SURVEILLANCE IN ACTION:
Introduction, Techniques and Strategies

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Training Workshop for OIE National Focal Points for Wildlife

Arusha, Tanzania

March 16 – 19, 2010

OVERVIEW

1. Introduction - Why participate in wildlife health surveillance?

2. What, When, Where, Who and How?

   – The techniques of wildlife health surveillance.

3. Special problems associated with wildlife health surveillance.
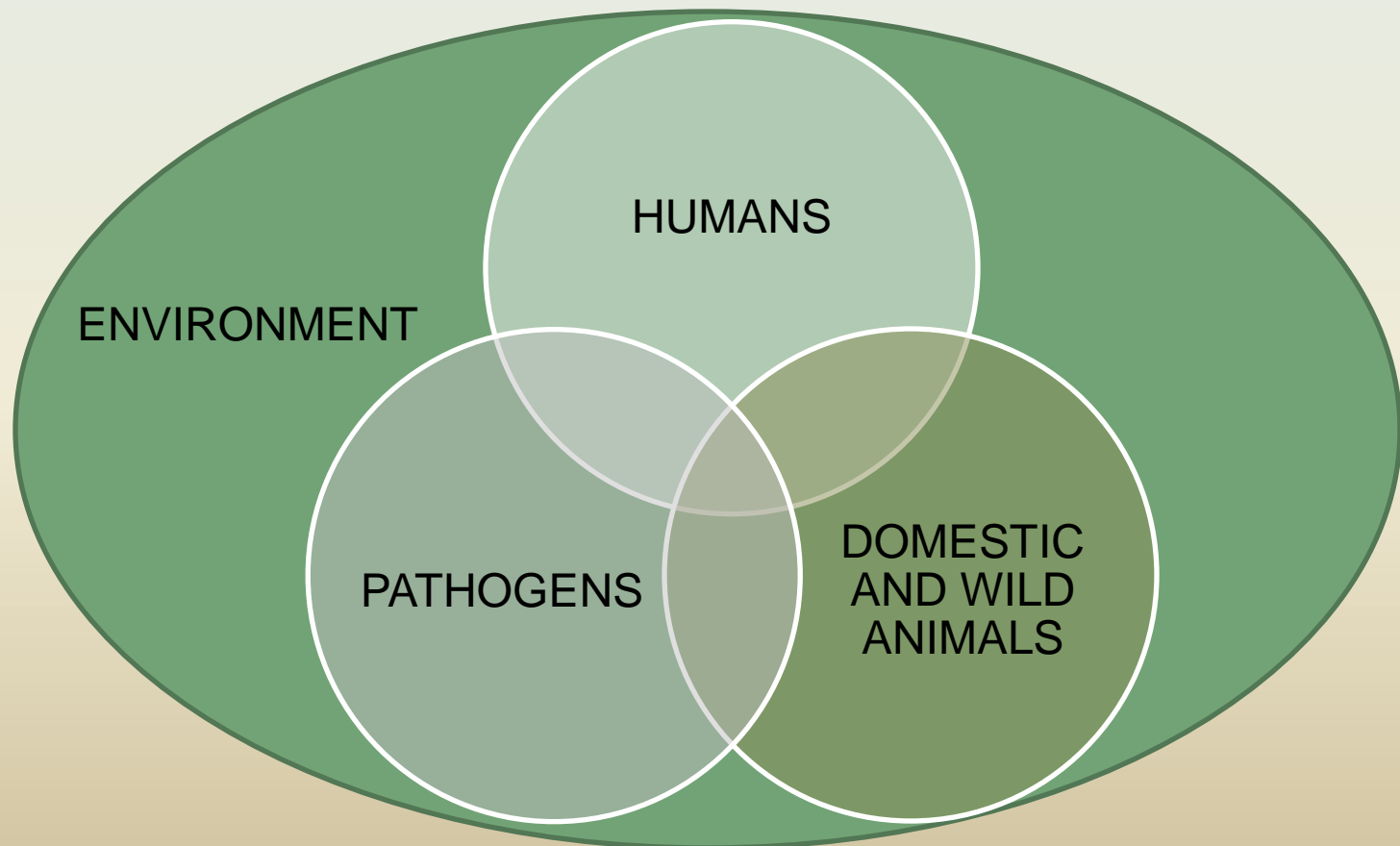
4. Questions.

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE

One World One Health Concept
(Wildlife Conservation Society, September 2004)

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE
Emerging and Reemerging Diseases

• 75% of all emerging infectious diseases of humans are zoonotic; most originate in wildlife; and their incidence since 1940 has increased (Vet Pathol 47:34-39, 2010).

•Critical issues – International trade and travel; global climate change; habitat destruction; overpopulation; and ecotourism.
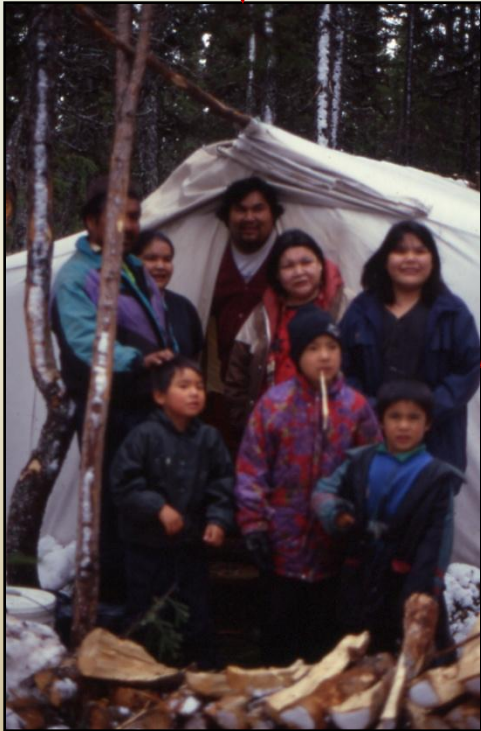

http://onehealthinitiative.com/deploy/map.php
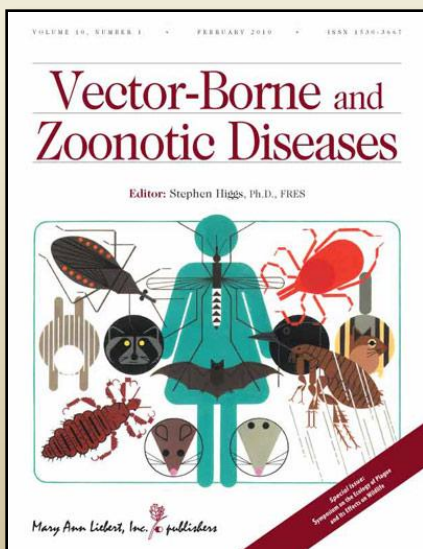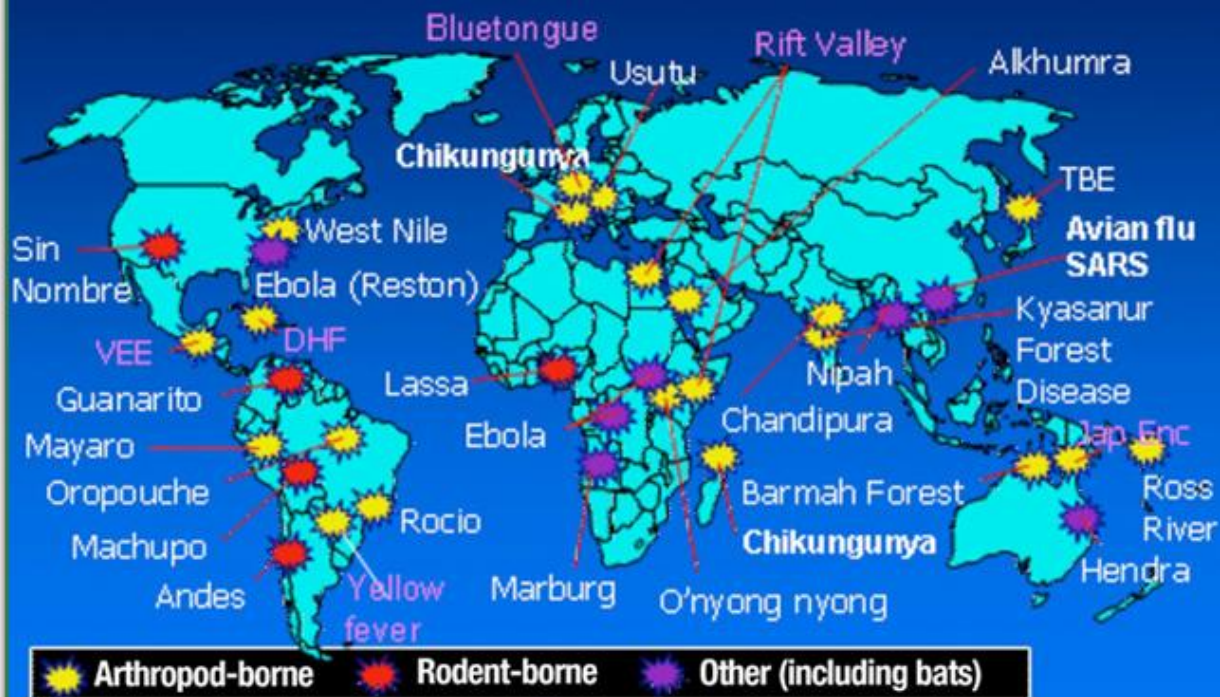
RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE
Environmental Health/Food Safety

© A Magoun

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE
Sentinels

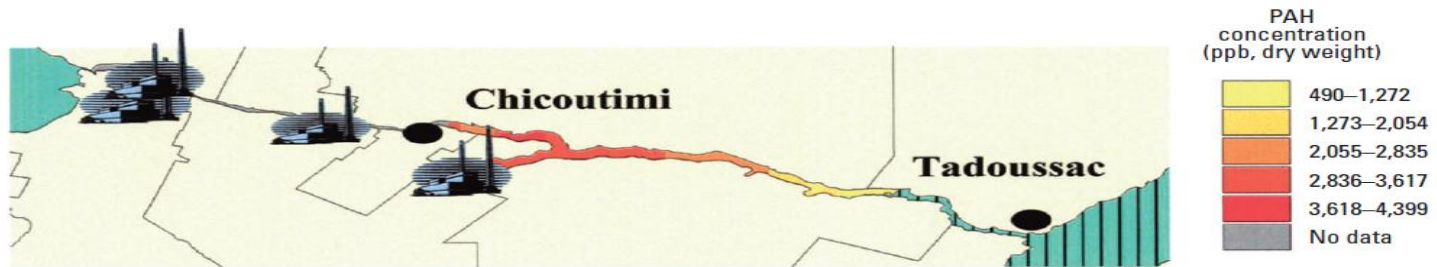# RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE
Sentinels

Figure 5. Saguenay River, Québec, Canada. Polycyclic aromatic hydrocarbon concentration in sediments (parts per billion, dry weight) (*43*). Chimney icon: aluminum smelters.

Martineau et. al., 2002

PAH concentration (ppb, dry weight)

▨	490–1,272
▨	1,273–2,054
▨	2,055–2,835
▨	2,836–3,617
▨	3,618–4,399
▨	No data

Date: Sat, 6 Mar 2010 11:57:22 -0500 (EST)
From: ProMED-mail <promed@promed.isid.harvard.edu>
Subject: PRO/AH/EDR> Cancer, sea lions - USA: (CA)

CANCER, SEA LIONS - UNITED STATES OF AMERICA: (CALIFORNIA)
****

Cancer Kills Many Sea Lions, and Its Cause Remains a Mystery
- --
For 14 years, since they 1st reported that a disturbing proportion of deaths among rescued California sea lions was caused by metastatic cancer, researchers have been trying to pinpoint the source of the illness.
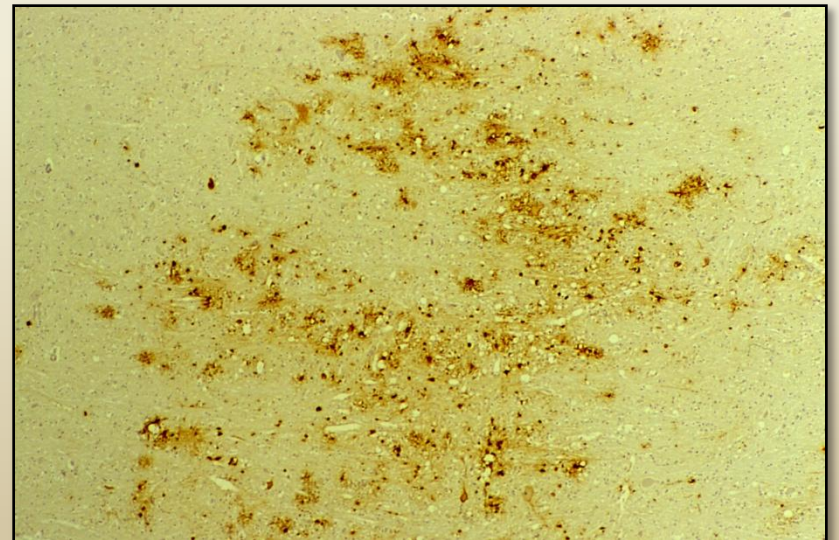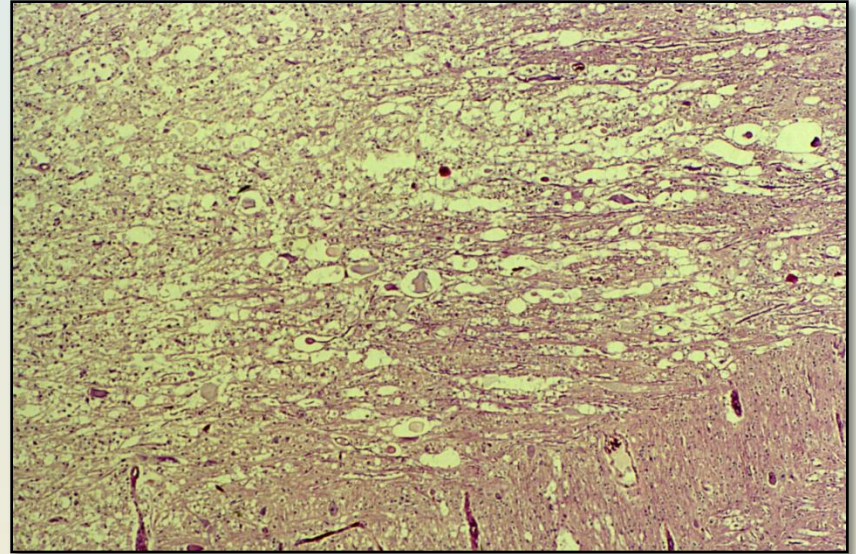
CANINE DISTEMPER VIRUS

+
DROUGHT
+
PARASITIC INFECTIONS

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE
Wildlife Health – What is Old and What is New?

RATIONALE FOR WILDLIFE HEALTH SURVEILLANCE

1. **It is the foundation of a National Wildlife Health Program.**
2. **It provides science-based information critical to public, domestic animal and environmental health.**
3. **It leads to the development of a national inventory of wildlife pathogens including pathogen distribution and range of host species.**
4. **It acts as an early warning system for new and emerging pathogens.**
5. **It builds capacity to manage urgent disease events.**
6. **It is a key component of wildlife conservation programs.**
7. **It has international trade/border security implications.**

© T. Andrewartha / naturepl.com

G. Du Toit / Barcroft Media
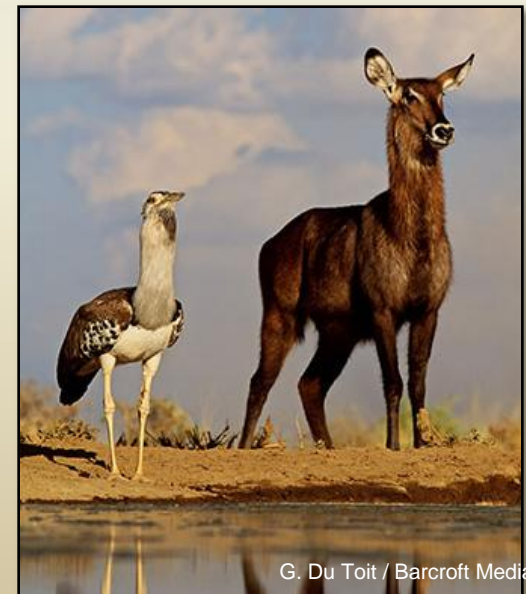
WILDLIFE HEALTH SURVEILLANCE TECHNIQUES

- **What is surveillance?**

- **How is surveillance accomplished?**

- **When and where are surveillance activities focused?**

- **Who needs to be engaged and involved in surveillance?**

WHAT IS SURVEILLANCE?

DEFINITION:

" the systematic <u>on-going collection</u>, collation, and <u>analysis</u> of information related to animal health and the <u>timely dissemination of information</u> to those who need to know so that action can be taken."*

OIE Terrestrial Animal Health Code

WHAT IS SURVEILLANCE?

- **Key Attributes:**
  - **A <u>Continuous</u> activity.**
    - **Constant vigilance.**
  - **<u>Collection</u> and <u>Analysis</u> of Information.**
  - **<u>Communication</u> of results.**

"Wildlife" Defined[1]

		Phenotype Selected by Humans	
		YES	NO
Animals live under Human Supervision and Control	YES	Domestic Animal	Captive Wildlife
	NO	Feral Animal	Wildlife

- **Pathogens and diseases from <u>all four groups</u> must be reported**

- **Wildlife Focal Points may be asked to report on Pathogens in:**
    - **Wildlife**
    - **Feral Animals**
    - **Captive Wildlife (Zoos, Wildlife Parks, etc.)**

TYPES OF SURVEILLANCE

G. Kourounis

1. General (Scanning/Passive) Surveillance
- Covers <u>all</u> host species, <u>all</u> pathogens.
- Samples of opportunity: wildlife found sick or dead.
- Tests: necropsy, pathology, full laboratory testing.
- Data mostly are qualitative.

2. Targeted Surveillance
- Limited Scope: one pathogen.
- Samples - Blood, feces, swabs, tissue.
- Tests: Serology, PCR, Culture.
- Can be statistical, quantitative or qualitative.

DIFFERENT TYPES – DIFFERENT OBJECTIVES

1.   **General/Scanning Surveillance**
- **Continuous vigilance, 365 days per year.**
- **Detection of Emerging Diseases.**
- **Inventory of pathogens and hosts.**
- **Assess changing patterns of disease.**
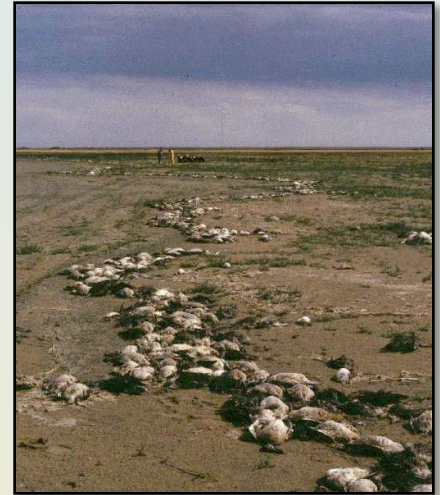
2.   **Targeted Surveillance**
- **Details about a particular pathogen.**
- **Assess magnitude of a disease problem.**
- **Data to plan management responses.**

GENERAL (SCANNING) WILDLIFE HEALTH SURVEILLANCE

Consists of Four Very Different Activities which must be Tightly Coordinated:

1. Mortality/Sickness Detection.
2. Identification of Diseases (broadly defined) and Pathogens.
3. Information Management.
4. Analysis and Communication.

SURVEILLANCE: FOUR ACTIVITIES

1. Detection of Mortality or Sickness

2. Identification of Pathogens and Diseases

3. Information Management

4. Analysis and Communication
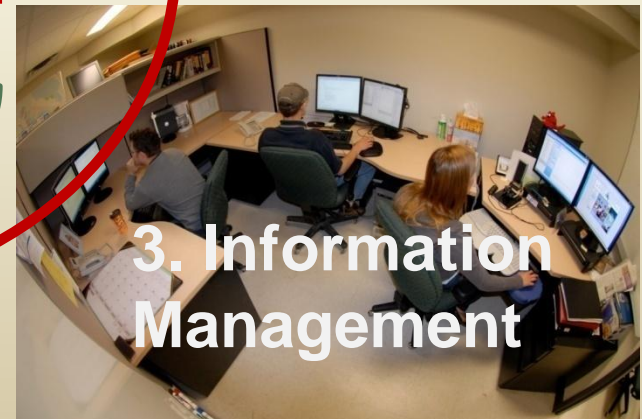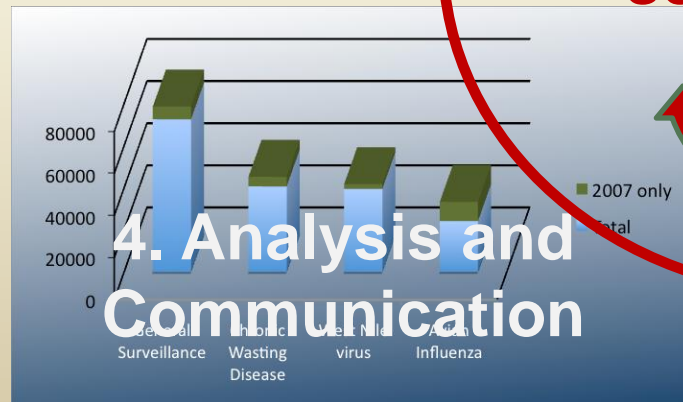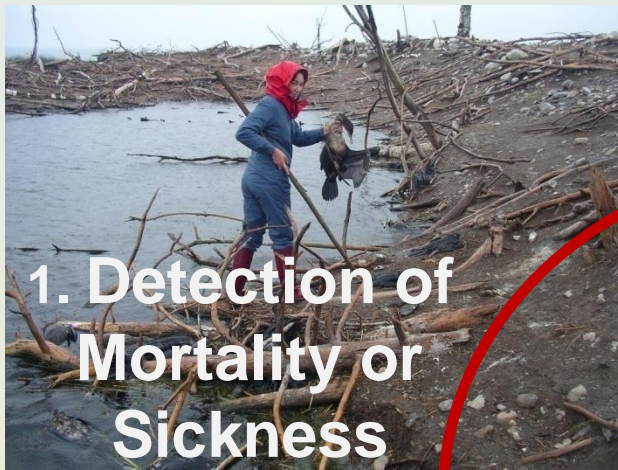
PATHOGEN SURVEILLANCE

1. <u>DETECTION</u> OF MORTALITY OR SICKNESS:

1. Reporting <u>Dead</u> or <u>Sick</u> <u>Wild Animals</u>.
2. Sending carcasses or samples to Laboratory.

- **Who Can Do This ?**
  - **Field Personnel and Scientists of Government Ministries and Departments - especially <u>Wildlife/Environment/Forestry</u>.**

  - **Government personnel require official permission and encouragement to participate in wildlife pathogen surveillance.**

  - **Inter-Ministerial/Departmental cooperation is essential.**

1. DETECTION OF MORTALITY OR SICKNESS

Other?

- **Hunters, Fishermen, Naturalists and EcoTour Guides.**
- **Private/Public Zoos, Wildlife/Game Reserves and Parks, Wildlife Rehabilitators, and Exotic Pet Industry.**
- **University Scientists.**
- **Members of the Public.**
- **Pest Control Officers?**
- **Agriculture and Public Health Personnel?**

1. DETECTION OF MORTALITY OR SICKNESS

Teamwork Required
Partnerships and Trusting Relationships

- **An Organized Network of Field Personnel.**
- **Constant Communication and Encouragement.**
- **Training, Information, Advice.**
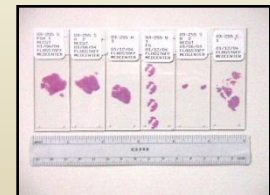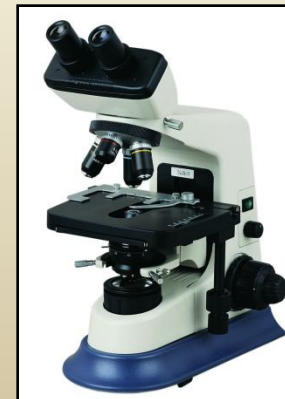
2. IDENTIFICATION OF PATHOGENS AND DISEASES

1. **NECROPSY: Cause of Death or Disease**

2. **Further Tests:**

   - **Histology, Bacteriology, Virology, Toxicology, Parasitology, Molecular, etc.**

- **Who Can Do This and Where is it Done?**

   - **Qualified Veterinary Pathologists, Diagnosticians and other Specialists in full-service diagnostic laboratories.**

3. INFORMATION MANAGEMENT

Detection of Mortality and Sickness

Identification of Pathogens and Diseases

Information Management

Analysis and Communication
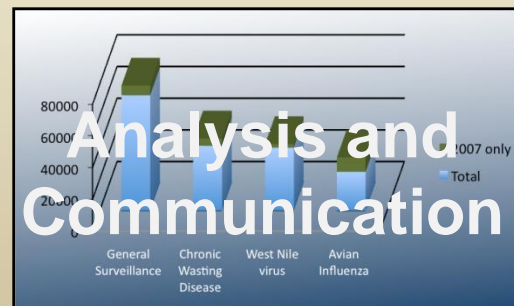
3. INFORMATION MANAGEMENT

1. Database of all information from detection of mortality/sickness and identification of pathogens/diseases.
2. Must be geo-referenced and searchable with mapping capability.
3. Permanent data archive over time.

Who Can Do This?

Personnel trained in Information Technology in CONSULTATION with database users and epidemiologists.

3. INFORMATION MANAGEMENT

1. **Requires dedicated full-time personnel for:**
   - **System Development**
   - **System Maintenance**
   - **Data Management**
2. **One system can serve both <u>General</u> and <u>Targeted</u> Surveillance Programs.**
3. **Ideally the database should be user friendly and easily accessible to a wide variety of users.**

4. **ANALYSIS AND COMMUNICATION**

- **Must provide reliable scientific information needed by:**
  - **Partners or Collaborating Agencies, Departments and Individuals.**
  - **Veterinary Services and others interested in Domestic Animal Health (eg. farmers).**
  - **Public Health Authorities.**
  - **Wildlife Conservation and Management.**
  - **Environmental Management.**
  - **Members of the Public.**
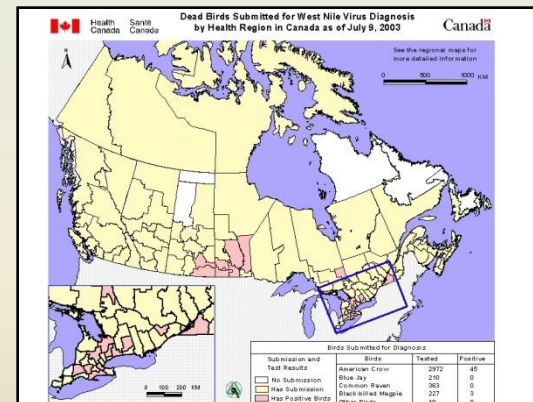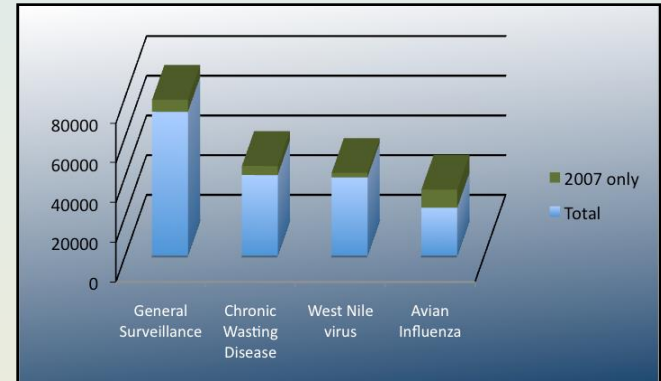
4. ANALYSIS AND COMMUNICATION

To Meet the Objectives of the Surveillance Program

•Inventory of Pathogens and Diseases:
  •Geographic distribution.
  •Changes over time.

-OIE Reports
-Scientific Papers
-Data Analyses

•Detection of New/Emerging Diseases.

-OIE Notification
-National Alerts

•Inform Government Policies and Decisions:
  •Public Health.
  •Agriculture and Food.
  •Wildlife and Environmental Management.

-Reports
-Committees
-Conferences
-Inter-Ministry exchanges

Recovery Plan for Moose in Mainland Nova Scotia — March 2007

Nova Scotia Endangered Species Act
Recovery Plan Series

Recovery Plan for Moose (*Alces alces americana*) in Mainland Nova Scotia

March 2007

JOURNAL OF WILDLIFE DISEASES
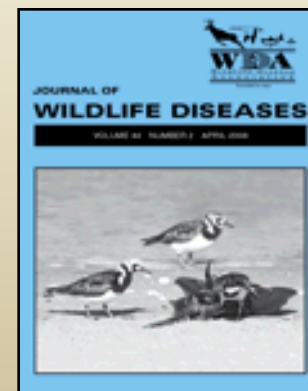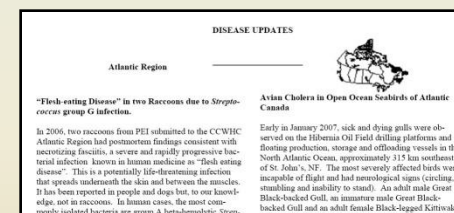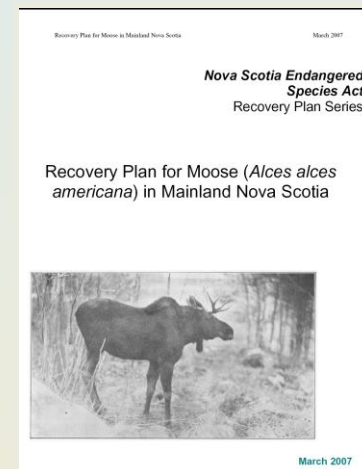
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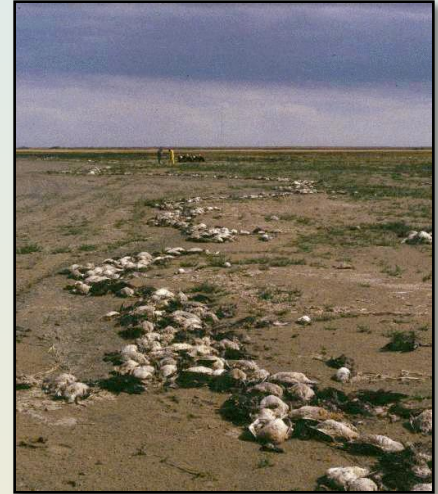
2.   **Targeted Surveillance**
- **Details about a particular pathogen.**
- **Assess magnitude of a disease problem.**
- **Data to plan management responses.**

TARGETED PATHOGEN/DISEASE SURVEILLANCE

OBJECTIVES

Information about one pathogen or disease to define and identify:

- geographic area affected;
- proportion of population infected (prevalence);
- host species infected; and
- strains and varieties of the pathogen.

• Strengths:
- Probability-based sampling is sometimes possible.
- Permits statistical estimates such as prevalence.

• Weaknesses:
- Tests for only one pathogen.
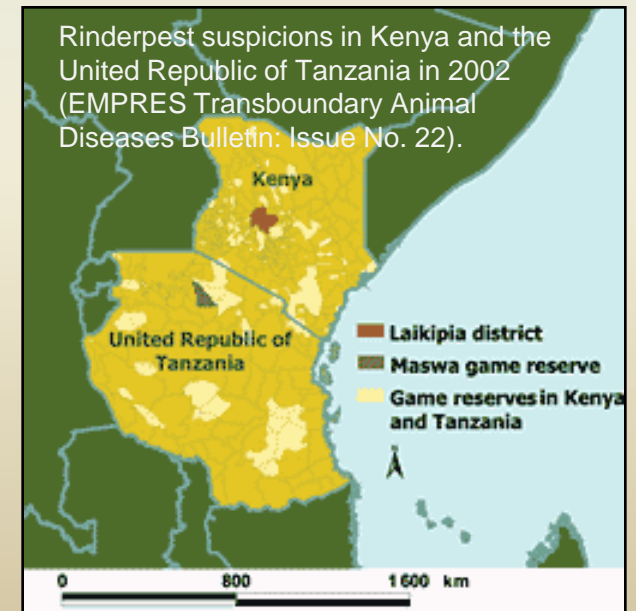- Does not detect new or emerging pathogens.

TARGETED PATHOGEN/DISEASE SURVEILLANCE

Has the same four components as General Surveillance but focused:

1. Pathogen detection (through <u>PLANNED</u> rather than opportunistic sampling).

2. Identification of specific pathogens using predefined laboratory tests.

3. Information management designed to answer specific questions.

4. Analysis and Communication of results.

Requires special attention to:

- Sampling strategy for valid statistical analysis.

- Sensitivity and specificity of laboratory tests.
  - Must include these in statistical analysis.

Avian Influenza Virus Surveillance Program

Rinderpest suspicions in Kenya and the United Republic of Tanzania in 2002 (EMPRES Transboundary Animal Diseases Bulletin: Issue No. 22).

Kenya

United Republic of Tanzania

- Laikipia district
- Maswa game reserve
- Game reserves in Kenya and Tanzania

0   800   1 600   km

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

Problem of False Results

- **<u>ALL</u> Laboratory Tests can produce <u>FALSE</u> Results.**

- **Many excellent tests developed and utilized in Domestic Animal Disease Surveillance will produce <u>FALSE RESULTS when applied to WILDLIFE Specimens</u> because they were not designed for use in these species.**
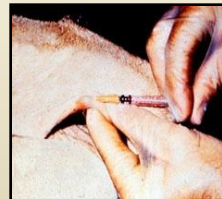
WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

Laboratory Tests and Wildlife

- **Many laboratory tests were developed for one or more species of domestic animals.**

- **They may be invalid when applied to other species.**

- **Examples:**

  - **Standard Enzyme-linked Immunosorbent Assay (ELISA) for antibodies – valid for 1 species only.**

  - **Skin test for Bovine Tuberculosis:**
    - **Cattle – 85% Sensitive (15% false negative results).**
    - **Bison – 67% Sensitive (33% false negative results).**

- **Some Tests methods are less affected by host species: Polymerase Chain Reaction (PCR), Blocking or Competitive ELISA.**

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

Test Sensitivity:

"The **proportion of truly positive animals** correctly identified as positive by the test."

- If 100 **truly infected** animals are tested, and
- if the test identifies **80 as infected**.
- Then, the **Sensitivity** of the test is **80%**.

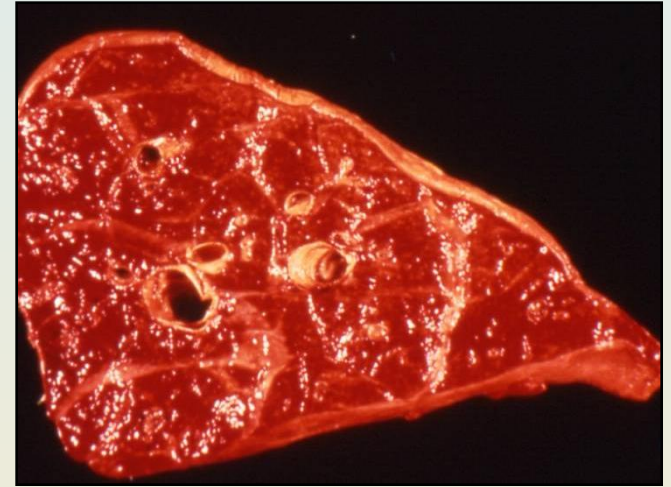|	Pathogen +ve
Test +ve	**80**
Test –ve	20*
Total	100

*20% of the time, the test gave false negative results

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

Test Specificity:

" The **proportion of truly negative animals** correctly identified as negative by the test."

- If 100 **truly uninfected** animals are tested, and
- if the test identifies **90 as uninfected**.
- Then, the **Specificity** of the test is **90%**.

	Pathogen -ve
Test +ve	10*
Test –ve	**90**
Total	100

*10% of the time, the test gave false positive results

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

Test Sensitivity and Specificity

- A perfect test would be:
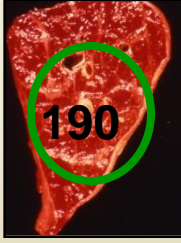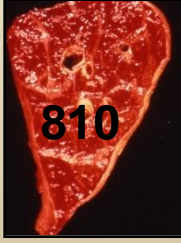 - 100% Sensitive
  - 100% Specific

	Pathogen +ve	Pathogen -ve
Test +ve	100	0
Test –ve	0	100
Total	100	100

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

- **Sensitivity and Specificity must be known for each test used on each species of host animal.**

- **Example:**

  - **1000 animals tested for antibodies to Pathogen X.**

  - **Test is 100% sensitive; 90% specific.**

  - **Results: antibodies are detected in 5% of animals.**

  - **Interpretation: High probability that none of the animals have the antibodies the test is designed to detect because 10% false positive results are expected.**

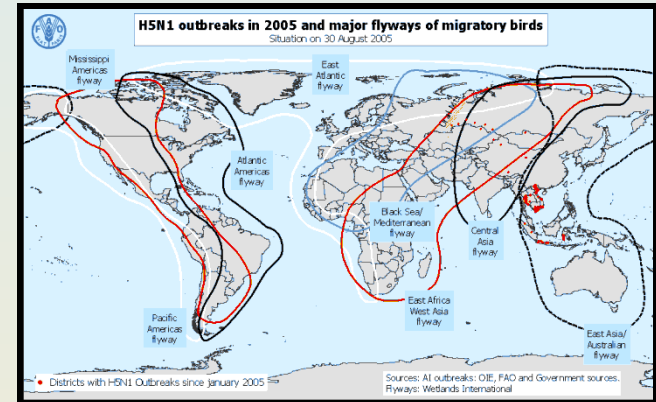# WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

• There are no perfect laboratory tests. Some have sensitivities and specificities as low as 30% (<u>FALSE</u> results 70% of the time).

• Comparative Cervical Skin Test for Tuberculosis when used in white-tailed deer has a 97% Sensitivity (<u>FALSE NEGATIVE</u> results 3% of the time) and an 81% Specificity (<u>FALSE POSITIVE</u> results 19% of the time).

	Pathogen +ve	Pathogen -ve
TEST +ve	970	190
TEST -ve	30	810
Totals	1000	1000

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

1. **Government Structure and Wildlife Diseases**
   - **Wildlife does not respect political or geographical borders so Wildlife Health Surveillance Requires new forms of Inter-agency and International Collaboration.**
   - **Confusion about Ministerial and Financial Responsibilities:**
     - **Health.**
     - **Agriculture, Livestock and Veterinary Services.**
     - **Wildlife-Fisheries-Environment.**

H5N1 outbreaks in 2005 and major flyways of migratory birds
Situation on 30 August 2005

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

2. **<u>Detection of Mortality and Sickness</u>**

– **No Animal Owners or Medical System.**

– **Depends on wildlife field personnel:**

- **Often not connected with Veterinary Services.**
- **Often quite distanced from a diagnostic laboratory.**

Photo Credit Lion Guardians

?

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

2. **Detection of Mortality and Sickness**
   - **Sick animals often hide and are difficult to find prior to or after death.**
   - **Once animals die they are quickly scavenged or rapidly decompose.**


Photo Credit Lion Guardians

WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

3. Knowledge of Animal Populations

- Population size often unknown.

- Host animal biology and ecology often incompletely known.

- Host animal identification:

  - Very large number of host animal species.

 - Often requires special expertise.
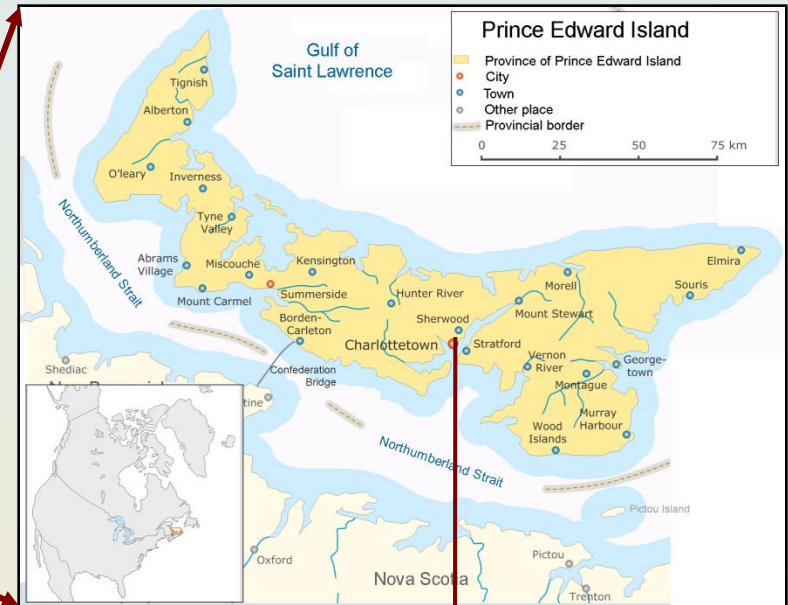

Photo Credit A. Hicks

White Nose Syndrome and Major Indiana and Gray Bat Colonies
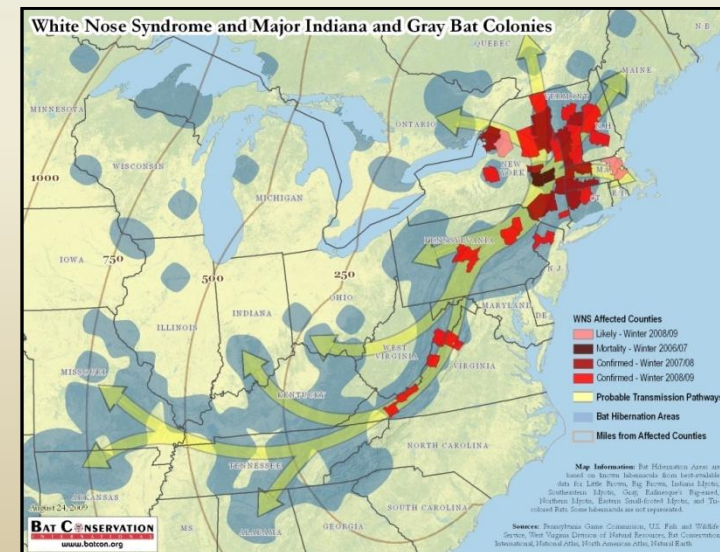
WILDLIFE HEALTH SURVEILLANCE SPECIAL PROBLEMS

3. **Knowledge of Animal Populations**

   – **Subtle effects of disease (eg. reproduction).**

   – **Challenge extrapolating results from an individual mortality event to the population level.**

   – **Disease is often the result of the complex interaction of several uncontrolled factors.**

   – **Interpretation of necropsy findings for the layperson.**
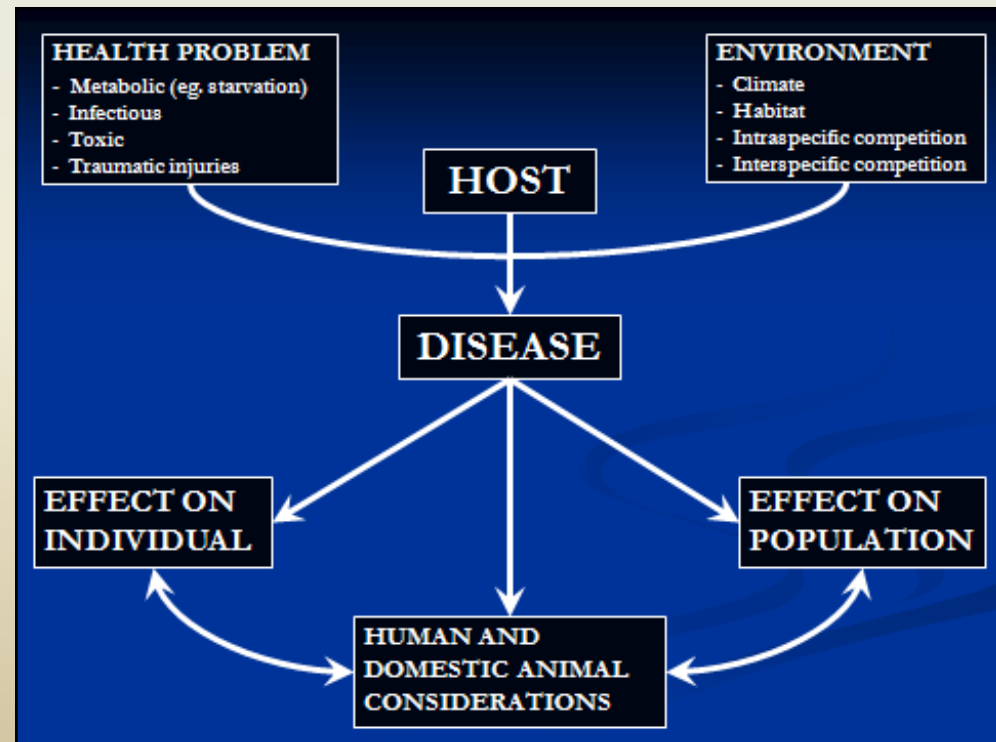
CANADIAN COOPERATIVE WILDLIFE HEALTH CENTRE

QUESTIONS?