

**Climate
Change**

**Human Population
Growth and Consumption**

**Biotic
Impoverishment**

**Global
Toxification**



Increase in UV-B Light Exposure

- Increase in skin cancers
- Depressed immune systems
- Effects on aquatic eggs & larvae
- Enhanced algal growth?

What's Happened Since Silent Spring?

New Diseases & Increased Disease Frequency

Loon Mortality Caused by Humans (on freshwater)

1. Lead tackle
2. Boat trauma
3. Fishing line
4. Gun shot

Death of Coral Reefs

- 10% of coral reefs destroyed today
- Over 4,600 sq miles killed each yr
- Or 6,575 football fields each day
- Up to 70% destroyed in the next 30 yrs

Massive Wildlife Extinctions

- Exotic Species Introduction
- Habitat loss, fragmentation, degradation

Other Causes of Wildlife Extinctions

- Over-exploitation
- Poaching
- Over-harvesting
- Environmental
Pollution

Impacts of Amphibian Declines

- Loss of a large vertebrate biomass
- Shift in predation patterns
- Loss of predators
- Increase of insect pops. & other vectors
- Eutrophication

Amphibian Malformations

- Reported in ~42 states in the USA
- High prevalence in some populations
- Most deformities in metamorphosing-anuran age group
- Inconspicuous in younger stages
- Impact survival at population level

Amphibian Malformations

- Many species affected
 - N leopard frogs, green frogs
 - Mink frogs, tree frogs
 - Cricket frogs, spring peepers
 - American toads, bullfrogs
 - Salamanders (long-toed, tiger, spotted)

Abnormalities in Metamorphosing Frogs

Missing limbs

Supernumerary limbs

Anophthalmia
Ectropic eyes

Multiple limbs (polymely)

Causes of Amphibian Malformations

Multifactorial etiology

- Xenobiotic chemicals
- Viruses, bacteria, trematodes & fungi
- UV-B radiation
- Exposure to retinoic acid
- Physical trauma

Warmer?

Wetter?

Drier?

Stormier?

Arctic ice cap & Siberian permafrost melts

Global Climate Change Predictions

- Sahara desert turns into lush forest
- Europe plunged into big freeze
- Arctic ice cap & Siberian permafrost melts
- Amazon rainforest turns into desert
- More forest fires in northern regions & tropics

Climate Change and Vector-Borne Diseases

- Climate restricts range of vectors
- Weather affects timing and intensity of disease outbreaks
- Rates of insect biting and maturation depend on temperature
- Increased global temperatures favor spread of vectors to higher altitudes and latitudes

Environmental Change and Disease Vectors

- Opportunists colonize stressed environments
- Insects, rodents and microorganisms are opportunists that multiply rapidly
- Predators control pest populations in stable environments

“The wild beasts of this century and the next are microbial, not carnivorous.”

Joel Cohen

Environmental Stress

- Alteration of environmental factors lead to increased stress, which causes decreased natural immunity and increased susceptibility to disease

Ecological Distress Leads to Emerging Disease

Cumulative & Synergistic

Effects of Multiple Stressors

Basic Concepts in Infectious Disease Emergence

Wilson, 1995

- Emergence of EIDs is complex
- Infectious diseases are dynamic
- Most new infections not caused by genuinely new pathogens
- The concept of the microbe as *the* cause of the disease is incomplete and inadequate
- Human factors are the most potent factors driving disease emergence
- The current global situation favors disease emergence

Emerging Diseases

- Ecological change
- Human demographic & behavior shifts
- International travel and commerce
- Technology and industry
- Microbial adaptation and change
- Breakdown in public health measures

Emerging Diseases

- Spill-over
- Pathogen pollution
- Passive emergence

Daszak et al. 2000

Emerging Diseases

Spill-over of infectious disease from:

- Domestic animals
- Humans

- Imported & translocated wildlife

Emerging Diseases

Translocation of host, vector and/or pathogens:

- Conservation
- Hunting

- Agriculture & food
- Pet trade

Passive Emergence of Diseases

- No “overt” human involvement
- Climate change/ warming, sea level change, ozone thinning, increase of UV-B, climatic instability

Consequences of EIDs

- Mass mortality events
 - Population declines
 - Local extinctions
 - Global extinctions
- EIDs causing subtle population losses

Florida Panther Population & Reproductive Problems

- Massive habitat alterations
- Genetics?
- Toxics?
- Introduced pathogens

Origin of Pulmonary Hantavirus Syndrome in USA (1993)

- Six-year drought
- Reduction of predator populations
- Heavy rains with depleted predator and increased rodent populations
10 times the normal
 - » Elimination of virus by feces & urine
- Pathogen invasion
- Human exposure by inhalation of aerosols
- Epidemic of PHS

NEW CHALLENGES

- Emerging diseases
- Environmental disasters
- Eco-toxicology
- Conservation of endangered species

Research Priorities of Conservation Medicine

- Expansion of transdisciplinary interaction
- Integrated ecological assessment & monitoring
- Expanded diagnostic capability
- Resolution of human and wildlife conflict
 - implementing conservation medicine practice in conservation reserve design and management

IN SUMMARY...

- Examine patterns of disease emergence and transmission across species in stressed, fragmented or degraded habitats
- Develop protocols for long-term monitoring
- Provide veterinary clinic/epidemiologic expertise
- Conduct training courses to local scientists
- Communicate the importance of health issues in ecosystems & species conservation

What's Needed in the Future?

- Surveillance, including improved reporting
- Research
- Public Education
- Changes in human attitudes towards:
 - ✓ Wildlife & exotic species
 - ✓ Human population
 - ✓ Achieving a balance...

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