Climate changes and animal infectious diseases

HOW TO LIMIT POTENTIAL RISK

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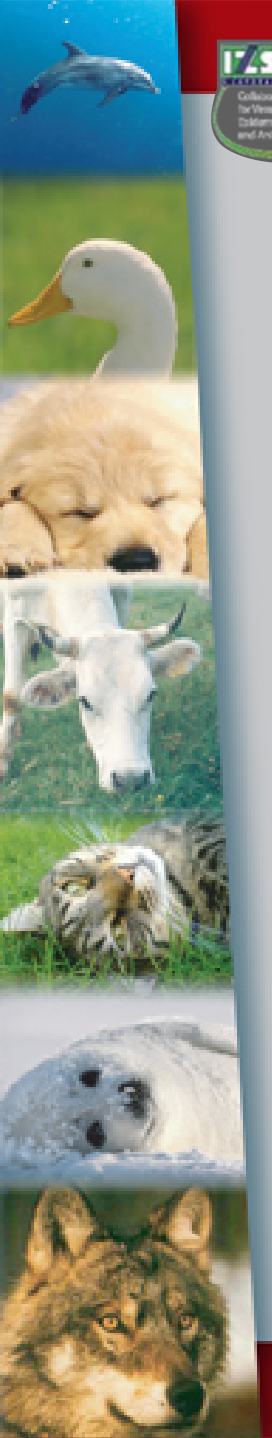
Which are the most climate sensitive diseases?

- Vector-borne diseases
- Water-borne diseases
- Soil-borne diseases
- Diseases transmissible by direct contact
- Food-borne diseases
- Sexually-transmitted diseases

Vector Borne Diseases

- Many parts of complex systems are climate sensitive
  - Vector survival, reproduction, development, biting rates
  - Pathogen reproduction, development
- Disease activity depends on multiple factors and is region specific
  - Strict relationship with the physical environment, involvement of different vertebrate species, presence of wildlife reservoirs, vector control measures
- Surveillance needed for imported diseases
  - Greatest threat remains foreign trade and travel, control of border areas

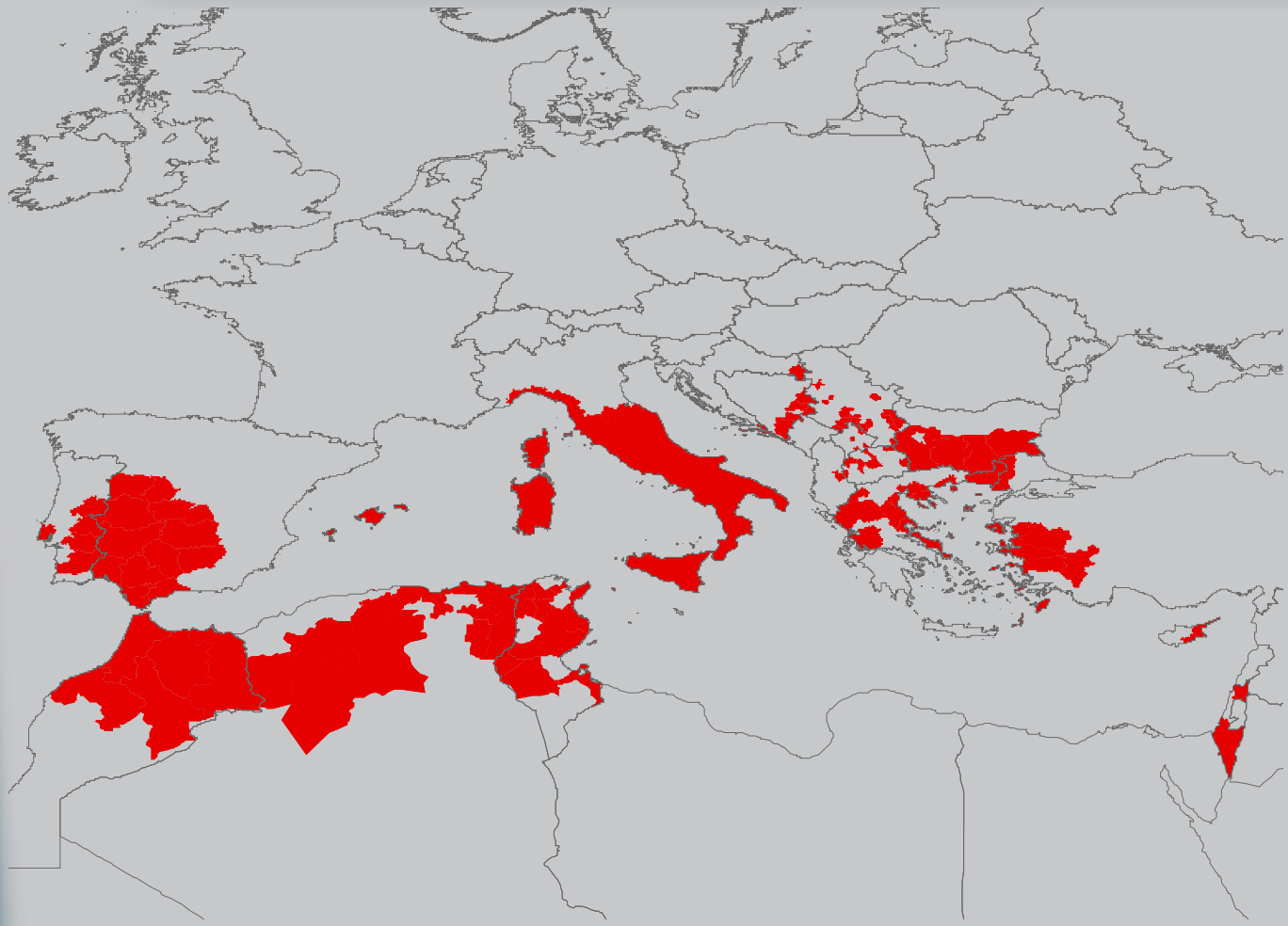


Climate Changes and Vector Borne Diseases

- Several studies have concluded that temperature affects the major components of **vectorial capacity**, but other environmental factors, besides temperature, play a significant role
- In particular, survival rate of vector and the extrinsic incubation period (incubation periods for the parasites and viruses within vector) are temperature-dependent
- Reproduction rate of many vectors is rainfall dependant

Emerging Vector Borne Diseases

Bluetongue in the Mediterranean Basin and in Europe



from 2000 to July 2006

Emerging Vector Borne Diseases

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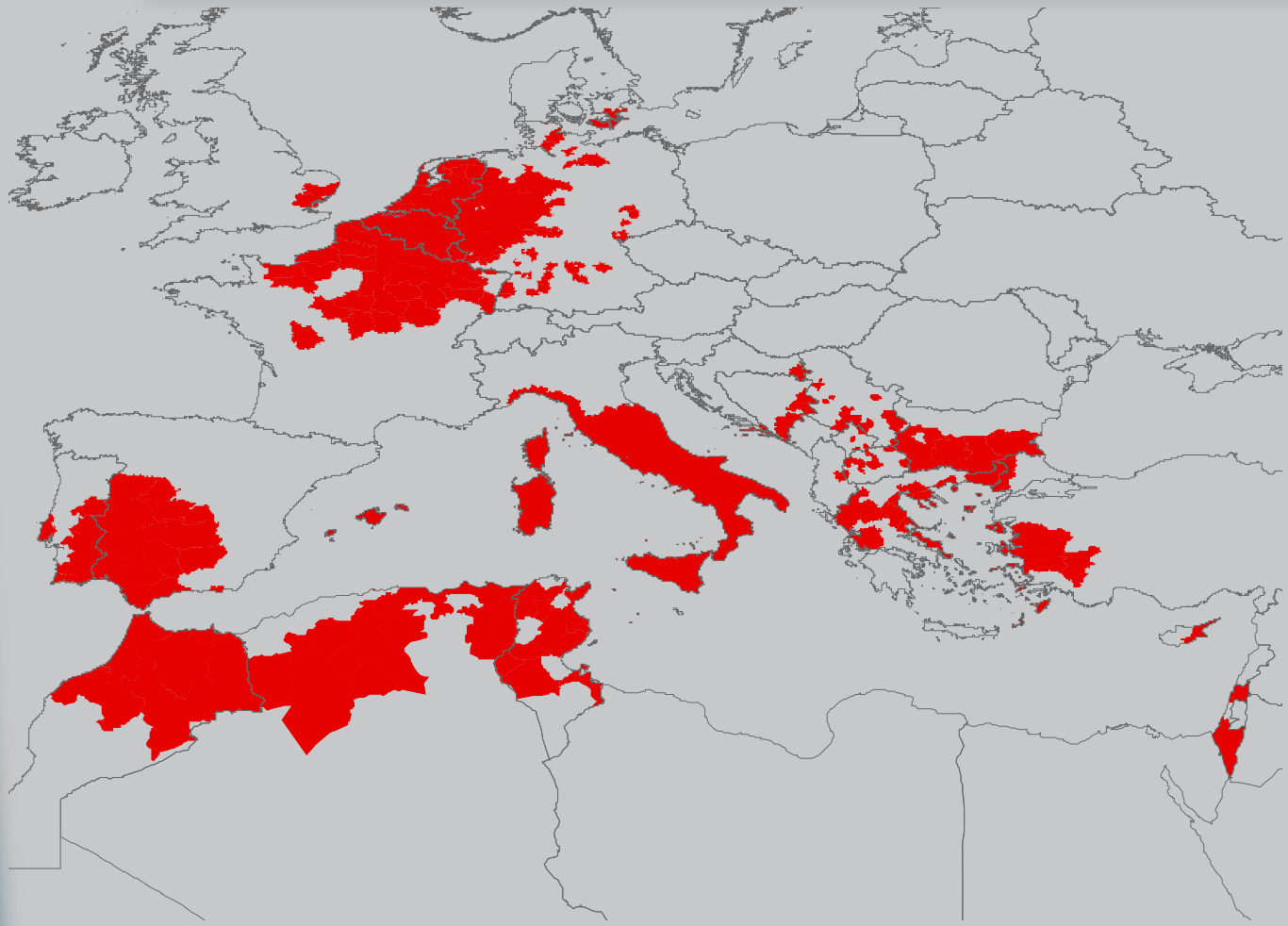

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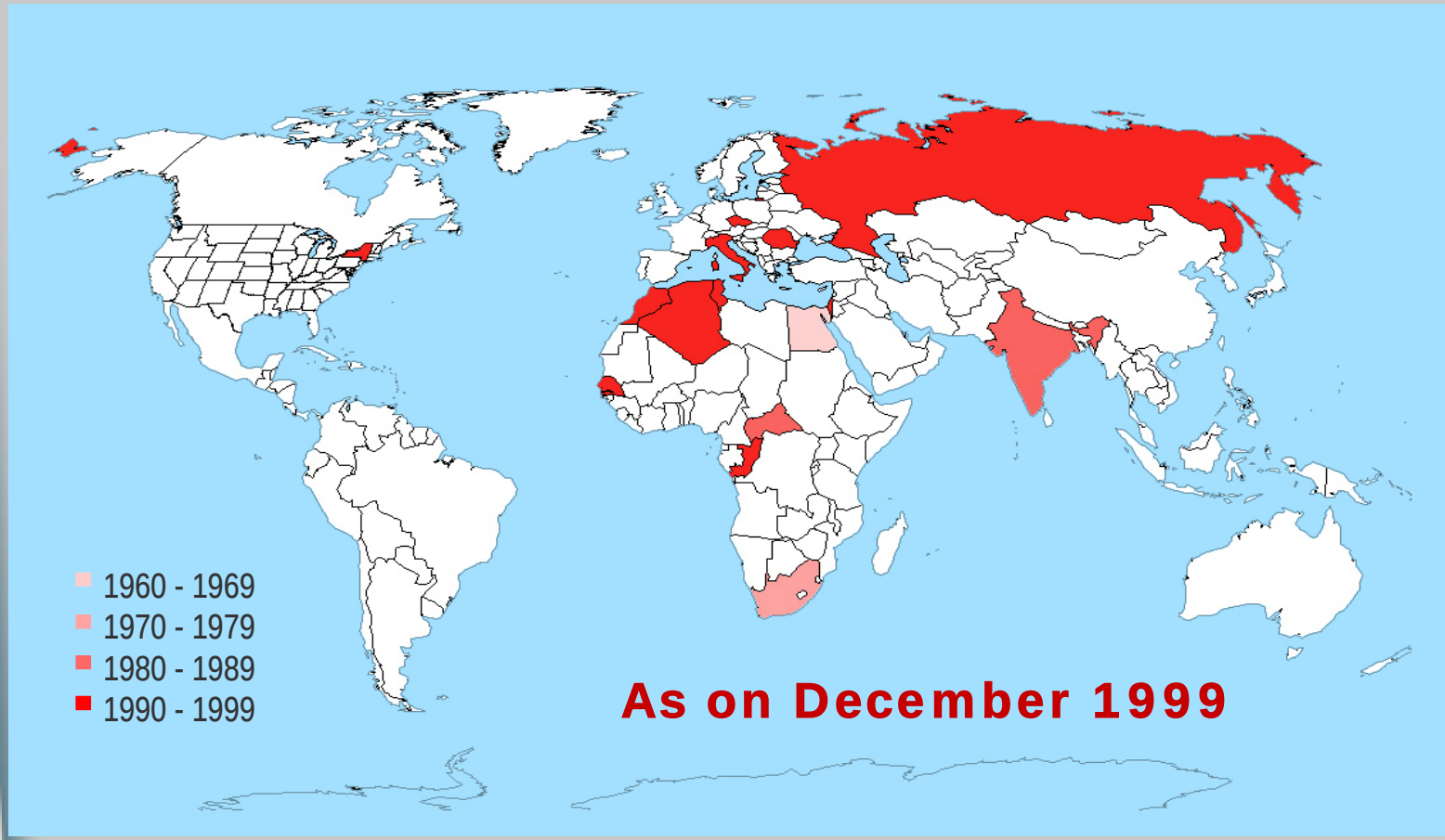
Emerging Vector Borne Diseases

West Nile Disease in the World



Emerging Vector Borne Diseases

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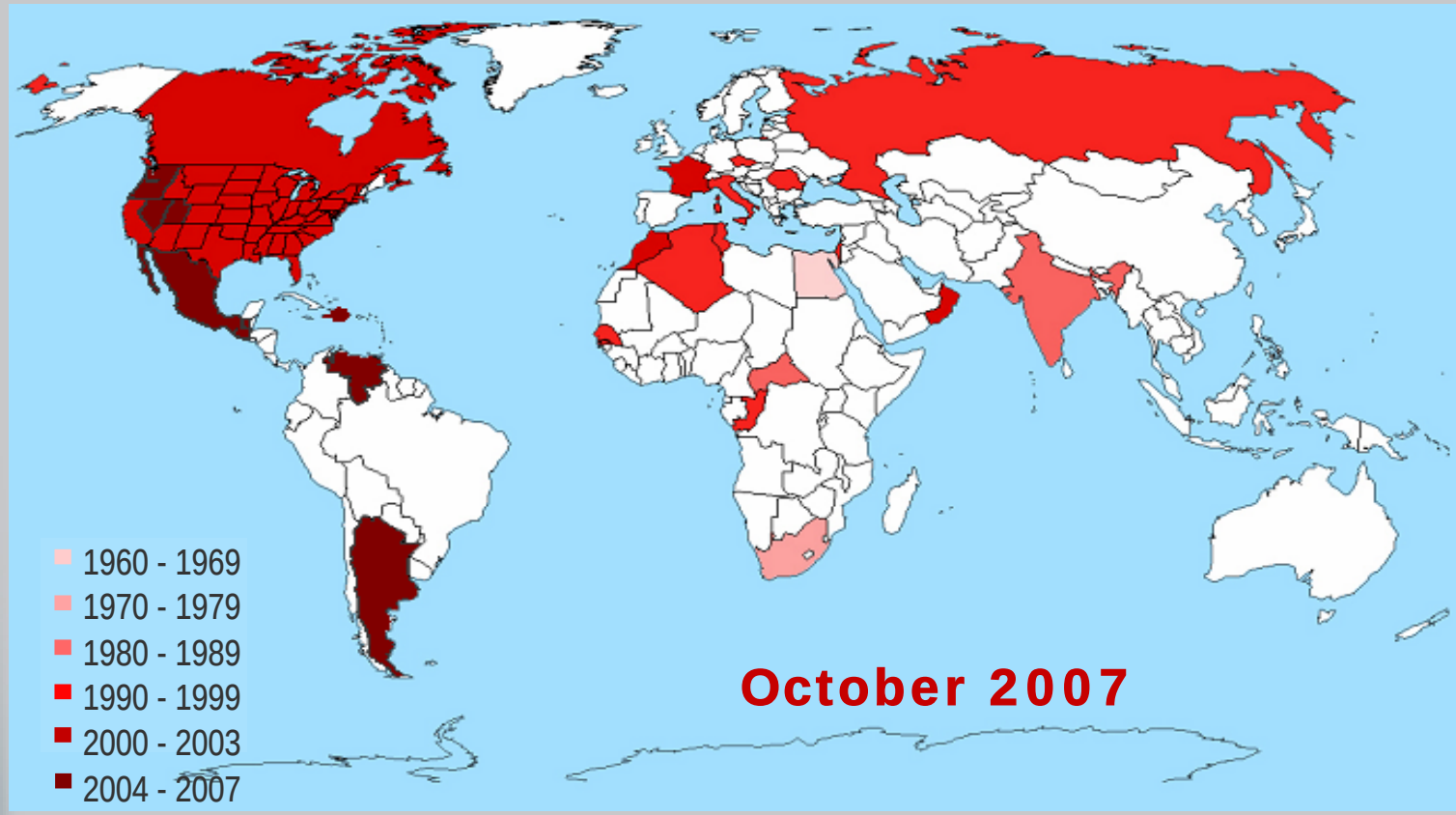
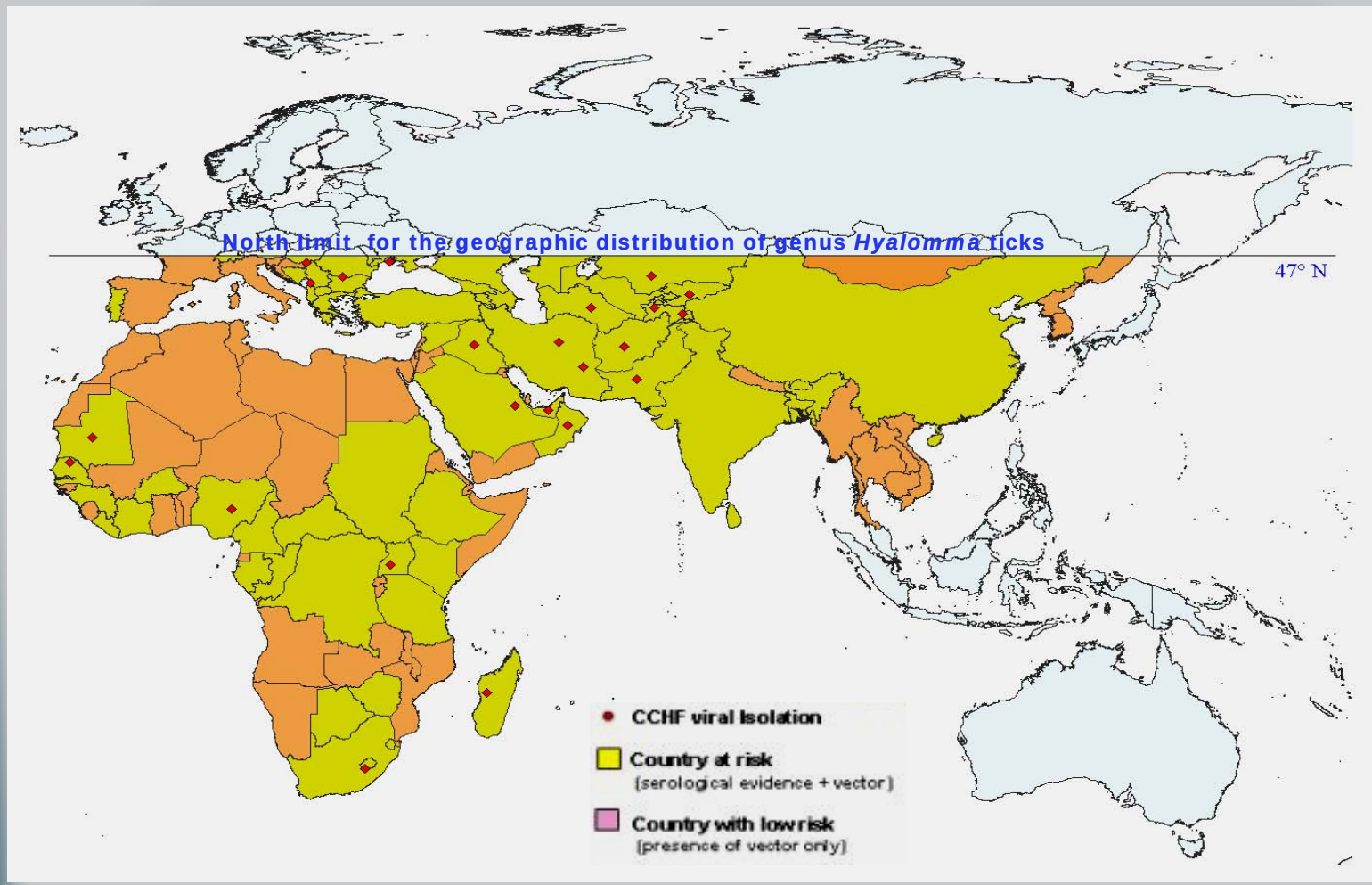


Emerging Vector Borne Diseases

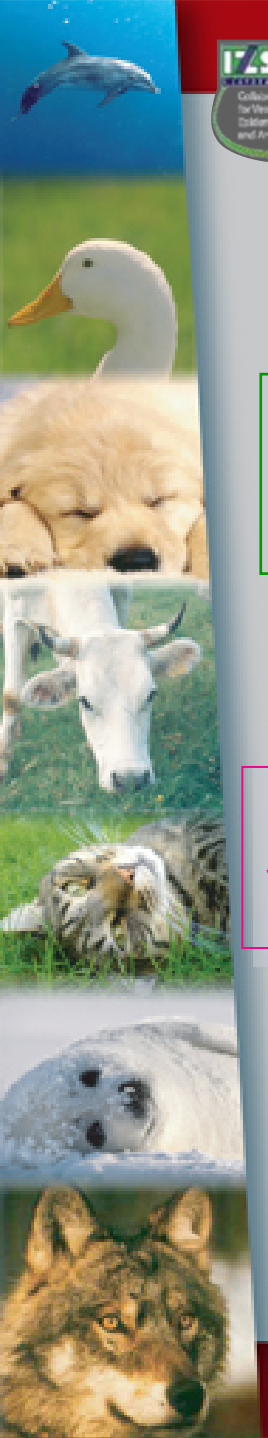
Crimean-Congo Haemorrhagic Fever in the World



Instability of Ecosystem

- Ecosystem instability due to climate change and concurrent stresses (e.g. land use changes, animal movements, species dislocation, increasing global travel) could influence genetics of pathogenic microbes through mutation and horizontal gene transfer
- New interactions among hosts, disease agents and their vectors could occur, fostering emergence of new infectious disease threats or re-emergence of just well known diseases

Where is *rapid* intervention most possible?



CLIMATE
Mean temperature
Precipitation
Humidity
Extreme weather events

ECOLOGY
Vegetation
Soil moisture
Species competition

TRANSMISSION BIOLOGY
Microbe replication/movement
Vector reproduction/movement
Microbe/vector evolution

HUMAN CONTROLLABLE FACTORS
Farming condition
Sanitation
Vector control
Economy
Animal trade
Agriculture system
Veterinary organization

DISEASE OUTCOME
Increasing risk
Emergence of new pathogens
Increasing rate of transmission
Spread to new areas

Trans-boundary animal diseases

- Due also to climate change, most of vector borne diseases have an increasing potential for very rapid spread irrespective of national borders (Trans-boundary Animal Diseases (TADs), causing serious socio-economic and public health consequences as several of them are zoonoses
- Trans-boundary animal vector borne diseases that were originally confined to tropical countries, are on the rise around the Globe including Europe
- Control and Surveillance of TAD's need an international approach

How can *rapid* intervention made possible for trans-boundary action?

SOCIAL FACTORS

Veterinary Organization

OIE

World Organization for Animal Health

- Improving diagnostic skills in developing countries for international approach to disease outbreaks (twinning OIE)
- Strengthening and good governance of veterinary services
- Evaluation through PVS tool
- Use of risk analysis in the evaluation of the disease management strategies and in the international trade policy

❖ **Surveillance**

- ✓ national surveillance systems
- ✓ surveillance networks
- ✓ early warning systems

Information for

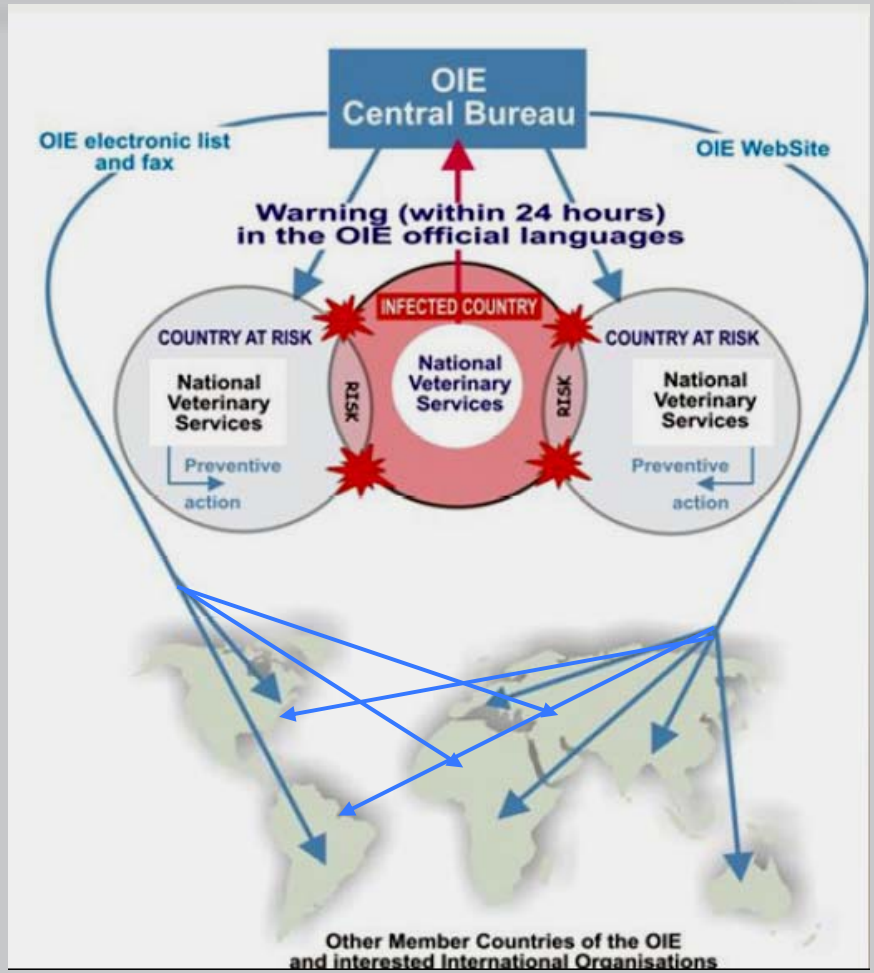
- ❖ Risk Analysis
- ❖ Control programs

Early Warning Systems

OIE - Early Warning System

World Organization for Animal Health (OIE) operates an early warning system to warn the International Community of exceptional epidemiological events in its Member Countries.

This alert system is aimed at the decision makers, enabling them to take any necessary protective measures as quickly as possible.

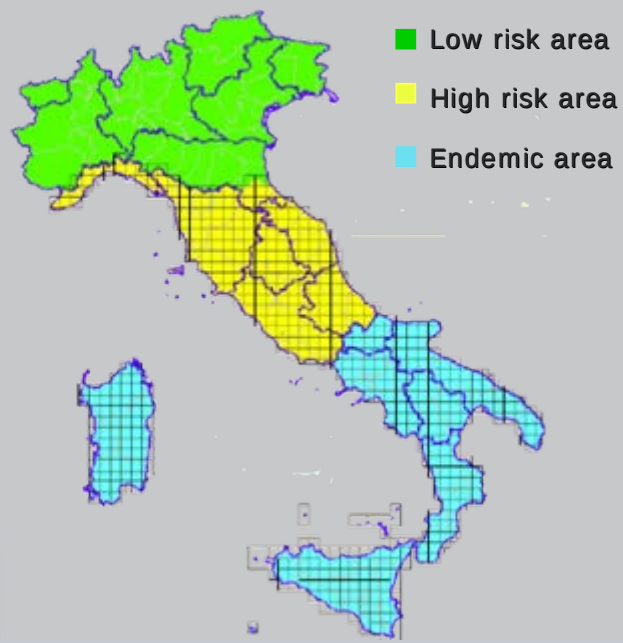


National Surveillance Systems

Italian BT Surveillance System

Serological Surveillance

- ✓ To verify the antibody coverage in vaccinated population
- ✓ To detect or exclude virus circulation



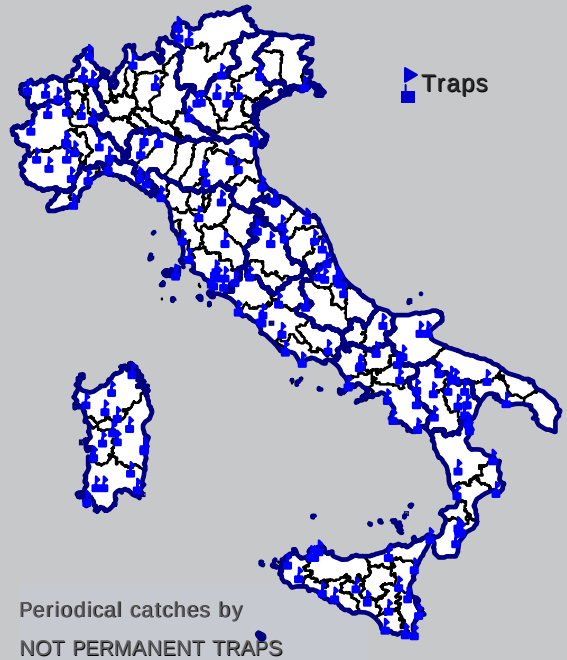
Classification of geographic area at different risk of introduction

A net of sentinel cattle periodically tested

Survey in vaccinated population to verify the level of antibody coverage

Entomological Surveillance

- ✓ To define the geographical distribution and dynamics of *C. imicola*
- ✓ To prepare risk maps
- ✓ To evaluate the epidemiological role of other species of *Culicoides*.



Periodical catches by

NOT PERMANENT TRAPS

PERMANENT TRAPS

National Surveillance Systems

West Nile Disease in Italy

- **Clinical cases**
  - **in 1998 in Padule di Fucecchio (Toscana)**
- **Surveillance system (2002)**
  - 15 areas considered at risk
  - Chickens bled every 15 days
  - Dead wild birds testing
  - Horse seasonal testing
  - Mosquitoes capture and PCR testing
- **Results**
  - Annual positive serology for WND (Emilia - Romagna - Lazio, Toscana)
  - Isolation of Usutu virus in Ravenna
  - Annual positive serology for Flavivirus (?) in the sub-Alpine environment

National Surveillance Systems

Italian BT Surveillance System

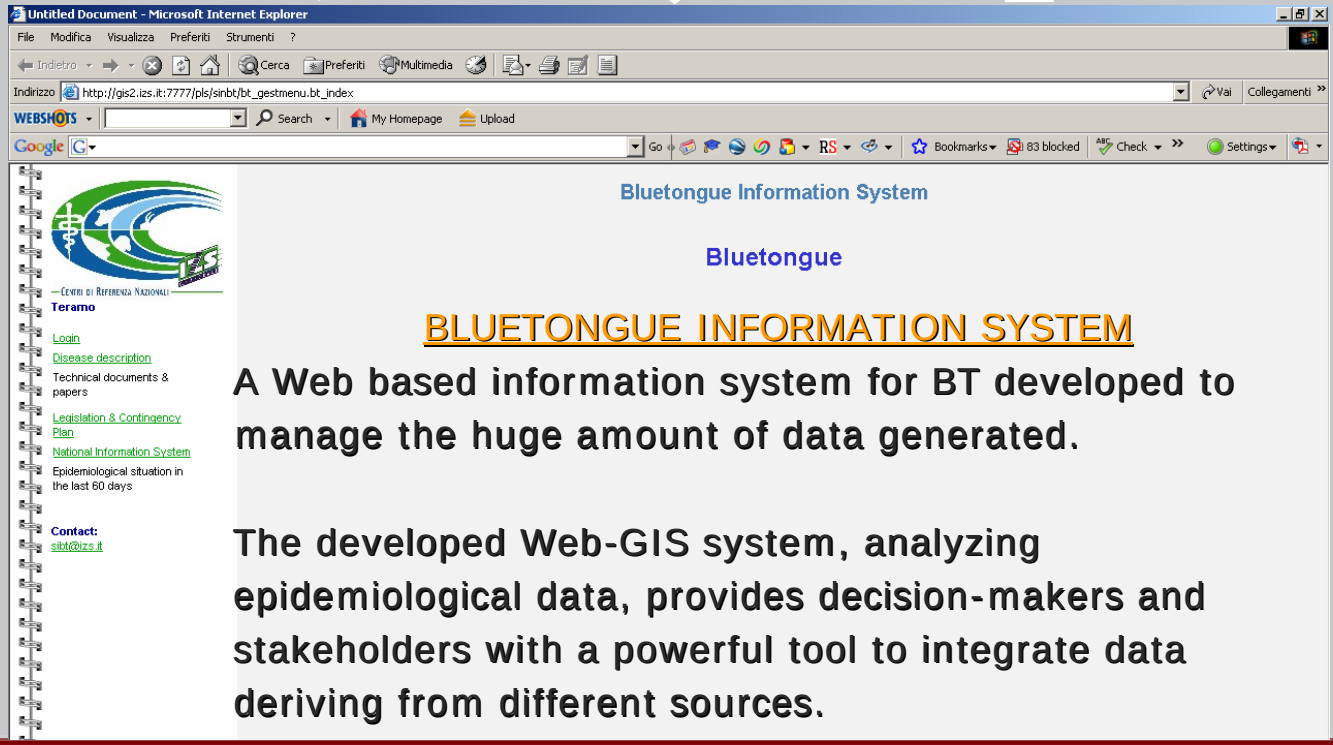
ENTOMOLOGICAL SURVEILLANCE

CLINICAL SURVEILLANCE

VACCINATION ACTIVITIES

SEROLOGICAL SURVEILLANCE (laboratory results)

OUTBREAK NOTIFICATIONS



A Web based information system for BT developed to manage the huge amount of data generated.

The developed Web-GIS system, analyzing epidemiological data, provides decision-makers and stakeholders with a powerful tool to integrate data deriving from different sources.

Surveillance networks

EAST-BTNET

East-BTNET and East-BTNET2 are two project for the implementation of a regional surveillance network for vector-borne diseases of veterinary (BT) and public health concern (WND, CCHF) in the Balkan Region.

They are promoted by the Italian Abruzzo Region and funded by the Italian Ministry of Foreign Affairs, and coordinated by the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G.Caporale'.

www.east-btnet.izs.it/index.htm

Surveillance networks

EU-BTNET

EU-BTNET

A web-based system to

- collect, store, and analyze Bluetongue surveillance data in the EU Member States developed
- ensure more effective and efficient exchanges of information between Member States and the Commission

www.eubtnet.izs.it/btnet/

Surveillance networks

OIE-BT Reference Laboratories Network

- A worldwide network of “OIE Bluetongue Reference Laboratories” has been instituted under the auspices of the World Organization for Animal Health (OIE)

- It is a web-based system where laboratory and epidemiological information, including BTV strain genetic characterization (sequences), are made available. It includes a GIS application to facilitate the representation of BTV circulation and vectors global distribution

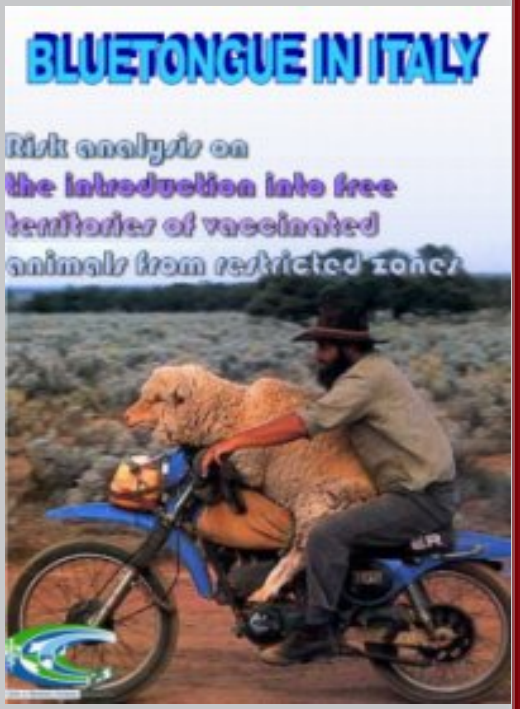
Risk Analysis

- In the case of arthropod-borne diseases, direct control measures are useless to limit both the losses and the spread of infection
- The choice of control strategies should be based on Risk Analysis using *FACTUAL* data generated by dedicated surveillance networks and scientific research

Risk Analysis

BT control strategy in Italy

- To limit the spread of Bluetongue, Italy has based the choice of control and prevention strategies on the basis of risk assessment based on data collected by the
  - ✓ Use of vaccination not only to limit the direct losses but also to reduce the virus circulation
  - ✓ Definition of infected zone, free zone and seasonal free zone and restriction of animal movements
- These strategies have been effective to control the BT spread all through Italian territory.



References

1. A. Giovannini; S. Mac Diarmid; P. Calistri; A. Conte; L. Savini; D. Nannini; S.Weber *(2004)* The Use of Risk Assessment to Decide the Control Strategy for Bluetongue in Italian Ruminant Populations *Risk Analysis* Vol.24, pp. 1737-1753 (17)
2. V.Caporale; A. Giovannini; C. Patta; P. Calistri;D. Nannini; U. Santucci *(2004)* Vaccination in the control strategy of bluetongue in Italy. *Development in Biologicals Vol.*119, pp.113-27.

Risk Analysis

Changes of BT control strategy at International and Community

- These results have contributed considerably to update the OIE Terrestrial Animal Health Code Standards and the European Union legislation with particular reference to vaccination strategies and animal movements from infected zones

Risk Analysis

Modeling of infectious diseases

- The use of new techniques in several disparate scientific disciplines (sequencing of microbial genes, satellite-based remote sensing of ecological conditions, Geographic Information System (GIS), new analytical techniques) has improved the ecosystem analysis capabilities of risk based predictive models

- Even so long–term predictions are still not easily feasible, climate forecasts and environmental observations could help to identify areas at risk of epidemics in the context of each situation.

Vaccination

- Vaccines availability
- Vaccines acceptance
- Vaccines authorization procedure for use

Conclusions

- Unpredictability of climate-disease linkages suggests reducing animal and human population vulnerability is the most prudent strategy
- Since understanding climate linkages to ecosystems and infectious diseases is not solid yet, development and application of surveillance systems - networks and early warning systems are the only feasible way to protect human and animal health and more in general ecosystem health
- Thus, strengthening & *networking* of veterinary organization at national and international level should have the highest priority

Conclusions

1. Risk analysis may help considerably in the management strategy
   - since understanding of climate linkages to ecosystems and infectious diseases is not solid yet
   - to reduce to acceptable level the *massive uncertainty* in which one is called to operate when facing “new” diseases risk analysis should be based on *specific surveillance data collected in the same environment in which the analysis is carried out*

Conclusions

2. Long–term predictions for climate changes and for the behavior of vector-borne diseases in a changing climate are still missing.
   Therefore a very humble attitude is required in every forecast about disease evolution (see what happened in north Europe with BTV8 and the fairly surprising reactions of many scientific and regulatory bodies)

3. Massive training and communication programs should be carried out for all stakeholders to face a challenge represented by diseases on a total different nature compared to the one currently present

Conclusions

4. Pragmatic - and courageous - attitudes should be adopted to imagine and implement new strategies
(i.e.: vaccination of bovine animals in southern Europe);

5. In front of new challenges experience and conservative thoughts might not be the optimal solution
(i.e.: allow unlimited wild viruses spread because vaccines are considered a potential danger)

6. Only cooperation at the international level can have a chance of controlling fast spreading trans-boundary diseases such as the vector-borne ones, successfully

Conclusions

7. Diagnostic tools and vaccines should be made available whenever possible in advance

8. Have Laws, regulations & POLICIES that permit a PROMPT RESPONSE


Thank you for your green-house gases!