Surveillance and Management Strategies to Address Climate Change and Wildlife Health

Dr. Jonathan Sleeman Senior Science Advisor, Wildlife Health U.S. Geological Survey Midcontinent Region



# Emerging Infectious Diseases

- Global environment favoring the emergence of infectious diseases
- Many emerging disease threats to human, animal and ecosystem health are of wildlife origin







Global Warming, Animal Migration and Spillover



 This increases risk of spillover; importance of maintaining wildlife habitat





Edited by Thomas E. Lovejoy and Lee Hannah



# Climate Change Impacts on Biodiversity

- Changes in habitat availability, food availability, phenology, etc.
- 18% of insects, 16% of plants, 99% of corals, and 8% of vertebrates forecasted to go extinct with global warming of 2°C
- Significant evidence of climate change effects on the incidence and geographic distribution of fish and wildlife pathogens



Outcomes of a Climate Change and Wildlife Health Workshop

January 2020



- Systematic Health Surveillance
- Take a Systems Approach
- Manage for Health, Not Disease
- Implement Climate Adaptation
  Strategies

# Working in the Dark ...

Lack of long-term, systematically collected data is an impediment to understanding the effects of climate change on wildlife health

# HealthyInfected

- Cause of "withering disease" in abalone found to be correlated to ocean water temperature
- Analysis of abiotic and biotic data led to the discovery of a bacterial cause of the disease understanding of the differential susceptibility of mollusk species

#### Components of a Wildlife Health Surveillance and Management System





*<b>≋USGS* 



#### Wildlife Health Information Sharing Partnership Event Reporting System



#### Harmonized Data and Information Sharing

Map scale 1:36.978.596 | Zoom level 4 Latitude 53.7279 | Longitude -110.9133



Guatematic

#### Avian Influenza and Marine Mammals: Case for Data Integration

Elephant seal (*Mirounga leonina*) pup mortality. Photo: Ralph Vanstreels.

#### One Health Problems are Wicked Problems

- The problem is longstanding and attempts to solve it have failed
- There are multiple perspectives on the cause of the problem and what should be done
- Diverse stakeholders find it difficult to align their efforts; people have competing objectives
- Actions may have unintended consequences



ttps://www.intapp.com/blog\_posts/tackling-wicked-problem-firm-leadership-continued-success-conundrum-part-1/



#### THE ICEBERG MODEL

**EVENTS** 

What is happening?

#### Systems Approach

- Designed to reveal the root causes of events by identifying the underlying patterns of behavior, supporting structures, and mental models of a system
- Allows for new perspectives and leverage points



PATTERNS OF BEHAVIOR

Use this tool to help you think more systemically!

What trends are there over time?

#### SYSTEMS STRUCTURE

How are the parts related? What influences the patterns?

#### MENTAL MODELS

What values, assumptions, + beliefs shape the system?

cademy for Systems Change

#### Systems Approach: Causal Loop Diagrams

- Visualization of how different variables in a system are causally interrelated
- Identifies balancing and reinforcing feedback loops in the system
- Again, the goal is to identify leverage points in the system



Photo credit: Protracted learning





Donella Meadows, Thinking in Systems



Climate Change and Pathogen Spillover: Hendra Virus

- Ocean temperatures rise during El Nino events
- This leads to food shortages for fruit bats in Australia
- This causes bats to forage more in urban areas
- Results in increased transmission of Hendra virus from bats to horses
   SUSGS





#### **Reforestation is the Win-Win Solution**



#### One Health Impact Pyramid

Increasing impact

Decreasing effort





Sleeman, et al, 2019

RESIST: Where managers focus on maintaining current or historical ecosystem structure and function



ACCEPT. Where managers do not intervene and allow the ecosystem structure and function to emerge from ongoing transformations

#### Manage for Health **SUSGS**

Health of wildlife populations goes beyond absence of infectious agents or contaminants and includes population sustainability and resilience



Health promotion approach especially important in marine ecosystems



Glidden et al, Strategies for managing marine disease, 2022

## Climate Change Adaptation

- Ecosystem-based adaptation to provide services that help people adapt to the adverse effects of climate change
- For example;
  - Coastal defense through the maintenance and restoration of mangroves and other coastal wetlands





Climate Change Adaptation

- Reducing non-climatic stresses, such as pollution, over-exploitation, habitat loss and fragmentation, and invasive alien species to increase resilience
- Wider adoption of conservation and sustainable use practices including the strengthening of protected area networks
- Facilitating adaptive management through strengthened forecasting, disease surveillance and evaluation systems, and response capabilities



#### **Thank You**

#### **Questions?**

