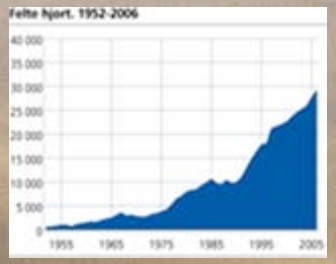
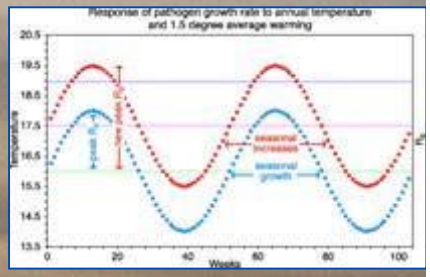
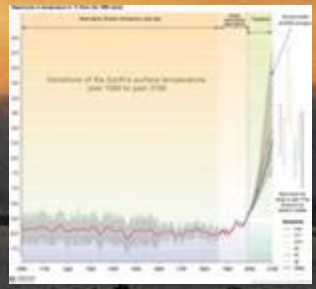
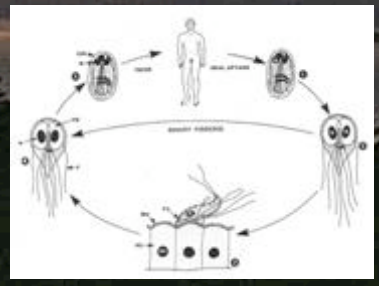




Care and Use of Animals in Field Research -

Health monitoring and Zoonoses





Bjørnar Ytrehus
Head of Section, dr.med.vet. [PhD]
Section for Wildlife Diseases

Veterinærinstituttet
National Veterinary Institute

Section for Wildlife Diseases, NVI

- Health and Disease in Wildlife (mammals, birds, reptiles, amphibians)
- Norway's only special unit for disease diagnostics and health surveillance of wildlife
- Diagnostic investigations also performed in regional laboratories in Stavanger, Bergen, Trondheim, Harstad and Tromsø
- Close cooperation with other parts of NVI
- NVI's main task: "…development of knowledge and competency in order to promote the health and welfare of animals, to ensure food safety, and to contribute to a sustainable bioproduction"

Veterinærinstituttet

Why do diagnostics on wildlife?

- important for the wildlife – basis for managment that provides
  - healthy, sustainable populations
  - minimal distress, pain and discomfort due to disease
- important for humans
  - avoid zoonoses
  - knowledge to avoid irrational fear and inappropriate measurements
- important for domestic animals
  - avoid transmission of pathogens
  - knowledge to give a correct diagnosis
- important for the environment
  - health of wildlife a good indicator of environmental change – pollution, global warming
  - good surveillance a prerequisite for early warning

What is disease?

- very difficult to define!
  - absence of health?
  - continuum between absolute health and death – when functions are so compromised that life is impossible
  - relative health blends over into disease
- mortality an end-result!
- cost of disease
    - decreased energy intake because of inappetance
    - reduced intake because of impaired mobility and/or altered behaviour
    - decreased digestive efficiency
    - increased energy for thermoregulation
    - increased energy demand because of fever
    - increased energy demand because of altered behaviour
    - increased energy for inflammatory, immune and repair functions
    - increased loss of nutrients in excretions
- disease affects the animal long before it is visible as mortality

(Wobeser, 2006)

AGENT(S)

dose, virulence,
tranmission mode,

HOST

condition, age,
stage, other
disease,

ABSOLUTE

HEALTH **HEALTH** **DISEASE** **DEATH**

vippe fra Søve Leke-miljø, www.sove.no

Veterinærinstituttet

A rapidly changing world

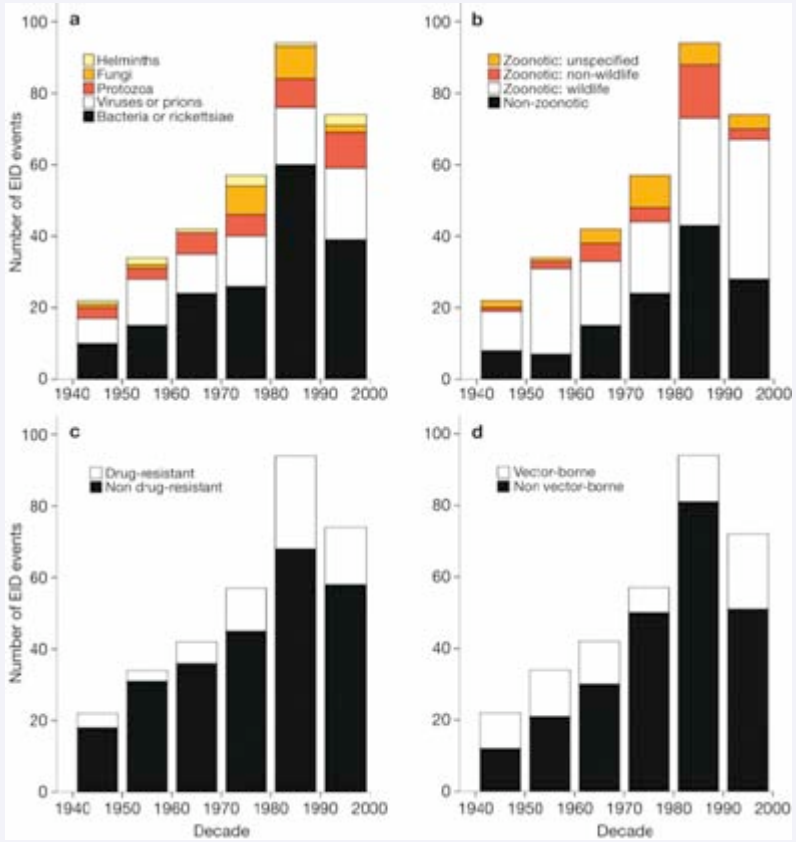
- growth of human population
- urbanisation
- globalisation
  - production transferred to development countries
  - increased transport of goods
  - increased travelling
  - increased transport of animals
- changes in agricultural practices
  - in development countries increased deforestation and encroachment on remains of wildlife habitats
  - in our part of the world reforestation
- increased exploitation
- high population density of some species
- climate

Emerging Infectious Diseases (EIDs) in humans

"… diseases that have recently increased in incidence or geographic range, recently moved into new host populations, recently been discovered or are caused by newly-evolved pathogens (Daszak, 2001)"

- increasing (maximum in 1980s)!!
- 60 - 70% from animals (1945 – 2007)
- 42% from wildlife – increasing proportion!!
- lack of surveillance
- lack of knowledge and overview
- vector-borne diseases typical

- Nipah, Ebola, AIDS, SARS, Avian influenza, Lyme borreliosis, tuberculosis, rabies,
- Human population density, increased contact between wildlife and humans, increased susceptibility in human population

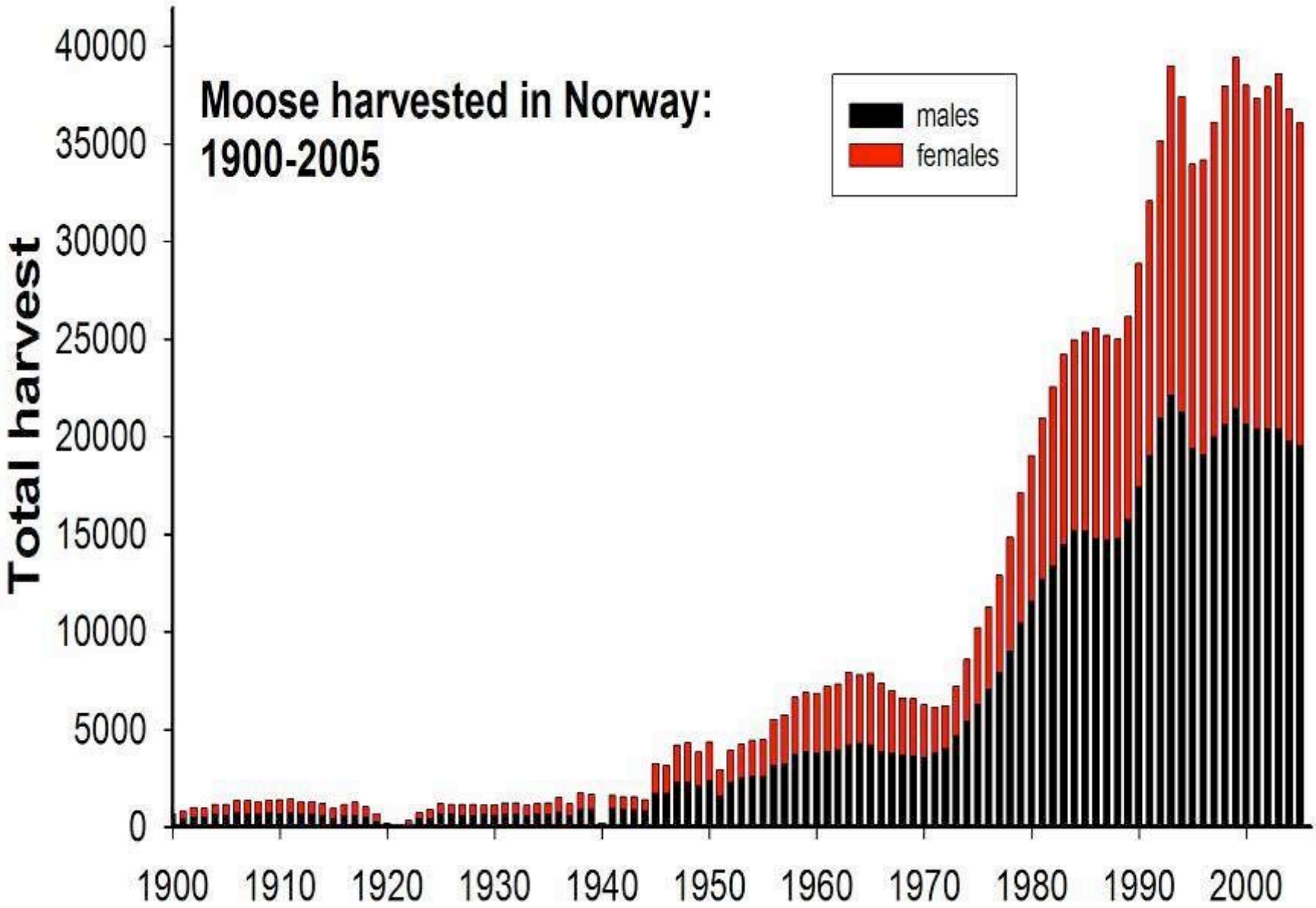


Number of EID events per decade (Jones et al., 2008)

Veterinærinstituttet

EIDs in Wildlife

- anthropogenic environmental changes
- secondary changes in host-parasite/pathogen ecology
  - domestic animal population expansion and encroachment
    - increased contact between species
    - spill-over from domestic animals
  - introduction of new species
    - carrying pathogens
    - acting as reservoir
  - human encroachment
    - spill-over from man
    - sublethal toxin accumulation
    - habitat fragmentation or destruction
    - feeding
    - managment (increases in host density)
- may cause mass mortalities, local or even global extinction
- dearth of knowledge on wildlife diseases, particularly those of less-charismatic vertebrates and invertebrates, of non-game animals and in marine ecosystems (Daszak, 2001)



(E. Solberg, NINA)

Veterinærinstituttet

High population density

- affect the condition of the animals
- may increase stress
- increase contact rate (transmission potential)
- increase parasite load
- increase contact between species
  - different susceptibility to more or less common pathogens/parasites
  - potential for introduction of ”new” pathogens/parasites
  - ”apparent competition”

Connection between population density and disease?

$$R_0 = \frac{\beta X}{(a + b + \sigma)}$$

R_0 = (for a virus or bacteria) average number of secondary infections that arise from introduction of one infected individual into a totally susceptible population

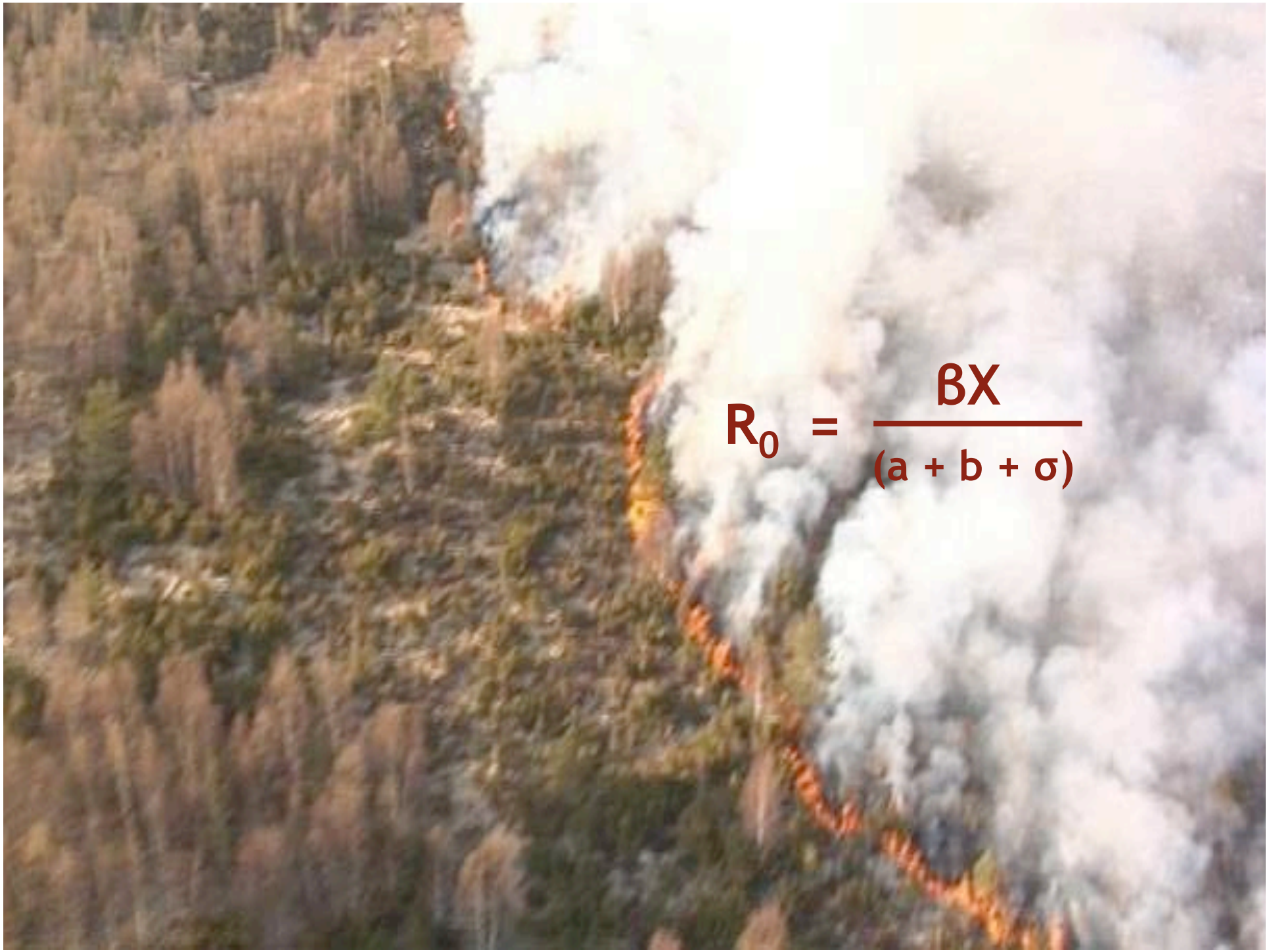
β = probability of transmission between susceptible and infectious host animals

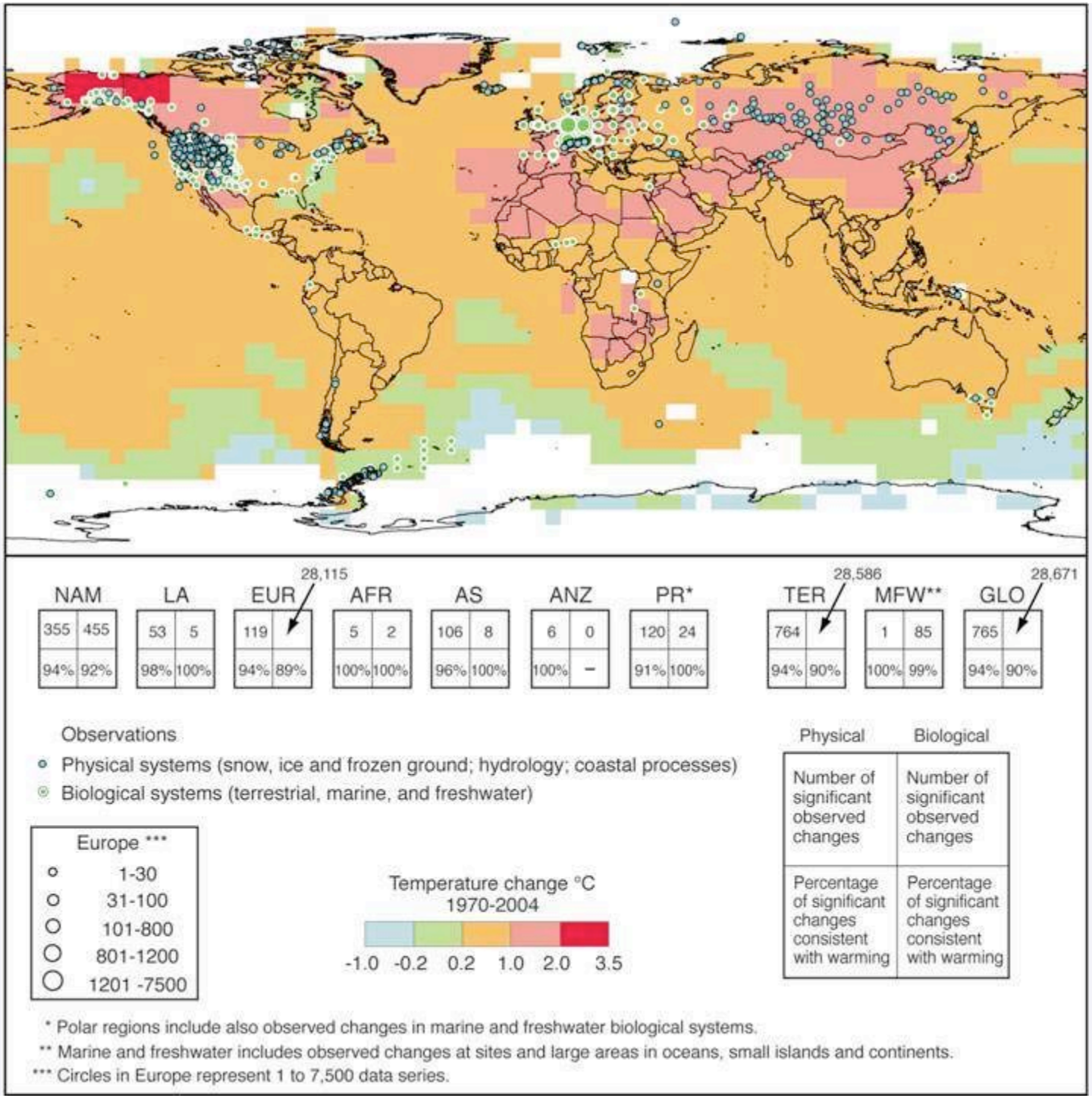
X = host population density

a = disease-induced mortality rate

b = mortality rate of uninfected animals

σ = rate of recovery from infection

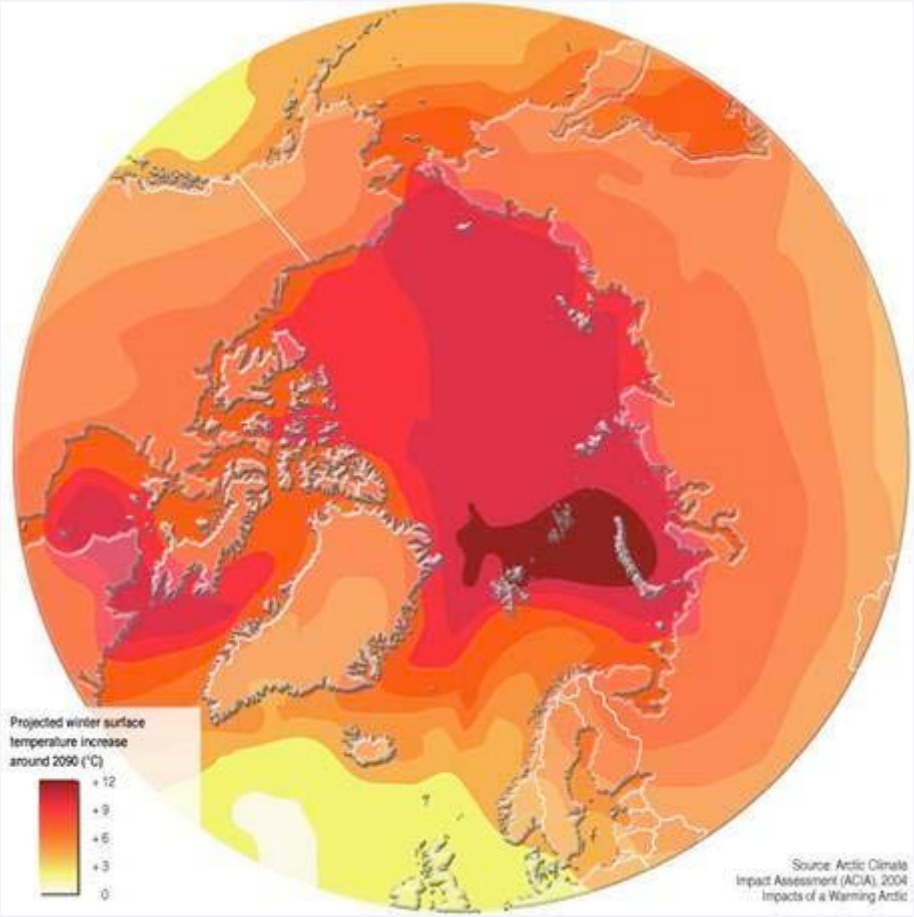

$R_0 = \frac{\beta X}{(a + b + \sigma)}$



Veterinærinstituttet

Bilde fra: http://maps.grida.no

Consequenses of climate change



Map from: http://maps.grida.no

- warming expected to be greatest over land and in high northern latitudes
  - earlier spring, later autumn
  - more frequent hot extremes and heat waves
  - more frequent heavy rainfall
  - atmospheric water vapour increased
  - increase in precipitation in high latitudes

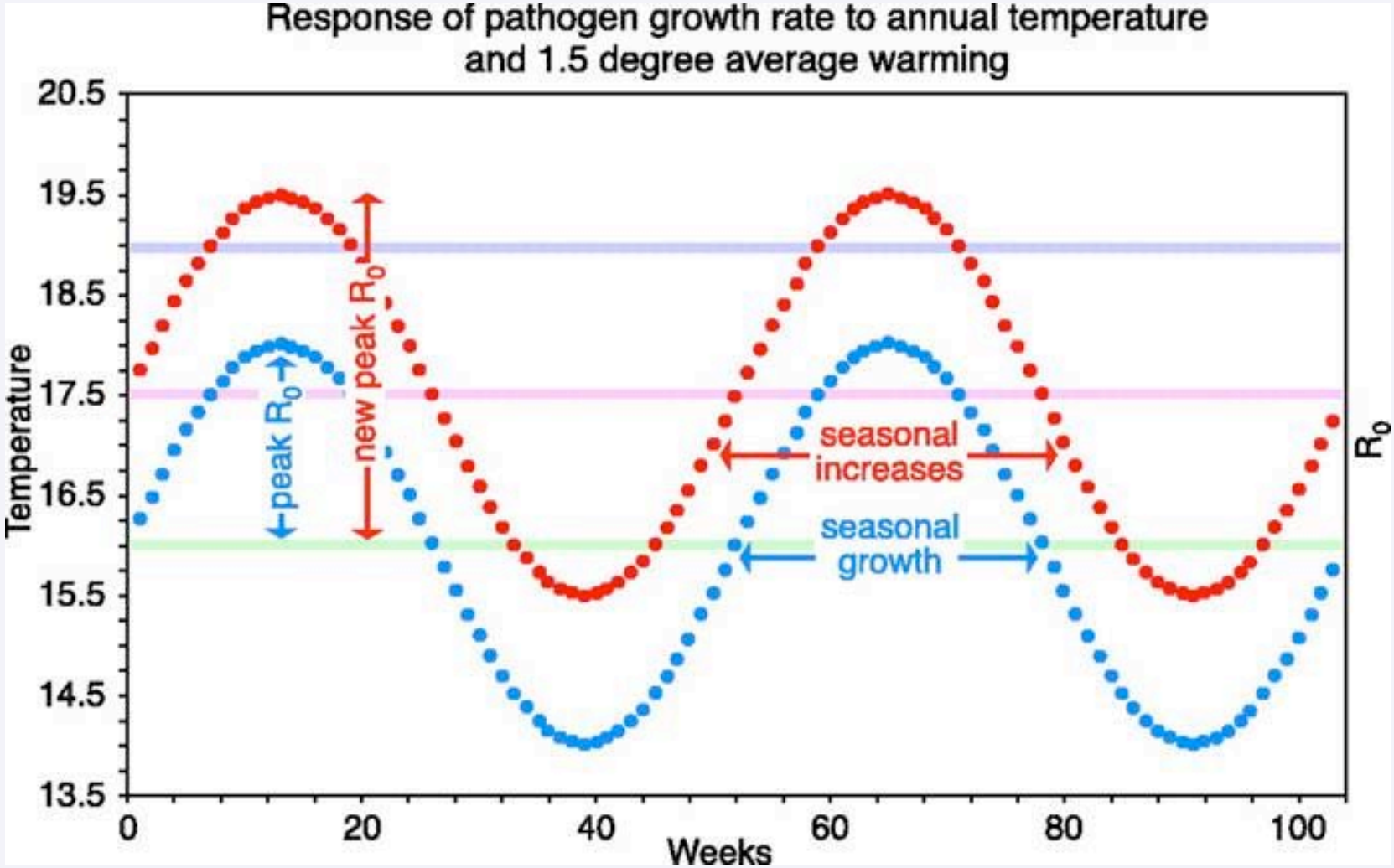
Veterinærinstituttet

Climate change and disease in wild animals

- dearth of studies
- few available data on baseline occurrence
- presumed to increase in prevalence
  - parasitic and vector-borne diseases
    - accelerated development rate of pathogen and/or vector
    - increased vector activity – increased transmission rate
    - increased geographic range
  - relaxing overwintering restrictions on pathogen life cycles
  - modified host susceptibility

- increased disease can contribute to population or species declines, especially for generalist pathogens infecting multiple host species (Harvell 2002)

Veterinærinstituttet



C. D. Harvell et al., Science 296, 2158 -2162 (2002)

Veterinærinstituttet

Published by AAAS

Science

AAAS

Zoonoses

- disease of vertebrate animals transmissible to man
- the animals represent the reservoir – the place the disease agent persists
- infection and disease dependent on the interaction of agent, host and the environment they share
- risk factors
  - close contact with animals
  - increased susceptibility to infections
  - lack of knowledge
  - bad hygiene
  - bad food and water hygiene

Anthroponoses, antropozoonoses and other unwanted impacts of field research

- Disease that may be transferred from man to animals
- Disease where the researcher or his equipment act as a mechanical vector
- The mere presence of the researchers may be an important morbidity and mortality factor!
    - nest success?
    - hatching success?
    - chick mortality?
    - capture and immobilisation – from minor changes in blood constituents to fatal capture myopathy
    - stress
    - lesions and handicaps produced by collars, ear-tags etc.

Generalist pathogens

- have the ability to infect a wide variety of species
  - rabies
  - anthrax
  - tuberculosis
  - leptospirosis
  - brucellosis (*B. abortus*) – not in Scandinavia
  - salmonella
  - pasteurellosis (*P. multocida*, *Mannheimia hemolytica*)
- stay away from
  - animals with peculiar behaviour
  - carcasses (with blood from natural orifices)
  - emaciated and cachectic animals

Photo: Tord Bretten

Zoonoses from cervids

- disease not prevalent
- fairly well studied
- relatively easy to discover disease
- brucellosis – not found in Norway
- leptospirosis – not found in Norway
- tuberculosis – great problem in red deer in many parts of the world – minimal prevalence in Norway
- Salmonella – not found
- Enterohemorrhagic *Escherichia coli* – not found

- toxoplasmosis
- listeriosis
- Giardia
- Cryptosporidium

- vector-borne disease
  - anaplasmosis
  - babesiosis
  - doubtful role in Lyme borreliosis and tick-borne encephalitis
  - bartonella?
  - Q-fever (*Coxiella burnetti*)

- Conclusion:
  - LOW RISK for field researcher

Veterinærinstituttet

Veterinærinstituttet

bilde fra internett: www.stopa.cso.pl

Veterinærinstituttet

Veterinærinstituttet

Veterinærinstituttet

Veterinærinstituttet

Zoonoses from wild rodents and lagomorphs

- leptospirosis from rats (*Leptospira interrogans*)
- pseudotuberculosis (*Yersinia pseudotuberculosis*)
- tularemia (*Francisella tularensis*)
- murine typhus (*Rickettsia typhi*) not found in Scandinavia
- rat bite fever (*Streptobacillus moniliformes*)
- hantavirus renal syndrome (Nephropathia epidemica) from voles
- plague with fleas (*Y. pestis*)
- tularemia (*Francisella tularensis)* with mosquitos, ticks etc.
- Lyme borreliosis (*Borrelia burgdorferi)* with ticks

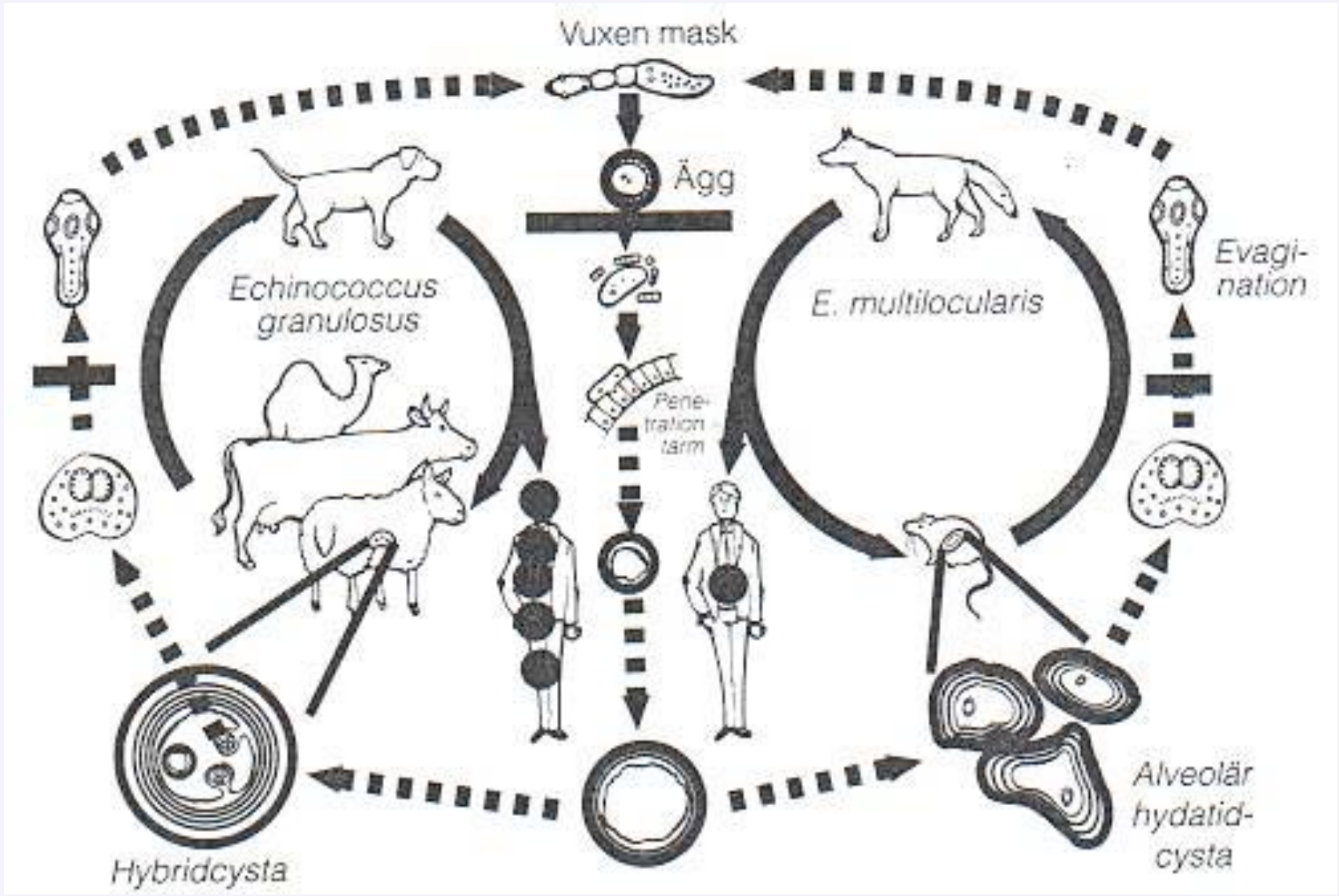
Zoonoses from carnivores

- disease not prevalent among the large northern carnivores
- more prevalent in foxes – but spill-over

- Salmonellosis
- Rabies
- Sarcoptic mange
- Toxoplasmosis
- Trichinosis
- Echinococcus multilocularis (not found)
- Echinococcus granulosus

- LOW TO MODERATE RISK

Veterinærinstituttet



From ”Liv och Död blant vilda djur”, T. Mörner

Veterinærinstituttet

Zoonoses from sea mammals

- erysipelas (*Erysipelothrix rhusiopathiae)*
- trichinellosis
- toxoplasmosis
- salmonellosis
- mycobacteria
- *Brucella pinnipediae* in phocines
- pox-virus
- influenza A

- LOW RISK
- lack of studies

Veterinærinstituttet

Zoonoses from birds

- long-distance carriers of a wide range of pathogens
- lack of knowledge!!

- Ornithosis - Chlamydophila psittaci
- Salmonella
- E. coli O157
- Mycobacterium avium
- Avian influenza
- Newcastle disease (paramyxovirus)
- nest mites (*Dermanyssidae*)

- Campylobacter jejuni
- Helicobacter spp.
- Coronavirus

- Vector-borne diseases
  - Lyme borreliosis (*Borrelia burgdorferi)* with ticks
  - Anaplasmosis
  - Tick-borne encephalitis
  - West Nile virus (*Culex* spp)
  - Sindbis virus

- LOW TO MODERATE RISK – high degree of uncertainty
- Must expect the unexpected!!

Veterinærinstituttet

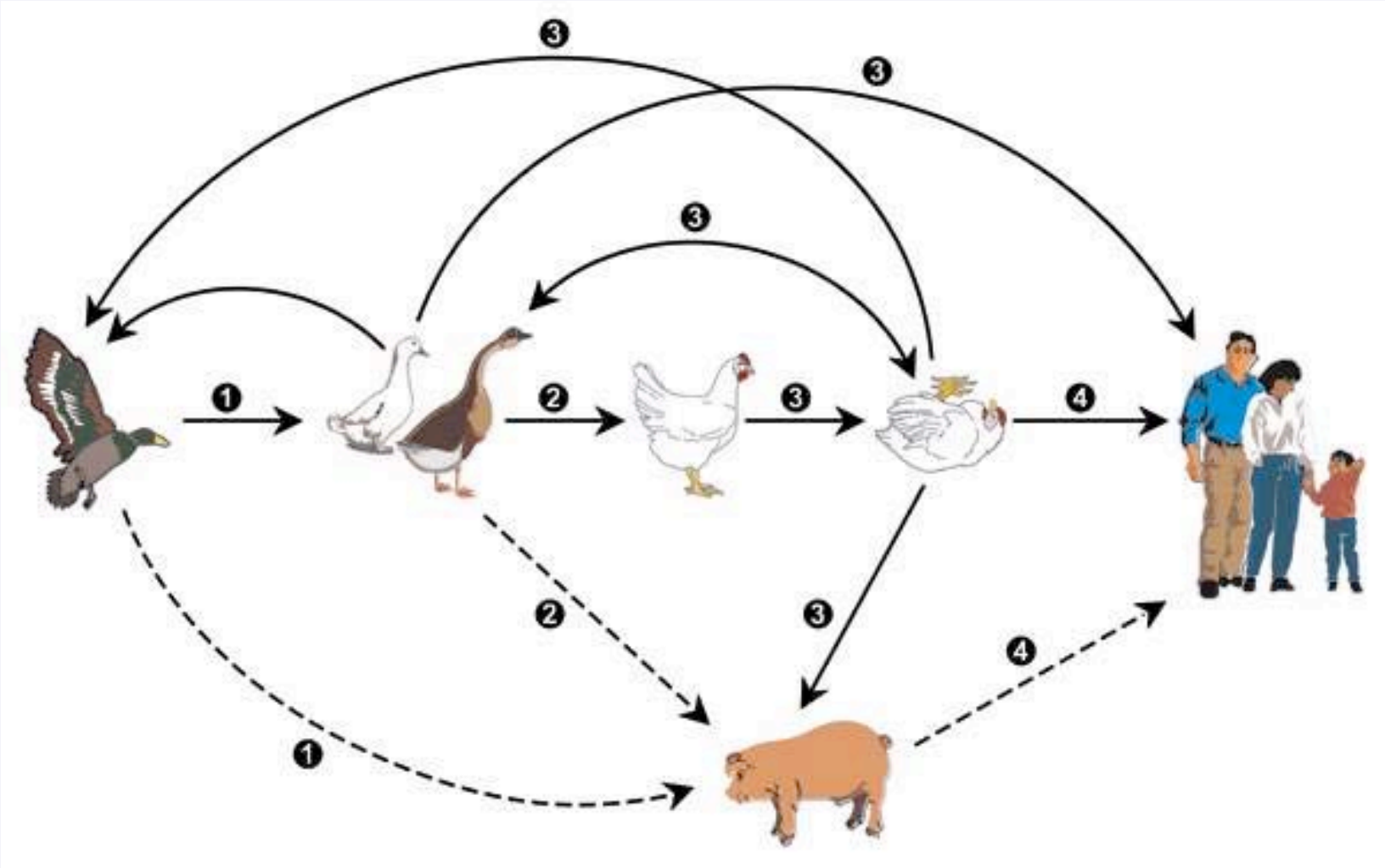
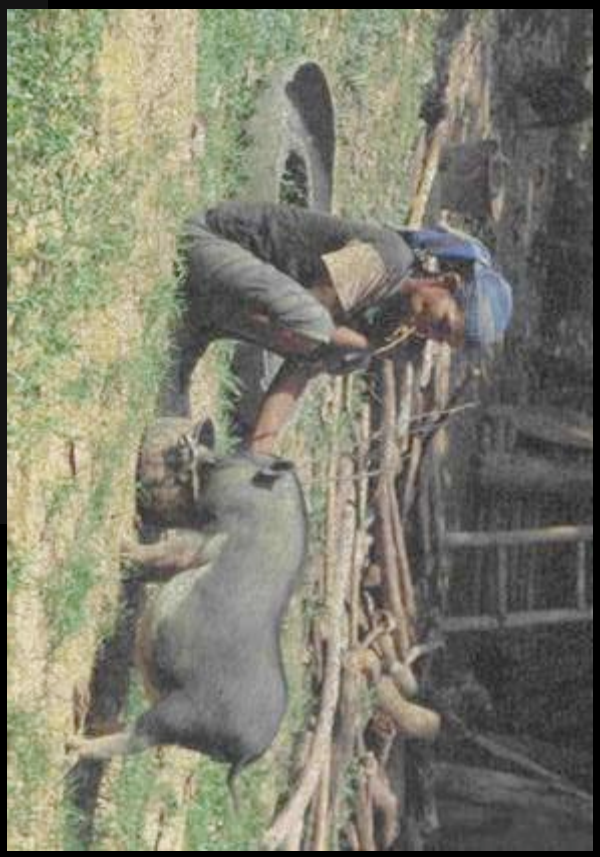


Figure from Webster, Peiris, Chen and Guan, 2006,
Emerging Infectious Diseases 12, 1: 3 - 8

Veterinærinstituttet

Veterinærinstituttet



Veterinærinstituttet

Which precautions may be taken against zoonoses

- knowledge (prevalence, clinical signs, mode of transmission, precautions)
- minimise contact
- stay outdoors
- clean hands, clothes and equipment after contact
- health surveillance – monitoring of animals

Health surveillance in field research - why

- evaluate the health of study animals in order to avoid biased results
  - behaviour, migration, reproduction, feeding etc. may be affected by disease
- monitor the animals' health during the study as a measurement of the impacts of your presence and/or manipulation
  - introduction of disease
  - induction of disease
  - distress, discomfort pain
- survey and monitor the health of the animals with respect to presence of zoonoses
- increase general knowledge on prevalence and nature of disease

Health surveillance in field research - how

- general examination (condition, weight, behaviour etc.)
- blood samples
  - serology
  - clinical biochemistry
  - blood pathogens
- fecal samples
  - enteric bacteria and virus
  - parasite load
- syndromic monitoring – treatment or euthanasia if intervention has caused severe disease
- research protocol should have procedures that ensure a thorough and objective investigation (necropsy) of animals dying during the study

Summing up

- large-scale changes occurring all over the World are presumably increasing the over-all prevalence of disease in wild animals
- the same changes are drivers of the emergence of ”new” infectious diseases in humans and wildlife

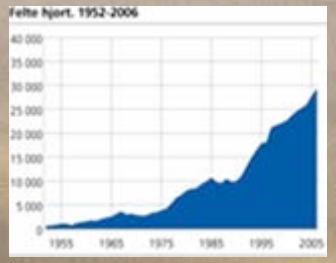
- in most animal species, there is a great dearth of knowledge on which disease agents that exist and how common they are
- the field researcher is at risk for contracting known and new zoonoses
- field studies represent a risk for introduction and/or promotion of disease in wild animal populations
- intervention may increasingly trigger disease or even epizootics

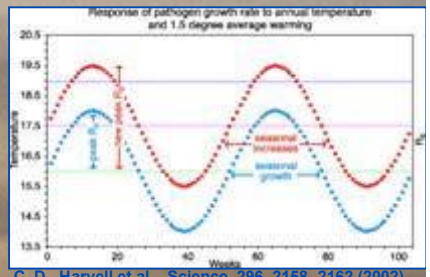
- health surveillance of study animals is important
  - to reveal if disease interfere with research results
  - to reveal if research negatively affect the animals
  - to check for presence of zoonotic diseases
  - to gain new knowledge

Opinion

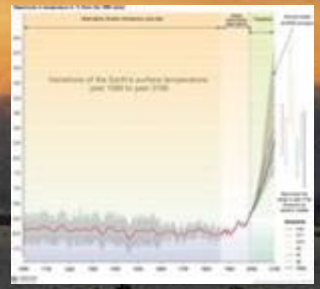
- field studies should include assessment of the health of the animals before, during and after the study
  - risk of introduction of disease
  - risk of zoonoses
  - risk of triggering disease – effect of intervention
  - procedures for health monitoring
- procedures for handling of unexpected mortality should be included
  - as a ”health insurance” for animals and researchers
  - as a control of the animal welfare – whistle-blower
- projects where assessment of animal health (and welfare) and evaluation of possible negative effects of intervention not is taken into consideration, should be discouraged on an ethical and scientific basis

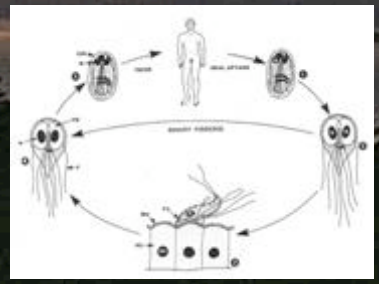
Veterinærinstituttet





C. D. Harvell et al., Science 296, 2158 -2162 (2002)





Care and Use of Animals in Field Research -

Health monitoring and Zoonoses