

Vector-Borne Diseases: Impact of Climate Change on Vectors and Rodent Reservoirs
Berlin, 27 & 28 September 2007

The EDEN project

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The EDEN project (Emerging Diseases in a changing European eNvironment) is a Europe-wide research project involving 47 institutions in 24 countries. It includes six sub-projects investigating either one disease or a group of diseases. These are:

- Tick-borne Diseases,
- Rodent-borne Viruses (hanta, arena, cowpox),
- Leishmaniasis,
- West Nile Virus,
- Malaria,
- “African Platform” (new pathogens imported from Africa).

Most of the selected diseases are zoonoses involving both domestic and wild animals as hosts for vectors and /or reservoirs for pathogens. The EDEN project aims at quantifying the epidemiological role of wild and domestic animals in the amplification and the endemisation of selected emerging disease. Therefore, the specific composition and abundance of wild reservoir populations in contact with vector population must be studied. Spatial distribution, local displacements and seasonal dynamics of host populations must be compared to disease patterns. The risk of introducing new pathogens through active transport by wild (e.g. migrating birds) or domestic animals must also be investigated.

EDEN deals with emerging diseases linked to a changing environment. One must therefore identify environmental changes likely to favour (re-)emergence and spread of pathogens. This is achieved with predictive emergence and spread models. Such models, however, must be fully parameterized. A catalogue of ecosystems and environmental conditions likely to harbour “emerging disease hot-spots” is thus required. This will allow the development of a monitoring and early warning system. This should then contribute to decision support and policy making.

The environment is a combination of various components including hosts, reservoirs, vectors and pathogens. It is therefore necessary to consider each of these in an epidemiological model taking into account the interactions between them and their environment in terms of co-adaptation and selection. One ought to characterise the infectious agents most likely to (re-)emerge or spread in Europe, as well as the capacity of potential vectors, hosts and reservoirs to perpetuate or spread new disease cycles.

In order to forecast the future, one must examine current and expected future changes in the European environment likely to favour the emergence or re-emergence of vector-borne diseases. One may then develop statistical models and “risk maps” of vector and disease distribution and abundance or prevalence.

Such “risk maps” include the description of biotopes suitable for selected diseases, and imply monitoring and describing changes occurring there which are likely to affect transmission cycles by influencing vectors, hosts, or reservoirs.

The sub-project investigating tick-borne diseases (TBD) is precisely doing so on a most suitable ground. Indeed, it covers a wide geographic area, with partners in 14 different countries (Czech Republic, Estonia, Germany, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Spain, Switzerland and United Kingdom). Between them, these countries have experienced a large range of socio-economic, agricultural and environmental changes in the recent past (from the collapse of communism to the first signs of global warming).

A particular emphasis has been put on woodland habitats, which are thought to be optimal habitats for ticks. It was then realised that additional attention ought to be paid to reduction in agricultural land and reversion to shrub, a more suitable habitat for some rodent species. Indeed, rodents play a major role as hosts and reservoirs for ticks. This point has led to the creation of a joint database on rodent populations in collaboration with members of the rodent-borne viruses (ROBO) sub-project.

Tick-borne diseases have recently shown considerable increases in incidence, at least partly due to changes in human behaviour in relation to the environment. Tick-borne pathogens are already present in Europe. Some are widespread (e.g. Lyme disease) whereas others display a focal distribution (e.g. tick-borne encephalitis). This is thought to be due to varying interactions between pathogens, ticks, vertebrate hosts, and environmental conditions.

Therefore, the general objective of EDEN-TBD is to identify which socio-economical and environmental factors govern the currently observed upsurge of tick-borne diseases in Europe. In particular, one wishes to establish if local socio-political factors have altered human behaviour and agriculture, causing greater contact with tick-infested habitats during work, food harvest, and leisure activities. In addition, TBD incidence may be influenced by changes in public health activities (e.g. vaccination, improved diagnostic or reporting).

More precisely, the EDEN-TBD sub-project wishes:

- to explore and model the relationship between climate and landscape changes and incidence of tick-borne diseases,
- to describe the impact of environmental changes or human intervention on host availability (e.g. rodents and deer),
- to describe the impact of environmental changes or human intervention on abundance and seasonal dynamics of ticks,
- to establish the present relationship between tick abundance and seasonal dynamics, host availability and infection prevalence in tick populations with selected pathogens.

Pathogens selected for this study are: Tick-borne encephalitis virus, *Borrelia* spp, *Babesia* spp and *Anaplasma phagocytophilum*. These are diagnosed by molecular biology methods based on the amplification of nucleic acids by PCR. The University of Munich (LMU) is responsible for molecular diagnostic quality control.

Furthermore, LMU is in charge of collecting and analysing data for Germany. Ticks have been collected since 2006 on a monthly basis by dragging a 1m² white flag over soil and vegetation over a 100m² transect at various field sites in Bavaria. These field and laboratory data shall be integrated in a Pan-European data-bank and analysed in this wider framework. At Munich, these local data shall further be included as parameters in a computer model exploring the relationships between ticks, tick-borne pathogens, and reservoir hosts (e.g. rodents and deer) in Bavaria.

Source: This presentation is mainly based on Annex 1 of the EDEN integrated project.

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