Impact Objectives

- Investigate the biological, ecological and epidemiological components of vector-borne disease introduction, emergence and spread
- Create new tools to control these diseases

Tracking diseases

***Renaud Lancelot** is a CIRAD Epidemiologist and Coordinator of the multifaceted EDENext project. The following provides extracts from a number of videos, white papers and project newsletters highlighting the importance of understanding more about vector-borne diseases and their impact across Europe*

First, can you briefly introduce the focus for this project?

EDENext is investigating the biological, ecological and epidemiological components of vector-borne disease introduction, emergence and spread, and creating new tools to control them. The project focuses on the biology and control of vector-borne infection in Europe. This is a big project with 22 countries and 46 partners so we want to make sure that there will be benefits for the countries' farmers, medical services and so on, and that they will be able to build their own capacities for research and development.

Why is understanding more about vector-borne pathogens so important for Europe?

Since vector-borne diseases constitute a matter of public health it is of importance to establish a systematic approach for the understanding, analysis, assessment, communication and the management of risks associated with them. Risk assessment of vector-borne diseases, however, is hampered by the fact that many factors influence the infection probability in humans and animals, and the spread of a pathogen or its vectors to so far unaffected areas – factors such as climate change and changing human living habits, agricultural land use, individual human behaviour, travel and global trade. Moreover, the risk perception of the public has a high potential to prevent a risk and to influence the effectiveness of public health interventions.

What are some of the drivers for new vector-borne diseases?

The emergence of new diseases and pathogens or their re-emergence in areas previously considered to be free can be associated with ecological factors and changes in land use such as deforestation, urbanisation or irrigation measures that result in changes in the vector populations. Human factors also play a role, for example an increase in global travel and trade that favours the spread of vector species to previously unaffected areas. Climate changes, for their part, may allow not only the northward expansion of vector species but also virus persistence during winter.

How is the team structured to make the most of the diversity of scientific knowledge available?

The general structure of the project is made up of vertical vector groups, such as mosquitoes, sandflies and so on. These groups are crossed by horizontal teams who want to integrate that data, for example to develop models, to provide the same environmental data to all the vector groups, or to develop a public policy approach which is a very important part of the project. EDENext is seeking to make research more visible, comprehensible and applicable to the public and policy makers, embedding the research results from each vector group in the context of public health and vector-borne disease control in Europe.

The project aims at preventing diseases through a regional approach. How is this achieved?

The importance of vector-borne diseases to new and emerging diseases in Europe was demonstrated by the recent outbreak of West Nile virus infections in the area of Thessaloniki, Greece, and the spread of Crimean-Congo haemorrhagic fever virus (CCHFV) across Turkey, south-western countries of the former USSR, and the Balkans. There is a systematic approach for the analysis, assessment and governance of emerging health risks attributed to vector-borne diseases – a holistic approach developed by the International Risk Governance Council (IRGC) called the IRGC Risk Governance Framework. This framework is applied to CCHFV as an example to analyse the situation in Europe in order to provide operational guidance for the management of the risk caused by CCHFV.

Europe's toolbox for controlling vector-borne diseases

Through their efforts developing a science-based and data-driven suite of intervention and control management approaches, the EDENext project is successfully bridging the gap between European science, policy and implementation on ways to curb the spread of vector-borne disease

The World Health Organization states that every year more than a billion people are infected and more than a million die from infectious vector-borne diseases. With a dramatic increase in global access and rapid urbanisation over the last two decades, we have also seen the re-emergence or spreading to new parts of some of the most lethal vector-borne diseases. Increasingly, these are being seen within Europe's borders, including recent reports of the mosquito-borne dengue fever in Portugal and malaria in Greece.

To enable Europe to be better prepared for such diseases a project known as EDENext is looking at the biology and control of vector-borne diseases in the region. Renaud Lancelot, Coordinator of EDENext, says that vector-borne pathogens can have considerable impact on human and animal health and this is not going unnoticed: 'Newly emerging and increasing case numbers of endemic diseases in Europe have received considerable public attention in recent years'. With 46 partners in 22 international countries, this initiative has fostered a network of dedicated scientists researching the various multifaceted components of how different vector-borne diseases are introduced, emerge and, ultimately, spread.

EDENext is taking a collaborative approach to this challenge, which includes a wide diversity of scientists coming from all sorts of backgrounds with vastly different skills. This is considered to be essential for the success of the project because the issues being dealt with by the project are quite complex. Sophie Vanwambeke, a member of the EDENext Geograph Modelling group, says that the team are also trying to gain a clear understanding of the spatial patterns and dynamics of the transmission systems: 'Through their work the scientists are attempting to make sense of the complexity of the issue by using a lot of data, including environmental data, possibly extracted from remote sensing, and also by using a wide range of modelling approaches.'

Four main groups of arthropod vectors who are known to transmit vector-borne diseases in Europe have been chosen because of their importance in the public and animal health arena, including those with insufficient epidemiological knowledge or existing control measures available as well as diseases that have been identified as a priority for European public health agencies. These are ticks, mosquitoes, sandflies and biting midges. They are being investigated through different types of vector and disease quantitative modelling. Rodents, insectivores and rodent-borne diseases are also part of the study. The aim of EDENext is to better understand vector population dynamics of these arthropod and rodent vectors in order to design appropriate control strategies.

PREDICTIVE, QUANTITATIVE MODELS OF VECTOR-POPULATION DYNAMICS AND DISEASE SPREAD

To learn more about the way that vectors move and how the diseases are spread, scientists need to look at introduction, emergence and spread as three separate pieces of the puzzle. Only once each of these is clearly understood can appropriate intervention and control measures be developed. The vectors and pathogens or parasites need to be separated into individual groups as the routes to spread can be quite contrasting. Different model diseases are being used to enable the EDENext team to garner more information about the underlying mechanisms.

Biological mechanisms, such as basic biology of vector and disease reservoirs and natural cycles, are being examined, as well as ecological processes such as wind analysis and dispersion models. Some of these are being completed using field studies, for example ectoparasites borne by migrating birds. Field studies are then duplicated where there is considered to be a key threat, like vector-invasion front lines. A number of environmental factors, such as climate, and human factors, including land use, are also being researched. Highly specific assays have been used to enable the detection of pathogens and predictive simulation models have been developed to assess some different scenarios, which in turn allow the identification of control strategies.

Field studies across Europe have helped project partners determine the emergence of various pathogens carried by ticks, as well as bacteria and viruses encountered in rodents and insectivores. One key finding is the high level of mobility of exotic species to Western countries. Heidi Hauffee, Zoologist with the EDENext Tick Group explains: 'We don't know a lot about how these ticks move across geographical areas and between posts, so our work will provide parameters for disease risk models so we can learn more, and perhaps even collate how tick-borne diseases spread.' They have also found, by means of landscape genetics, that the landscape factor does have a key influence on transmission of diseases; seasonal patterns, however, are also a strong influence. Of course, other factors are still significant, for example they have found that it is possible to transmit a virus carried by mosquitoes vertically, from a mother to a baby during pregnancy or childbirth.

RIGOROUS SCENARIO TESTING IN A CONTROLLED ENVIRONMENT

A number of novel tools are being prepared by EDENext to address control of new vectors, including laboratory colonisation of vector species. Through such studies additional information on specific control methods can be studied in a controlled laboratory environment. Control strategies are investigated using simulation models, such as vaccination, which can be then be mapped against a number of anticipated scenarios, like environmental change. In this way, public health bodies are able to relatively easily assess how certain situations may progress over time and experiment with different management strategies within the laboratory environment. This information is then fed into decision-making tools that stakeholders are using to provide robust and rigorous testing. In addition, predictive models are helping to assess a number of indicators of planned control measures, for example the ratio of cost versus benefit.

EDENext also has a public health work package which is tasked with working closely and collaborating with human and veterinary public health stakeholders and public health agencies around the world. Their work revolves around understanding the public health messages that are needed and formulating the style and content of these to enable the stakeholders and agencies to reach out to the target groups under certain scenarios. This is helped by having representatives from various international organisations and public health agencies involved at different levels within EDENext, such as on the EDENext Advisory Board. Crimean-Congo haemorrhagic fever is one of the diseases selected for study under this part of the project. Lancelot uses the example of how the IRGC Risk Governance Framework can be applied in this case to help understand when and how control measures need to be used: 'This can be used by decision makers and general public health authorities in order to evaluate the situation regarding a specific pathogen and to decide if additional measures should be implemented.'

Given the global nature of this field and the large number of partners involved, there are a wide group of stakeholders, institutes and authorities who are very interested in the results from EDENext's investigations. Dissemination of their findings is an important step to controlling vector-borne diseases. The group communicate in a number of ways, including through preparation of papers in highly respected industry journals, presentations at conferences and workshops, and the publication of their newsletter, PUBLICise HEALTH. Ultimately, it is hoped that the team is able to build upon the strong scientific results and research networks established by EDENext on emerging, vector-borne diseases and prepare Europe for its fight against such diseases.

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Project Insights

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