EurOCEAN 2010
Thermae Palace (Oostende, Belgium, 12-13 October 2010)

OCEANS AND HUMAN HEALTH and HUMANS AND OCEAN HEALTH: *RISKS AND REMEDIES FROM THE SEA*

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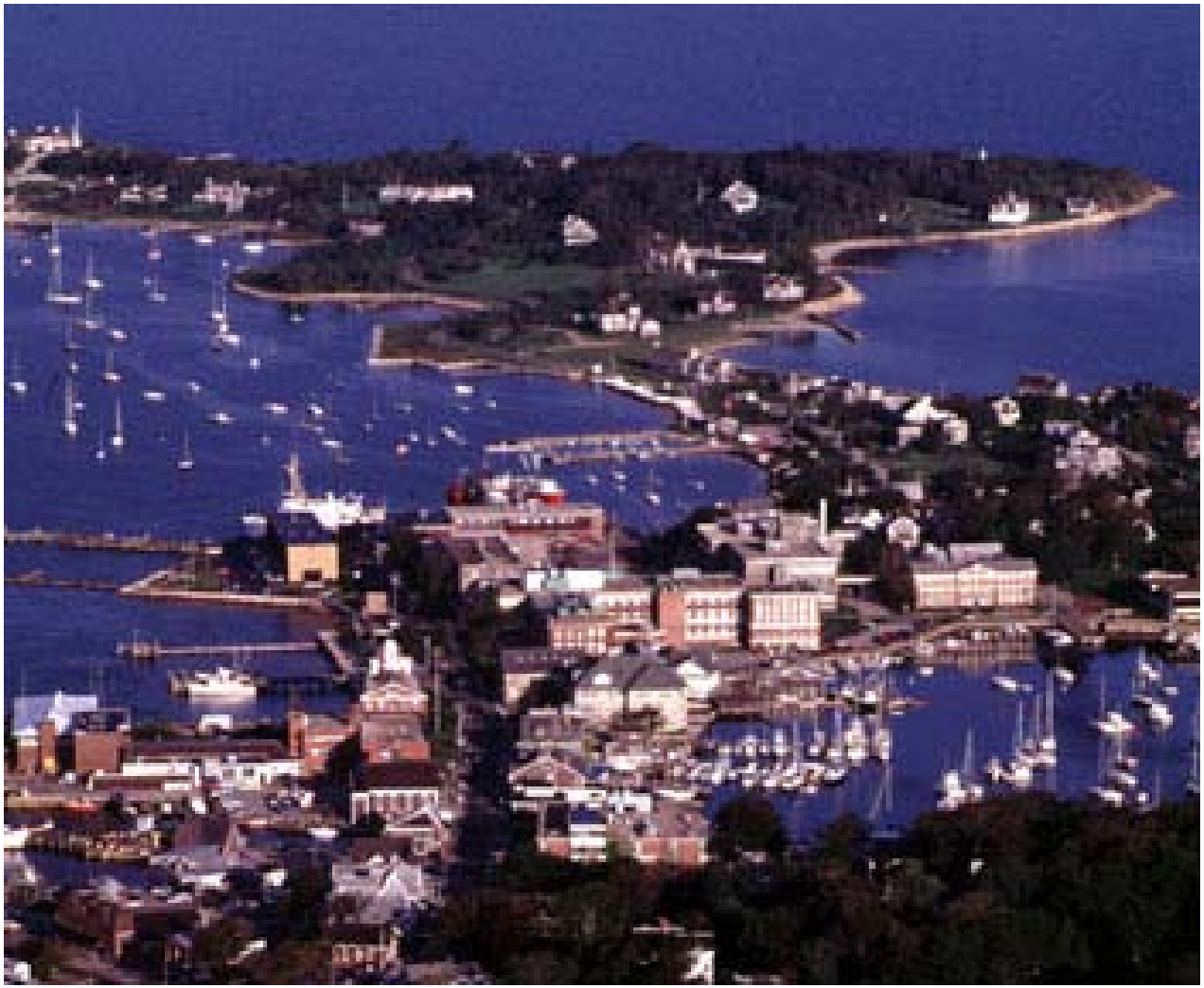
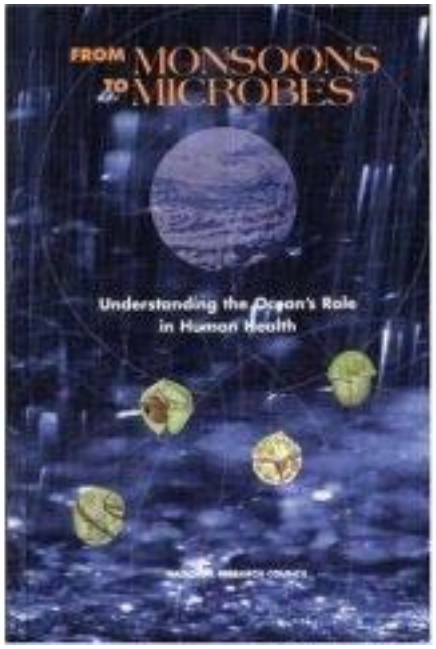


Woods Hole

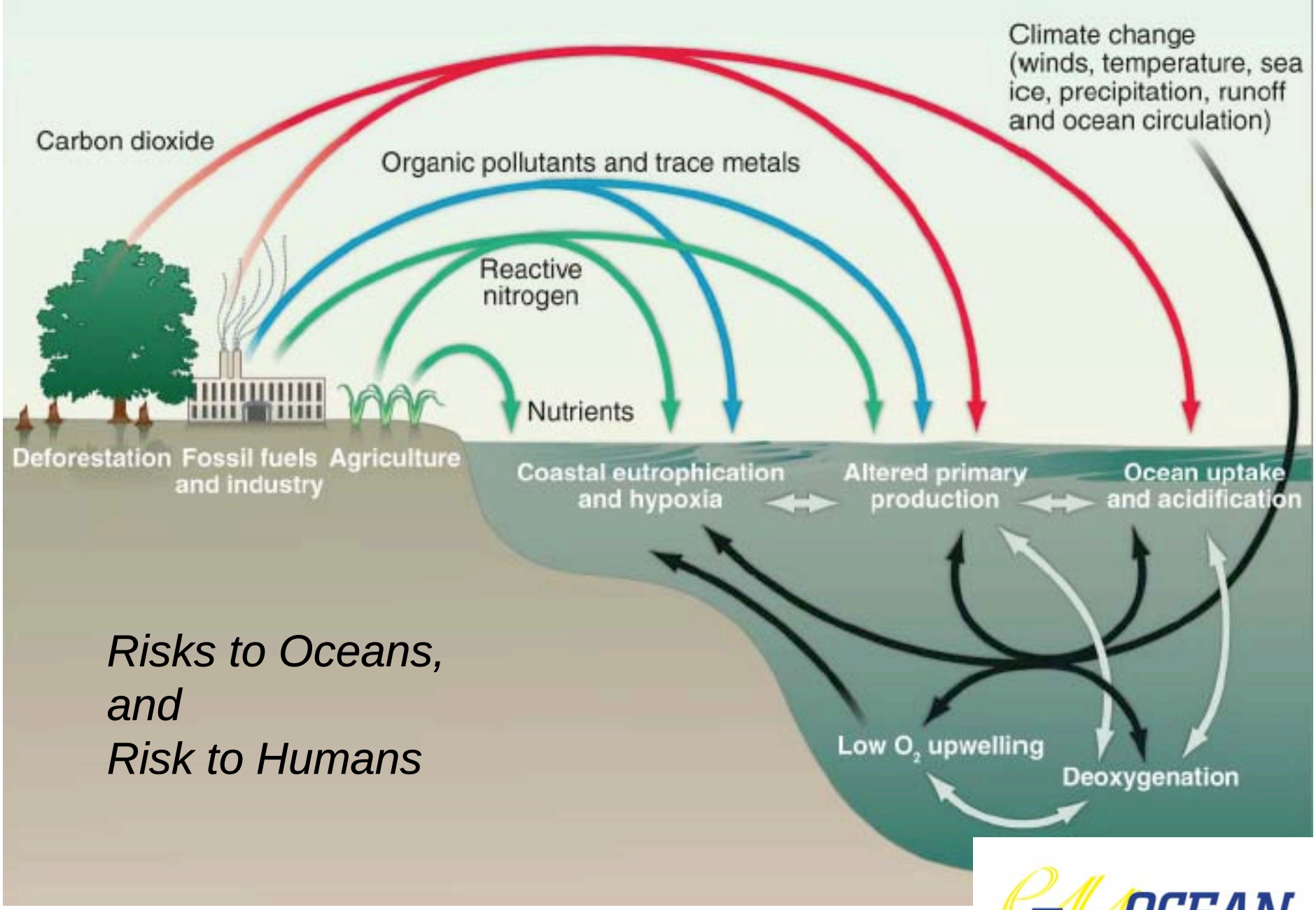
Human health and well-being are fundamentally and inextricably linked to the oceans.

Scope laid out in a Natioanal Research Council report of a decade ago



Human and Ocean Health Interactions are Global Issues.

EurOCEAN 2010

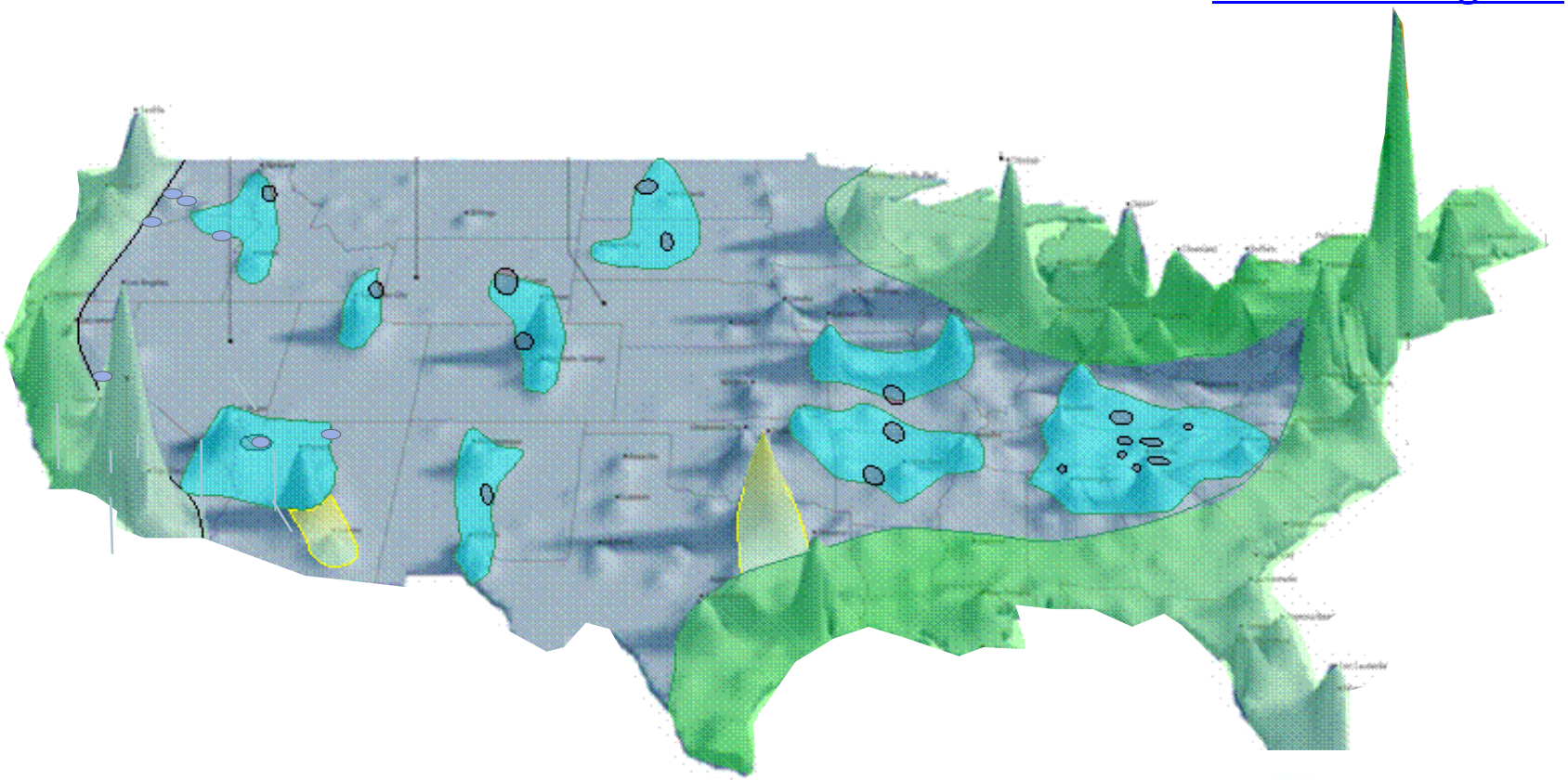


Risks to Oceans,
and
Risk to Humans

Doney, Science (2010); Science Special Section on Oceans

Plot of Population

Plot of Population and Bright CAES Capability Regions, from ThoughtForm, Understanding USA



Brian Von Herzen
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COHH

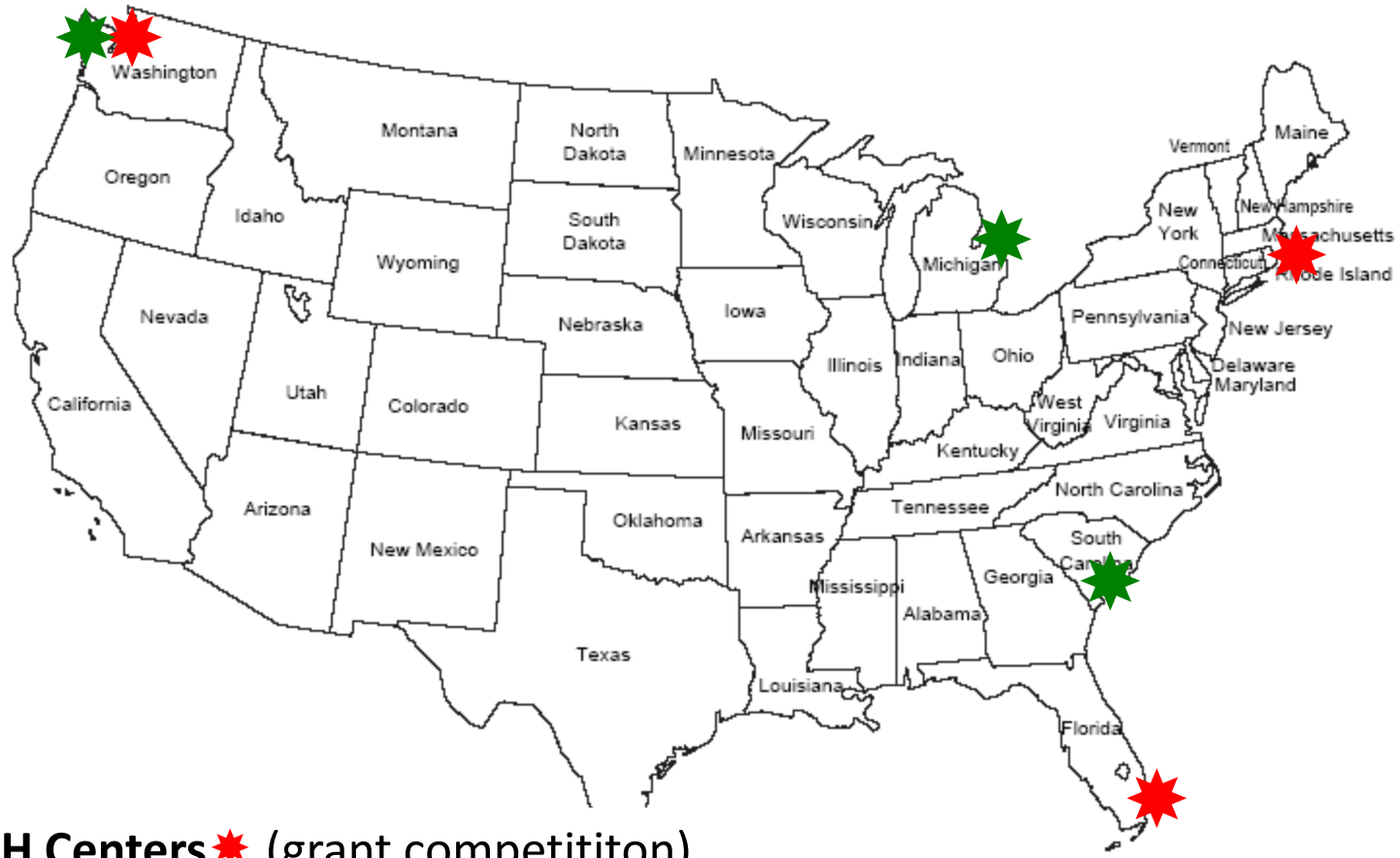
Centers for **O**ceans and **H**uman **H**ealth

Program Jointly funded by U. S.
National Institutes of Health (NIH) and National Science Foundation (NSF)

Conduct, Coordinate and Communicate research

Brief research examples, directions, and how to progress.

Centers for Oceans & Human Health



HI

NSF - NIH Centers (grant competititon)

NOAA Internal Centers

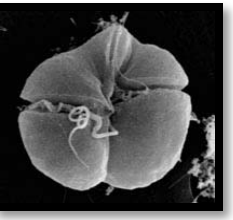
Focus on Risks

Microbial Pathogens

Harmful Algal Species

Chemical Exposures

Integrate biology, genomic methods, physical oceanography, modeling, epidemiology, sensor development, cost analysis, science communication, inter-agency cooperation



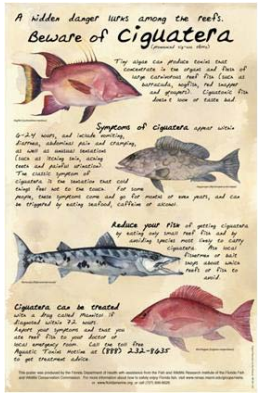
Pathogens and HAB

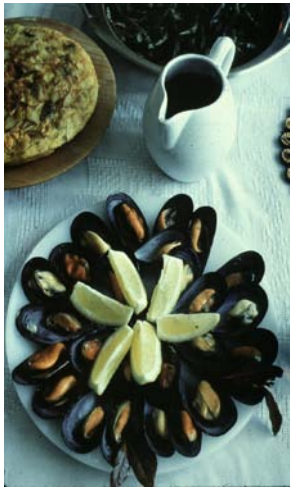
Human/animal exposure and health effects of toxins ($10-100s mil/yr)

- ❖Blue Green Algae (BMAA/DAB, Microcystins)
- ❖Ciguatera (Ciguatoxins)
- ❖Amnesiac Shellfish Poisoning (Domoic Acid)
- ❖Neurotoxic Shellfish Poisoning & Aerosolized Respiratory Irritation (Brevetoxins)
- ❖Paralytic Shellfish Poisoning (Saxitoxins)

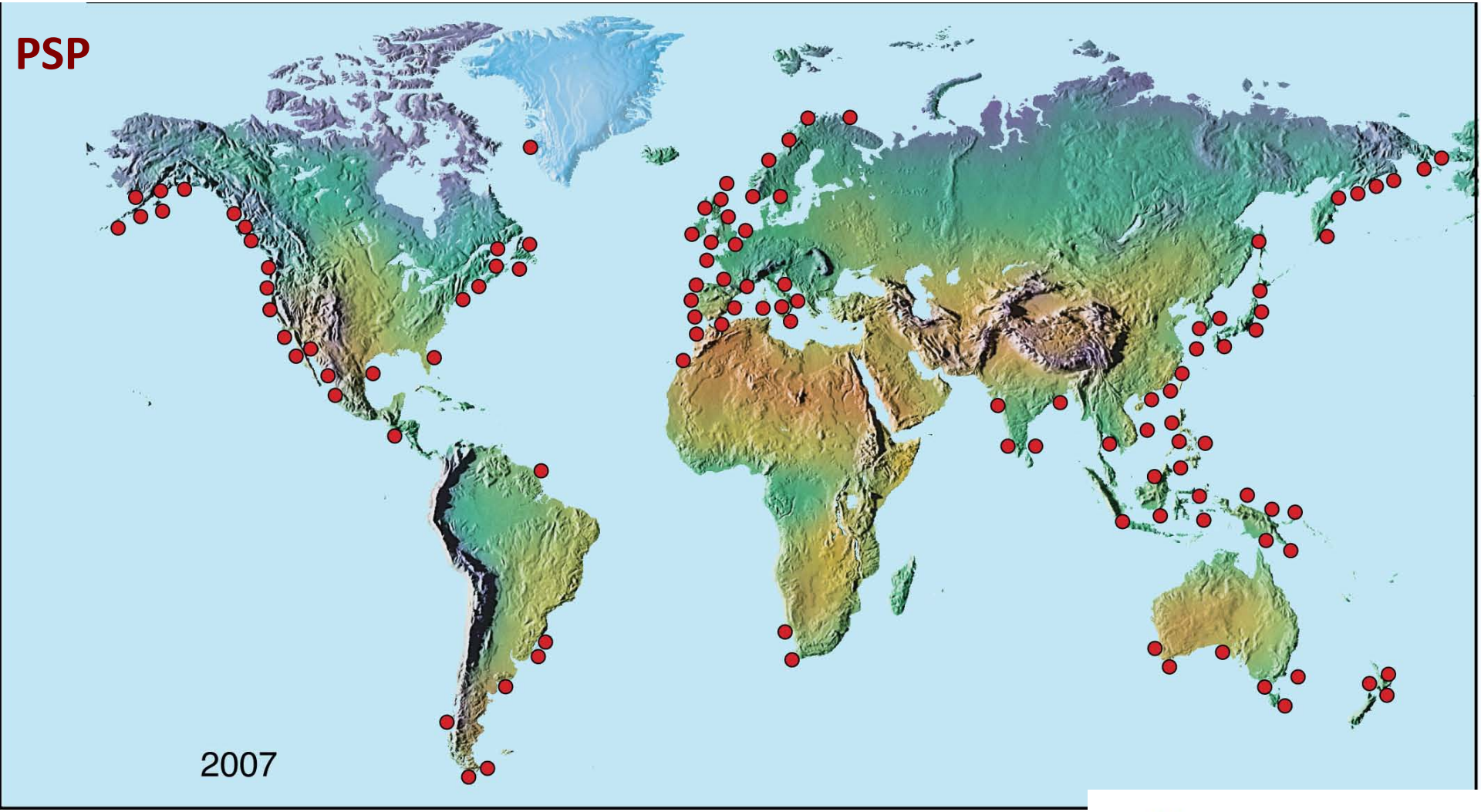
Pathogens,viruses ($100s mil/yr)

❖Gastric, skin, hepatic diseases





HAB incidence growing worldwide



HAB can cause mortality of fish, birds and mammals

"Oceans and Human Health"

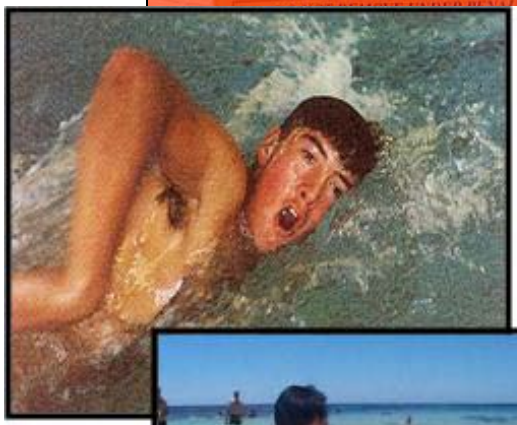
DDT, PCBs, Dioxins, PAHs,
Other POPs, Metals.

PFOA, BDEs, algal toxins,
pharmaceuticals, etc. etc.

Sample COHH Findings

Human pathogens in the marine environment

- Widespread antibiotic resistance
- New species (*V. psch.*)
- Legionella, and others
- Sources of pathogens



The 2005 bloom

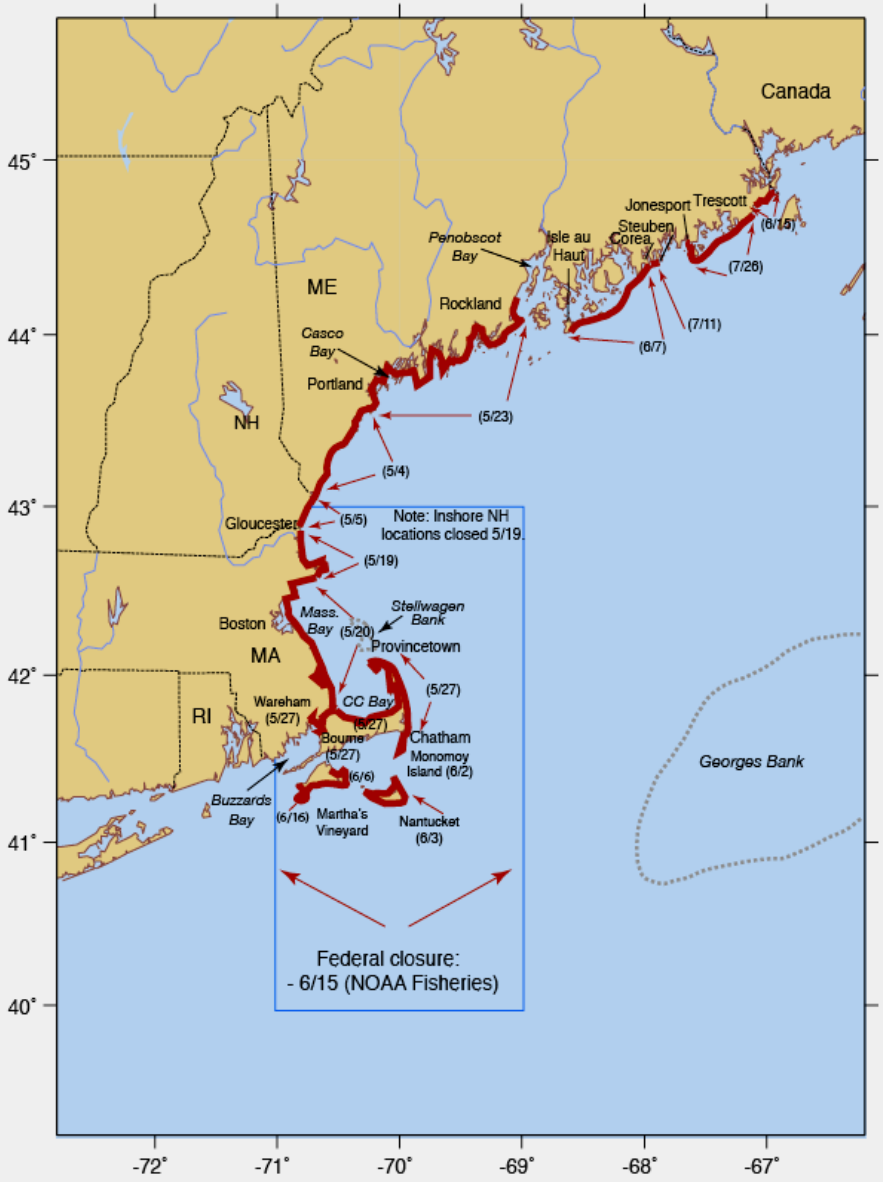


Figure 2

Anderson et al., 2005

- **Most widespread and intense bloom in at least 33 years, perhaps longer**

- **Record levels of toxicity in some locations; first-time ever records of toxicity in others**

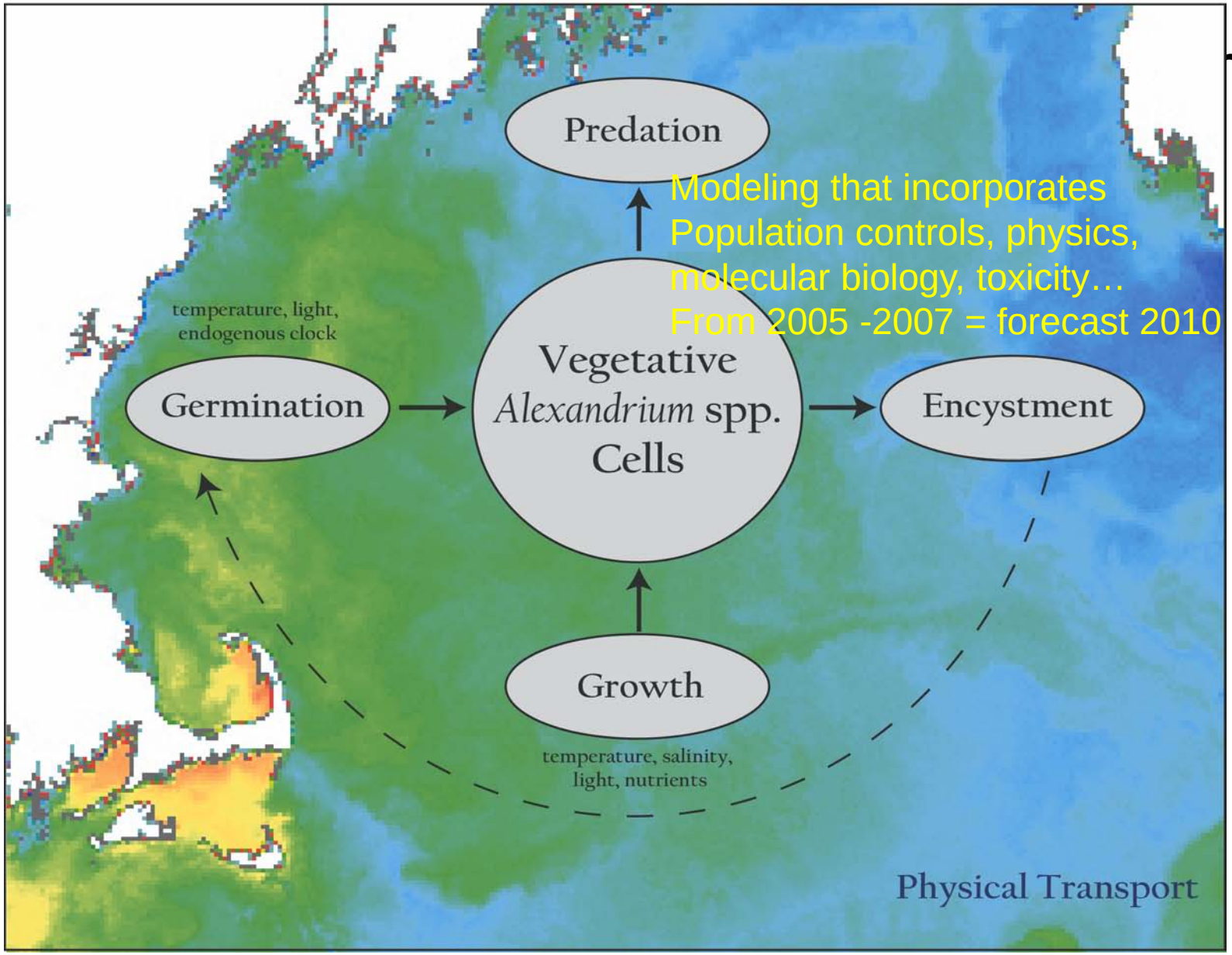
- **Record high *A. fundyense* cell concentrations (for this region)**

- **Large closure of federal (offshore) waters**

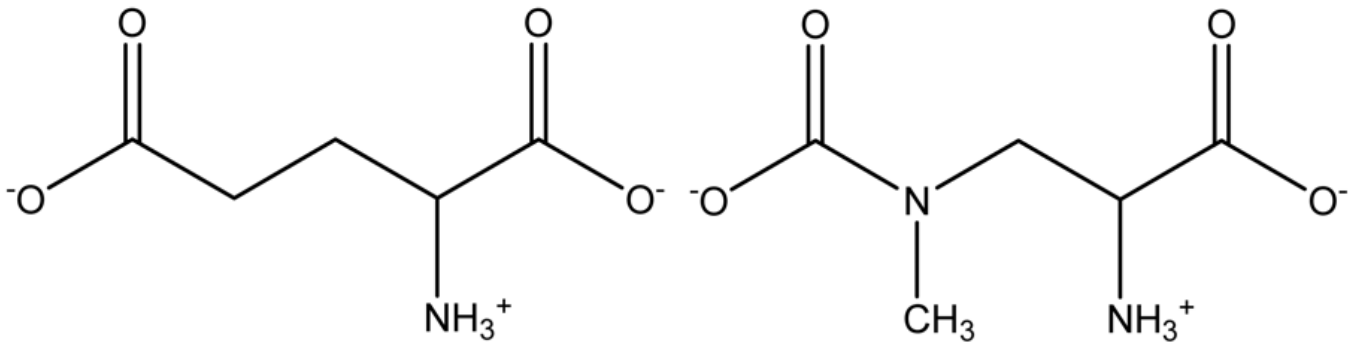
- **> $50M loss to shellfish industry in MA alone**

- **Maine, MA - disaster declarations**

Population Dynamics of *Alexandrium* spp.



Cyanobacterial toxins – insidious threats (e.g., BMAA; ß-N-methyl-aminoalanine)



Glutamate (neurotransmitter) BMAA carbamate ion (neurotoxin)

Associations with Parkinsons, ALS ?

Remedies
(Resources)

Pharmaceutical agents

Antibiotics, antivirals, anti-inflammatories,

Nutraceuticals

PUFA,

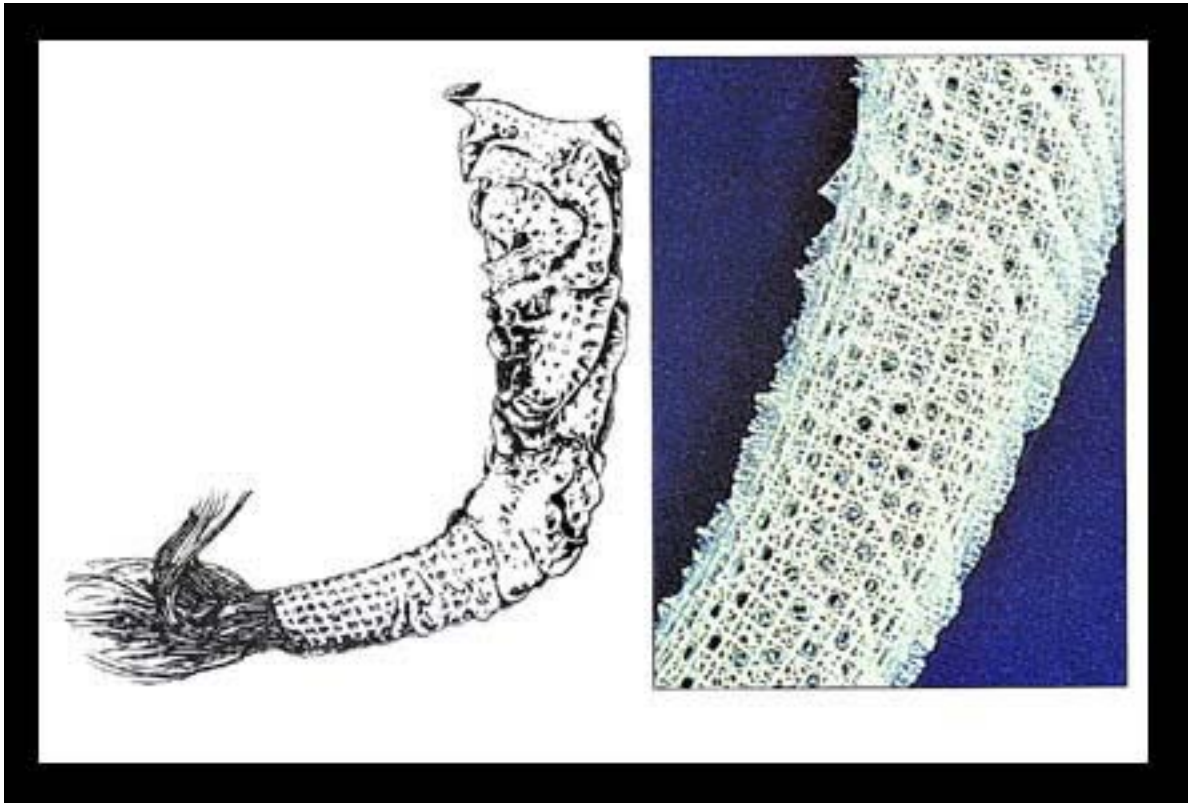
Material resources

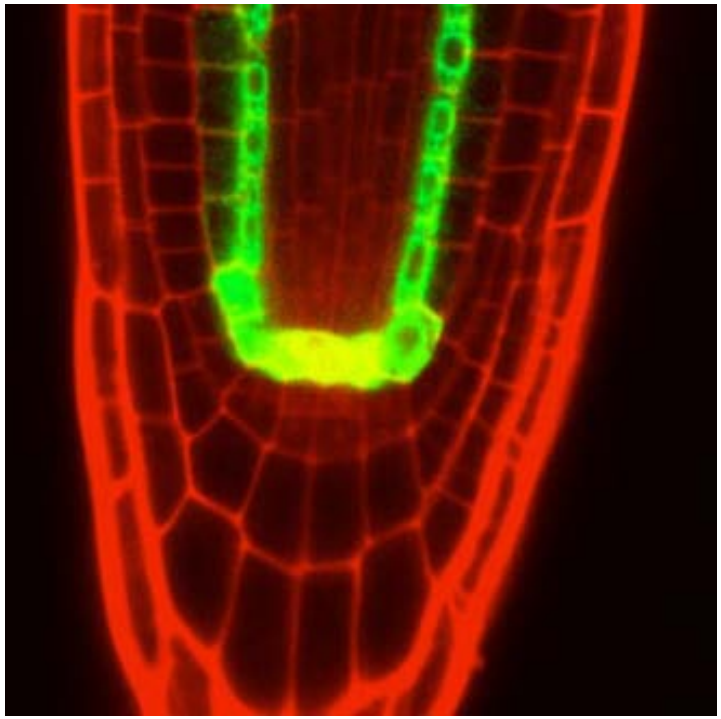
research materials, nanomaterials

Recreation and health

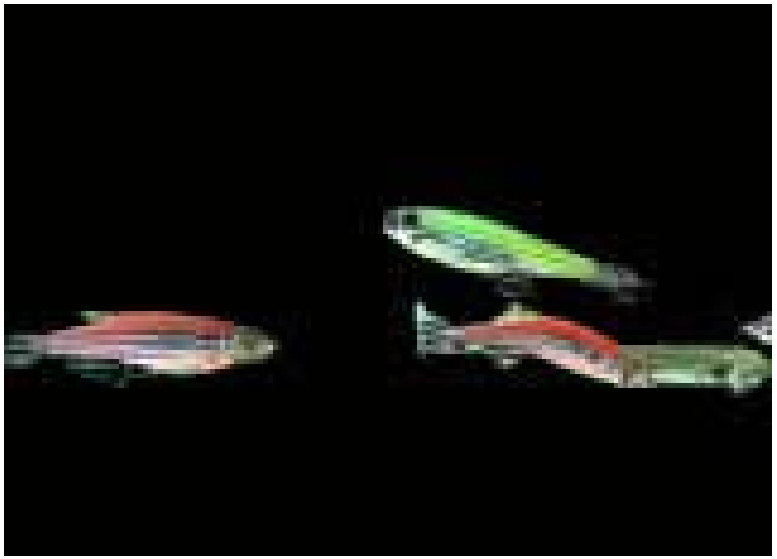
The Blue Gym

- Industrial or commercial biomolecular materials
  - –Nanotechnology based on silicon crystal production in sponges
  - –Adhesives based on mussel byssus (attachment) threads





Study plant growth control



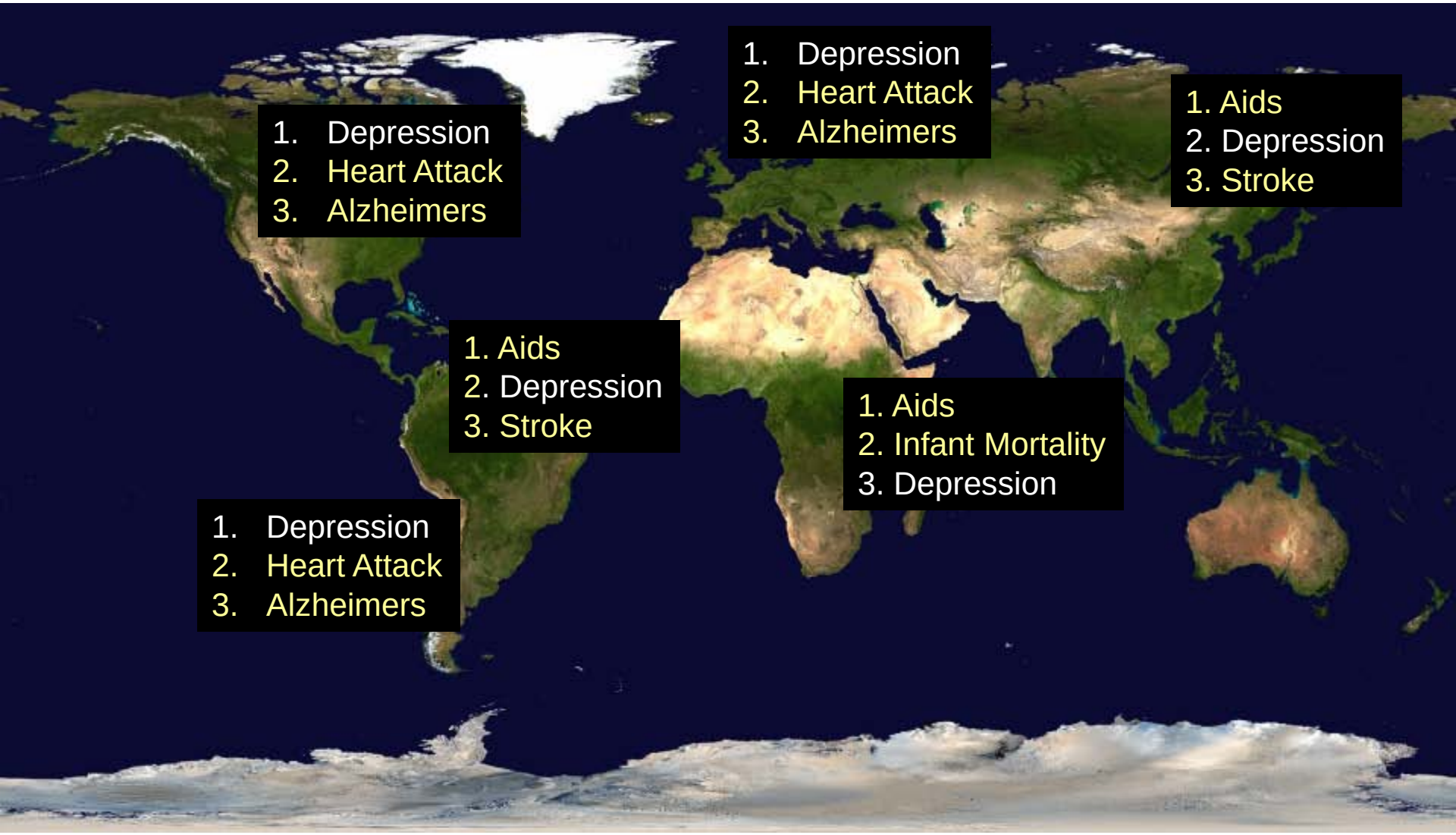
Pollution sensing fish

Green Fluorescent Protein

Biomedical research

Disease patterns by 2030

Recreation and health
"The Blue Gym"



How to enhance opportunities?

Pharmaceuticals:

Identify organisms - simply

- Wise searching for organisms (micro/macro)

Exploit biotechnologically

- Gene clusters for synthesis (e.g., PKS-P450)
- Culturing the unculturable organisms

Nutrients: Farming in ecologically sensible ways.

genes for nutrient synthesis.

Materials: Identification and development

Private Investment and biotechnology

Mental health:

Policies to encourage healthy recreation

How to meet the challenges?

Microbes:

Identify pathogens - Deep sequencing

Antibiotic Resistance determination

Accurate monitoring

Harmful Algae:

Identify toxic strains and genes

Forecast blooms – Technology to monitor

Determine chronic exposure effects

Chemicals:

Understand mechanisms

Establish exposures

Determine significance of low level exposures

Gene Interactome – adaptive /adverse?

The Environmental Sample Processor (ESP)

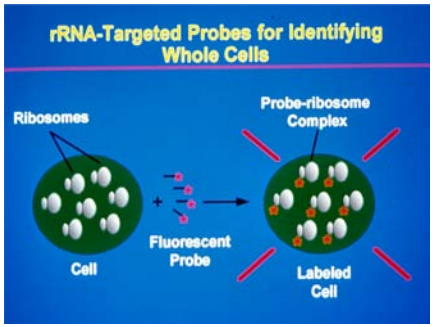
- **Rotating carousel with 132, 25mm pucks holding user-defined filters or solid phase media**

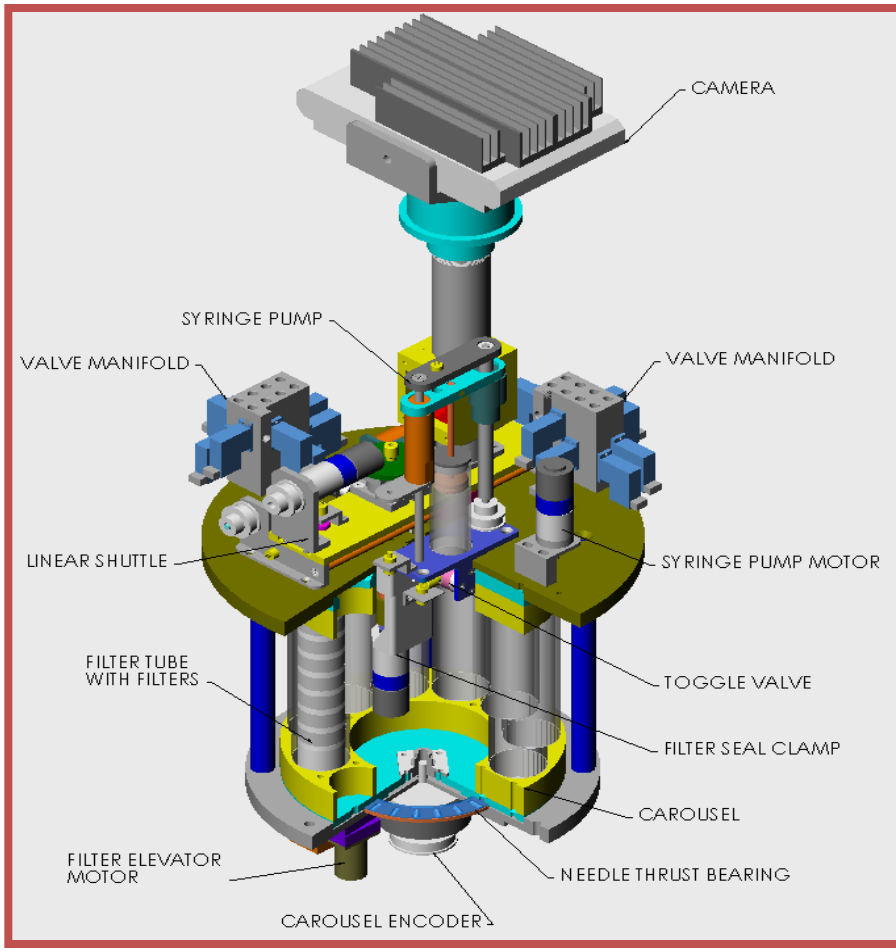
- Fluid handling system permits autonomous collection of samples and timed application of multiple reagents *in situ*, subsurface

- Real-time

- Modular – allows multiple analyses downstream of core fluid collection

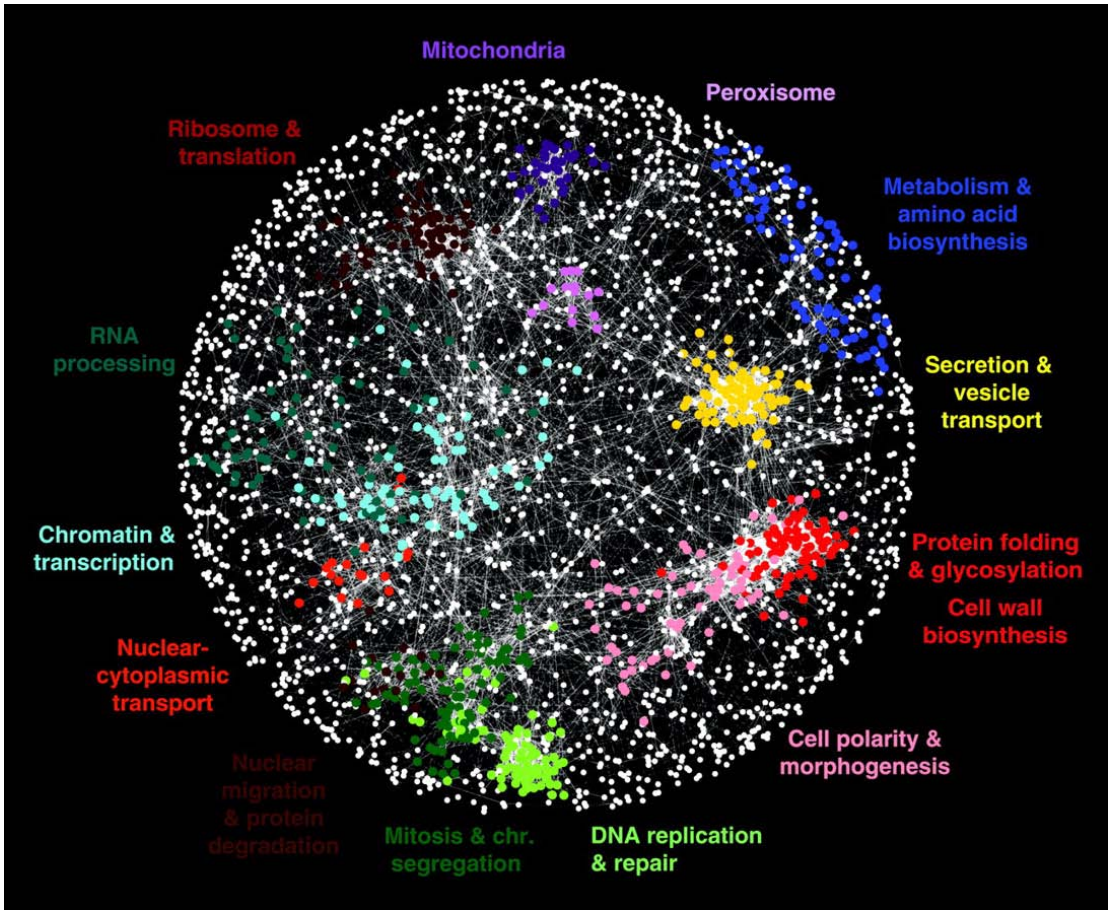
- Two-way communication





Scholin et al (Europa)

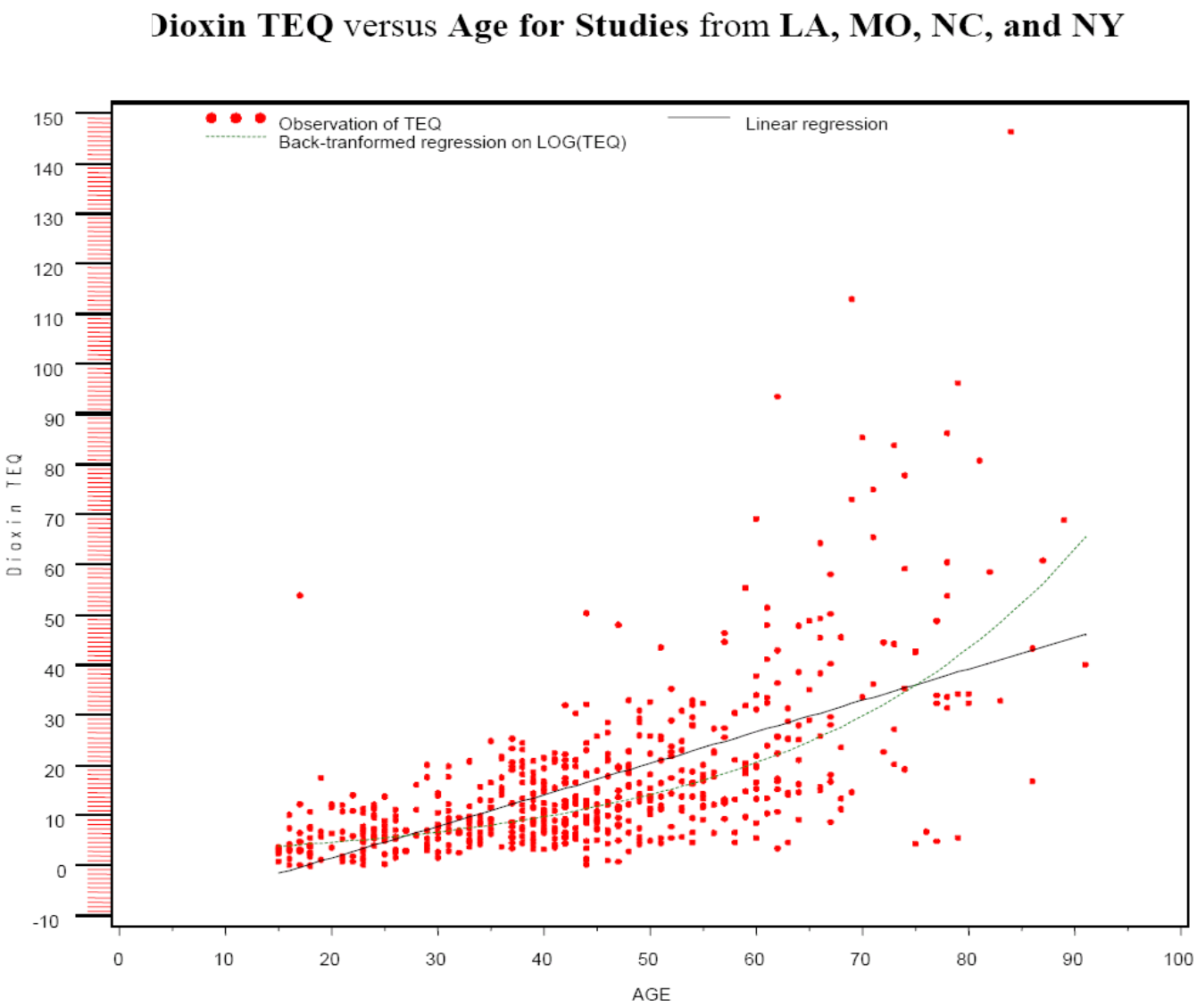
A correlation-based network connecting genes with similar genetic interaction profiles



M. Costanzo et al., Science 327, 425-431 (2010)

Examined 5.4 mil gene pairs in yeast.
Obtained much unique functional information.

Dioxin TEQ levels by age: 4 studies



Fish a source of POPs (risk) and of PUFA (benefit): Balance?

Meeting the Challenges

Advances in identifying pathogens/ toxic strains

= better sensing

Advances in technology for sensors

= better detection and prediction

Advances in knowledge of toxicant action

= better markers and prediction of adverse (humans and marine animals)

Advances in determining human exposure

= better epidemiology & clinical intervention

Determining costs

= influence political will

How to Proceed?

- Involve global collaboration (Trans Atlantic)
- Engage multi-disciplinary approaches (Physics to Epidemiology)
- New partnerships among agencies
- Public-Private partnerships (e.g., Pharma)
- Communication properly to public/ clinicians/politicians
- Influence Political Will
- OHH should be part of larger “Health and Environment Program”, including Public Health and Ocean Health

Summary Thoughts

1) OHH issues are of growing global significance; need global collaboration and global solutions.
2) Climate change impacts will be felt early on in the coastal zone, where population densities are increasing.
3) Biodiversity loss in the oceans impacts human health and resources.
4) Advancing biotechnological approaches and sensors will be critical to solutions of detection and monitoring to protect public health.
5) Chronic, low level effects of environmental chemicals and toxins are of enormous concern.
6) Technology to assist developing nations R & D.