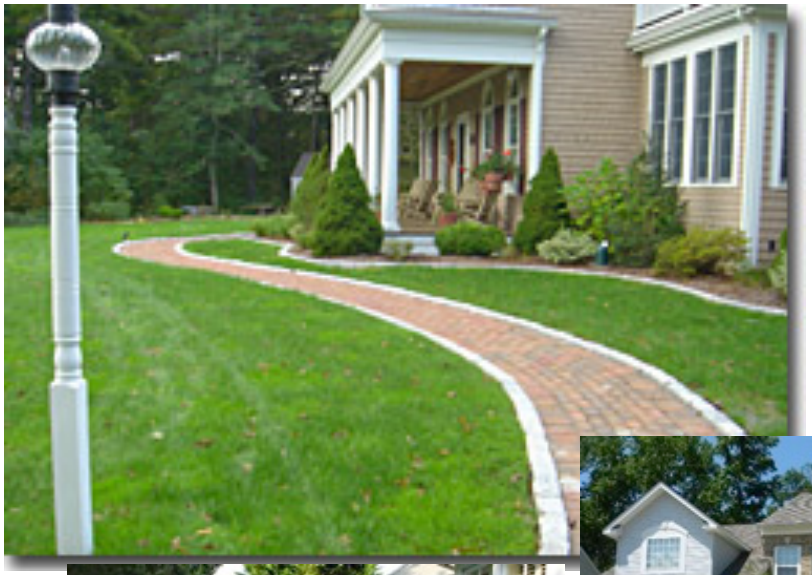




Univ. of CT, CT DEP

A Way Forward

Low Hanging Fruit

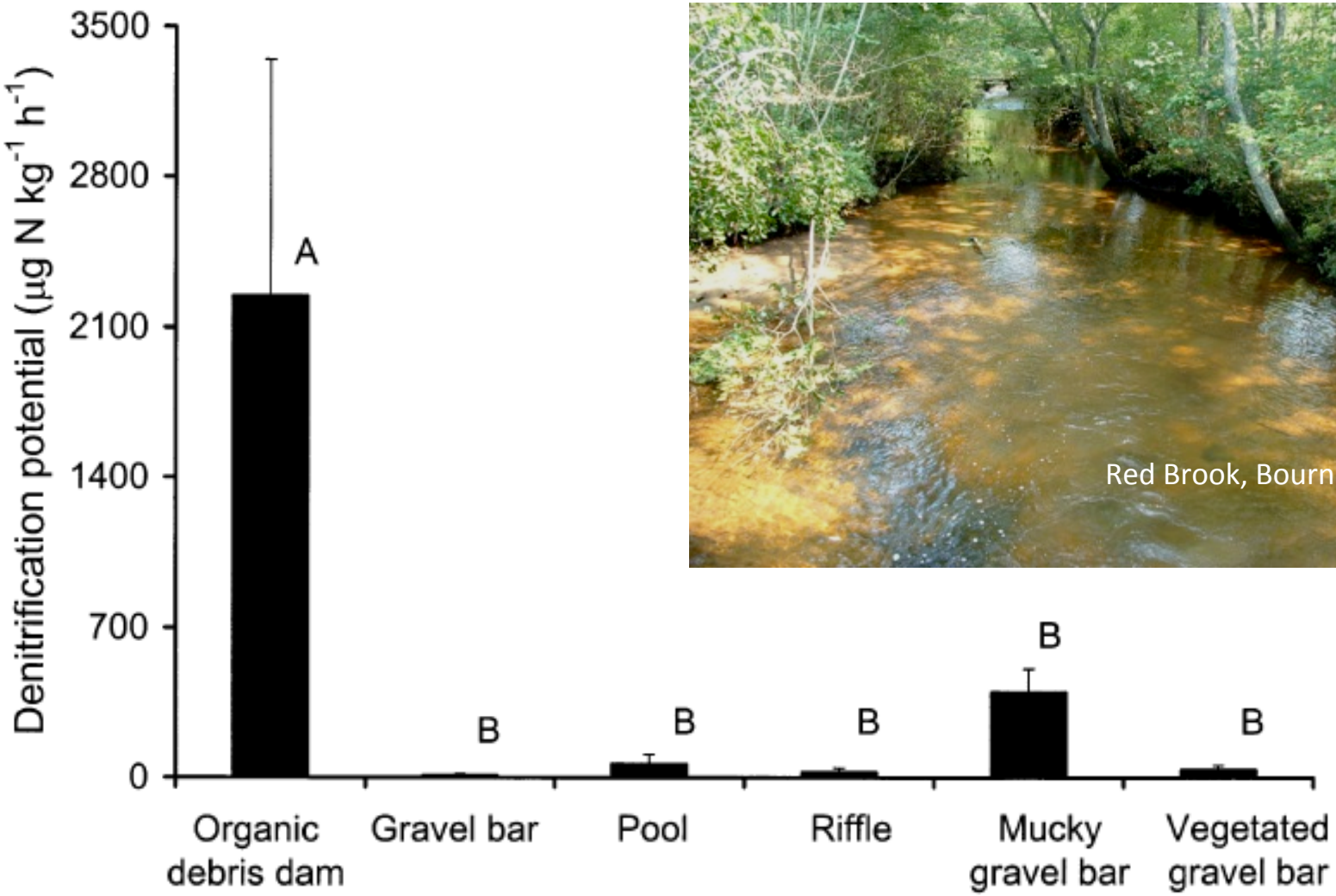


MBL

A Way Forward

Low Hanging Fruit

Enhance Ecosystem Service of N Removal



Groffman et al. 2005

A Way Forward

Projects in Phases

Voters approved a $3.4 million Proposition 2½ debt exclusion to fund a water filtration plant for the town's main water source at Long Pond and an additional $5.6 million to begin implementation of the town's comprehensive wastewater treatment plan. That question passed 5,094 to 3,646, with **58 percent** voting in favor.

CAPE COD TIMES

MBL

May 22, 2013

A Way Forward

Good Science is Essential (and Valuable)

Multiple Approaches

Restoration as Experiment

MBL

THE UNIVERSITY OF CHICAGO