

Adaptive and Behavioral Responses to a Changing Climate: A Genomic Perspective

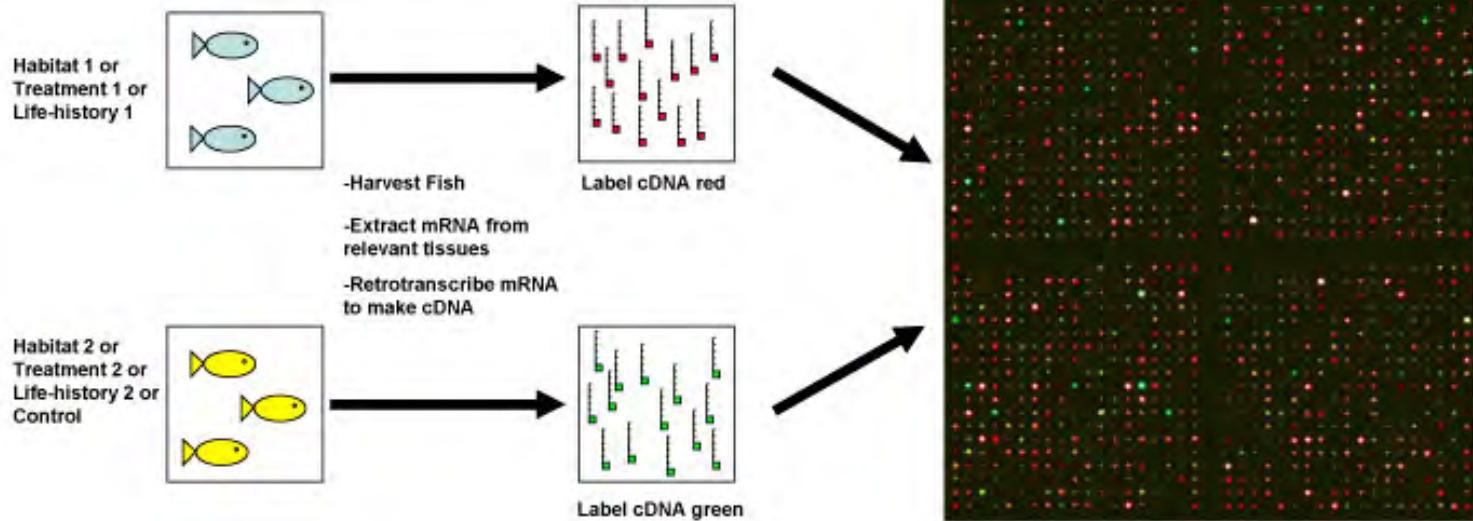
Jennifer L. Nielsen



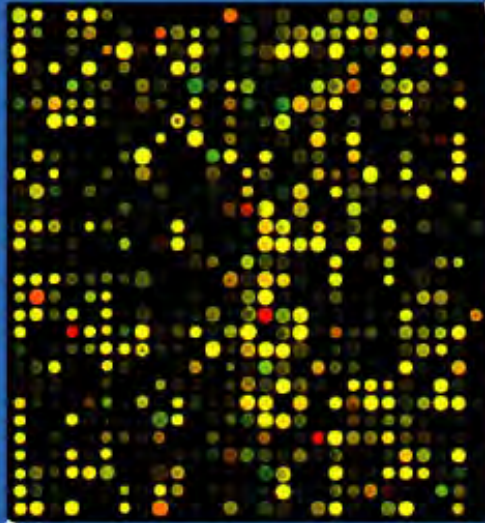
Integrative Genomic Approaches

- **Model organism genomes**
- **High throughput sequencing**
- **Transcriptome sequencing and microarrays**
- **Functional gene sequencing**
- **Evolution of adaptive traits**
- **Protein synthesis and binding site regulation**
- **Modeling protein-protein interactions**
- **Environmental epigenetics**

Transcriptome Experiments



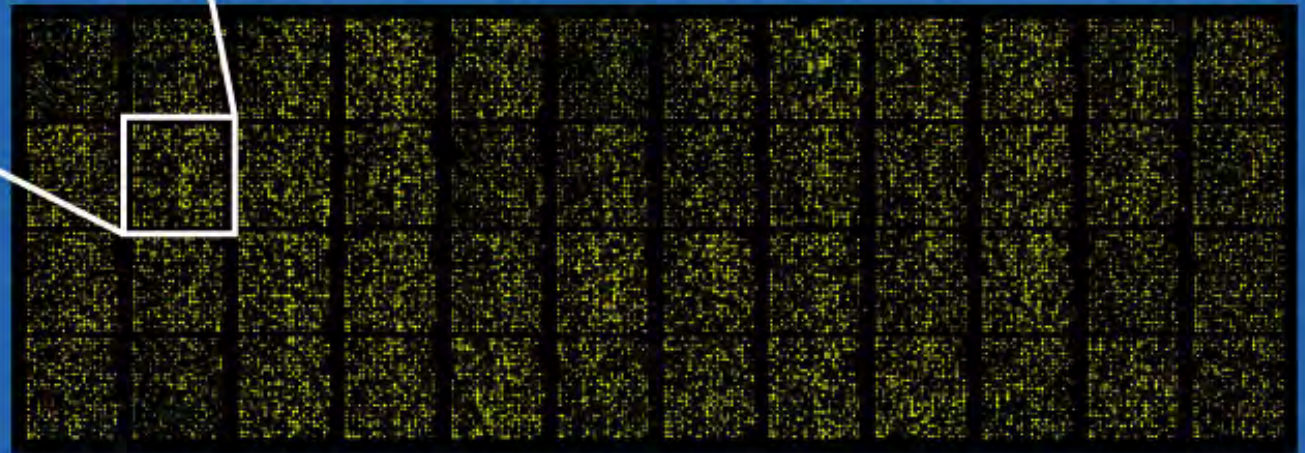
Expression Profiles

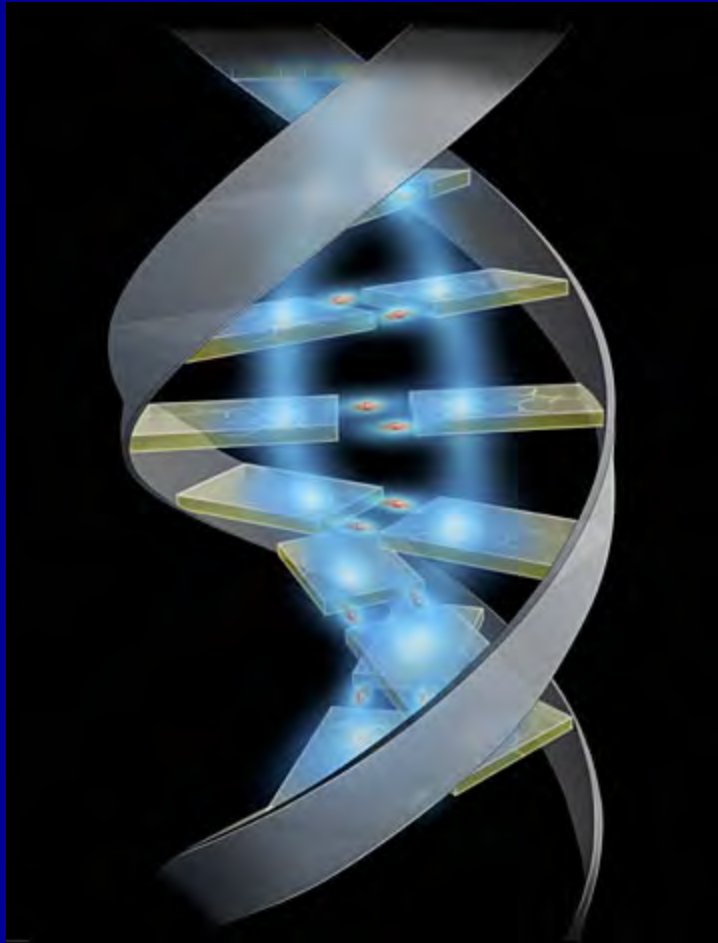


% Down-regulated Genes



% Up-regulated Genes





- **ChIP-seq**
- **DeepCAGE**
- **DeepSAGE**
- **RNA-seq**
- ***de novo* sequencing**
- **SNP detection**
- **miRNA profiling**
- **Targeted resequencing**

Publications: Fish Genomics

Alternative reproductive strategies and tactics

- Behavioral dominance strategies
- Ecological divergence

Phenotype response & plastic life cycles

- Migration timing
- Functional diadromy

Adaptation through physiological pathways

- Endocrine function
- Temperature & oxygen thresholds

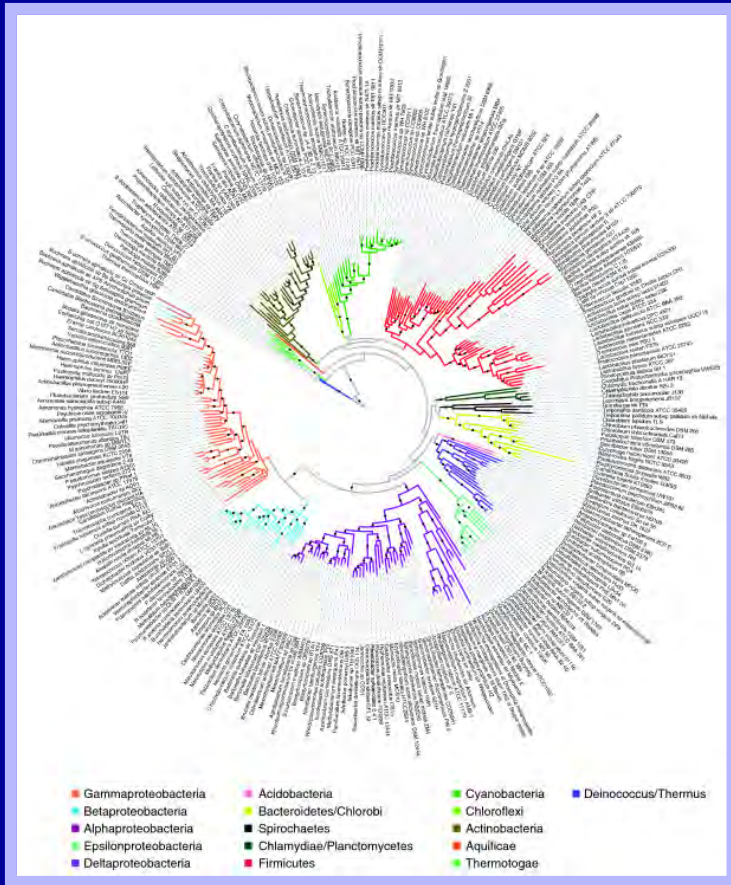
Shifting ranges

- Phenology
- Novel colonization

Functional genes

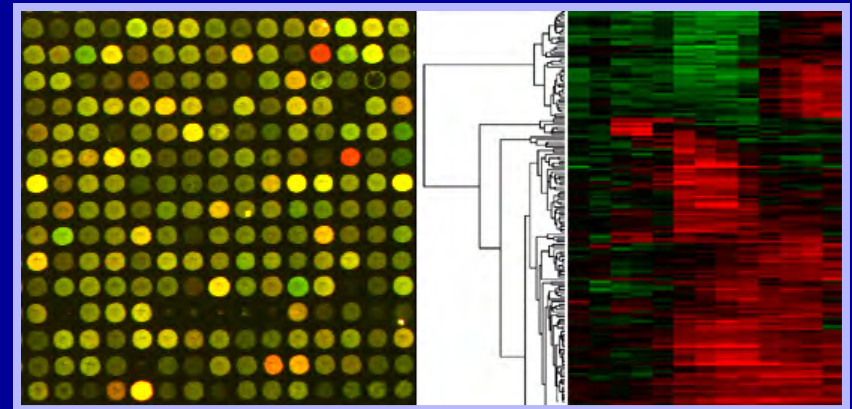
- Variation in *foraging* and *wander* genes

Evolutionary Insight from Functional Genes



Sequence phylogenies

Seeking “evolutionarily significant” genes



Transcriptome phylogenies

Environmental Epigenetics

- Heritable changes in gene expression that occur without changes in DNA sequence
- Flexible genomic parameters that change genomic function under exogenous influence

Gene activity states can be carried through generations

Two known cases inherited along with chromosomes



DNA methylation

(silencing repetitive DNA and transposons)



Histone tails in chromatin proteins

(inhibition of transcription)

Real-time Microbial Genomics in Oceanography

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COMMENTARY **INSIGHT**

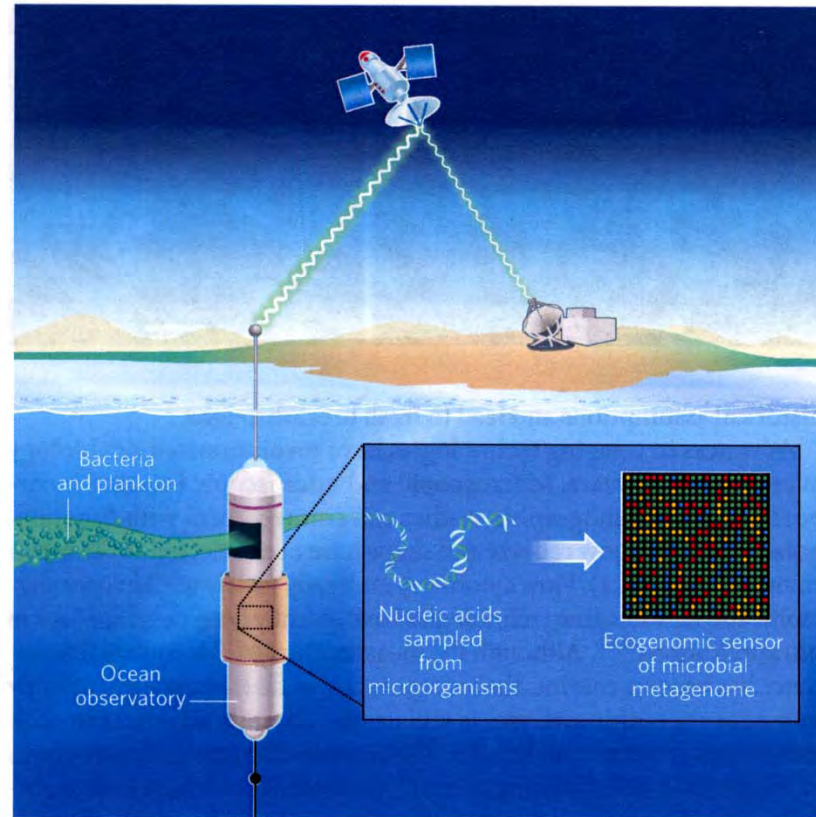


Figure 3 | Miniaturized ecogenomic sensors to measure microbial activity. The sensors could be installed into advanced ocean observatories to monitor DNA and RNA from diverse microbial communities. Subsystems for monitoring, data management and communication, and data modelling would be incorporated for data contextualization. The sensors would report to a worldwide network of laboratories in real time by satellite telemetry.

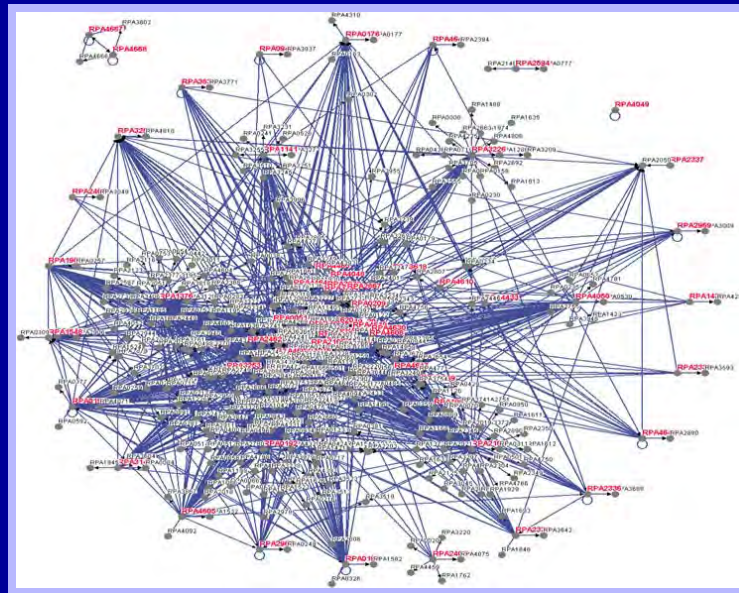
Bioinformatics

New algorithms

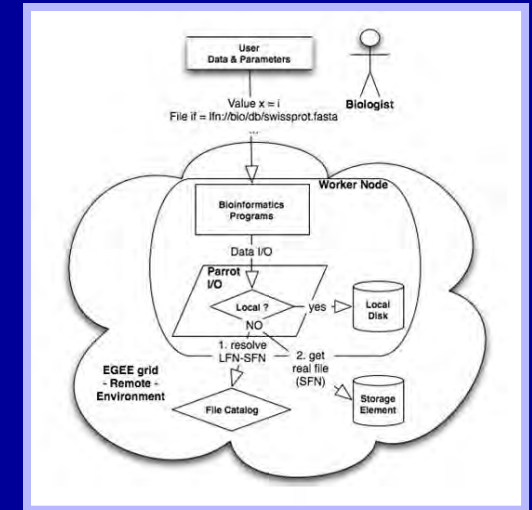


Database search technologies

State/space models



Mapping protein-protein interactions



Data storage pathways

New Genomics Journals



**New Springer International Journal
“Genomics in Fisheries and Oceanography”**



Photo by A.
Solonsky

**Getting to genomic
variation affecting
whole organism
function
in a changing climate**

