Water Research at Rutgers

Joan G. Ehrenfeld
NJ Water Resources Research Institute
Dept. Ecology, Evolution & Natural Resources

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NEW JERSEY WATER RESOURCES RESEARCH INSTITUTE

The New York Times

April 13, 2008
Extended Forecast: Bloodshed
By NICHOLAS D. KRISTOF

Here's a forecast for a particularly bizarre consequence of climate change: more executions of witches.

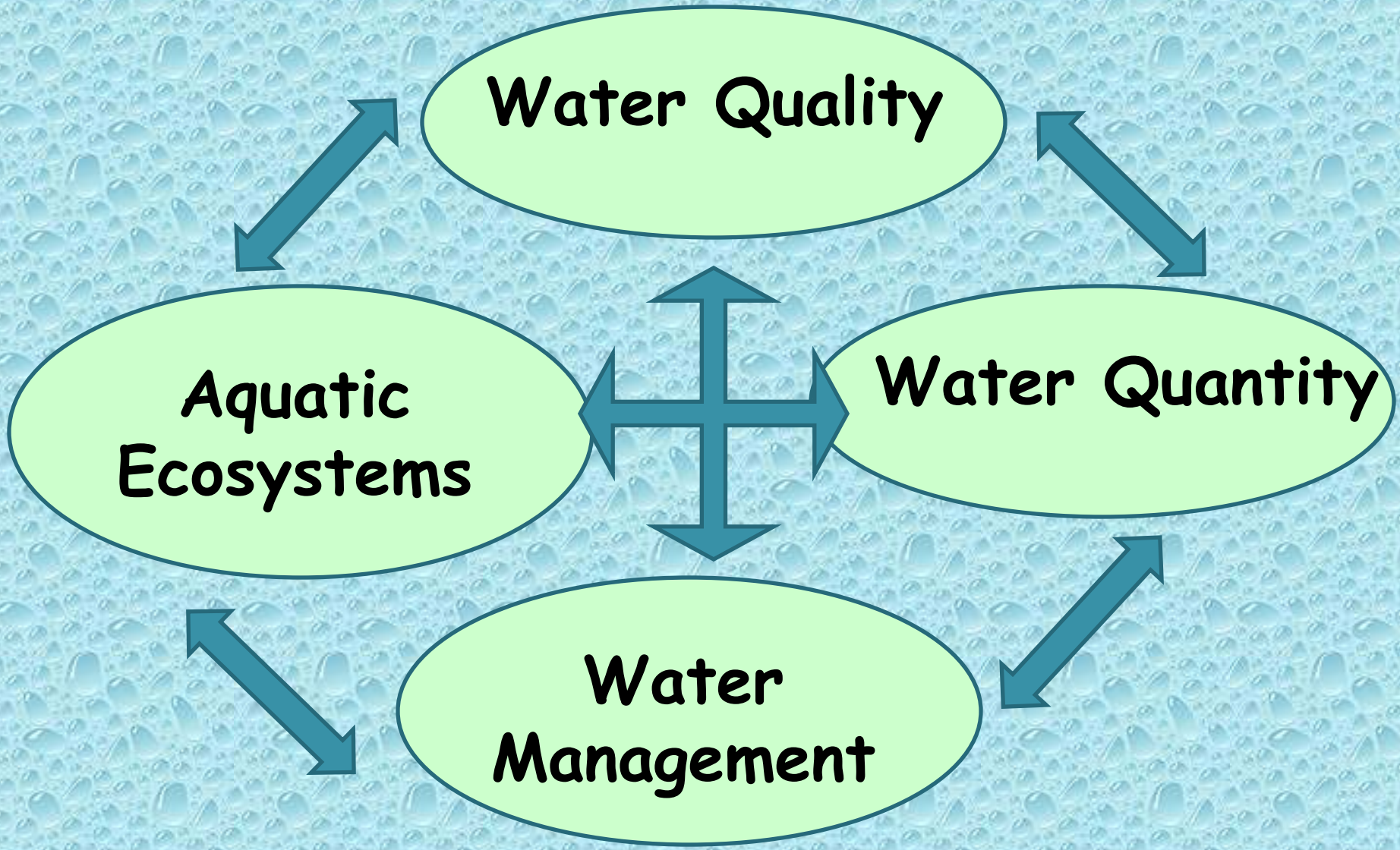
As we pump out greenhouse gases, most of the discussion focuses on direct consequences like rising seas or aggravated hurricanes. But the indirect social and political impact in poor countries may be even more far-reaching, including upheavals and civil wars — and even more witches hacked to death with machetes….

The New York Times

April 7, 2008
Grains Gone Wild
By PAUL KRUGMAN

These days you hear a lot about the world financial crisis. But there's another world crisis under way — and it's hurting a lot more people.

I'm talking about the food crisis. Over the past few years the prices of wheat, corn, rice and other basic foodstuffs have doubled or tripled, with much of the increase taking place just in the last few months. High food prices dismay even relatively well-off Americans — but they're truly devastating in poor countries, where food often accounts for more than half a family's spending…



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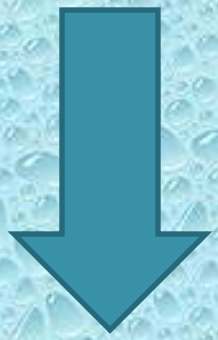
New Jersey's Waters



Global

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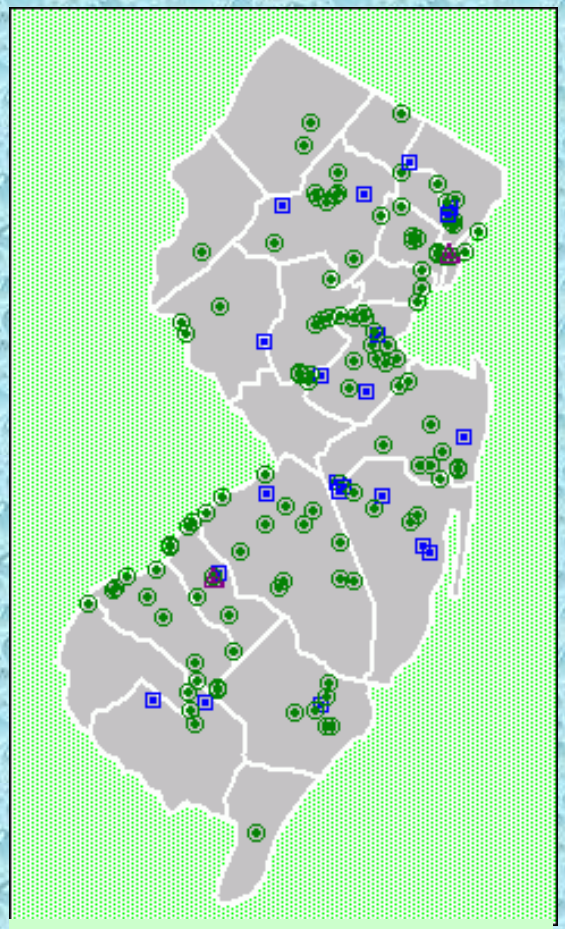
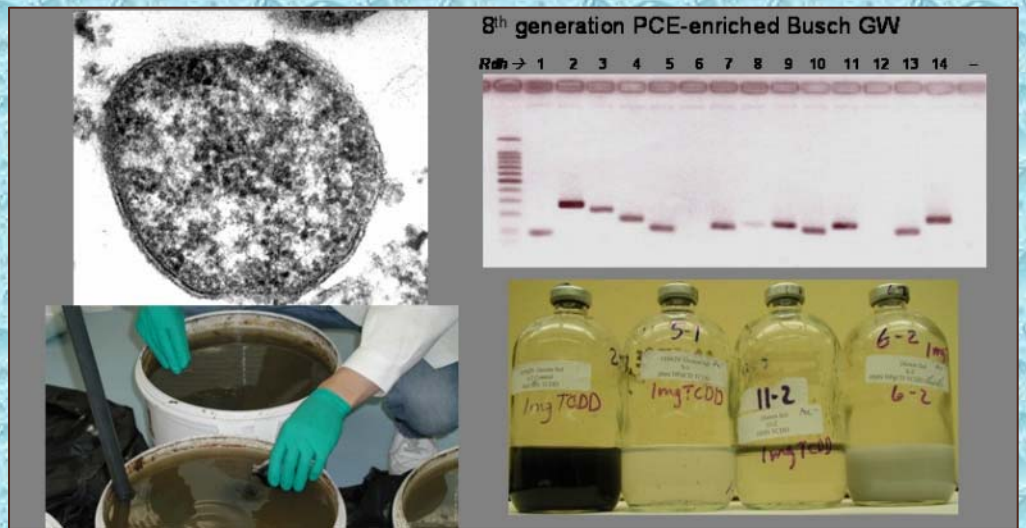
Water Quality

Donna Fennell, Dept. Environmental Sciences



14,000 contaminated sites

- Bioremediation
  - Chlorinated compounds (PCBs, dioxins, others)
  - Novel bacteria
  - Application to groundwater *in situ*
  - Federal-state-industry partnerships



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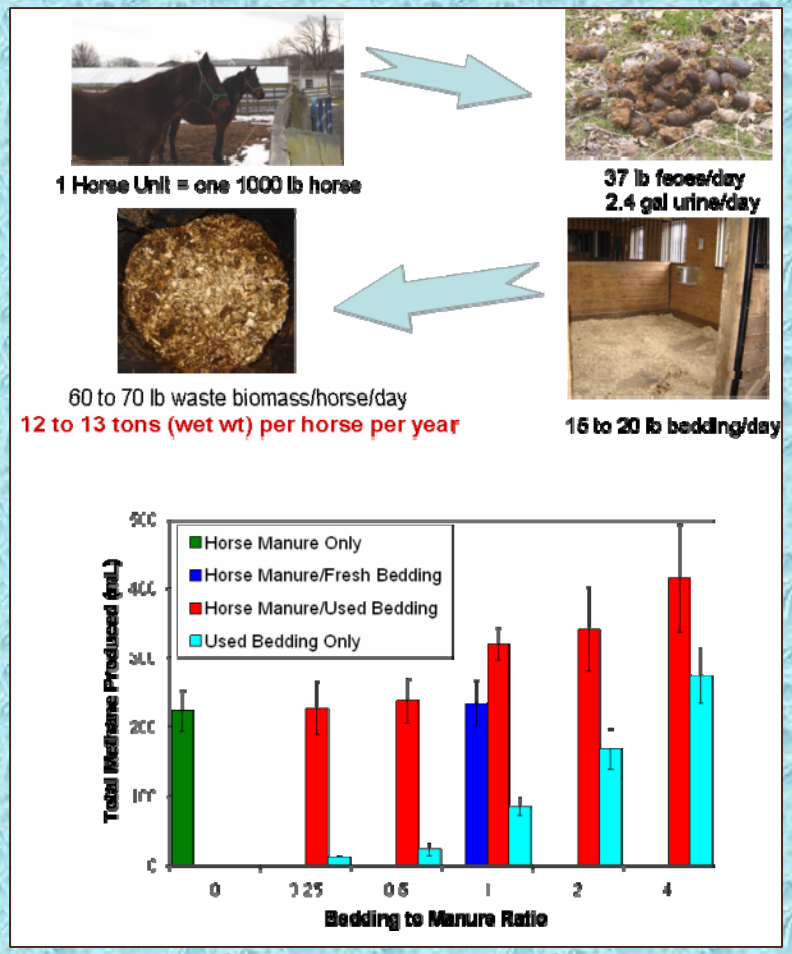
Water Quality

Donna Fennell



Water pollution?

- 50,000 horses in NJ
- ~60 lbs/day of manure

Bioenergy!

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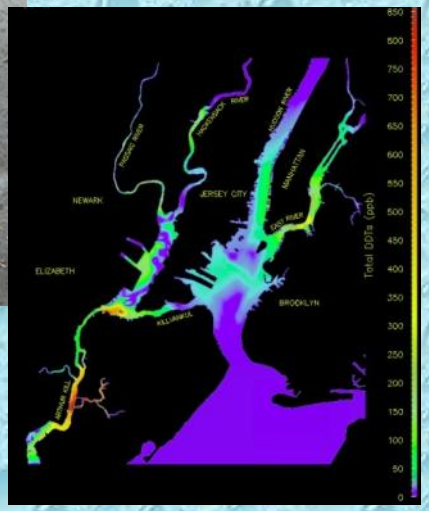
Water Quality

Max Haggblom, Biochemistry & Microbiology



Dehalogenating bacteria are everywhere!

- Finding and characterizing bacteria, including new species
- Understanding biochemical mechanisms
- Understanding microbial transformations of other toxics (As, Se)

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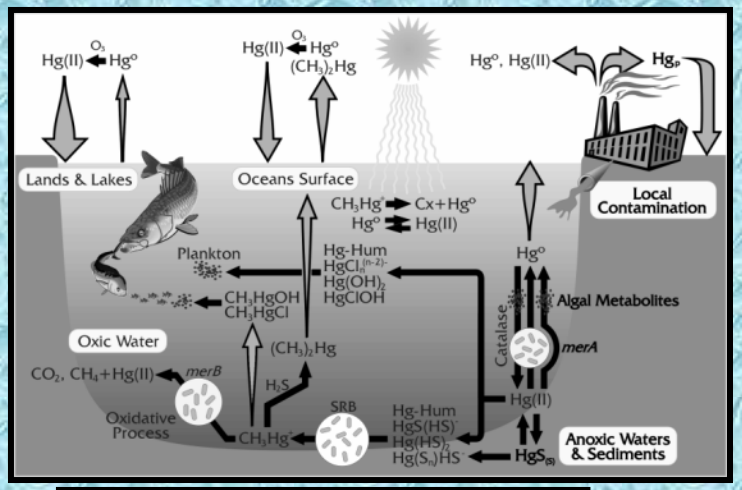
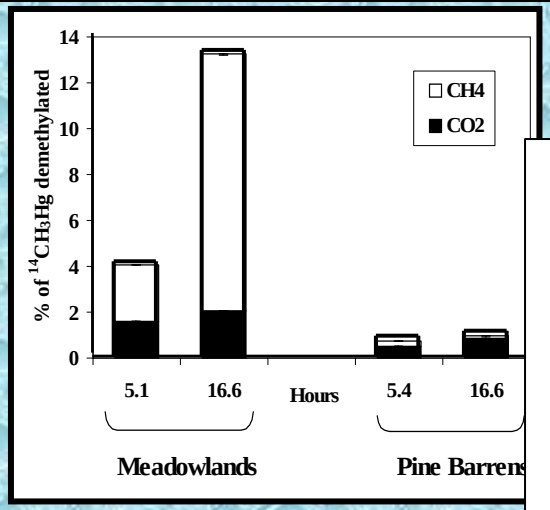
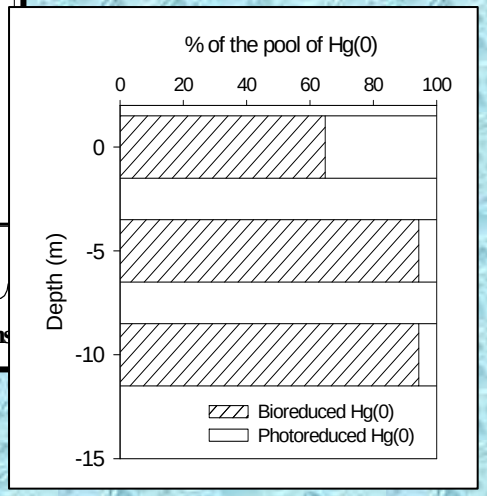
Water Quality

Tamar Barkay, Biochemistry & Microbiology







Microbiology of mercury

- controls on methylation & demethylation
- Hg(II) reduction in the high Arctic
- stable isotope methods for measuring process rates

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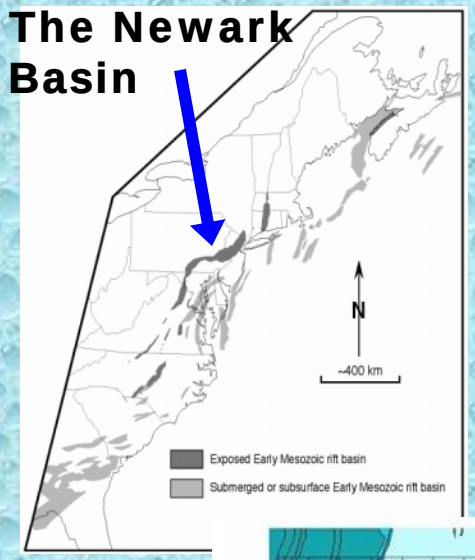
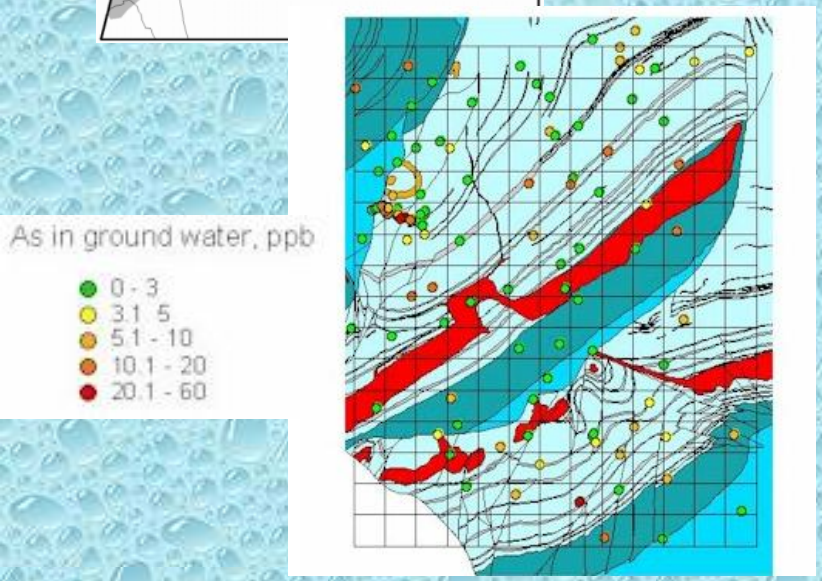
Water Quality

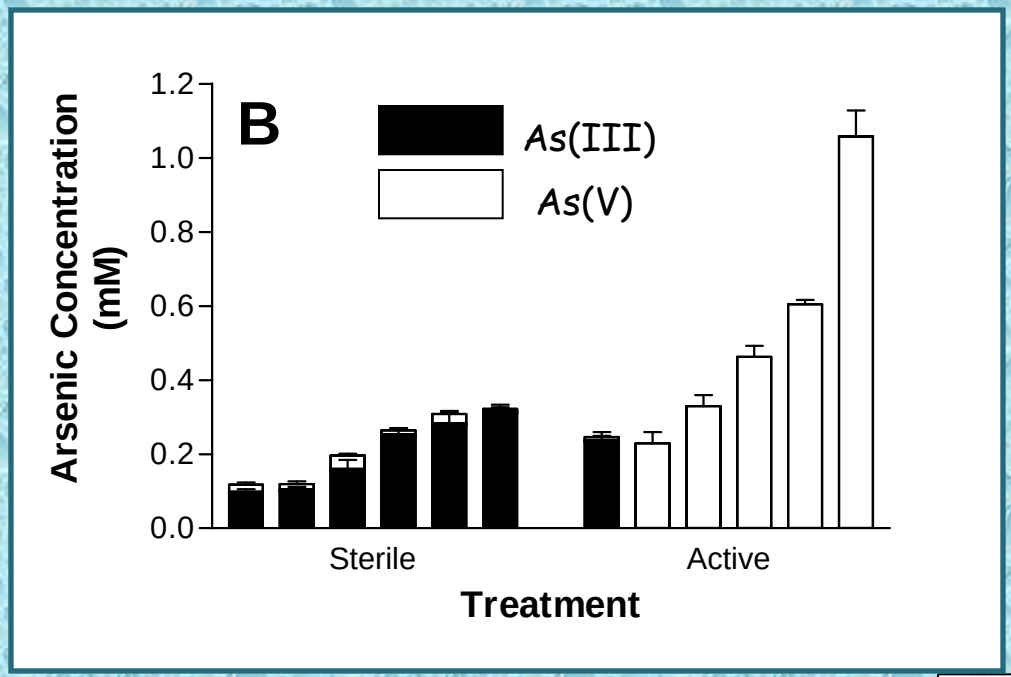
John Reinfelder, Lily Young, Environmental Sciences



Mobilization and speciation of arsenic in Newark Basin sedimentary rocks

- **Lockatong Formation – 10-60 ppb As in groundwater**
- **Microbial role in As oxidation**





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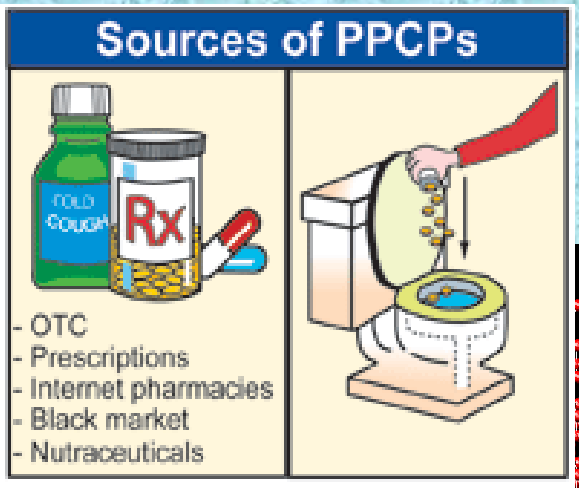
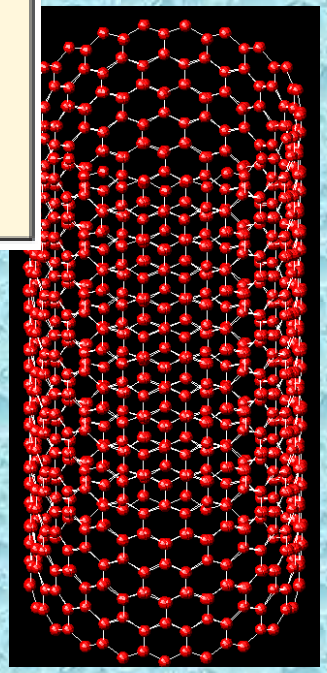
Water Quality

Weilin Huang, Environmental Sciences

Organic and inorganic pollutants in urban watersheds





- role of colloids & particles in pollutant transport in stormwater
- tidal energy & sediment re-suspension
- pharmaceuticals & personal care products → synthetic hormones in combined sewer overflows – methods of detection
- Nano-carbon tubes for removing trace organic pollutants, chlorinated compounds

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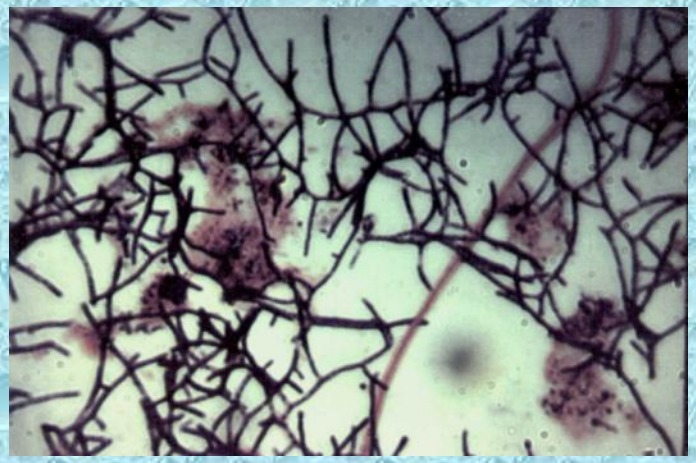
Water Quality

Peter Strom, Environmental Sciences

Nocardia-like Foam in Activated Sludge Settling Tank for Wastewater Treatment



Effect of increased temperature on proliferation of the filamentous bacteria?

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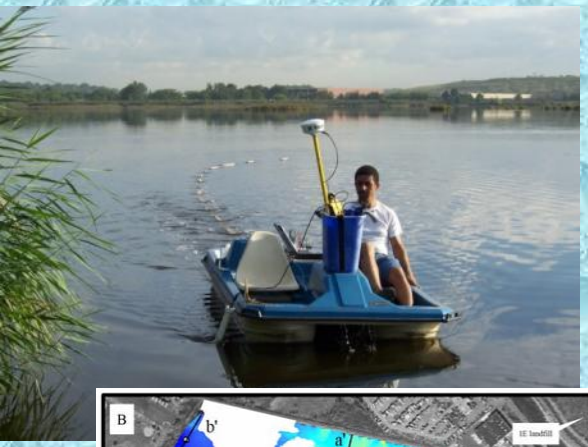
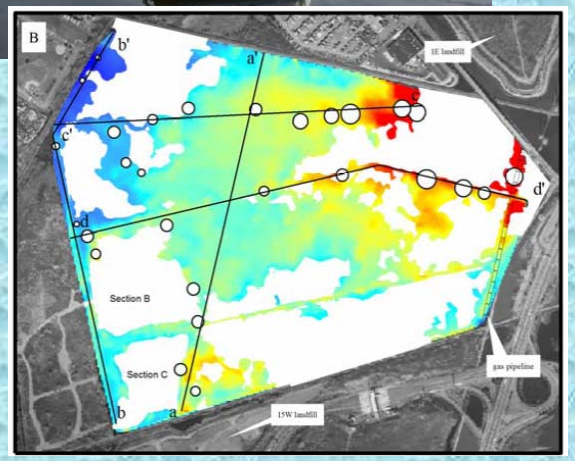
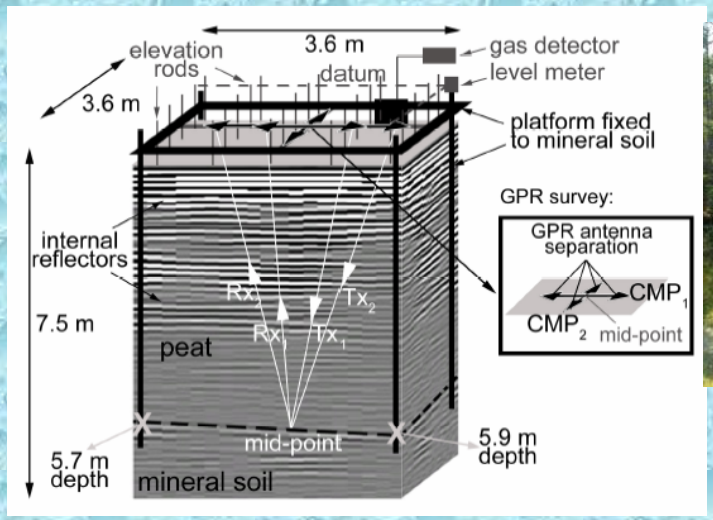
Water Quality

Lee Slater, Earth and Environmental Sciences, Rutgers-Newark





- Non-invasive geophysical characterization of contaminated wetlands
- Geophysical methods to quantify methane fluxes in peatlands



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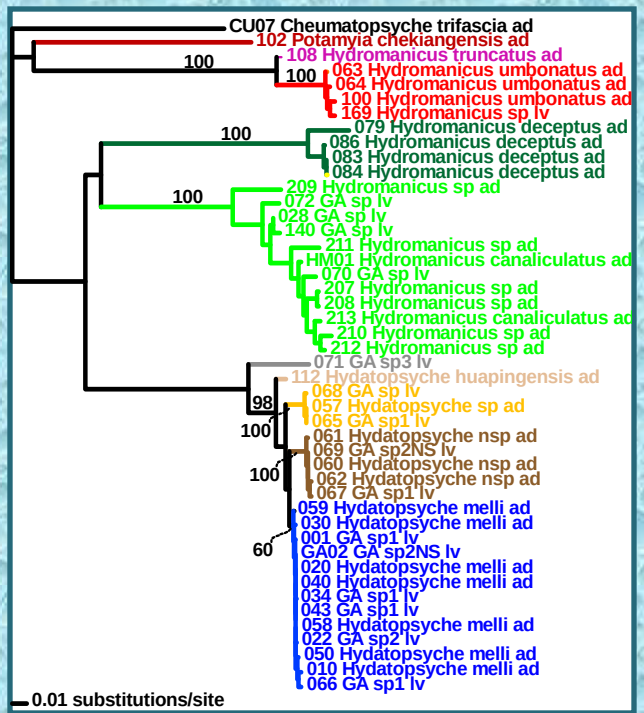
Water Quality Ecosystems

Karl Kjer, Ecology, Evolution & Natural Resources



- Ephemeroptera/Plecoptera/Trichoptera for Water Quality Monitoring
  - Cheap, fast, well validated
  - Wide range of pollution tolerances
  - Species identification & taxonomy of larvae is poorly known
  - Molecular methods combined with morphology

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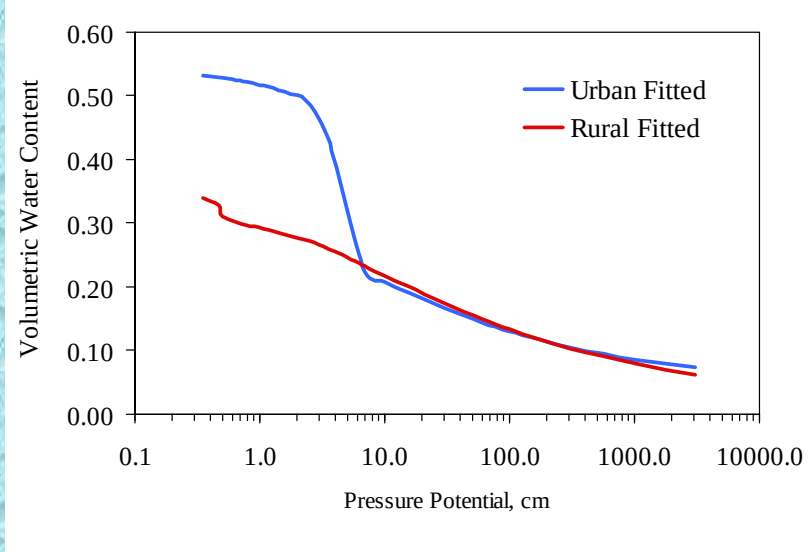
Water Quantity & Flow

Daniel Gimenez, Environmental Sciences

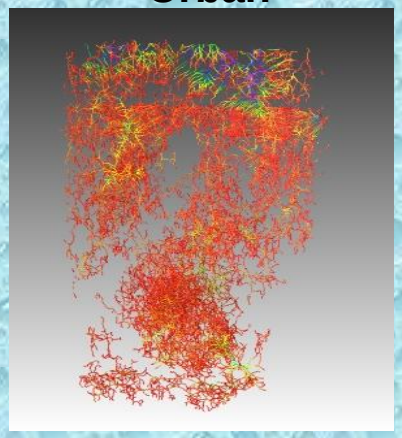


Water flow through soils: effects of CO2 and temperature changes

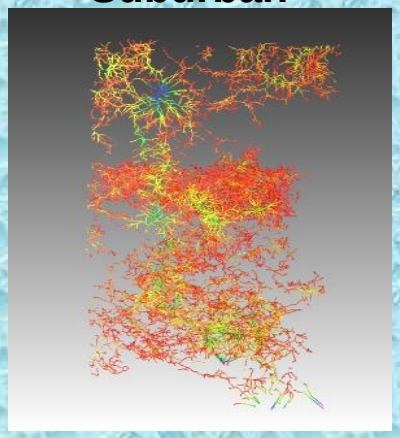
- **Urban soils → higher temperature, CO2 than rural → model for climate change**
- **CT scanning of soil samples – 3D imaging of pore structures**
- **Change in water retention capacity in urban soils**

Soil Samples

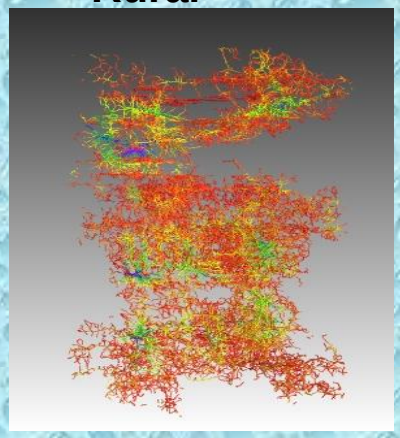
Urban



Suburban



Rural



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Water Quantity & Flow

Ying Fan Reinfelder, Earth and Planetary Sciences & Environmental Sciences

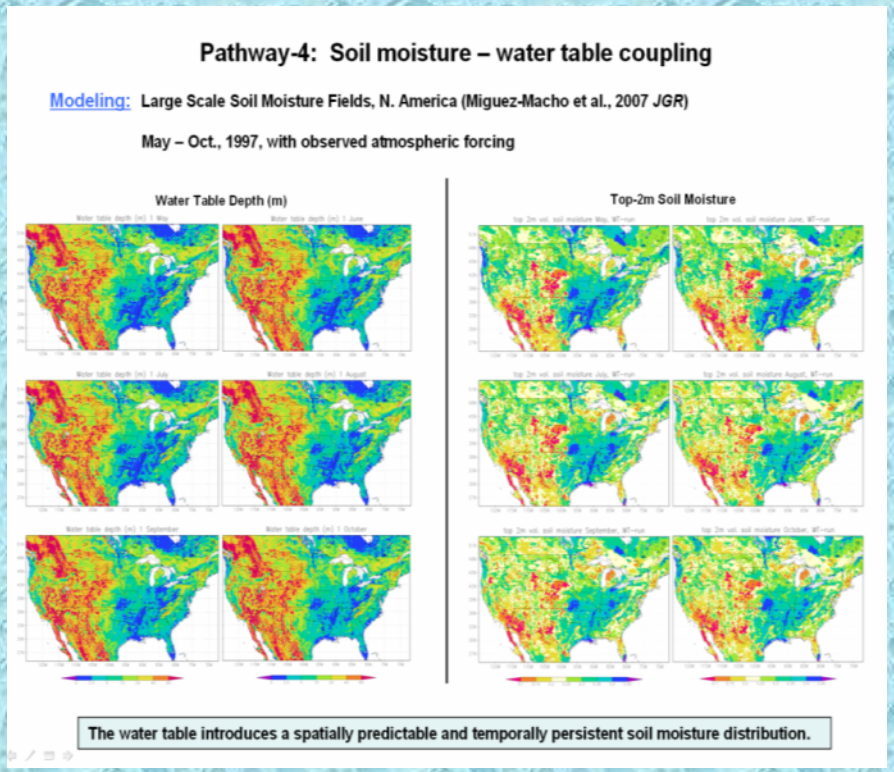

Fig.3. Simulated 1997 June-October water table depth and root-zone soil moisture content. As the season progressed, the water table fell, but the spatial pattern remained. The soil moisture also decreased, but the spatial pattern persistent throughout the dry season. In most climate models, soil moisture resembles rainfall pattern, and the wet patches last only days-weeks.

Continental-scale hydrologic models

- linkage among pools & fluxes
- atmospheric & coastal ocean drivers
- feedbacks
- role of groundwater reservoir in linking sea level to continental drainage

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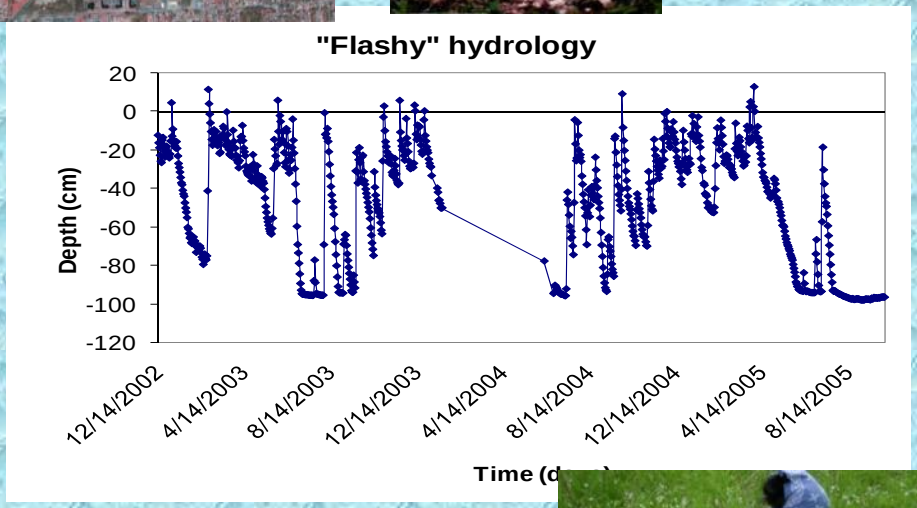
Aquatic Ecosystems

Joan Ehrenfeld, Ecology, Evolution & Natural Resources



Urban wetlands

- Biodiversity
- Hydrology
- Nitrogen retention
- Exotic species
- Natural & urban soils
- West Nile Virus

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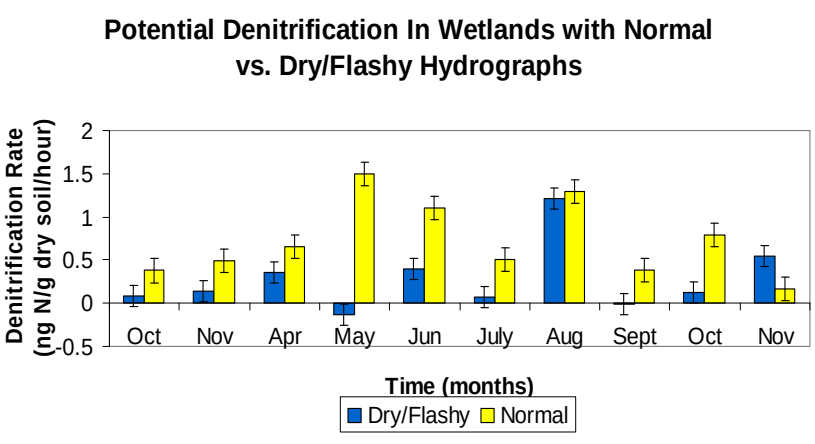
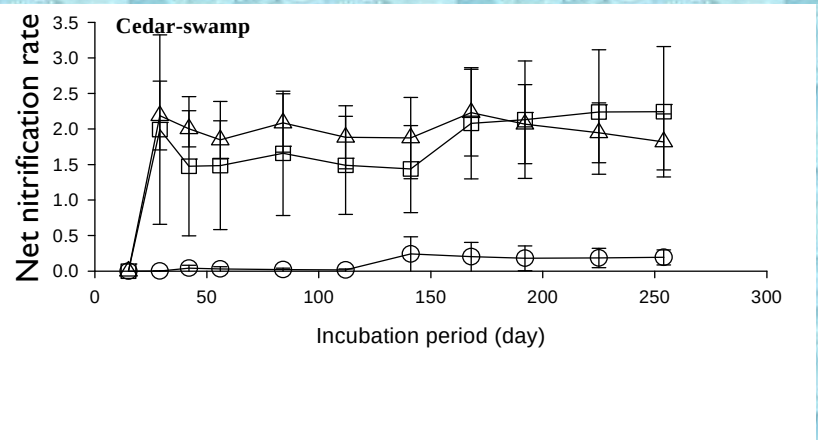
Aquatic Ecosystems

Joan Ehrenfeld





Urban wetlands: hydrology & nitrogen cycling

Pinelands wetlands: effects ofdrawdowns on nitrogen cycling

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Aquatic Ecosystems

Michael Sukhdeo, Ecology, Evolution & Natural Resources & Animal Science

- Fish parasites as indicators of water quality & aquatic ecosystem integrity
- Parasites in food webs as indicators of water quality

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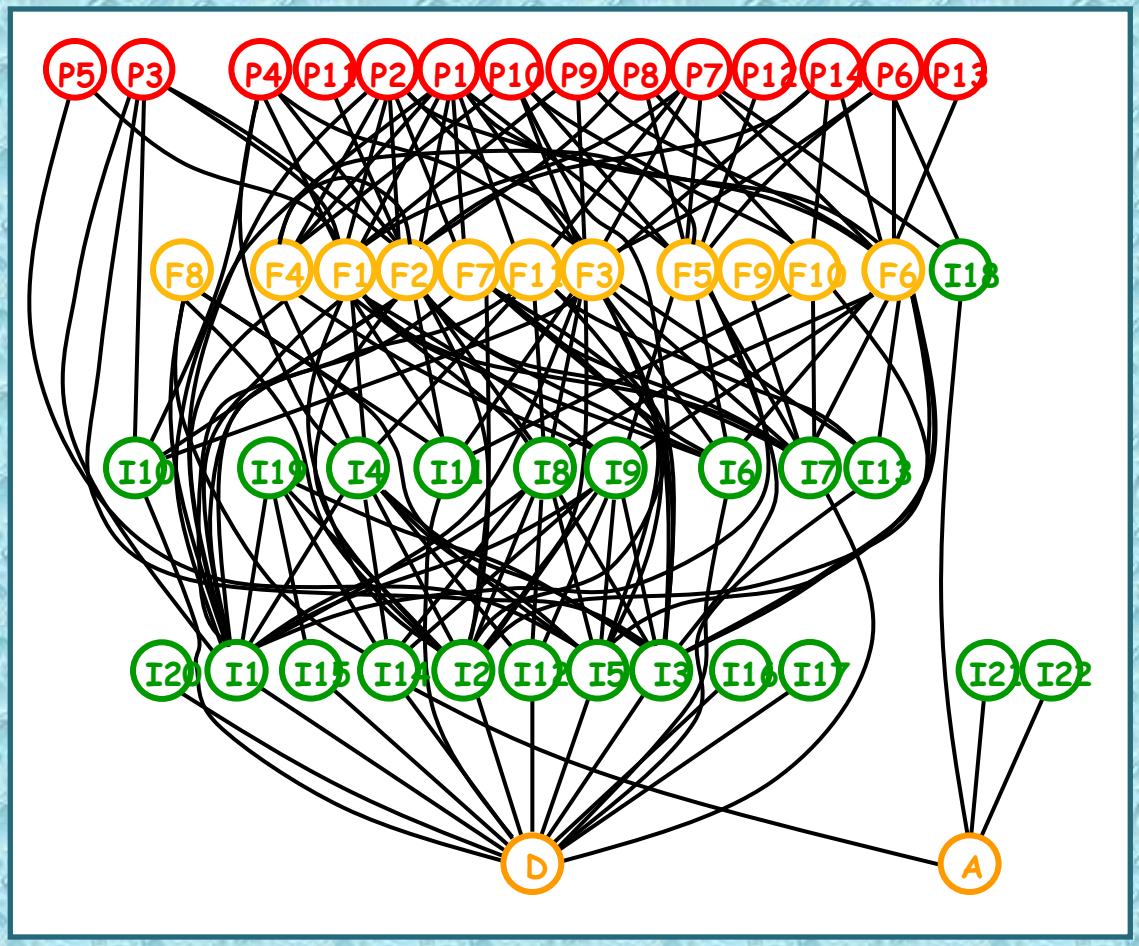
Aquatic Ecosystems

Michael Sukhdeo

Pinelands Stream Food Web (with parasites)



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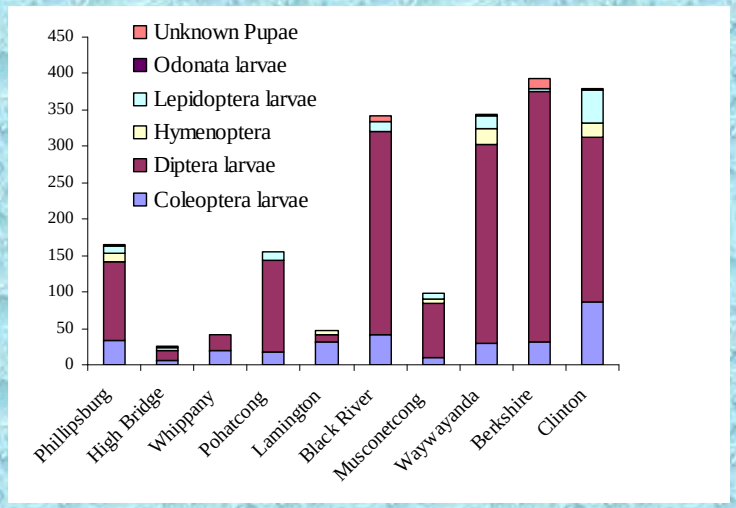
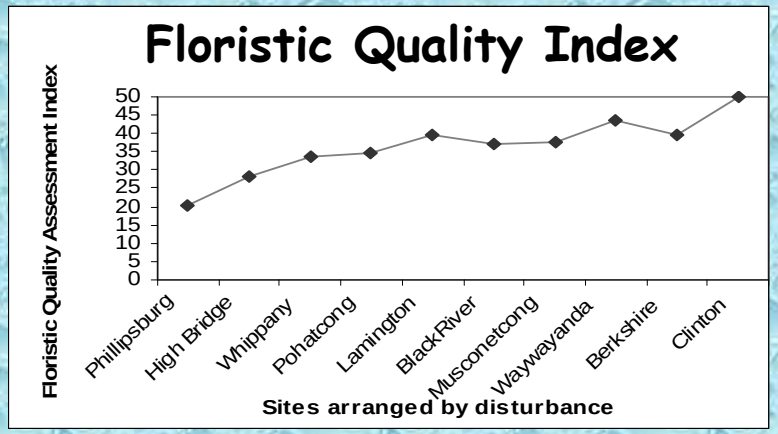
Aquatic Ecosystems

Michael May, Entomology
Jean Marie Hartmann, Landscape Architecture

Wetland Index of Biotic Integrity

- Appropriate indicators for NJ
- Vegetation, insects, invertebrates
- Calibrated across disturbance gradient





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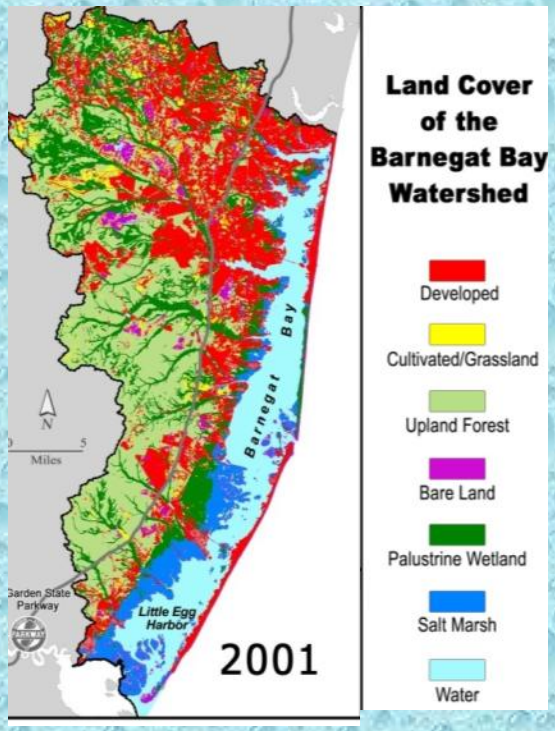
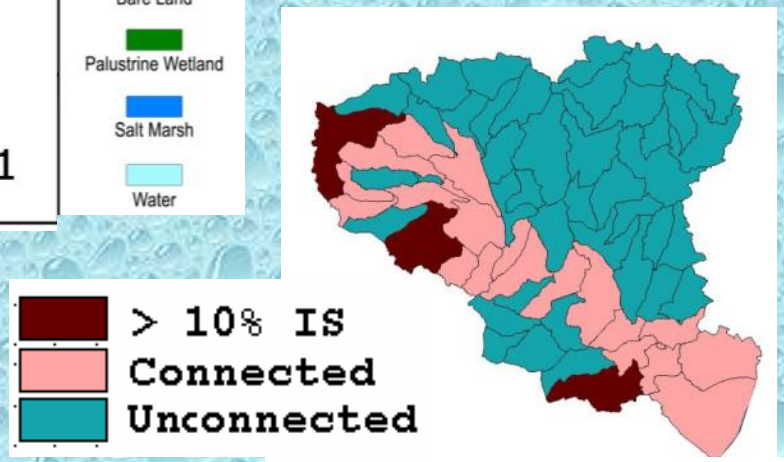
Water Management

Rick Lathrop
Ecology, Evolution & Natural Resources
Center for Remote Sensing and Spatial Analysis



- Land use/Land Cover Change as an indicator and driver of changing watershed functions
- Identifying hotspots of potential degradation



Mullica River Watershed

- Pinelands
- Coast
- Highlands

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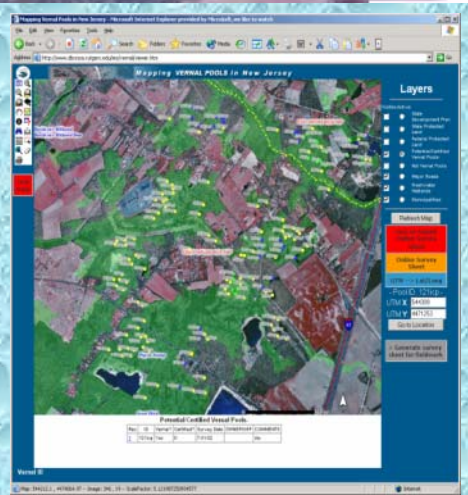
Water Management

Rick Lathrop

- 13,000+ pools mapped
- Interactive map server to communicate information to public



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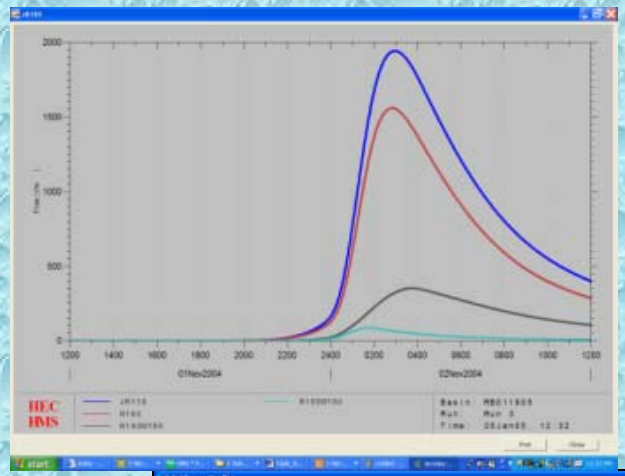
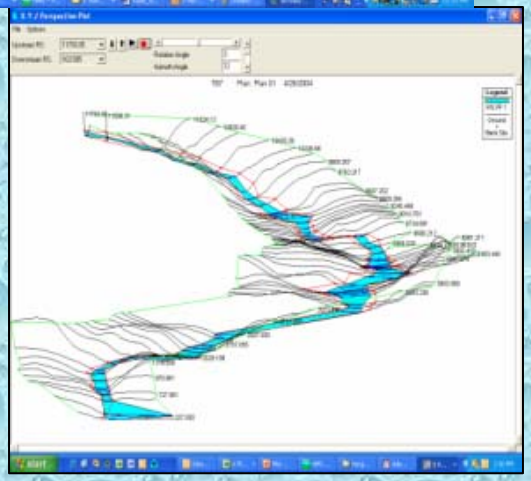
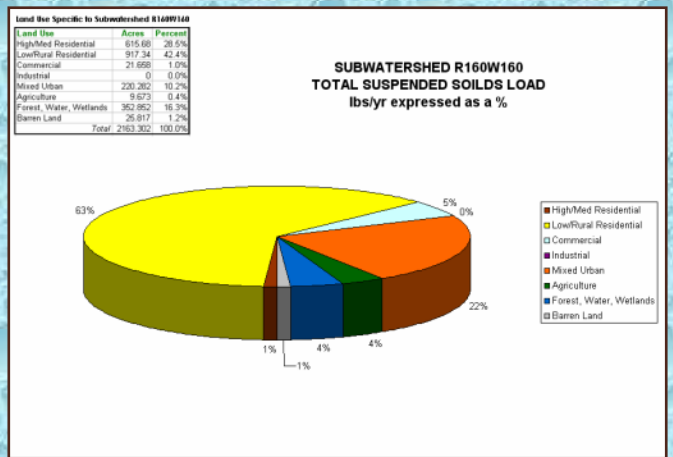
Water Management

Chris Obropta, Water Resources Program (RCE)





- TMDLs
- stormwater & watershed management
- Water quality & quantity modeling
- Onsite water treatment (e.g., rain gardens)
- pollution trading



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Water Management

Chris Obropta, Water Resources Program (RCE)

- Education – K12 through graduate students
- Programs for stakeholders, adults
- Bioresource engineering senior design

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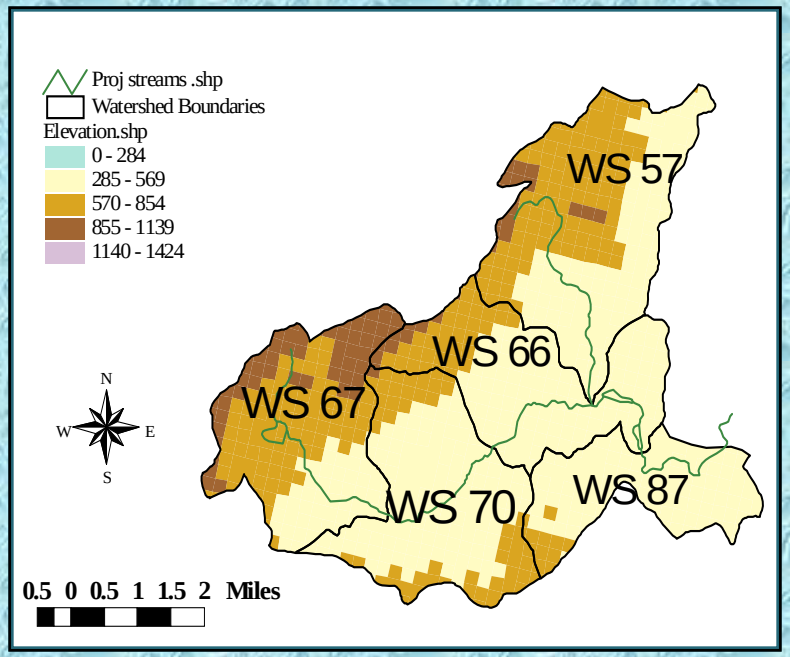
Water Management

Qizhong (George) Guo, Civil & Environmental Engineering



- Watershed modeling to understand and manage stormwater flows with altered precipitation inputs
- Analysis of Best Management Practices for stormwater management

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Water Management

Qizhong Guo

- Flood zone delineation
- Experimental studies of sediment flushing devices

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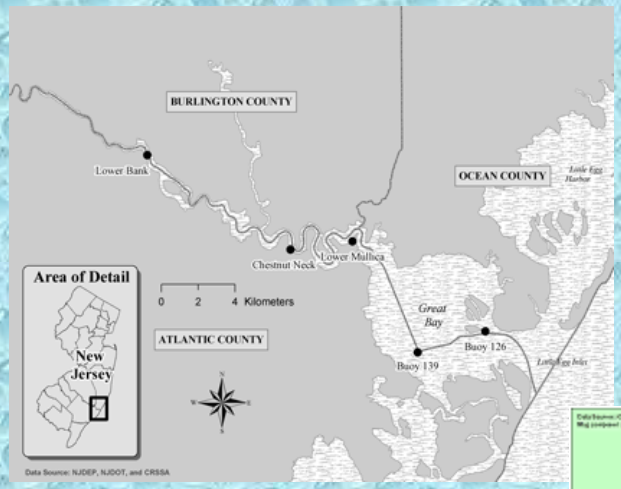
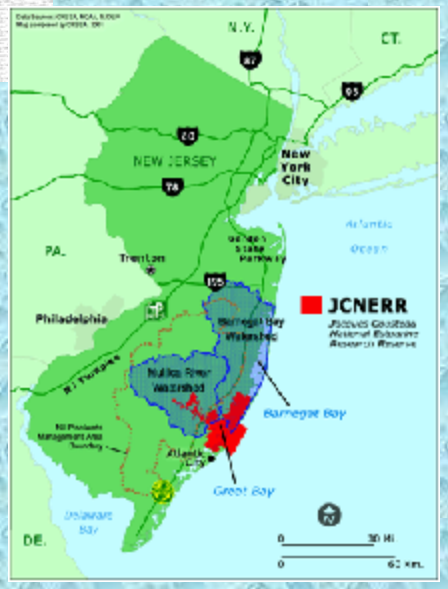
Water Management

Jacques Cousteau National Estuarine Research Reserve, Institute of Marine & Coastal Sciences



System-wide monitoring
Build-out analyses (CRSSA)
Watershed management workshops



COASTAL TRAINING PROGRAM
Jacques Cousteau
National Estuarine Research Reserve

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Water Management

Karen O'Neill, Human Ecology

- Natural resource management & government policies and programs
- Farmers & flood control programs
- Government policies and the Katrina disaster
- River basin management

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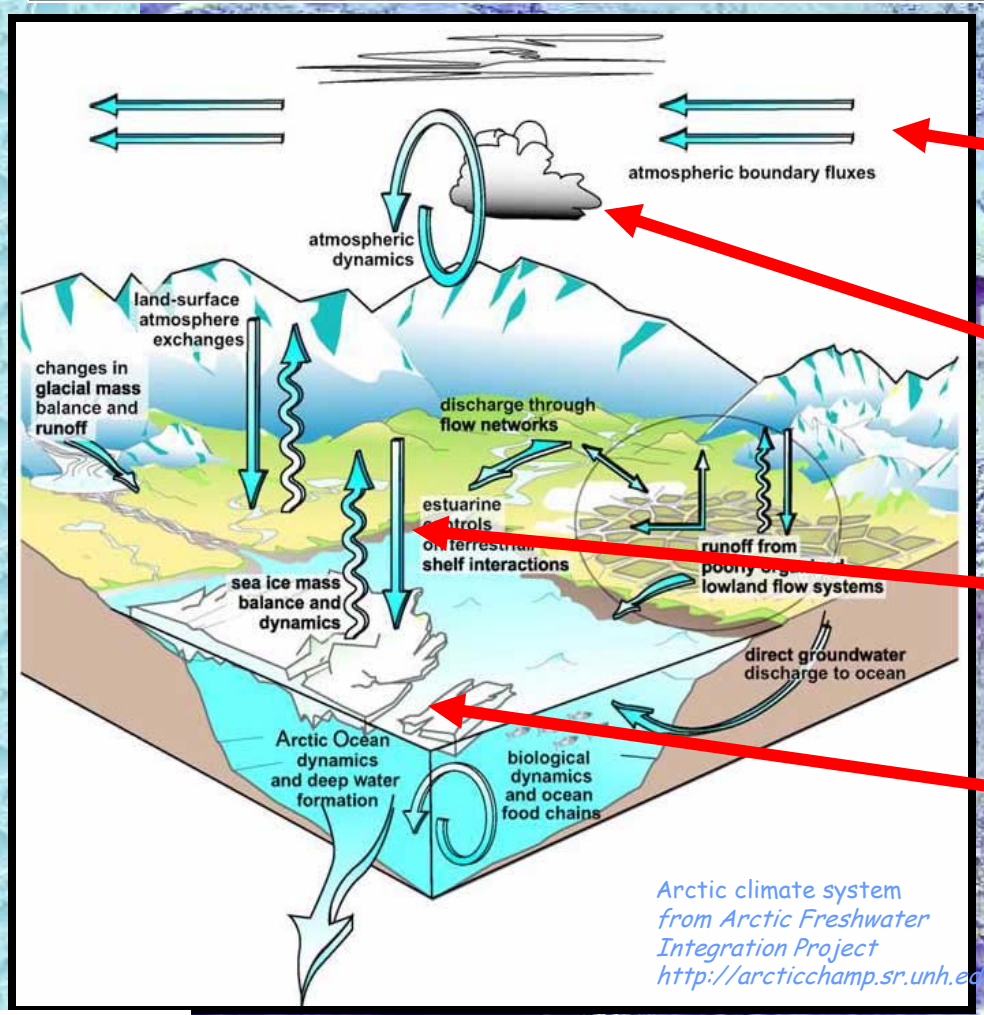
Global

Jennifer Francis, Institute of Marine & Coastal Sciences

Change and Feedbacks in the Arctic Hydrologic System



Arctic climate system
from Arctic Freshwater Integration Project
http://arcticchamp.sr.unh.edu

Dr. Jennifer Francis' group, Department of Marine and Coastal Sciences

- Satellite remote sensing of Arctic clouds, water vapor, moisture transport, and precipitation
- Effects of hydrologic change on Arctic system, including marine productivity, vegetation, and humans

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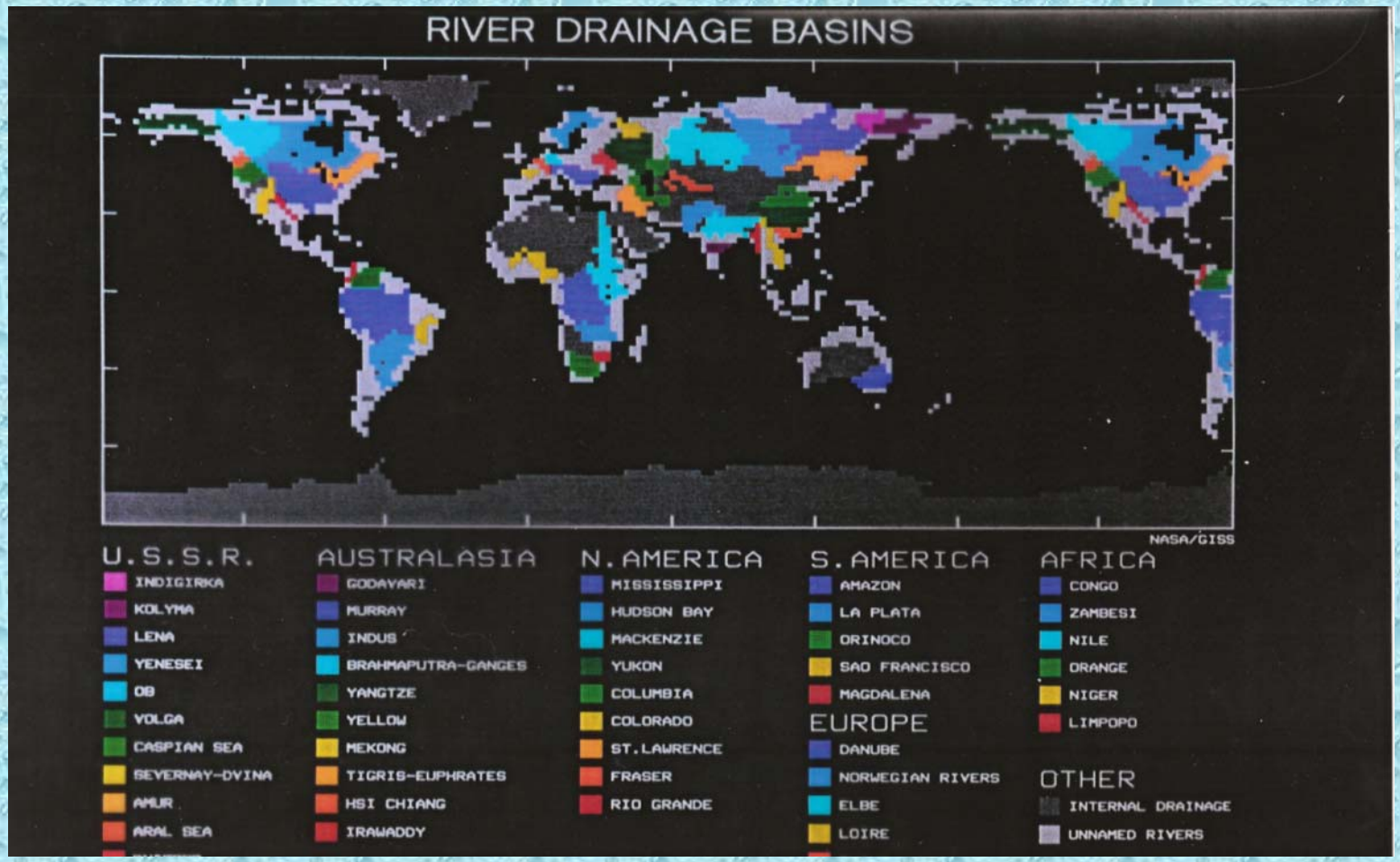
Global

Jim Miller, Institute of Marine & Coastal Sciences

Climate models → climate change effects on river flow



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Global

Trevor Birkenholtz, Human Ecology

Water Scarcity in Africa – Institutional and Social Solutions

- do scarcity-reducing technologies work?
- how do local social power relations, adaptive institutions, and groundwater policy affect water scarcity
- new institutions & methods of governance can help

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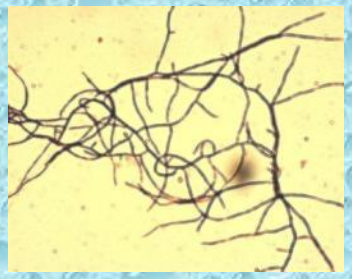
Global

Häggblom Laboratory –Arctic Microbiology Research Consortium, Rovaniemi, Finland

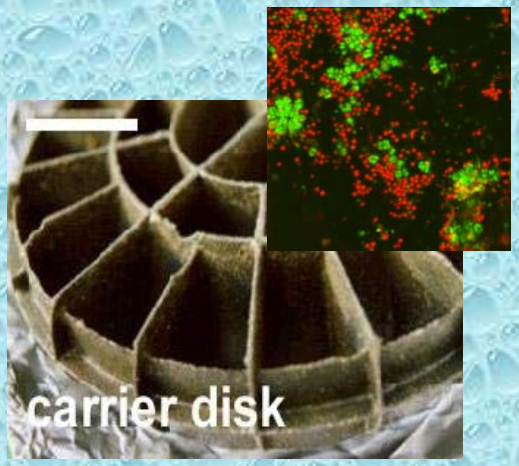


Biodegradation of wastes and toxic chemicals

Bioprospecting for psychrotolertant microbes

Microbial soil processes

Environmental biotechnology
Wastewater treatment



Novel enzymes
Pharmaceuticals

Sustainable use of the arctic environment

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NJ Water Resources Research Institute
Graduate Student Researchers

- Restoration of cranberry bogs
- Polybromated dimethyl ethers landfills
- Arsenic and selenium biotransformations
- Denitrification modeling
- Restoration of oyster reefs
- Methylmercury & microbes
- Carbon nanotubules for TCE removal
- Water movement through fractured rock aquifers
- Exotic isopods in Delaware Bay
- Dechlorination of dioxins
- Functional assessment of biofilters
- Biotransformation of MTBE
- Assesment of bioretention BMPs
- Isotopes for Hg pollution tracking
- Seed dispersal for marsh restoration
- Nitrogen deposition and retention in wetlands

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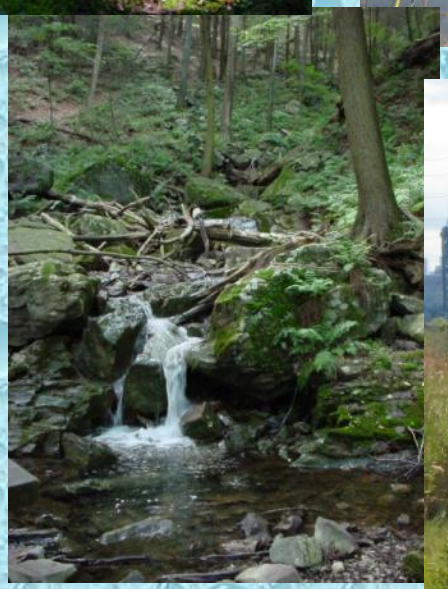
Research at Rutgers – protecting our waters, at home & around the world



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