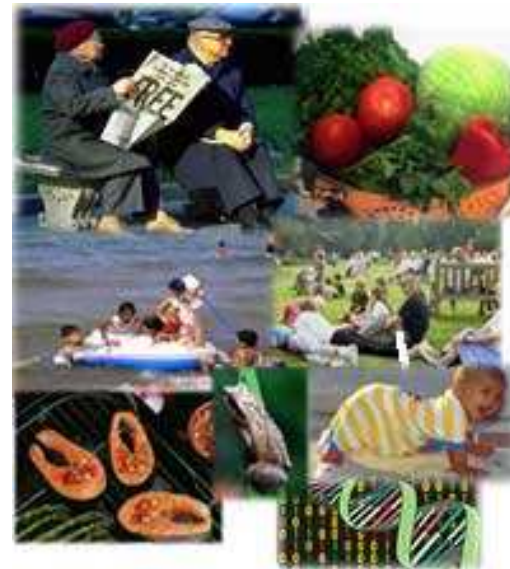


Users, Applications, and Needs: Biodiversity and Human Health



U.S. Environmental Protection Agency
May 2008

OUTLINE

- Background
- Interdisciplinary Approach – including multiple disciplines **and** end users (GEO UIC Task US-06-02)
- U.S. Research and Programmatic Projects (US-06-01)
 - Who are the users?
 - What data do they currently use and how?
 - What types of data (observations, analyses, models) do they need to do their work better?
- Next Steps ?? [**Gary, how best to end the presentation?**]
 - Data standards, availability, reliability?
 - Data common to users?

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

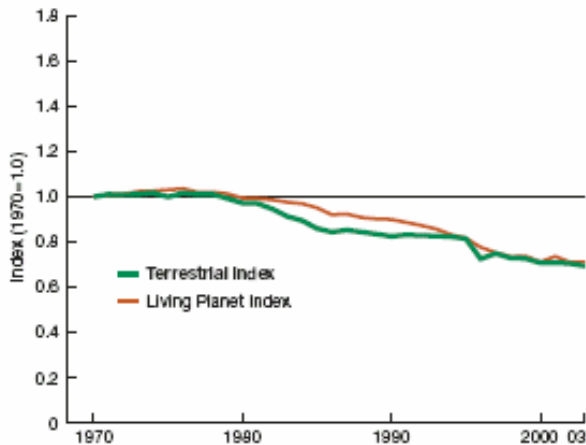


Fig. 5: MARINE LIVING PLANET INDEX, 1970–2003

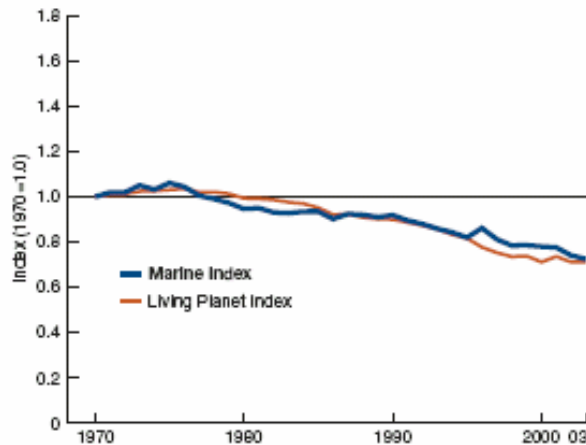
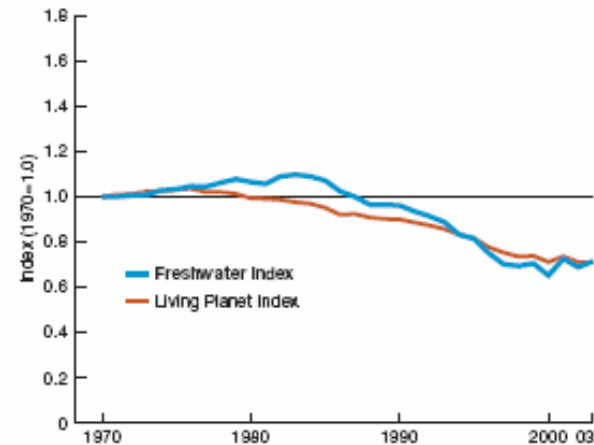


Fig. 6: FRESHWATER LIVING PLANET INDEX, 1970–2003



From WWF, "Living Planet Report," 2006.

BBC NEWS
 Tuesday, 21 May, 2002, 13:48 GMT 14:48 UK
 Front Page
 World
 UK
 UK Politics
 Business
 Sci/Tech
 Health
 Education
 Entertainment
 Talking Point
 In Depth
 AudioVideo

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.

WORLD CUP
 DING DONG
 SERVICES
 Daily E-mail
 News Ticker

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
 AIRS: Saturdays 3 p.m. ET / Sunday 5 p.m. ET

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

BBC NEWS
 Last Updated: Thursday, 18 September, 2003, 12:04 GMT 13:04 UK
 E-mail this to a friend
 Printable version

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.

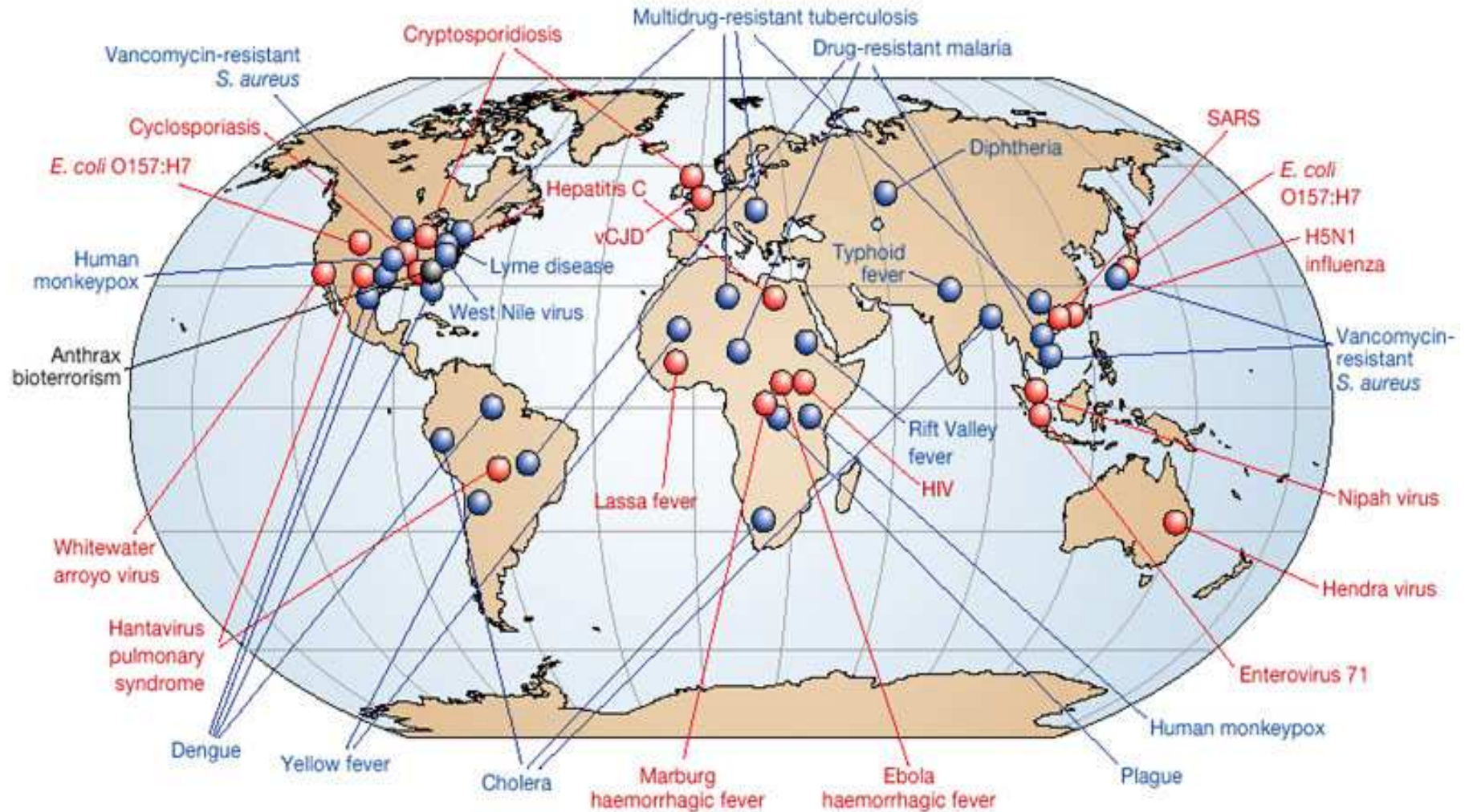


There are now only 23,000 left, compared to an estimated 200,000 two decades ago.

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

Biodiversity and Human Health: An Opportunity for GEO

- Reducing the emergence and spread of vector-borne diseases is a societal benefit
- Producing knowledge/insights that links human health and biodiversity can contribute to this societal benefit
- Help to demonstrate the value of working through the GEO structure
 - At the local level, experts in public health and ecology will carry out basic science and identify data needs for biodiversity and health – how can earth observations fill these gaps?
 - Economists can help identify data needed to do valuation
 - Social scientists can help with communication and gauge community knowledge of and responses to risk
- Determine how studies and assessment done at the local level are scalable to the global level

Biodiversity and Human Health: An Opportunity for GEO

- Complements existing domestic and international priorities to assess and manage emerging human diseases and ecosystem health hazards
- Links earth observation data to two societal benefits related to health and biodiversity outlined in U.S. Strategic Plan for IEOS and the GEOSS 10-year Implementation Plan
- Integrates ecosystem services and human health through interdisciplinary collaboration
- Takes advantage of US government's integral role in GEOSS to solicit tools and integrative approaches for using information like earth observation data
- Long-term and pilot projects inside and outside of the U.S.

Approach:

Identifying User Needs via Collaboration Among Multiple Disciplines and End Users

USER TASK US-06-01:

Identify Priorities and Synergies between SBAs

- Establish a GEO process for identifying critical Earth observation priorities common to many GEOSS societal benefit areas, involving scientific and technical experts, taking account of socio-economic factors, and building on the results of existing systems' requirements development processes.

Approach: Identifying User Needs via a Community of Practice

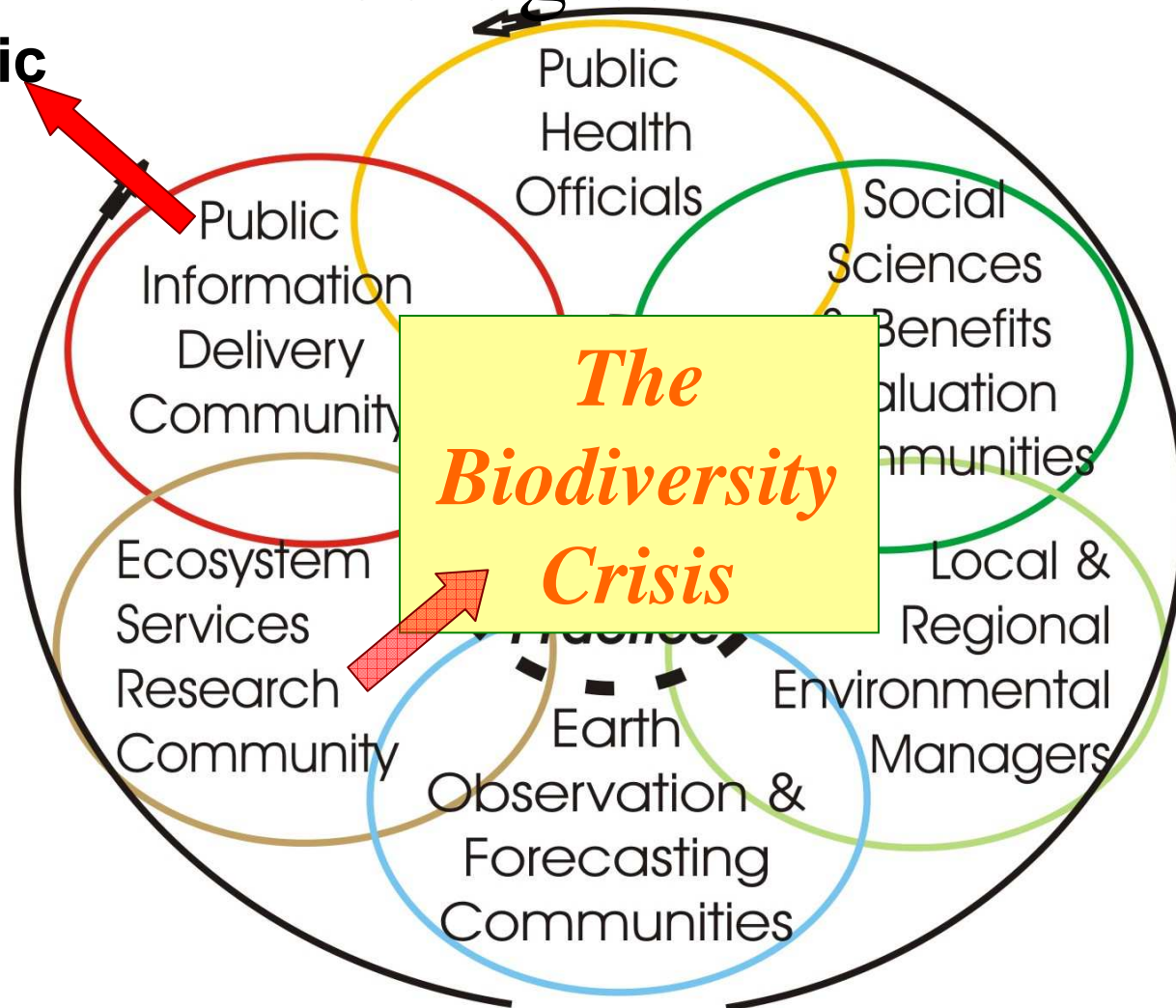
USER TASK US-06-02:

Pilot Communities of Practice (e.g. Health and Biodiversity)

- Initiate pilot communities of practice to identify and further refine users' needs, in particular on cross-cutting areas, building upon the initial experience of community of practice and on information provided by national, regional and project-level surveys.

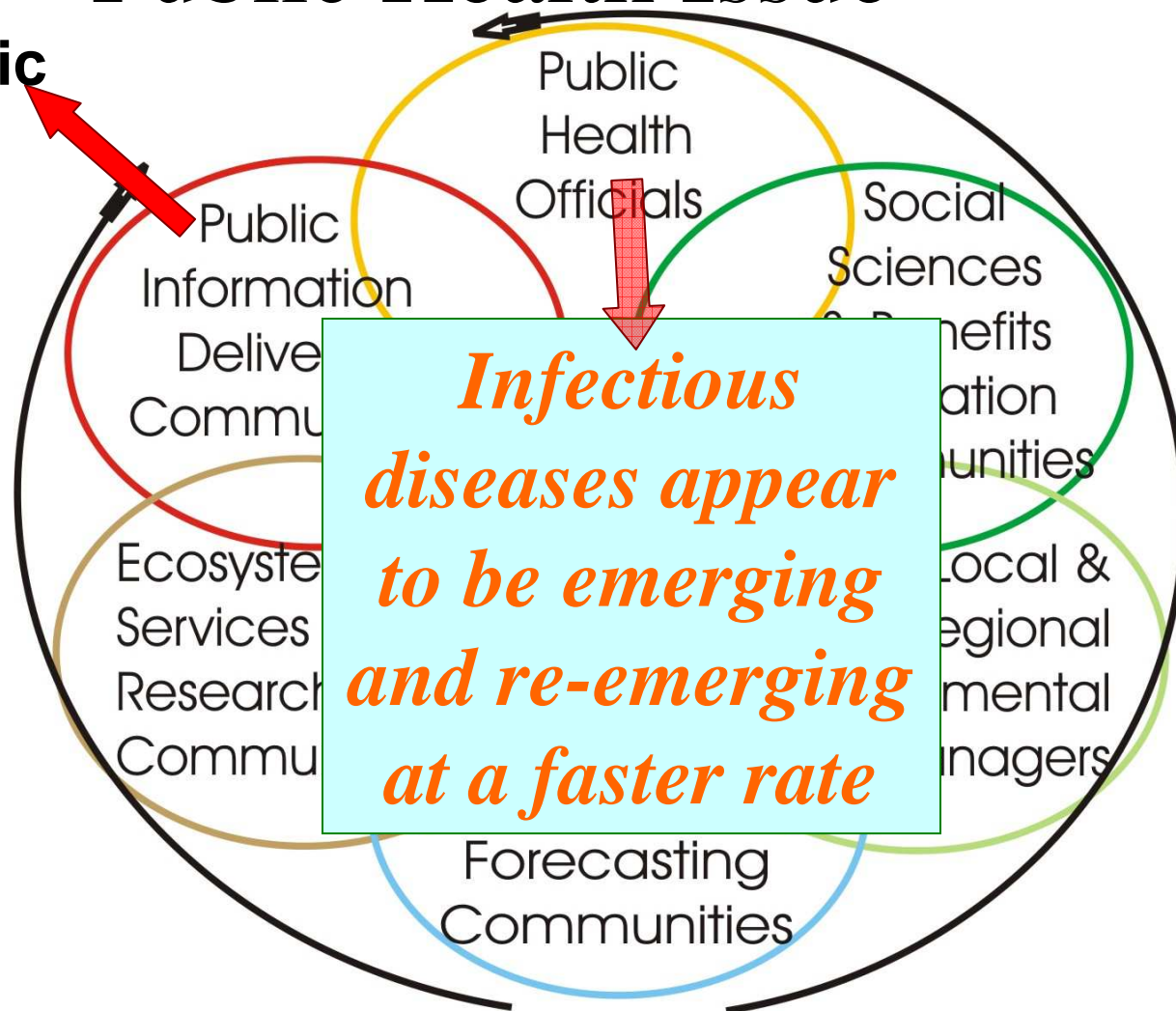
Start with an Issue From the Ecologists

The Public



Look for the Connection with a Public Health Issue

The Public



A Possible Biodiversity & Health Community of Practice

The Public
& Public
Officials





Biodiversity-Health Research Initiative

U.S. EPA

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

Linking Biodiversity Change to Lyme disease Risk (U.S.) (EPA-CDC-Yale-NASA Ames)

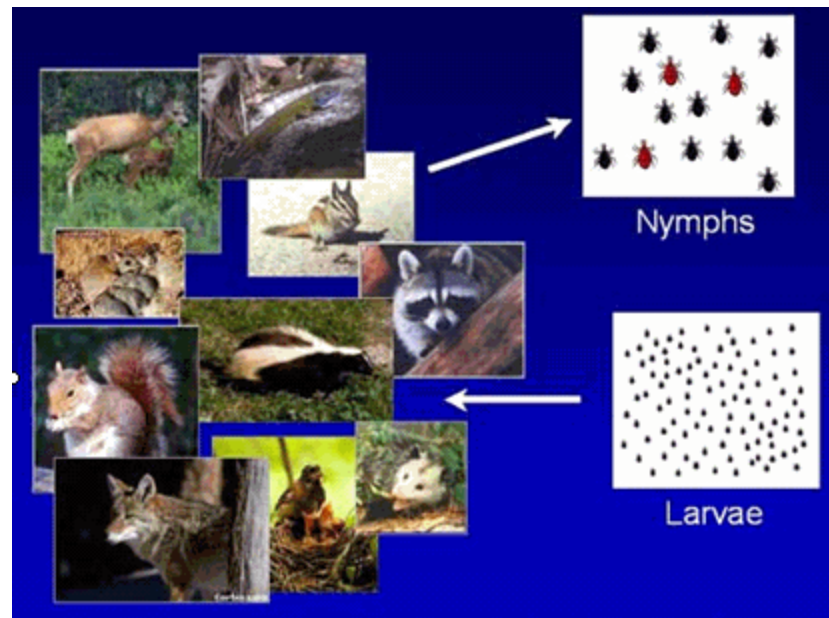


Figure from LoGuidice et al. 2003.

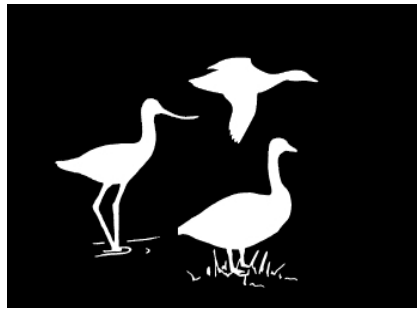
Linking Biodiversity Change to Lyme disease Risk

- 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:
 - **Does pathogen prevalence reveal spatial patterns that are dependent on climate and landscape characteristics?**
 - **How does pathogen prevalence respond to changes in habitat structure, vertebrate communities, or other indicators of biodiversity?**
- Use of NASA Terrestrial Observation and Prediction System (TOPS)
- Surface map of human risk for infection from Lyme disease throughout the range of the primary vector, *Ixodes scapularis*
- CDC and EPA are collaborators

Linking Biodiversity Change to Lyme disease Risk

- **Who are the users?**
 - State and local health department managers, general public (particularly those living in the higher-risk Northeastern U.S.)
- **What data do they use?**
 - Spatial risk model/map outputs identifying areas of highest risk of Lyme disease in the U.S., based on tick density and rates of ticks infected with the Lyme disease pathogen
- **How do they use these data?**
 - Inform prevention/mitigation guidance to public
 - Assess risk trends over time (LD is the most prevalent vector-borne disease in the U.S.)
- **What types of data do they need to do their work better?**
 - We hypothesize that the inclusion of real-time data on forest fragmentation, and earth observation surrogates for mammalian diversity and bird diversity can improve the spatial risk model to provide better estimates of disease risk at a finer scale. Surrogates to be tested. Pilot study results expected December 2008.

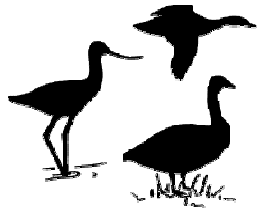
**Global Avian Influenza Network for
Surveillance (GAINS)
(USAID, CDC, USDA, Wildlife
Conservation Society)**



GAINS

- ➔ To improve the understanding of the epidemiology of influenza viruses in wild birds, both captive and free-ranging
- ➔ To share data on avian influenza to all levels of governments, international organizations, the private sector and the general public.

- Provides ecological and epidemiological information in one place ... holistic approach to avian influenza
 - ➔ Identify and manage risk
- Users can use GAINS tools to store, manipulate and manage their own data, as well as integrate data with the larger global effort
- Currently, there are >100,000,000 bird observations and >20,000 samples entered in web-accessible, open database
- GAINS work occurs in 34 countries across Asia, Africa, and the Americas, with 23 partner organizations



GAINS in Practice

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.



GAINS Field Training Unit

Training in sample and data collection

Global Network of monitoring sites (International NGO partners)



PRIVATE INDUSTRY

(OFFLU)

Global Network of Diagnostic Labs

Data users and policy makers (WHO, FAO, OIE, USDA, CDC, HHS, local officials, private industry, individuals, etc.)

Samples

Lab Results

Comprehensive disease and animal data

Survey and Migration Data

GAINS Data Center

GAINS

- **Who are the users?**
 - Health managers and policy makers (WHO, CDC, HHS, USDA, FAO), local officials
- **What data do they use?**
 - Avian Influenza strain types in wild birds sampled across Asia, Africa, and the Americas
- **How do they use these data?**
 - to identify locations of avian influenza viral strains; identify genetic changes in virus isolates; enhance links with wild bird distribution and migration information; and provide an early warning system for global spread of highly pathogenic avian influenza (HPAI) that threatens domestic poultry and human health as well as biodiversity (particularly avian)
- **What types of data do they need to do their work better?**
 - More timely analyses of collected samples
 - More AI strain identification data to increase spatial coverage of areas at risk

Healthy People in a Healthy Environment (Madagascar) (USAID)



Images from Healthy People in a Healthy Environment: Impact of an Integrated Population, Health, and Environment Program in Madagascar, USAID, 2005.

Intersection of human and ecosystem health in Madagascar

3% per year

Migration

Increasing population

Slash and burn agriculture

Significant deforestation

Change in rainfall

Erosion

Decreased soil fertility

Species extinction

200-400 tons
/ha/year

Silting up of rice
fields =
10 000 ha

Threatened
species

Food Insecurity - Malnutrition - Disease

Healthy People in a Healthy Environment (Madagascar)

- People with limited resources, especially in rural areas, cannot exercise adequate stewardship over natural resources upon which their lives depend unless their basic needs are met for: **health, nutrition, livelihood**
- NGO consortium worked together to facilitate access to health care, better nutrition through promotion of breastfeeding and natural resource management guidance
- Communities engaged through “Champion Community” “Farmer to Farmer” and “Child to Community” approaches
- This integrated approach has proven to be an efficient way of providing multi-sectoral services to remote areas, resulting in measurably improved basic maternal and child health, and environmental management (compared to when issues addressed independently).



Slide adapted from Presentation by Lynne Gaffikin, COHAB2 Side Session, 27 February 2008, Galway, Ireland.

Healthy People in a Healthy Environment

- **Who are the data users?**
 - Project intervention managers, local environmental managers, local health care managers, project evaluators
- **What data do they use?**
 - Indicator data on basic maternal (HIV/AIDS, antenatal care), child health (vaccination, vitamin A coverage), disease prevalence (diarrhea, fever, acute respiratory infections), natural resource management (reforestation, reported slash and burn), household livelihood, year-round food security (agricultural production)
- **How do they use these data?**
 - Assess conditions and trends
 - Raise awareness
 - Track progress toward goals
 - Prioritize issues
 - Address data gaps
 - Evaluate program performance
 - Inform strategic planning
- **What types of data do they need to do their work better?**
 - Prospective, long-term data on health and environmental indicators, covering many communities across different landscape conditions
 - Indicator data at regional and national levels (by scaling up cross-sectoral community-based strategies)

Next Steps ??

Protecting Biodiversity, Protecting Human Health

- Environmental factors contribute to health outcomes, and environmentally based strategies can reduce their burden
- Development of new tools to monitor and forecast risks
- Information that can be used to value biodiversity conservation related to health
- Improved strategies and communication which can encourage changes in human behavior
- Improved analysis of land use planning that considers environmental and human health impacts (e.g. food production, disease)
- Better cross-sectoral communication and coordination to protect both environment and health

Partners and Collaborators

- Group on Earth Observations (GEO)
- US Department of State
- US Agency for International Development (USAID)
- US Centers for Disease Control and Prevention (CDC)
- National Oceanic and Atmospheric Administration (NOAA)
- Center for Health Applications of Aerospace Related Technologies (CHAART) at NASA Ames Research Center
- World Health Organization (WHO)
- Yale Center for EcoEpidemiology
- University of California, Los Angeles

In Conclusion...

- Understanding the dynamics and mechanisms underlying the biodiversity-human health relationship is about understanding earth systems
- Valuation of the health benefits of protecting biodiversity can show value of an earth observation system that supplies information on ecosystems, biodiversity and health impacts (e.g. disease, agricultural production)
- Societal benefits are interconnected - studied in the same context, can enhance decision-making to promote collective and multiple benefits for health and the environment