Emerging Pathogens and the Role of Natural History Archives: The Hantavirus Example

Emerging Pathogens

- -newly appearing or spread of infectious diseases
  - -unrecognized/underreported due to
    - -ignorance of clinical expression
    - -lack of reliable test
  - -often associated with outbreak scenarios
- -1400 species known to be pathogens

Zoonotic Diseases: transmitted from animals to humans

Why are there more emerging diseases?

- -there is an increase in human-animal contact
  - -increase and spread of human population (2x the population since 1999)
- -recognition of more pathogens

Pop-Growth Consequences

- -need for space
  - -sprawl
  - -encroachment on natural areas
- -need for food
  - -habitat conversion

Habitat Conversion

- -50% of habitable land converted to farming
  - -includes land with high biodiversity
- -large-scale clearing fro intensive monocultures
- -human into natural areas
- -decrease in biodiversity

Outbreak Scenarios

Ebola Example:

- -reservoirs of long lived fruit bats
- -maintain pathogen for long periods in natural areas
- -human contacting virus in natural world

Hantavirus:

- -reservoirs of short-lived rodents
- -responds rapidly to environment change
- -2 types-rotates in natural and converted lands
- -human to animal transmission

Initial 1999 Outbreak

- -unknown disease emerged in SW killing 10 people in 8 weeks
- -victims experienced flu-like symptoms
- -caused the death of healthy individuals caused an initial level of panic

What was the disease agent?

-conspiracy theories
-massive collaboration
-virus isolation in human case
-reservoir of positive rodents that were carrying the virus

Why did this occur at this place and time?

-understanding reservoir ecology
-longitudinal studies
-8 sites in US monitoring
    -small mammal population
    -hantavirus prevalence

Reservoir Studies lead to predictive models

-precipitation catalyst in SW → trophic scale
-delayed density-dependent rodent response

Today

-639 cases
-mortality at 30-40%
-medical community recognition, treatment
-reservoir understanding

Many new Hosts for New Hantavirus

-new discoveries possibly with deep integrated specimen archives (moles, bats, etc)
    -bats especially have a lot of contact with humans

Holistic Voucher

-build a large collection
-frozen tissue by UNM is the largest in the world, 20x the size of the Smithsonian's collection
-valuable samples for molecular biologists
-traditional specimen has skin, tag, and skeleton associated
-collection not only valuable to taxonomists
-tying data sets to survey ecology/evolution for these species
-many collections are digitized and made available online
-specimen is time-stamped to see window during the environmental conditions during the time the organism existed (geo-referencing)

Integrated Archives

-temporally deep (sampled every year)
-geographically broad, site intensive
-geo-referenced

Phylogenetic Tree

-virus tends to cluster with nonmammalian hosts
-virus co-evolving with the mammals for a long time

What went wrong?

-durable infrastructure lacking- deep/temporal and wide/spatial
-focus on hypothesis driven sciences
    -funding availability
    -narrower scope of new collections
-reluctance of museums to engage other communities
    -shift from field work to public programs in many museums' cases
-slow response of museums to build integrated resources
-communication as weak
-weak data models

Next Steps for Pathogen Discovery and Mitigation?

-information and technology needs
-increased growth of collections
-increased human capacity
    -broadening participation