



Task Update HE-09-03c

Ecosystems, Biodiversity and Health: Decision-Support Tools and Research

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16 November 2009



Outline

- Background
- Interdisciplinary Approach
- Research Projects
- Community of Practice
- Anticipated Results, Links to Decision-Making

Ecosystem Services

As provided by the diversity of life on earth

Provisioning Services

Food
Freshwater
Wood and fiber
Fuel
Clean Air
Medicines

Regulating Services

Climate regulation
Flood regulation
Disease regulation
Water purification

Cultural Services

Aesthetic
Cultural
Recreational
Spiritual

Supporting Services

Nutrient cycling
Primary production
Soil formation

Adapted from the Millennium Ecosystem Assessment, 2005.

Biodiversity loss is accelerating

Fig. 4: TERRESTRIAL LIVING PLANET INDEX, 1970–2003

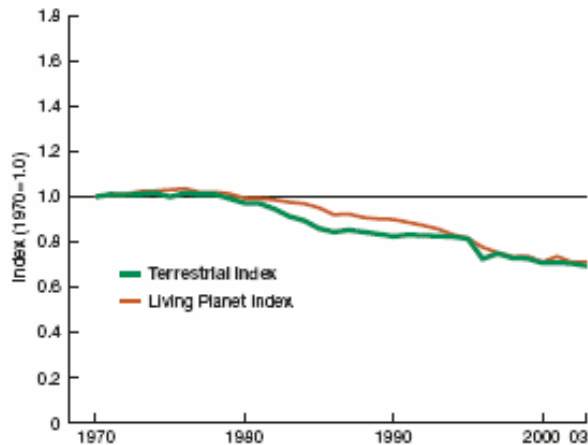


Fig. 5: MARINE LIVING PLANET INDEX, 1970–2003

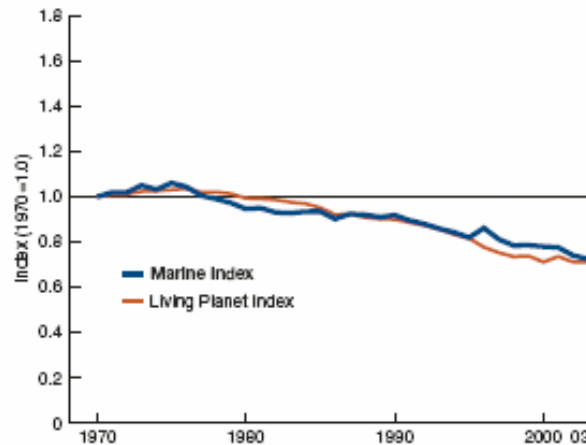
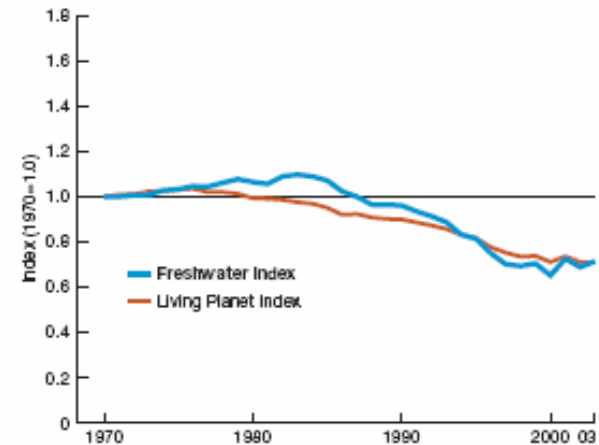


Fig. 6: FRESHWATER LIVING PLANET INDEX, 1970–2003



From WWF, "Living Planet Report," 2006.

BBC NEWS
 Tuesday, 21 May, 2002, 13:48 GMT 14:48 UK
 Front Page
 World
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 UK Politics
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Quarter of mammals 'face extinction'



Siberian tigers may vanish within three decades

By Corinne Podger
 BBC science correspondent

Almost a quarter of the world's mammals face extinction within 30 years, according to a United Nations report on the state of the global environment.

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CNN.com / SCI-TECH
 THE GREEN CENTURY

Scientists agree world faces mass extinction

August 23, 2002 Posted: 11:43 AM EDT (1543 GMT)

By Gary Striker
 CNN



Organ Pipe Cactus National

(CNN) – The complex web of life on Earth, what scientists call "biodiversity," is in serious trouble.

CNN.com / SCIENCE & SPACE
 NEXT@CNN

Study: Only 10 percent of big ocean fish remain

By Marsha Walton
 CNN
 Wednesday, May 14, 2003 Posted: 10:29 PM EDT (3229 GMT)

(CNN) – A new global study concludes that 90 percent of all large fishes have disappeared from the world's oceans in the past half century, the



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BBC NEWS
 Last Updated: Thursday, 18 September, 2003, 12:04 GMT 13:04 UK

Lions 'close to extinction'

Lion populations have fallen by almost 90% in the past 20 years, leaving the animal close to extinction in Africa, a wildlife expert has warned.

There are now only 23,000 left, compared to an estimated 200,000 two decades ago,

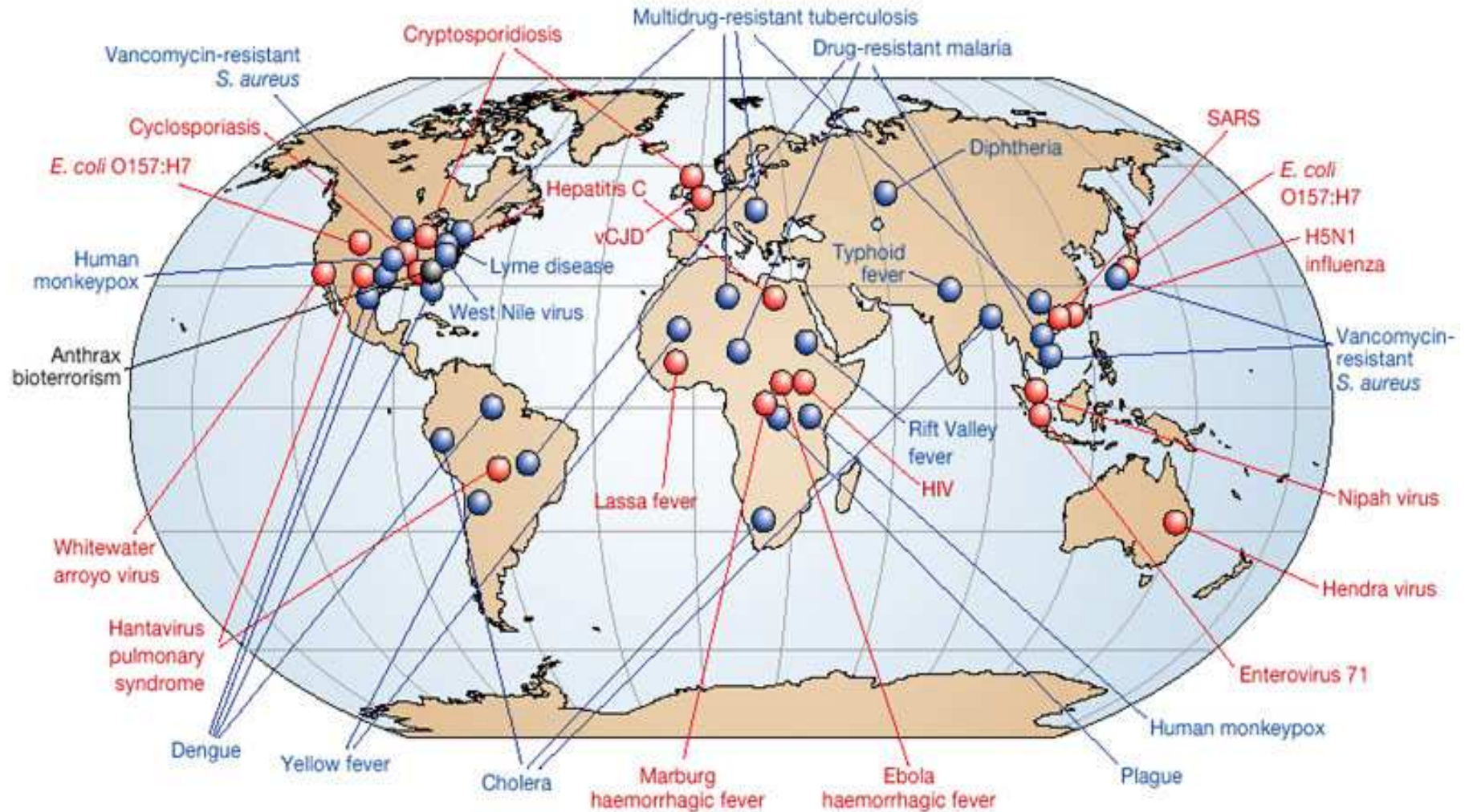


Live with them or lose them

SEE ALSO:
 Wildlife watchers stay away from Kenya
 22 Sep 98 | Africa
 Kenyan lions killed in revenge attacks
 23 Jun 03 | Africa
 Malawi's killer lion shot dead
 24 Feb 03 | Africa

RELATED INTERNET LINKS:

Infectious diseases appear to be emerging and re-emerging at a faster rate



* Modified from Morens et al. 2004 *Nature* 430:242

Interdisciplinary Forum and Workshop on Biodiversity and Human Health September 2006

**US EPA, Yale Center for EcoEpidemiology, Smithsonian
Institution, World Conservation Union**

- **Outreach effort**
- **Interdisciplinary participation**
- **Encouraged interdisciplinary collaboration, in the U.S. and internationally**
- **Workshop discussions on case studies and mechanisms, research priorities, & types of data and models needed to map biodiversity change and emerging diseases**





Biodiversity-Health Research Initiative

U.S. EPA

- Exploratory research funding – competitive extramural grants and interagency agreements
- Qualitative and quantitative relationships - how do anthropogenic drivers of changes in biodiversity affect the transmission of human infectious disease?
- Interdisciplinary research approach, including decision-makers
- Encourage coordination of earth observations with field data
- International and domestic projects

Why is this Research Important?

- Root causes of disease emergence and spread should be explored to assist in prevention and mitigation
- Lack of integrated tools and approaches that link biodiversity to human health
- Environmental and social factors contribute to these diseases – and environmentally-based and behavioral approaches can help reduce the disease burden

Summary Table of EPA's Exploratory Research Projects

	Characterizing Dilution Effect Mechanisms (Inst of Ecosystem Studies)	Plant – Animal – Mosquito Diversity and Human Perception (Rutgers)	Avian Diversity, Bioclimatic Factors, and Anthropogenic Change (UCLA)	Lyme disease Risk Map (Yale, CDC, NASA Ames, EPA)	Monitoring Mosquito Species Diversity Across a Landscape Gradient (EPA, Smithsonian)
Geographic Focus/Scale of Research	Forest plots across Dutchess County, NY	Townships across New Jersey	National (USA)	National (USA)	Barro Colorado Island/Panama Canal Watershed (Panama); Khao Chong, Thailand??
Disease System of Study	Lyme disease	West Nile encephalitis	West Nile encephalitis West Nile virus	Lyme disease	Mosquito-borne diseases
Multi-Disciplinary Team Makeup	ecology, population biology, epidemiology	ecology, parasitology, ornithology, social science, environmental education, environmental managers	ecology, virology, population genetics, remote sensing	epidemiology, ecology, remote sensing, environmental managers	ecology, epidemiology, entomology, biosystematics
Strengths of the Research Study	<p>"Dilution effect" hypothesis will be tested on a well-studied ecological-epidemiological system</p> <p>Much preliminary data are available and extensive study infrastructure already in place</p> <p>Planned interdisciplinary workshop to identify risk reduction strategies is directed to homeowners – connecting science to local residents</p>	<p>Attempting to quantify structural diversity, not just animal species richness</p> <p>Human behavioral component is innovative, attempting to link human attitudes of wetlands to disease risk</p> <p>Use of Bayesian methods is novel</p> <p>State Department of Environmental Protection (end-user) is involved in study design, execution, and implementation</p>	<p>Focus is on the role of bird reservoir hosts in disease prevalence</p> <p>Cutting edge technology to be used to evaluate virus from bird feathers and migration patterns</p> <p>Migratory connectivity is an important feature of study</p> <p>Use of earth observations on climate, land cover, and moisture for integration into the proposed distribution model</p>	<p>Building on an existing CDC-Yale spatial modeling project to test new hypotheses linking tick density and infection rates with new data on meteorology, mammalian and bird diversity</p> <p>Use of NASA Terrestrial Observation and Prediction System (TOPS) to deliver datasets from a variety of remotely sensed and <i>in situ</i> sources</p> <p>CDC and EPA are collaborators, helping to ensure that research results are communicated to the public and made relevant to decisionmakers</p>	<p>Addresses new questions about the relationship between landscape change, mosquito species diversity and pathogen diversity</p> <p>Provides new material for SI's mosquito barcoding initiative, and enhanced identification tools, in turn, could aid the monitoring work</p> <p>Partners include Gorgas Memorial Lab (entomological field work), Smithsonian (providing field sites in and outside of forest plot), EPA (decisionmaking relevance)</p>
Expected Research Outputs	Quantitative model of disease risk Risk reduction guidelines produced by an interdisciplinary workshop	Understanding of how wetland plant structure can be used to estimate animal host and vector diversity relevant to health Understanding of human factors affecting	Distribution models which estimate infection patterns in migratory and resident birds and in humans, as well as the effects of anthropogenic changes on distribution and	Surface map of human risk for infection from Lyme disease throughout the range of the primary vector. The map could be routinely updated using meteorological and remotely	New knowledge on the effects of landscape change on the distribution of mosquitoes and the ecological mechanisms that drive change New information can be added



EPA Regional Science Workshop

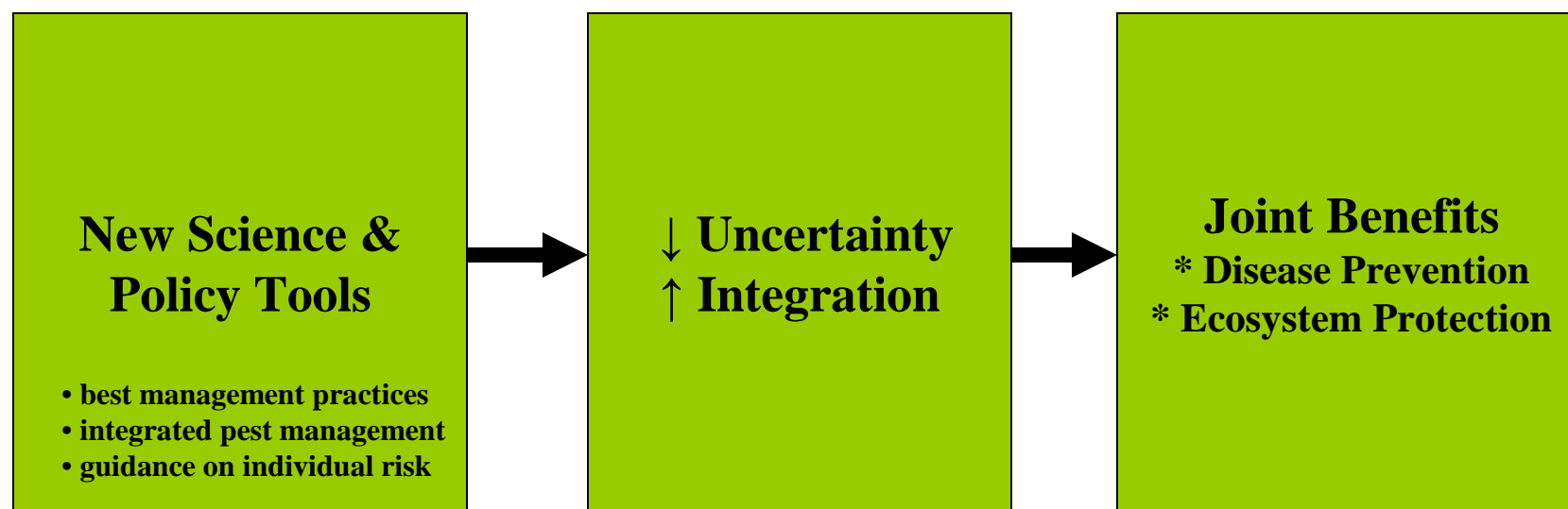
Landscape/Biodiversity Change and LD: Science and Application

September 22 -23, 2009

- The first EPA-sponsored forum to address decision-making and management applications related to the emerging science of Lyme disease risk monitoring and prevention in the context of biodiversity and landscape change -

- Raise awareness for stakeholders on the current and emerging state of the science related to the integrated, ecological nature of LD;**
- Explore and share stakeholder roles and understanding of the LD;**
- Identify decision-maker needs for research community**
- Develop a Community of Practice allowing researchers, managers and practitioners to collaborate and plan for integrating new science into real world applications and decision-making**

Value of New Science & Science-Policy Tools: Improved Decision-Making and Societal Outcomes



Interdisciplinary Research

*Integrated
Decision-Making*

Societal Outcomes

Protecting Biodiversity, Protecting Human Health

- Environmental factors contribute to emerging diseases and environmental strategies can reduce their burden
- Development of new tools to monitor and forecast risks
- Information that can be used to value biodiversity conservation
- Improved communication and outreach
- Improved analysis of land use planning
- Better communication and coordination among environmental and health managers

Partners

- US Centers for Disease Control and Prevention (CDC)
- Cary Institute of Ecosystem Studies
- Rutgers University
- UCLA
- Washington University
- Center for Health Applications of Aerospace Related Technologies (CHAART) at NASA Ames Research Center
- Gorgas Institute (Panama)
- Yale Center for EcoEpidemiology
- Smithsonian Institution
- US Group on Earth Observations (GEO)



Biodiversity and Human Health



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Biodiversity and Human Health:




Special Announcements

- Photos from the Field**
 Check out four slide shows highlighting images taken from a joint EPA-Yale field study exploring the links between biodiversity, habitat change, and Lyme disease risk.
- Could Preserving Biodiversity Reduce Disease? EPA Funds \$2.25 Million to Research Connections**
 EPA has awarded three grants, totaling \$2.25 million, to support research programs working to better understand and characterize the mechanisms that link environmental stressors, such as deforestation and climate change, to the loss of biodiversity and the transmission of infectious diseases to people. [\[Read More\]](#)

EPA recognizes the importance of healthy ecosystems for our health and well-being, and conserving biodiversity is a primary way to sustain healthy ecosystems and the services they provide to us. One ecosystem service EPA is trying to better characterize is disease regulation – that is, maintaining biodiversity may protect us against emerging diseases like Lyme disease and West Nile virus.

The biodiversity-human health project complements existing domestic and international priorities to assess and manage emerging human diseases and ecosystem health hazards. But the research program is unique in its plans to link earth observations to the societal benefits outlined in the [Global Earth Observation System of Systems \(GEOSS\) 10-Year Implementation Plan](#) [EXIT Disclaimer]: (1) understanding the environmental factors affecting human health and well-being, and (2) understanding, monitoring, and conserving biodiversity (GEOSS 2005).

Green Scene



Biodiversity and Human Health scientist Montira Pongsiri discusses biodiversity-human health connections in the research sponsored by the EPA STAR Research Program.

[Watch Video](#)

Research Project Search

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<http://www.epa.gov/ncer/biodiversity>
pongsiri.montira@epa.gov

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