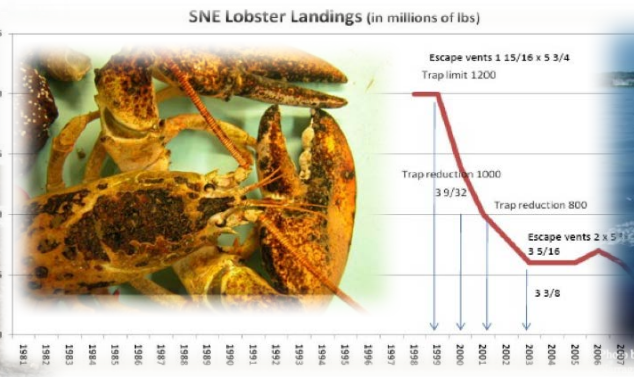
Managing diseases affecting Rhode Island Shellfisheries

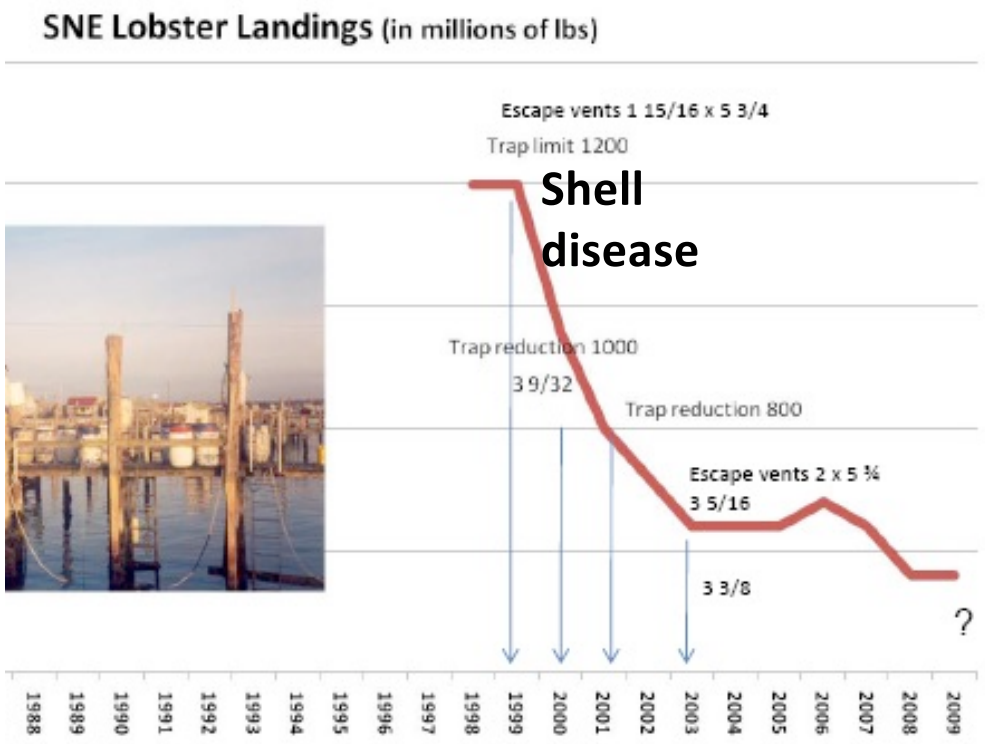
Marta Gomez-Chiarri, University of Rhode Island
gomezchi@uri.edu

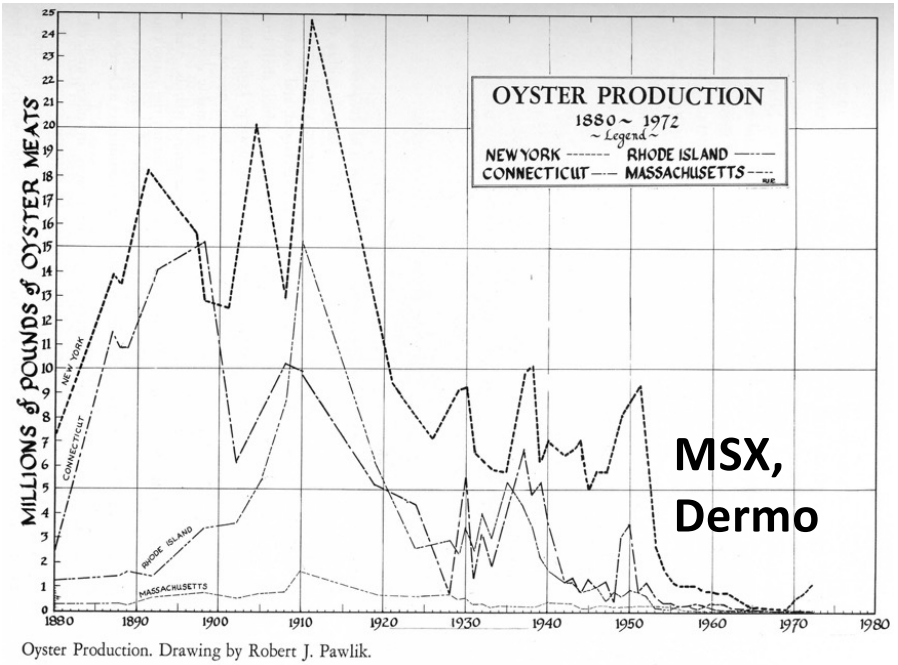
UNIVERSITY OF Rhode Island
Rhode Island NSF EPSCoR
USDA Northeastern Regional Aquaculture CENTER



1990 **1997-1998** **2003** **2010 - 2013**

The role of disease mortality on fisheries



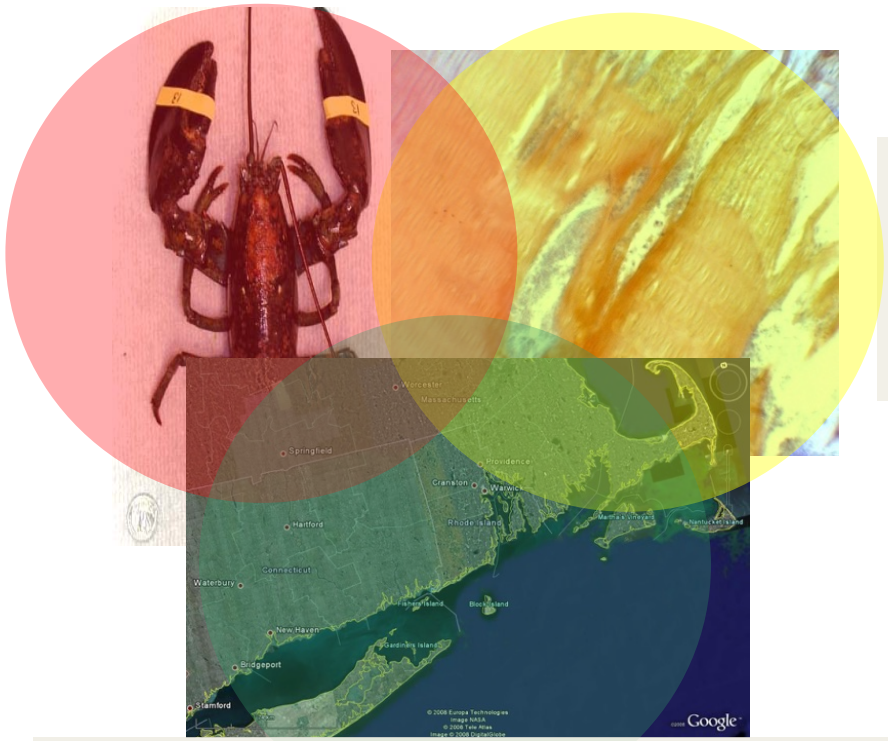


Oyster Production. Drawing by Robert J. Pawlik.

From Kochiss 1974. Oystering from New York to Boston (courtesy of R. Rheault)

Understanding and Managing Diseases

HOSTS
Immunity
Physiology
Genetics

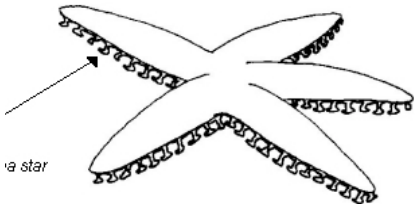


PATHOGENS
Microbial
community
Interactions

ENVIRONMENT
Temperature, Hypoxia, Acidification,
Storms, Food availability, Pollutants

Managing Diseases of Marine Organisms

Pathology Microbiology Biochemistry Chemistry Immunology Nutrition Genetics Genomics Ecology

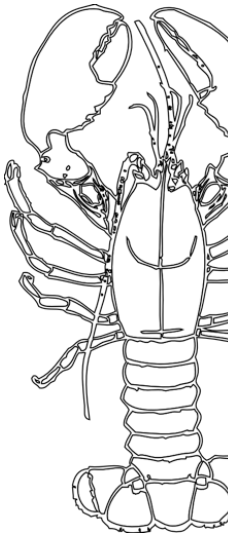


Identification

Mechanisms disease resistance

Monitoring

Host-Pathogen-Microbe Interactions



Impact of the environment

Tool development, outreach

Rhode Island NSF EPSCoR
Experimental Program to Stimulate Competitive Research

BROWN THE UNIVERSITY OF RHODE ISLAND

Roger Williams University

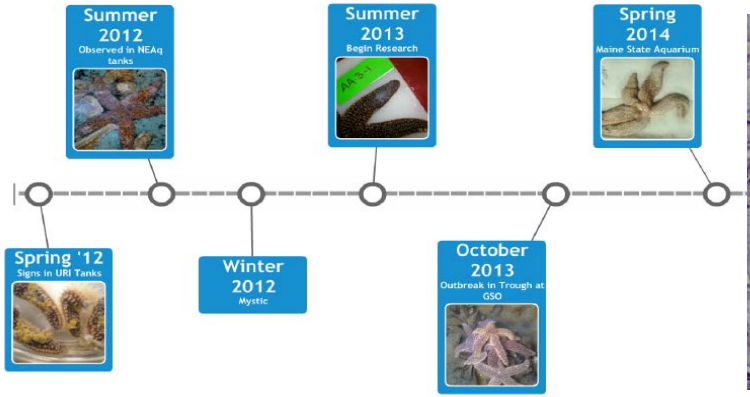
RHODE ISLAND SCIENCE & TECHNOLOGY ADVISORY COUNCIL

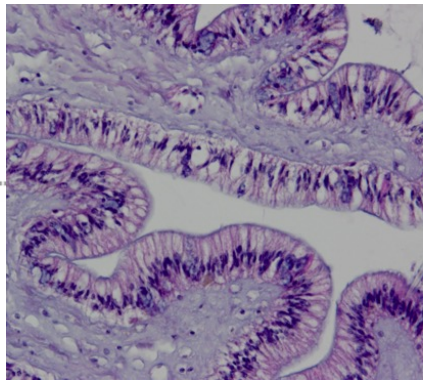
Responses of organisms to climate change:
Identification of the causative agent of Sea Star Wasting Disease

Gary Wessel – Brown University

Marta Gomez-Chiarri, Ed Baker, and **Caitlin DelSesto Bucci** - University of Rhode Island

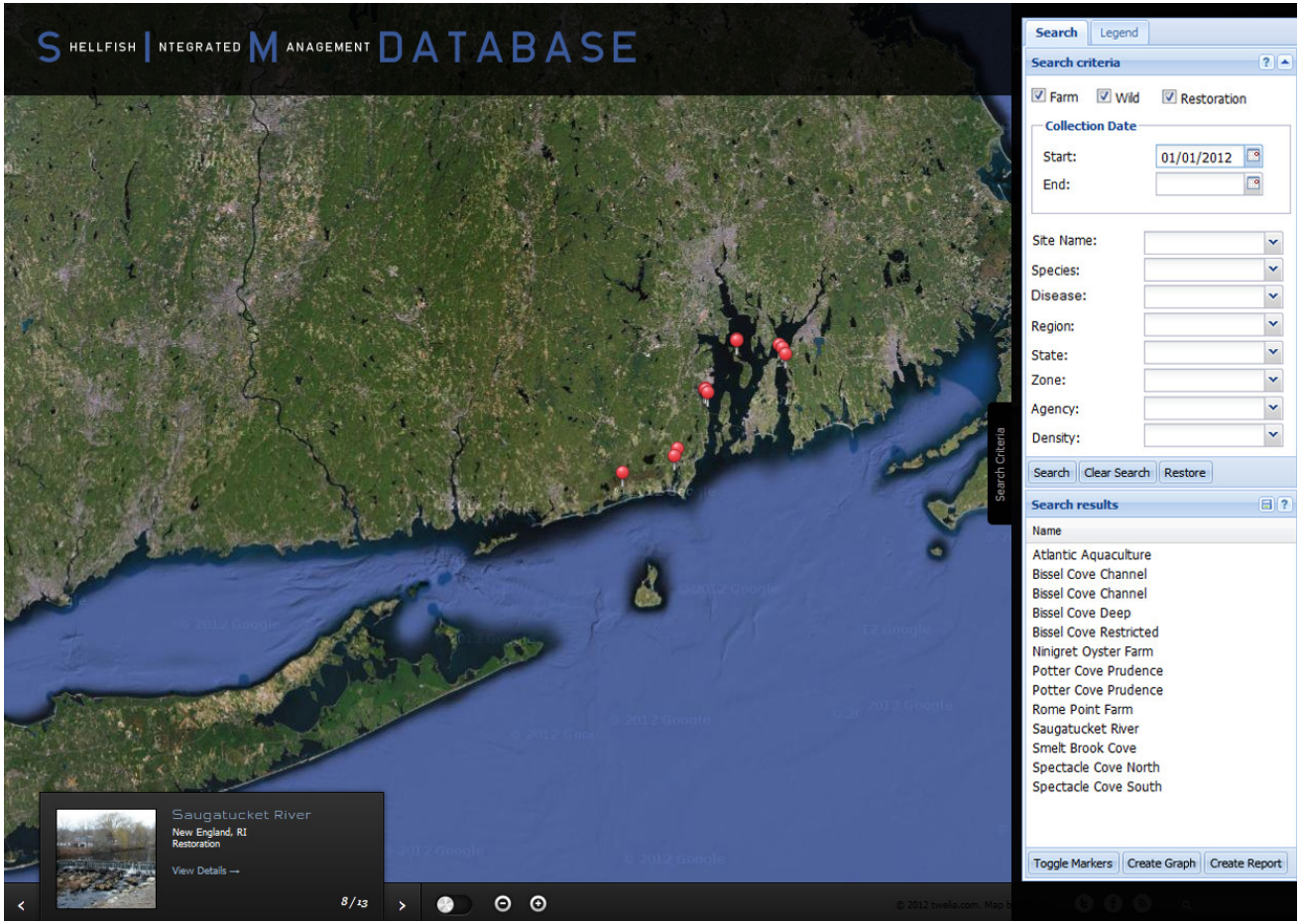
Roxanna Smolowitz – Roger Williams University





Bucci et al. 2017 – PLOS One

Effects of climate change on species: Disease Monitoring



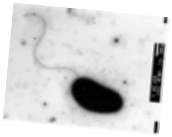
Rhode Island
NSF EPSCoR

Responses of organisms to climate change: What is the adaptive potential of oysters?

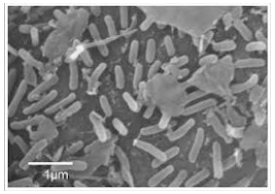
Life stages

Disease susceptibility level

Pathogenic challenge



Resistant and **Susceptible** Lines and Families



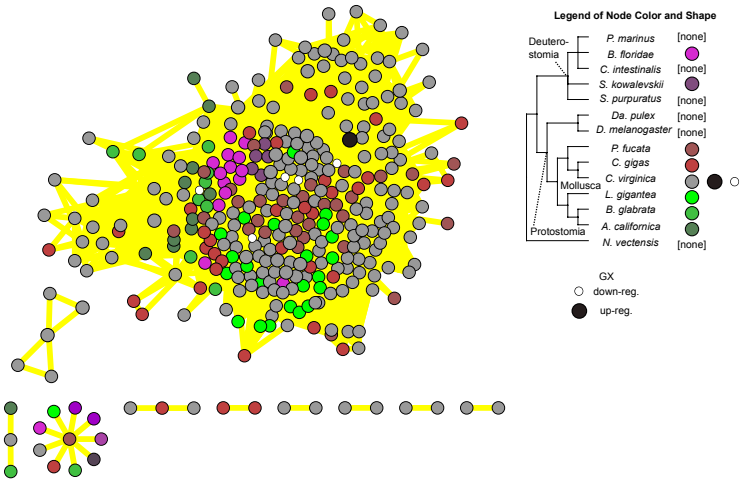
OYSTER SURVIVAL & GENE EXPRESSION

A Big Data Challenge

Rhode Island

NSF EPSCoR

Responses of organisms to climate change: What is the adaptive potential?



OPEN ACCESS Freely available online

PLOS ONE

Transcriptome of American Oysters, *Crassostrea virginica,* in Response to Bacterial Challenge: Insights into Potential Mechanisms of Disease Resistance

Ian C. McDowell[1], Chamilani Nikapitiya[1], Derek Aguiar[2], Christopher E. Lane[1], Sorin Istrail[2], Marta Gomez-Chiarri[1]*

1 College of the Environment and Life Sciences, University of Rhode Island, Kingston, Rhode Island, United States of America, **2** Department of Computer Science and Center for Computational Molecular Biology, Brown University, Providence, Rhode Island, United States of America

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journal homepage: www.elsevier.com/locate/fsi

ELSEVIER

Multi-species protein similarity clustering reveals novel expanded immune gene families in the eastern oyster *Crassostrea virginica*

CrossMark

Ian C. McDowell, Tejashree H. Modak, Chris E. Lane, Marta Gomez-Chiarri*

University of Rhode Island, Kingston, RI, USA

THE UNIVERSITY OF RHODE ISLAND

The Elizabeth H. and James S. McDonnell III McDONNELL GENOME INSTITUTE at Washington University

THE STATE UNIVERSITY OF NEW JERSEY RUTGERS

USDA

The Eastern Oyster Consortium

Oysters as a model to investigate adaptation to environmental stress

Gomez-Chiarri, Proestou, Puritz, Putnam

Organism Overview ; Organelle Annotation Report [1]

Crassostrea virginica (eastern oyster)

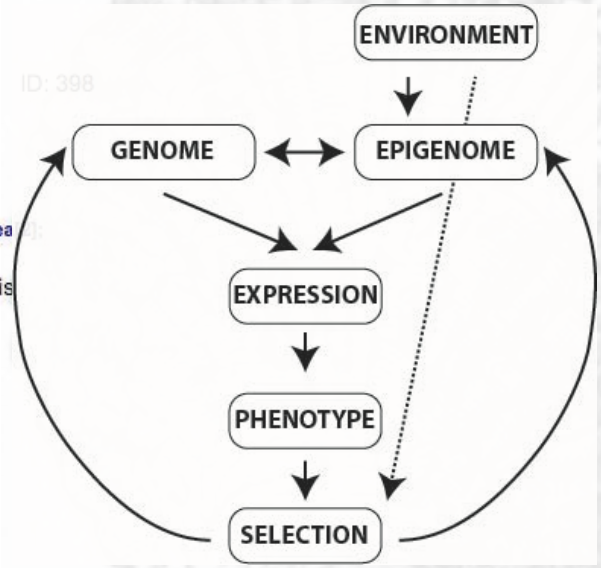
The eastern oyster is a mollusk of commercial importance

Lineage: Eukaryota[2659]; Metazoa[874]; Lophotrochozoa[28]; Mollusca[18]; Bivalvia[10]; Pteriomorphia[7]; Ostreoida[2]; Ostreoidea Ostreidae[2]; Crassostrea[2]; Crassostrea virginica[1]

The *Crassostrea virginica*, or eastern oyster, is a filter-feeding mollusk. It is a marine animal and consumes phytoplankton. This species is abundant on the east coast of America, and is of commercial value.

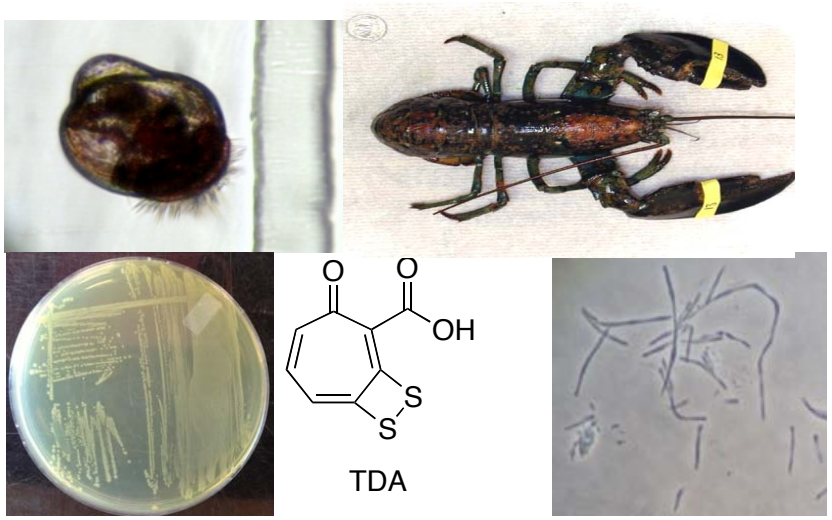
Summary

Submitter:	McDonnell Genome Institute - Washington University School of Medicine
Assembly level:	Chromosome
Assembly:	GCA_002022765.4 C_virginica-3.0 **scaffolds:** 11 **contigs:** 669 **N50:** 1,971,208 **L50:** 108
BioProjects:	PRJNA379157, PRJNA376014
Whole Genome Shotgun (WGS):	INSDC: MWPT00000000.3
Statistics:	total length (Mb): 684.741 protein count: 60213 GC%: 34.8191
NCBI Annotation Release:	100



Exploiting microbial-microbial interactions to manage disease

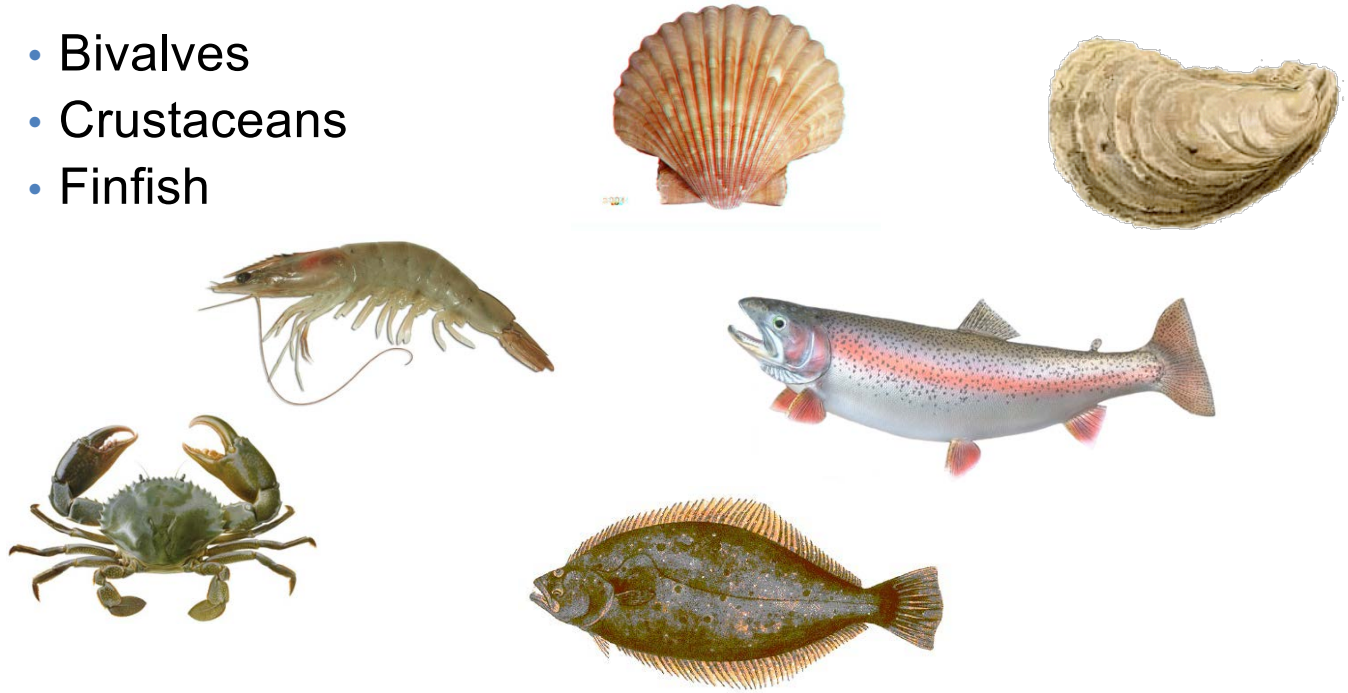
Kathy **Castro,** Barbara Somers, Mitch Hatzipetro, **Gómez-Chiarri**, Murni Karim, Saebom Sohn, Tejashree Modak, Melissa Hoffman, Sam Hughes, **David Nelson**, Jason LaPorte, Weijing Zhao, Chris Schuttert, Linda Kessner **Anton Post,** Rebecca Stevick**, David Rowley**, Christine Dao, Megan Hamblin, Hilary Ranson, **Ying Zhang,** Zachary Pimentel (URI)**; Roxanne Smolowitz**, **Dale Leavitt**, **Karin Tammi, Karen Markey (RWU)**



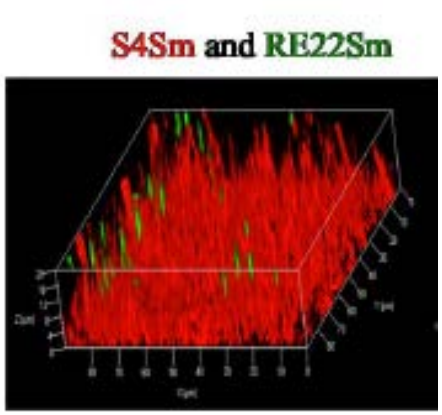
Probiotics and Aquatic Animals

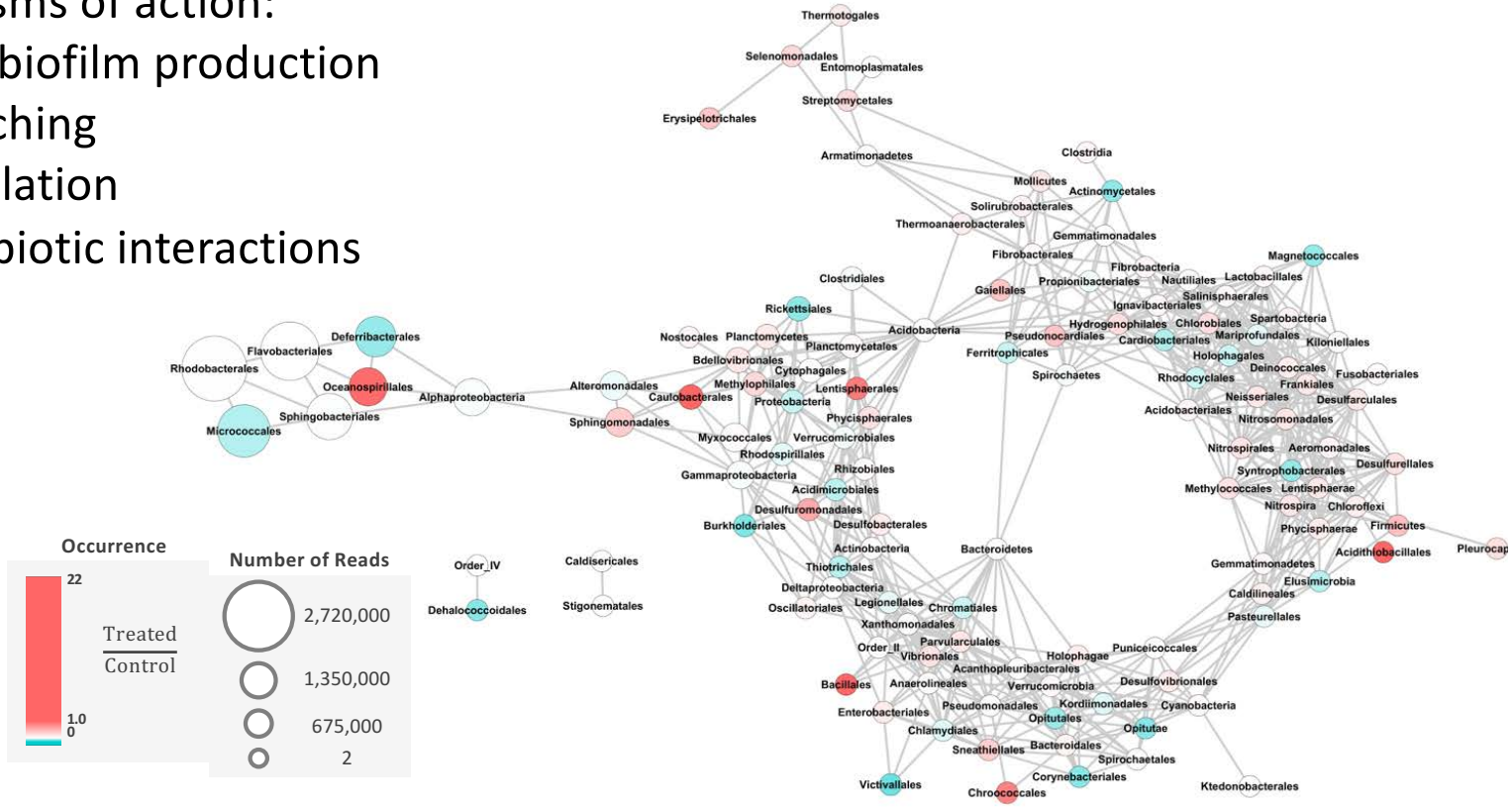
Disease protection in other farmed organisms as diet or water additive

- Bivalves
- Crustaceans
- Finfish



- Developed 2 probiotics that increase oyster and scallop larval survival after disease challenge in the lab and the hatchery
- Probiotic treatment has an effect on the microbial community in the hatchery (*microbiome studies)*
- Complex mechanisms of action:
  - Antibiotic and biofilm production
  - Quorum quenching
  - Immune modulation
- Role of algal – probiotic interactions





Candidate bacterial probiotics that could to **slow down or stop** the progression of Epizootic Shell Disease in lobsters.

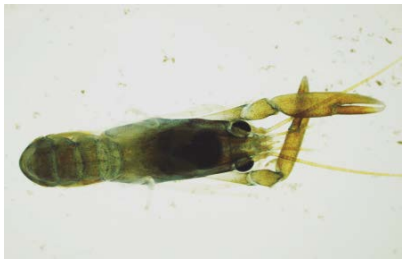
Credit: Mitch Hatzpietro & Melissa Hoffman 2016

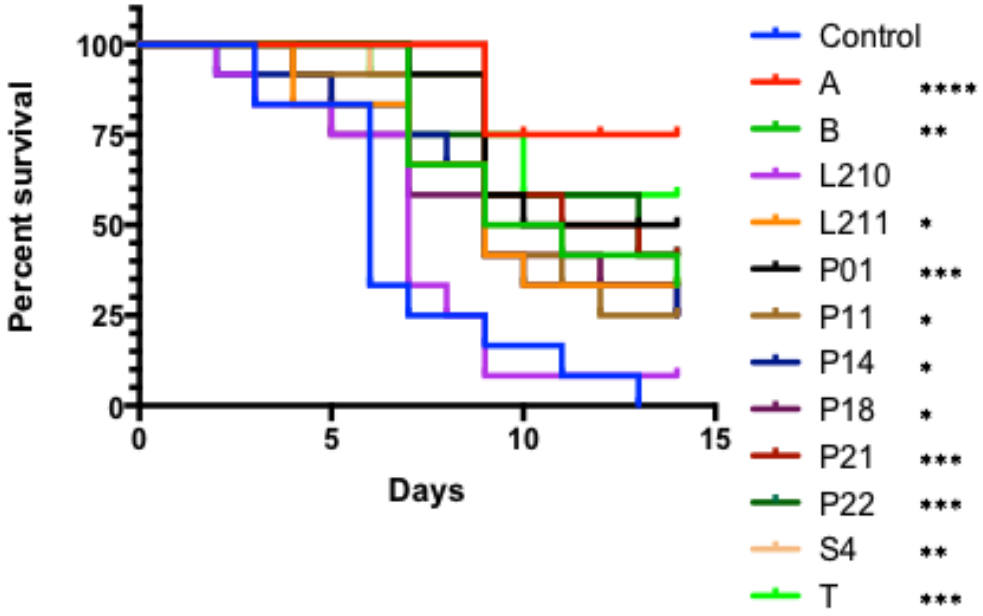
Kathy Castro
David Nelson
David Rowley

Melissa Hoffman
Grace Underwood
Hilary Ranson
Mitch Hatzipetro
Barbara Somers

Sea Grant
Rhode Island

Screen isolated probiotics on post-larval lobsters (PLs)





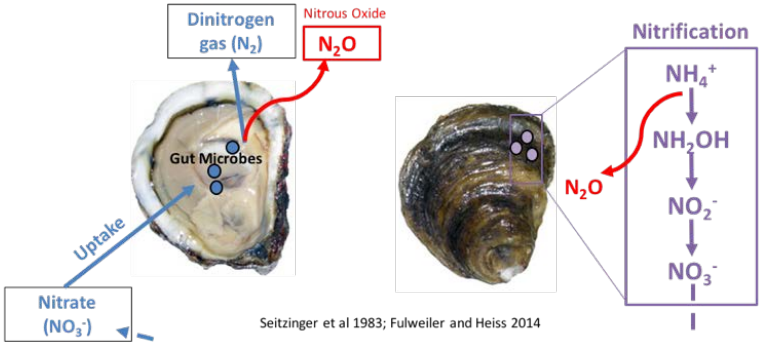
- Most candidates were safe to PL lobsters (*Loktanella* spp. may cause lesions)
- Pre-incubation with candidate probiotics reduced PL mortality under stress conditions
- S4 persists in the water longer and forms stronger biofilms *in vivo* when compared with other treatments

Pathogens, Nitrogen, and Changing Climate: Understanding impacts of multiple stressors on Narragansett Bay shellfish

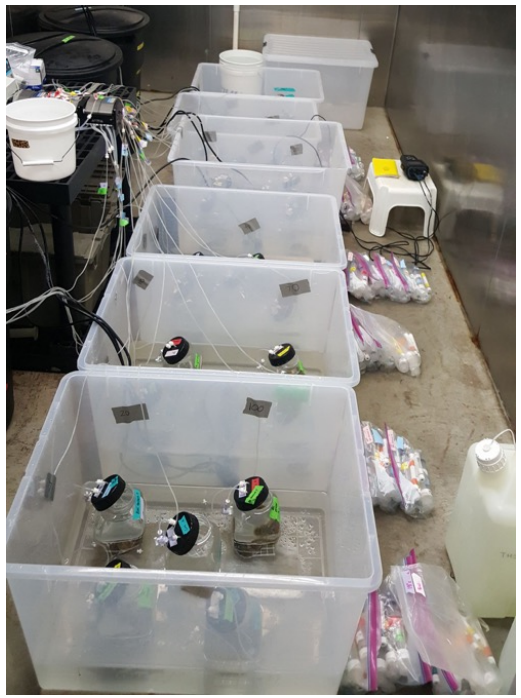
Ashley Hamilton, Serena Moseman-Valtierra, Marta Gomez-Chiarri (URI) & Roxanna Smolowitz (RWU)

Temperature + Nitrogen

Denitrification: NO_3^- → NO_2^- → NO +N_2O(g) → N_2(g)



Seitzinger et al 1983; Fulweiler and Heiss 2014



Pathogens, Nitrogen, and Changing Climate:
Understanding impacts of multiple stressors on Narragansett Bay shellfish

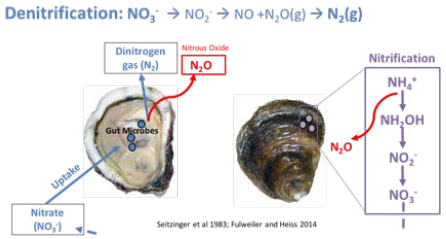
Ashley Hamilton, Serena Moseman-Valtierra, Marta Gomez-Chiarri (URI) & Roxanna Smolowitz (RWU)

Temperature + Nitrogen

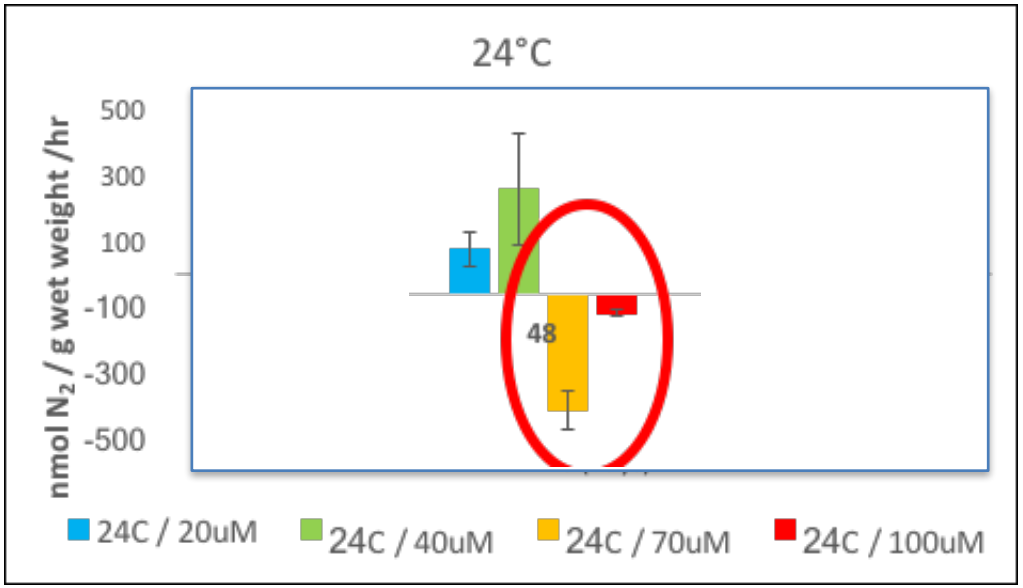
↓

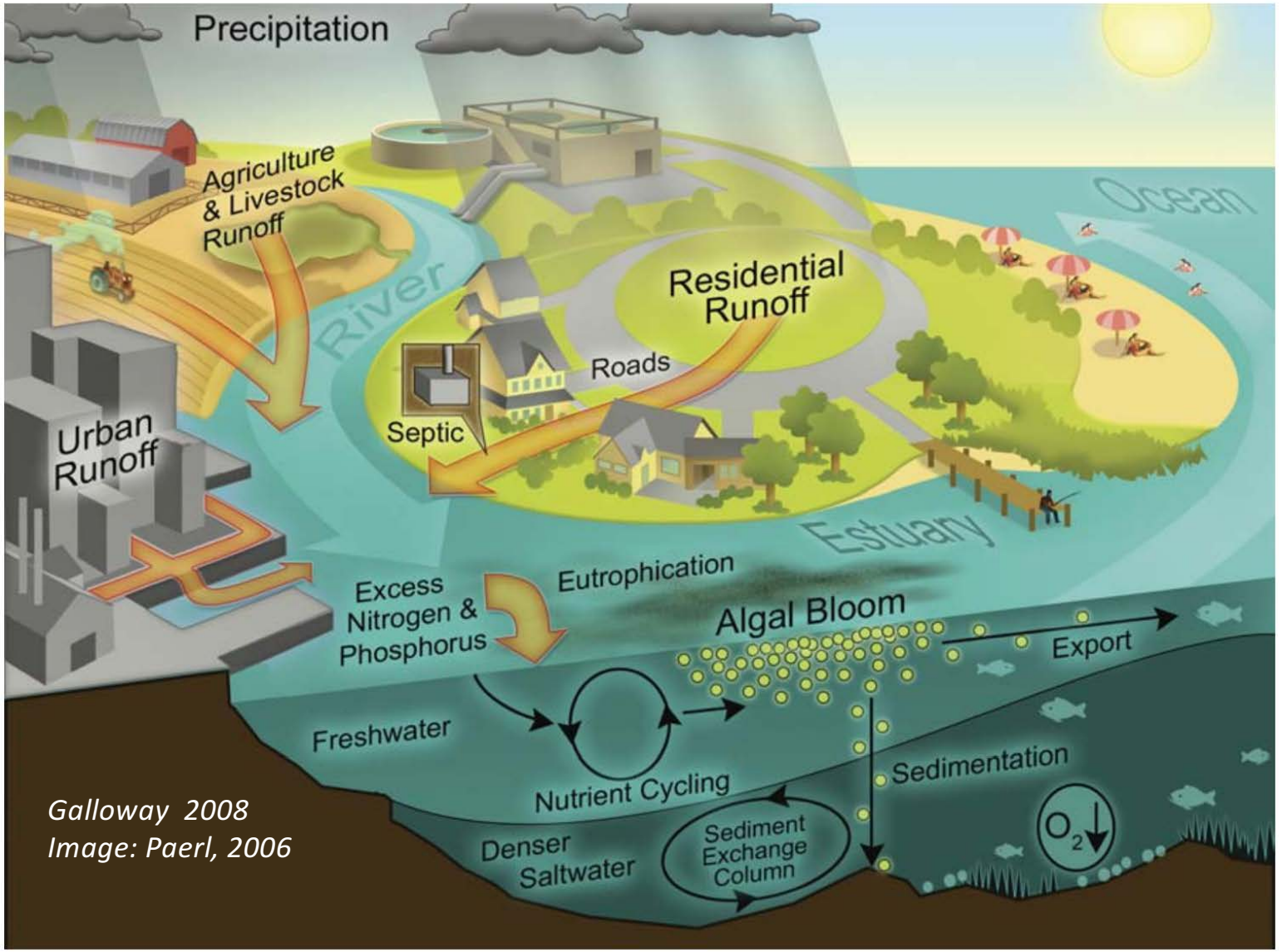
Microbial community Physiology

↓



DIsease





Galloway 2008
Image: Paerl, 2006