



National Microbiome Initiative: Opportunities for Research and Policy

August , 2016

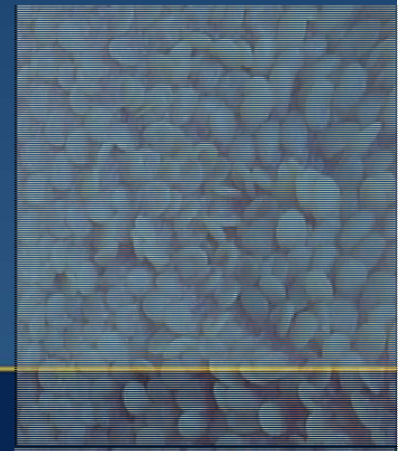
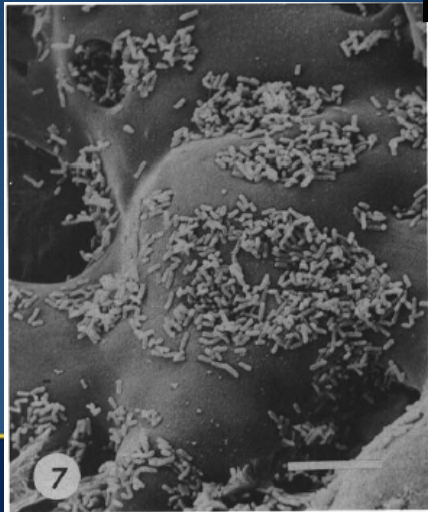
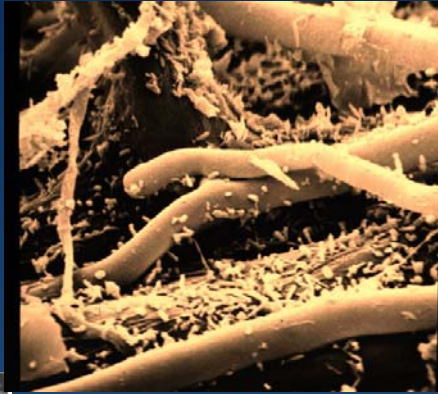
Jo Handelsman
Associate Director for Science
White House
Office of Science and Technology Policy

Microbiome – the collection of microorganisms associated with a particular habitat



Microbiome – the collection of microorganisms associated with a particular habitat

VIRTUALLY EVERY HABITAT ON EARTH



The National Microbiome Initiative

Topics

- ❖ Origins of the National Microbiome Initiative
- ❖ Goals of the Initiative
- ❖ Commitments
- ❖ Challenges and Policy



The National Microbiome Initiative

Obama Administration Priorities

- ❖ Applications needed for President's priorities

Precision medicine

Energy

Agriculture

Climate change

- ❖ Economic growth

Private-sector investments in the microbiome have surged



The National Microbiome Initiative

Fact finding

OSTP

- ❖ Convened 12 Federal departments and agencies
- ❖ Convened several groups of scientists
- ❖ Issued request for information in Federal Register



The National Microbiome Initiative

Cross-cutting Themes Emerged

Common questions across biological systems

- ❖ What is a healthy microbiome?
- ❖ What is the nature of a robustness?

Technology needed to

- ❖ Detect, measure, and model in multi-dimensions the chemical currency of microbial communities
- ❖ Develop computational tools to analyze vast datasets
- ❖ Model community behavior

Applications

- ❖ Alter microbiomes predictably and reliably

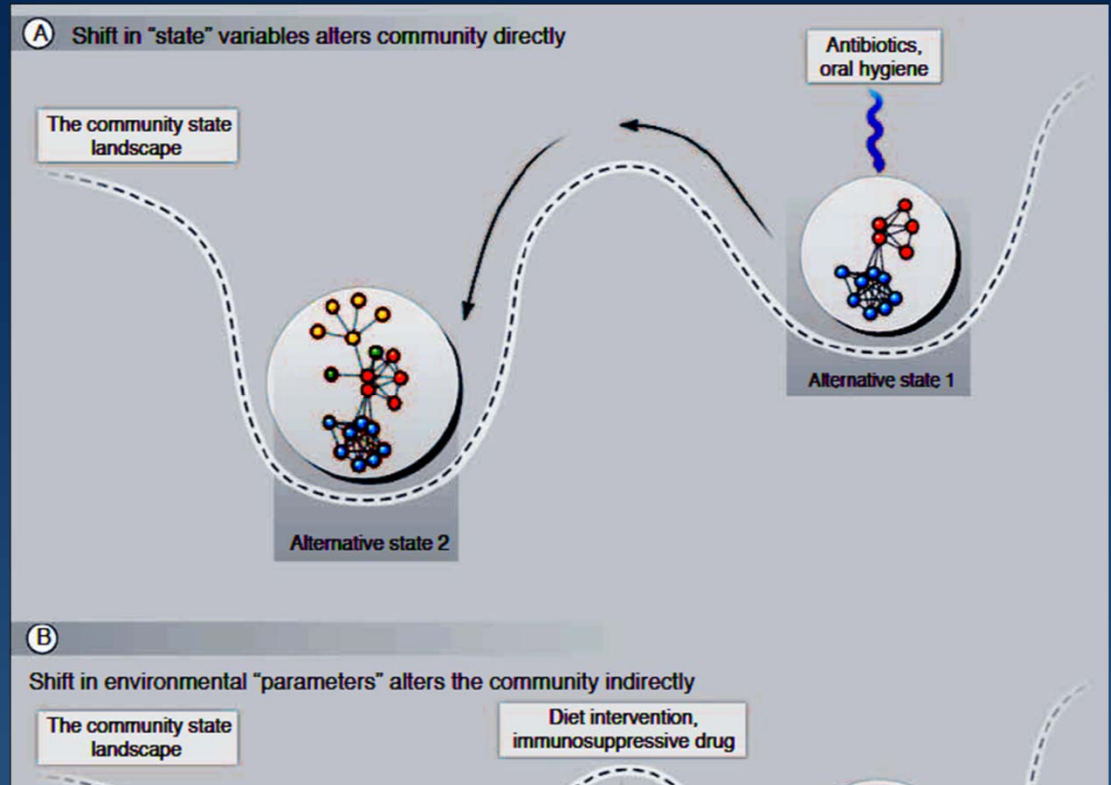
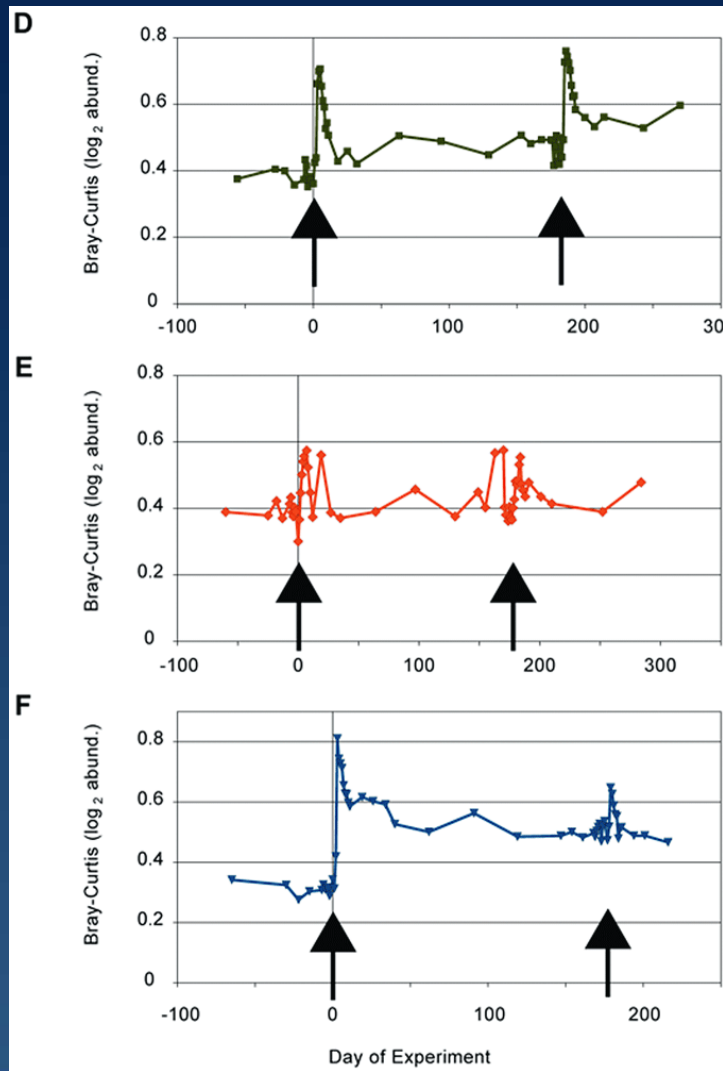


Parallels Among Microbiomes

Examples



Gut Microbiome Behavior After Antibiotics



Relman, D. Nutr Rev. 2012 70:S2-S9.



Gulf of Mexico Microbiome After Oil Spill

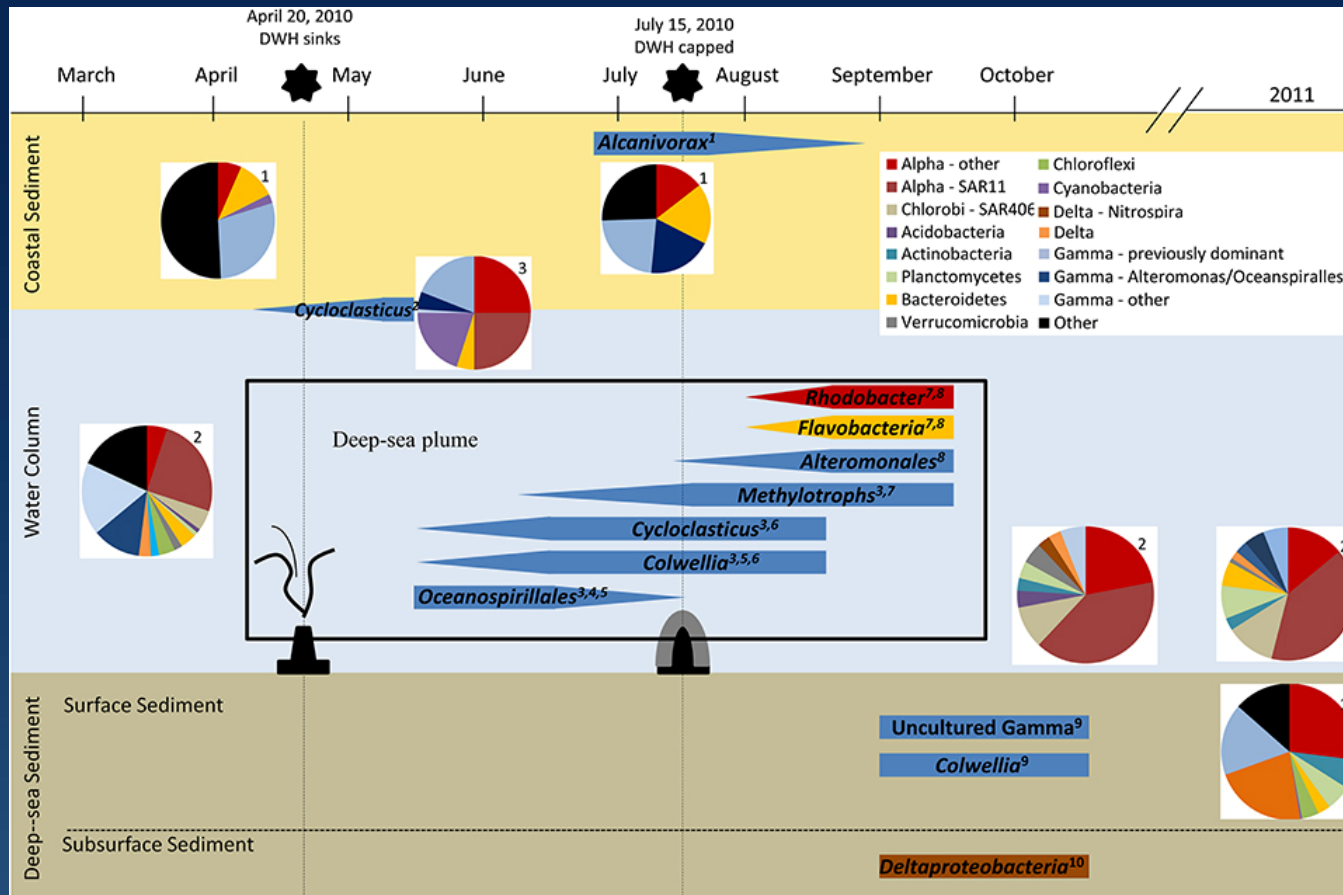
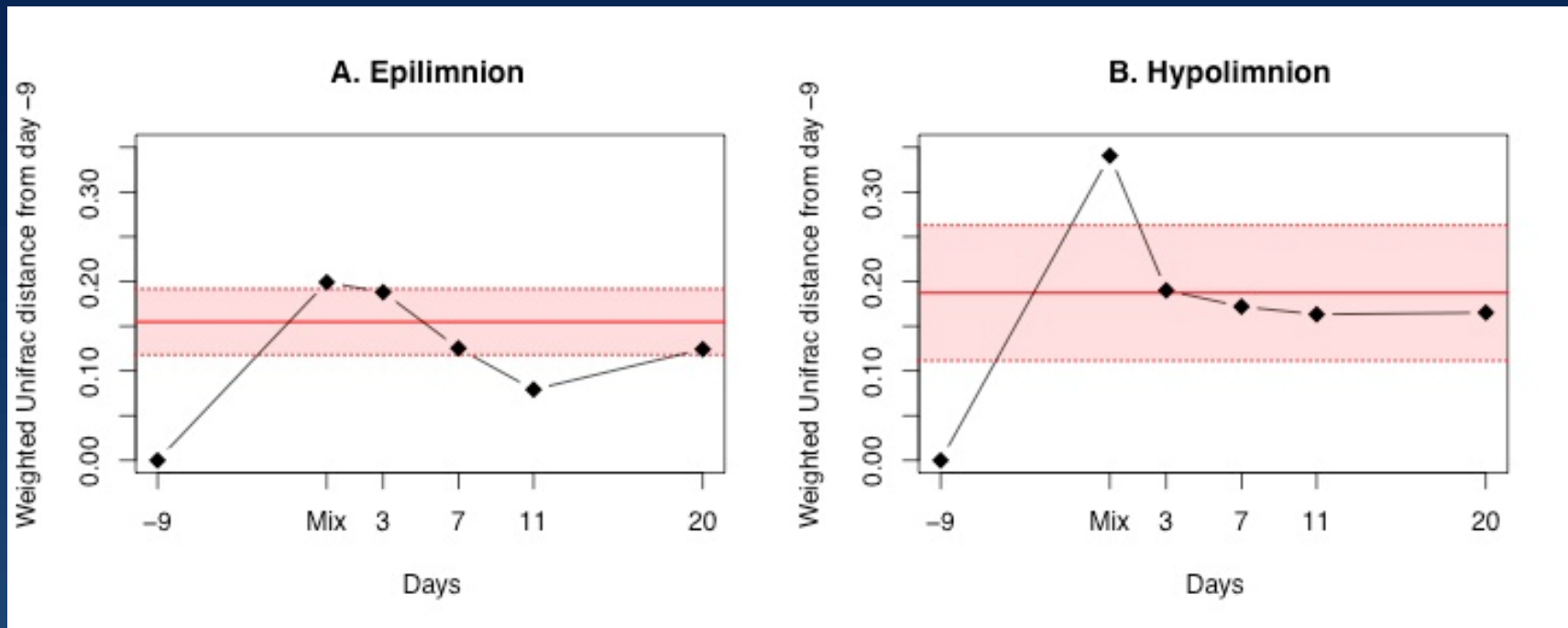


Figure 2. Overview of microbial response to the DWH oil spill. Data from numerous studies following the DWH oil spill are represented in this schematic using approximations from the published data referenced. 1, [Kostka et al., 2011](#); 2, [Yang et al., in press](#); 3, [Redmond and Valentine, 2012](#); 4, [Hazen et al., 2010](#); 5, [Mason et al., 2012](#); 6, [Valentine et al., 2010](#); 7, [Kessler et al., 2011b](#); 8, [Dubinsky et al., 2013](#); 9, [Mason et al., 2014b](#); 10, [Kimes et al., 2013](#); 11, [Liu and Liu, 2013](#).



Lake Microbiome After Mixing Disturbance



Weighted UniFrac distances between each July time point and the day before the mixing manipulation began, day -9. **(a)** Epilimnion (0 m) UniFrac distances. **(b)** Hypolimnion (4 m) UniFrac distances. The red line is the overall mean UniFrac distance for all possible epilimnion or hypolimnion July pairs. The dotted lines and red shading show one standard deviation from the overall mean. Pyrosequencing data were used for this analysis.



To harness microbiomes, we need to

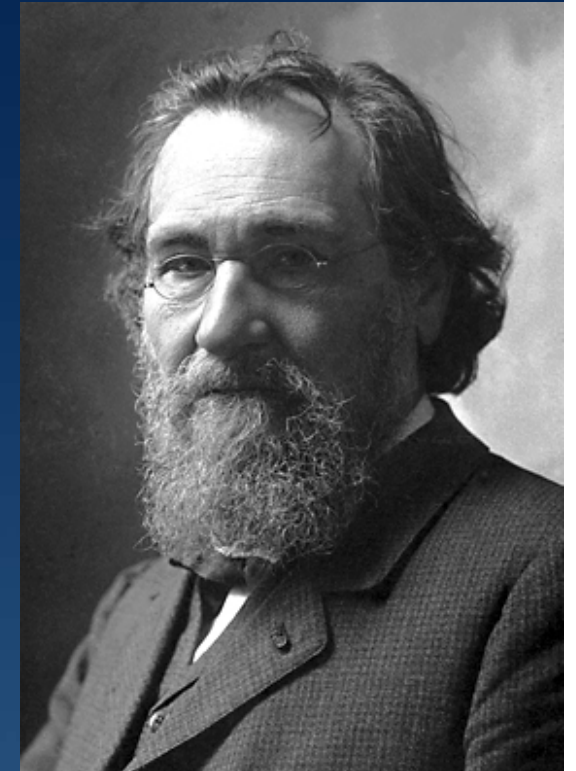
Alter microbiomes predictably and reliably

Understand robustness



Attempting to change microbiomes is not new

- ❖ Mechnikov consumed liters of yogurt containing *Lactobacillus* each day
- ❖ *Lactobacillus* disappeared from his microbiome upon cessation of yogurt consumption
- ❖ **Many microbiomes are resistant to and recover from change**



Ilya Ilyich Mechnikov
~1900



The National Microbiome Initiative

Goals of the Initiative

- ❖ Interdisciplinary research on fundamental questions about diverse microbiomes.
- ❖ Platform technologies for probing and changing microbiomes and data access.
- ❖ New workforce through citizen science, public engagement, and educational opportunities.



The National Microbiome Initiative

Commitments

- U.S. Government invested more than **\$900 million** over 2012-2014 in microbiome research

New Investments

- **\$120 million** of U.S. Government-supported research
- **\$400 million** in new commitments from non-Government groups



Community-Driven Research

- Collaborations between academic researchers and community groups
 - Ministries for Precision Health and University of Chicago
 - Problems defined by community (impact of sickle cell and PTSD from exposure to gun violence on the microbiome)
 - Scientific expertise and funding provided by researchers
- Encourage other collaborations between communities with particular health concerns and microbiome researchers
 - Effects of exposure of urban communities to toxins
 - Effects of exposure of rural communities to farm animals or pesticides
 - Effect of soil management practices on soil microbiome



Predicted Outcomes of The National Microbiome Initiative

- Unifying ecological principles
- Tools to probe microbiomes — microscopic and chemical profiles
- Tools to change microbiomes
- Products for humans, animals, agriculture, and environmental quality
- New model for research collaboration between communities and microbiome researchers



THE NATIONAL

MICROBIOME

INITIATIVE



@jo44

<https://www.whitehouse.gov/blog/2016/05/13/announcing-national-microbiome-initiative>

