



## EPA's Interdisciplinary Initiative on Biodiversity and Human Health

### Introduction

Conserving biodiversity is a primary way to sustain healthy ecosystems and the services they provide, which we depend on for health, well-being and development. But over the last 50 years, we have changed ecosystems to an unprecedented degree, reducing biodiversity, and putting ecosystem services at risk. At the same time that biodiversity loss has been accelerating, infectious diseases appear to be emerging and re-emerging at a faster rate. Some of these diseases are particularly sensitive to environmental conditions, and as humans change the environment, we are affecting these disease life cycles which in turn, affects how we may be at risk. EPA's Initiative on Biodiversity and Human Health is studying the quantitative and qualitative relationships between anthropogenic stressors, biodiversity, and infectious disease transmission using an integrated, transdisciplinary (ecology, public health, biology, social sciences) approach that involves decision-makers. The goals are to characterize causal mechanisms linking ecosystem change and disease emergence and spread, and to work with stakeholders during the research process to plan for implementing scientific tools and knowledge (risk models, ecological indicators of disease risk, best management practices on land use) that improve decision-making and management practices.

These science activities aim to develop environmentally-based (non-chemical) alternatives to pesticides that can reduce the risk of human disease. The *innovation* comes in identifying and implementing environmentally sustainable strategies to reduce or prevent disease emergence, so that the use of pesticides against disease-carrying vectors is minimized. These approaches can be part of a toolbox of strategies that are relevant the local level. Less pesticide use results in less pollution to land, air, and water. Expected science tools and strategies include:

- Quantitative risk models based on ecological field data
- Spatial models of disease risk based on ecological data and earth observations
- Ecological indicators of disease risk
- Best management practices on land use to protect public health

### Opportunity

- Characterizing the environmental and social/behavioral factors that contribute to human infectious disease can reveal the root causes of disease emergence and spread, which can lead to improved prevention and mitigation.
- The UN, through its Millennium Development Goals, recognizes the need to reconcile biodiversity conservation and the promotion of health and well-being because they are interdependent. However, these issues are generally not addressed in the same context.
- There is a need for integrated tools and approaches that link ecology to human health
- Climate change is likely to have direct effects on ecosystems, biodiversity, disease agents, vectors, and hosts. Potential ranges of certain diseases (e.g. vector-borne diseases) affected by temperature and precipitation changes are expected to increase.

### Activities

#### **(1) Extramural and Interagency Research Projects**

*Characterizing Mechanisms Linking Animal Host Biodiversity to Lyme Disease Risk (Cary Institute)*

- Quantitative risk model to inform land use development under IPM to reduce both environmental and public health risks; planned interdisciplinary workshop to identify risk reduction strategies and use of model at the local level



*Biodiversity in the Ecology of Hosts, Vectors and Humans in West Nile Transmission (Rutgers)*

- Inform wetland management and restoration, as well as public outreach to reduce disease risk; innovative use of social science survey to identify behaviors/attitudes on biodiversity among people living around urban wetland study sites

*Mosquito Species Diversity and Landscape Change (EPA, Smithsonian Tropical Research Institute, Gorgas Institute)*

- Inform forest management and reduce health risks of nearby communities; test new barcoding techniques for faster mosquito species id; add new data to global species monitoring project

*Web-Based Decision Support Tool for Risk-Appropriate Tick-Bite Protection and Disease Prevention (U. RI)*

- Risk calculator to be used by decision-makers to evaluate and implement integrated pest management (IPM) strategies to control tick-borne diseases; 2 statewide IPM training programs will teach new practices around homes and in public areas

*Developing Landscape Design Guidelines for Mitigating Human Risk of Lone Star Tick-Associated Pathogens (Washington U.)*

- Predictive risk model that can be used by health and land use decision-makers to reduce public health risks and guide land use and development

*Landscape Epidemiology and Integrated Mgmt of Tick-Borne Diseases (Cary Institute of Ecosystem Studies)*

- Predictive models of landscape-level variation in ecological risk of human exposure to Lyme disease, human anaplasmosis and human babesiosis; and, use of landscape variables to assess the likely impacts of land planning/development scenarios on the human risk of tick-borne diseases

**(2) Outreach**

- EPA-Smithsonian Exhibit “Healthy Ecosystems = Healthy People” with multimedia features on research, interactive games, and individual and community-level recommendations on biodiversity conservation for human health (Fall 2011)
- Established Community of Practice (CoP) “Biodiversity, Landscape Change and Human Health” to share scientific progress, learn decision-makers’ needs, and plan for science implementation

**Expected Outputs and Outcomes**

- Improved understanding of the mechanisms that link anthropogenic stressors, biodiversity, and infectious disease transmission to people
- Development of tools that can help forecast risks to biodiversity and human health
- Information that can be used to value biodiversity in human health terms (disease reduction)
- Improved strategies and communication that can encourage changes in human behavior to reduce exposure to disease risks
- Improved analysis of land-use planning that considers environmental and human health impacts
- Improved coordination and information exchange between state environmental decision makers and public-health decision-makers to protect biodiversity and human health

**Clients/Users**

EPA, CDC, WHO, conservation biologists and practitioners, infectious disease researchers and practitioners, land use planners, state/local environmental managers, state/local health departments

More information on EPA's initiative can be found at <http://www.epa.gov/ncer/biodiversity>