ABSTRACT BOOK

6th Symposium of the Belgian Wildlife Disease Society

Climate Change & Wildlife Health

Friday 16 October 2015

Queen Astrid Military Hospital - Brussels

RESEARCH INSTITUTE NATURE AND FOREST

BWDS

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Climate Change & Wildlife Health

6th Symposium of the Belgian Wildlife Disease Society

16 October 2015, QAMH, Neder-Over-Heembeek

Organizing and Scientific Committee:

Paul Tavernier

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Introduction: "Climate Change & Wildlife Health"

Global warming and its implications became a major concern for the scientific community. Although still subject to controversy, an ever growing body of publications and conferences reflects the importance given to the subject. Worldwide knowledge about climate change is centralized, assessed and disseminated by the Intergovernmental Panel on Climate Change (IPPC), supported by the United Nations. The various and profound consequences attributed to climate change, merit high attention within the context of wildlife health. Therefore it was an evident choice, that could no longer wait to be addressed, as the central theme of this 6th BWDS Symposium. Our aim is to contribute to the awareness about climate change by bringing together a number of experts who will illustrate on the one hand the observations supporting the phenomenon itself, and on the other hand the implications for wildlife health and disease emergence from wildlife.

There are different mechanisms by which climate change can interact with wildlife health. The observed and expected impacts do not only include geophysical alterations, but also direct and indirect effects on living beings. Climate change creates opportunities for infectious microorganisms to adapt their survival strategies and to proliferate. The same is true for the vectors transmitting some of these microorganisms. Climate changes can also create distribution and structural shifts in wild animal populations, with effects on their behaviour and health.

The field of vector-transmitted infections is probably the best documented field in the context of climate change impact on wildlife health. Ticks spend the largest parts of their lives in the environment and much less time on their hosts, by which their activity depends largely on environmental variables, mainly temperature (ticks being ectothermic) and humidity. *Ixodes ricinus* needs a determined moderate temperature and humidity range: in optimal conditions its life cycle is shortened substantially. *I.ricinus* ticks appear to extend their distribution range with climate warming up (Lindgren et al.,2000). Decreased hibernation of Mediterranean ticks such as *Hyalomma scupense* (vector for *Theileria annulata*) with higher winter temperatures could result in longer periods of activity, and an extended distribution range (Bouattour ea, 2009). Nevertheless, still other factors play a role in the numbers and distribution of vectors, such as human behaviour, landscape modifications, and the abundance of feeding hosts for ticks: a good example for north-western Europe is the increase in roe deer populations, being the main feeding host for for *I. ricinus* ticks (Medlock et al,2013). Also introduction plays a role, as known for mosquitos such as *Aedes albopictus* (yet reported in Belgium), able to transmit Dengue and Chikungunya virus.

Apart from the impact on vectors, climate change also impacts directly on the viability of many pathogens. An increased humidity and temperature (as found in flooded areas) is expected to favour the growth of hygrophilic/mesophilic bacteria such as leptospira. This will be the case in those locations where wild animals congregate in search for water, while in areas that dry up, the survival of such bacteria is limited (AFFSA, 2005). Increasing temperature favours the production of botulinum toxins and the proliferation of toxic algae, if in combination with other suitable environmental factors. Impacts of climate change may be various or even opposite, depending on local factors, as mentioned for leptospira (cf above), or for the intermediate hosts of *Fasciola hepatica* (Fox et al.,2011)

Much less documented are the effects of climate change on the population dynamics of wild living animals, and through this, indirectly on disease emergence. For Hantavirus it has been shown that epidemics were related to the cyclic pattern of seed-fall, creating increased food availability for *Myodes glareolus*, the host of Puumala Hantavirus, but in recent years this cyclic pattern has changed to a more diffuse pattern of outbreaks (Heyman et al.,2012). In mountain species, a population expansion towards higher altitudes is observed in relation to climate warming, altering social and predator/prey interactions and possibly leading to species extinctions (Lurgi et al., 2012). In contrast to birds, roe deer appear to be unable to put forward the timing of their reproduction, in order to make it coincide with the climate induced changes in vegetation phenology (Plard et al.,2014), which may influence negatively their population structure. Important changes in population dynamics will probably bring changes in the epidemiology of infectious and other diseases, although hard data about these complex interactions are scarce.

Very quickly after the choice of the subject climate change as the theme for this Symposium, we realized that composing a program that can illustrate the various effects of climate change was not an easy task: scientific evidence is not equally available for each of the mechanisms by which climate change is expected to impact on wildlife health. Without aiming to be exhaustive, we are confident that the speakers presenting today will offer you a good overview of current knowledge on climate change and its effects on wildlife health. We hope this frame will allow you to make your own risk assessment, and to provide ideas about how each one of us could contribute towards awareness and step by step management of the phenomenon climate change.

The BWDS board "warmly" wishes you an instructive and pleasant Symposium day.

Paul Tavernier

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Programme

Moderators: Tim Adriaens (INBO) & V. Vandenberge (CODA/CERVA)

08:30 - 09:30 Registration and coffee

09:30 - 09:40 Welcome (P. Heyman, president BWDS)

09:40 - 10:05 Global climate change: facts and myths (D. Verschuren, BE)

10:05 - 10:30 Emerging parasites in the North (A. Oksanen, FI)

10:30 - 10:45 The Asian tiger mosquito yearly reappearing in Belgium: time to act against before climate change facilitates its permanent establishment! (I. Deblauwe, BE)

10:45 - 11:15 Coffee Break

11:15 - 11:40 Harmful algal blooms in lakes and ponds (W. Vyverman, BE)

11:40 - 12:05 Impact on mosquito vectors of diseases (D. Bicout, FR)

12:05 - 12:20 Wild raccoon dogs in the Netherlands: public health problem or not? (M. Maas, NL)

12:20 - 13:30 Lunch/Poster session (on site)

13:30 - 13:45 TBEV seroprevalence and test accuracy in Flemish wild boar (S. Roelandt, BE)

13:45 - 14:10 Belgium under global warming (R. Hamdi, BE)

14:10 - 14:35 (Sub)tropical consequences of climate change (M. Niedrig, DE)

14:35 - 14:50 Two divergent hantaviruses are simultaneously circulating in the European mole in Belgium (L. Laenen, BE)

14:50 - 15:20 Coffee Break

15:20 - 15:45 Harmful algal blooms in coastal waters (K. Sabbe, BE)

15:45 - 16:10 Impact on diseases in arctic wildlife (J. Godfroid, NO)

16.10 - 16.25 Increase in tick population abundance: host related factors and relation to climate change (V. Obsomer, BE)

16:25 Closing remarks, Poster awards & Coffee

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The Research Institute for Nature and Forest (INBO) is the Flemish research and knowledge centre for nature and its sustainable management and use. INBO conducts research and supplies knowledge to all those who prepare or make the policies or are interested in them.

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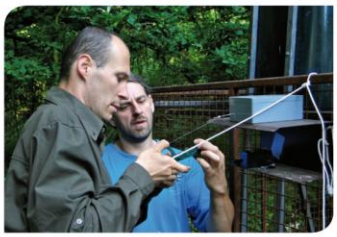
As a leading scientific institute, INBO works for the Flemish government primarily, but also supplies information for international reporting and deals with questions from local authorities.
In addition, INBO supports organisations for nature management, forestry, agriculture, hunting and fisheries.
INBO is a member of national and European research networks. It makes its findings available to the general public.

INBO employs some 250 staff, mainly researchers and technicians.
Besides its Brussels head office, INBO has branches in Geraardsbergen, Groenendaal and Linkebeek.



RESEARCH INSTITUTE
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In Defence of the Environment

What is our point of view?

Defence undertakes to prevent and limit the impact of its activity and installations on nature, while continuously improving its environmental performance.

For Defence, achieving this policy involves

- implementing an environmental management system;
- applying the relevant laws and regulations;
- systematically inserting environmental components at the planning stage in programmes and directives, including operations and exercises;
- contributing to the preservation and restoration of biodiversity on its grounds as well as developing a green spaces management focused on minimizing the use of herbicides.

This environmental policy rests on four pillars

- an environmental structure with environmental experts, coordinators and consultants;
- an internal environmental permitting system based on existing systems at regional level;
- continuous training and awareness-raising of personnel;
- communication and reporting.

Who are we?

The environment is everyone's concern at Defence. In 2005 an environmental structure was created in order to get environmental management on track and ensure compliance with the applicable legislation.

The environmental consultants belong to the units and receive a short internal training at Defence. In addition to their primary function, they keep their command advised of environmental issues and environmental policy with regard to activities both inside and outside the barracks, as well as abroad.

For technical advice, they turn to the environmental coordinators. These have been trained in an external institute providing accredited training in the field of environmental coordination. They work full time on environmental issues, and are geographically dispersed in environmental technical units across the country. Some of them are attached to the Defence staff in order to prepare and develop its environmental policy.

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What actions do we take?

Mobility

Based on a preliminary examination, Defence has reduced its vehicle fleet to cut CO_2 emissions. Older, more polluting vehicles are being gradually replaced by "cleaner" ones and transport facilities are used to best advantage.

Soil

Defence has developed a soil management policy to prevent further pollution. Response equipment has also been bought and distributed to enable personnel to react quickly to incidents.
Any existing and well known pollution problem is consistently treated according to the urgency of the matter and the available budgetary means.

Biodiversity

The grounds of Defence amount to acres of fantastic natural areas. Being mostly closed to the public, the grounds are home to many rare species of flora and fauna. After the integration of its parade grounds into the European Natura 2000 network, Defence has committed to preserving the flora, fauna and existing habitats. To that end, it has concluded agreements with regional civilian bodies, namely the Forest and Nature Agency (Agentschap voor Natuur en Bos) and the Directorate-General for Agriculture, Natural Resources and the Environment (Direction générale de l'agriculture, des ressources naturelles et de l'environnement). It has also cooperated in the application of the Walloon river contract and the protection of the North Sea in Flanders.

Energy

Defence wants to reduce its energy consumption (electricity and heating) in a structural way. A study has been made of the use of existing buildings and where possible, buildings with low occupancy rates have been evacuated in order to turn off the heating. Other economy-saving measures have been put into practice: better insulation, phasing out energy-guzzling lighting... True to its commitment to use renewable or sustainable energies, Defence has signed green energy supply contracts and both renovated and new buildings are equipped with solar panels or a cogeneration system.

Waste

Defence puts into practice European, national and regional policies with regard to waste sorting. When elaborating its policy or purchasing new products, Defence also takes into consideration waste generation (including packaging).

Water

Defence is determined to reduce its water consumption by increasing personnel awareness and taking water efficiency measures for the renovation or construction of buildings. In order to comply with the legislation on wastewater treatment, Defence avoids discharging wastewater directly into surface waters or on the land by providing for a separated drainage system (wastewater and rainwater).

Noise

In spite of its frequent use of heavy military vehicles and planes, Defence is trying to control and limit its noise pollution. The important thing here is to maintain good relations with local authorities and inhabitants. Municipalities are kept informed of exercises, and night flights do not take place during exam time. Infrastructure works (e.g. setting up acoustic barriers) are carried out where necessary.

Air

Heating, paint booths, fighting or ordinary vehicles, planes, ships... A wide range of Defence installations and activities release emissions into the air. Defence works towards controlling these emissions according to the standards set by law. All appropriate measurements and tests are carried out and where possible, interventions are made to prevent or reduce emissions (e.g. fitting vehicles with particulate filters).

Awareness-raising, training and information

Looking after the environment is everyone's concern at Defence. Special attention is given to awareness-raising and training of personnel. All trainings received by servicemen during their career include an environmental component. Defence also launches a poster campaign every year to increase personnel awareness regarding the rational use of energy, the reduction of soil pollution and water consumption, waste sorting...

Care for the environment during operations and exercises

Having been a routine part of exercises for many years, environmental issues affect operations too. International bodies like the UN, NATO and the EU have a specific environment policy and require armed forces to take appropriate measures concerning environmental management and protection, especially during the stabilization phase of an operation.
Taking care of the environment also offers operational advantages like winning the hearts and minds of a local population.

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Oral presentations

Global climate change: facts and myths

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From many lines of evidence it is now more certain than ever that human activity is changing Earth's climate. The atmosphere and oceans are warming, sea level is rising, Arctic sea ice is retreating, and many functional components of the biosphere, from individual organisms to entire ecosystems, are experiencing climate-related change. The recent demonstration that climate is also changing in Belgium brings the problem closer to home, and may serve as a final wake-up call for the general public that global warming is here to stay and will affect us all. Yet we should also be aware that our little neighbourhood of maritime north-western Europe is among the few world regions which will likely experience only modest negative impacts: shrinking beaches, wet winters (more rain than snow) and a handful of summer heat waves, but also generally nicer summer weather and no water scarcity worth mentioning. This is ironic, considering the dominant historical contribution of industrialized Western Europe to the global climate change experienced today. The greatest burden of climate change will rest on the poor and vulnerable populations of developing countries, whose entire livelihood depends on agricultural success in regions already suffering water scarcity and a general lack of arable land; forcing many to live in coastal areas now threatened by sea-level rise. In this regard, how we deal with climate change is a global-scale experiment in social justice.

While the scientific evidence for global warming is now undisputable, due to the complexity of the climate system and its myriad interactions with the biosphere, not every single detail of the science is totally settled; scientific evidence continues to be gathered around the world, and assumptions about climate change are continually being tested or approached from a different perspective. When lacking proper context, announcements of new findings in the media often appear contradictory to previous understanding; and unbalanced analysis of the available data has given rise to a diverse collection of climate 'myths' which play in the cards of the numerically dwindling but increasingly vocal climate sceptics. In this presentation I will briefly present the scientific case for anthropogenic global warming, including its physical basis and long-term perspective in relation to natural climate variability. In the process I try to differentiate between the facts of global warming and those various myths, hoping to help eradicate some.

Emerging parasites in the North

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Climate change has no mercy on the North; warming is most pronounced in the Arctic. Parasites are causes of many tropical diseases, but the North is not often seen as a parasite habitat. During previous climate changes, when the biogeographic situation was evolving fast, some typically tropical parasites started to parasitize the reindeer, the very symbol of the Arctic. *Linguatula arctica* is a pentastomid parasite of reindeer, but its closest relative known is the hyena parasite *L. multiannulata*. Another typically tropical reindeer parasite is *Besnoitia tarandi*. Perhaps both parasites switched host during the Ice Age, when reindeer were eaten by e.g. cave lions, hyenas and Neanderthal people.

The currently ongoing climate change has obviously already caused the emergence of filarioid nematodes in the North. *Setaria tundra*, a parasite of roe deer, probably invaded northern Fennoscandia with its principal host. *Setaria* infection was associated with severe peritonitis in Scandinavian reindeer in 1973. The latest big epizootic in reindeer started in 2003 in the southern part of the Finnish reindeer herding area. The known outbreaks were statistically associated with two consecutive warm summers. Again in 2014, *S. tundra* caused peritonitis in reindeer calves.

Two zoonotic canine *Dirofilaria species*, *D. immitis* and *D. repens*, are currently northward from the Mediterranean region. The nematode larva needs a threshold temperature to develop in vectors. The subcutaneous parasite D. repens has been found in all the three Baltic States. With warming, the threshold is expected to move further northward. Recently, an obviously autochthonous human infection was diagnosed in Finland.

Climate change is inevitable, and it is the responsibility of scientists to study its effects. It is exciting and challenging to try to anticipate the future development, as nature has an unlimited number of feedback mechanisms, many of which will surprise the open-minded humble researcher.

The Asian tiger mosquito yearly reappearing in Belgium: time to act against before climate change facilitates its permanent establishment!

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In 2013, 2014 and 2015 routine surveillance for invasive mosquito species was implemented in Belgium at 13 potential points of entry. Following the introduction of *Aedes (Stegomia) albopictus* (Skuse, 1895) into Belgium via a used tyre import company (Vrasene, Province of East Flanders) in July 2013 one female and 17 larvae were collected outdoors during a period of intensive surveillance in summer and autumn 2013, but no control measures were implemented. Although climatic conditions were suitable during the winter of 2013-2014, this reproducing population did not overwinter. Lack of genetic variation, incomplete diapause adaptation and egg desiccation due to long dry periods during diapause, or competition with endemic species are possible reasons.

More studies on the diapause/longevity of *Ae. albopictus* eggs in northern temperate climatic conditions and on the competition with endemic species in western and central Europe are warranted to assess the potential for this invasive mosquito to overwinter.

Furthermore, following the detection of four *Ae. albopictus* larvae in a shipment of lucky bamboo at the port of Antwerp in August 2014, one female, one male, 11 pupae and six larvae were collected at the destined lucky bamboo company (Lochristi, Province of East Flanders) in autumn 2014. In summer 2015, at the same lucky bamboo company, another five male, five female, six larvae and 32 eggs were collected. In these cases, immediate control measures were implemented at the nursery. It is not clear if the collections in 2015 originate from overwintering eggs or a new importation.

Because of increasing threats, more suitable climatic conditions and the absence of an invasive mosquito species control policy in Belgium, the need for a permanent and structured vector surveillance and control plan has never been so high.

Climate change and harmful algal blooms in inland waters – an ever increasing problem?

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There is increasing evidence that interactions between climate warming and eutrophication are enhancing the frequency and magnitude of harmful algal blooms globally and lead to the expansion of the geographic range of some toxic taxa.

The toxins produced by bloom-forming cyanobacteria in particular present a considerable risk to drinking water, result in substantial economic costs and negatively affect aquatic food webs and ecosystem functioning.

An overview of the nature of these blooms and the processes potentially underlying them, their impacts on public health, economy and the ecological well-being of aquatic ecosystems will be presented, together with potential ways to predict, prevent and combat these blooms.

Impact on mosquito vectors of diseases

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The undergoing global climate change we are experiencing is likely to result in serious impacts on spatial distributions of living beings and vectors of arthropod-borne diseases, as well as the associated phenology. Areas actually yet free of vector-borne diseases may become affected in future as a consequence of climate change. Within such a context, we conducted a study focusing onto two connected wetland areas in France: Camargue, South of France between the Rhone delta and the Mediterranean Sea, where the West Nile virus (WNV) is found frequently circulating, and the Dombes, 300 km northeast of the Camargue, a mosaic of nearly 1,400 ponds located in the northeast of Lyon, an area still free of WNV. Recent studies showed that the mosquito *Culex modestus* was the main vector of WNV in the Camargue and that its population was growing and spreading in the Dombes. Thus, the question we asked was: how the probability of presence of *Cx. modestus*, and therefore the risk of WNV circulation, would evolve in these areas in response to the climate change?

Our aim is to assess the potential for these areas of presenting favourable conditions for the reproduction, development and persistence of *Cx. modestus*, a main mosquito vector of WNV in Camargue. To this end, data on climate from the model ARPEGE-Climat (111 km resolution, IPCC scenario B2) downscaled to 15 km were used for characterizing the climate evolution in studied areas, and entomo-climatic indices were calculated for analyzing the relationship between climate conditions and *Cx. modestus* population.

As a result, we found for three time periods, past (1951–1980), present (1991–2020) and future (2031–2060), that there is an important rise in the mean temperature (+2.54°C in Dombes and + 2.07°C in Camargue between past and future) as well as a change in the yearly rainfall distributions that would result in a significant increase in the occurrences of suitable periods for *Cx. modestus* in the two studied areas.

Wild raccoon dogs in the Netherlands: public health problem or not?

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After its introduction to the former Soviet Union in the first half of the 20th century, the raccoon dog spread rapidly through Europe. Since 2001, the raccoon dog is sporadically sighted in the Netherlands and in 2012 the first reproduction of wild raccoon dogs was observed. It is expected that the raccoon dog will spread further across the country. The introduction of the raccoon dog is associated with the risk of introduction and spread of zoonotic pathogens. Therefore, the public health risk of the raccoon dog for the Netherlands was assessed.

First, a qualitative risk assessment based on literature was performed on the zoonotic pathogens for which the raccoon dog is considered a suitable reservoir. The assessment showed that, in the Netherlands, *Echinococcus multilocularis, Trichinella spp.* and *Francisella tularensis* pose the greatest public health risk. The high dispersion rate of raccoon dogs was an important factor in their relationship with these pathogens.

A subsequent study aimed to detect *E. multilocularis* and *Trichinella spp*. in raccoon dogs in the Netherlands. On nine raccoon dogs, mainly road kill, post mortal research was performed. All raccoon dogs tested negative for *E. multilocularis* by the sedimentation and counting technique, but one tested repeatedly positive in the PCR for *E. multilocularis*, though only with a low signal, suggesting a light infection. The positive raccoon dog was collected in the province of Flevoland, where no positive foxes were found in a previous study. One raccoon dog tested positive for *Trichinella spiralis* by the digestion of the forelimb musculature and the tongue. This raccoon dog was collected in Drenthe.

Since raccoon dogs can spread *E. multilocularis* and *Trichinella spp*. in the wildlife cycle, the results of this survey ask for a larger surveillance or a more long-term monitoring of these zoonotic pathogens in raccoon dogs in the Netherlands.

TBEV seroprevalence and test accuracy in Flemish wild boar

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The risk of TBEV-introduction into Belgium remains high and the presence of seroconverted wildlife and domestic animals in Belgium has already been demonstrated in multiple studies. In the frame of a Flemish wildlife surveillance in 2013, a serological screening was performed on sera from Flemish wild boar (n=238) in order to detect TBEV-specific antibodies. These sera were taken in 2013 throughout the whole Flemish wild boar population range. All samples were subjected to gold standard TBEV seroneutralisation (SNT). Seven wild boar were seropositive and showed moderate to high SNT-titers - three had borderline results. Seroprevalence was estimated around 4.20% (95%CI: 1.65-6.75%). Other Flaviviridae (Classical Swine Fever, West Nile Fever, Louping Ill) were ruled out and thirteen available tonsils tested negative in TBEV RT-PCR.

The test characteristics of a commercially available TBEV-ELISA were assessed against the gold standard results. Using the manufacturer's cut-offs and an alternately positive/negative interpretation of SNT-borderline results, the IgG protocol of this ELISA showed low diagnostic sensitivity and good diagnostic specificity (DSe: 40-57% and DSp: 91-92%). ELISA agreement with the SNT was judged "slight to fair". ROC-analysis showed that for early detection screening purposes (with SNT follow-up), the ELISA cut-off might be placed as low as low as 35 Vienna-units: this would result in improved DSe (70-71%) at the cost of DSp (64.04-69.74%).

This study showed the presence of TBEV-specific antibodies in wild boar and potential TBEV-foci in Flanders. Ongoing wild boar surveillance could serve as sentinel warning system for public/human health prevention. Additional active surveillance and direct testing are now recommended to attempt virus detection and to further determine the characteristics of endemic foci, while continued passive medical and veterinary surveillance is indicated to monitor the potential risk for Belgian public health.

Belgium under global warming

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Atmospheric General Circulation Models (GCM) currently have a spatial resolution in the range of 200 to 500 km. At this scale, only general trends of climate variables over a continent can be represented, but not at the scale of a country like Belgium. Regional Climate Models (RCM) with slightly higher spatial resolution are also used and simulation experiments over Europe are already available to the scientific community, but these models are still unable to represent small-scale meteorological systems which may strongly impact human and natural systems by providing for instance heavy precipitations.

Hence, the production of country-scale high-resolution (less than 10 km) climate projections is the necessary preliminary step before impacts of future climate change on human societies and ecosystems can be evaluated and adaptation measures formulated.

The atmospheric model used for the downscaling is ALARO, which is a new version of the hydrostatic limited area ALADIN model with a revised and modular structure of the physical parameterization. A new approach was proposed, with an integrated sequential treatment of resolved condensation, deep convection, and microphysics together with the use of prognostic variables. This new parameterization allows for the production of consistent and realistic results at resolutions ranging from few tens of kilometers down to less than 4 km (the so-called the gray zone).

This new version is used operationally by the meteorological services of the Royal Meteorological Institute (RMI) of Belgium to make short-range high-resolution weather forecasts. Recently, this new version was tested in a regional climate reanalysis-driven simulation over Belgium. The objective of this presentation is to explore the ability of high-resolution dynamical downscaling with the finest grid size of 4 km and sophisticated model physics scheme to examine the future climate of Belgium under global climate change.

(Sub)tropical consequences of climate change

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There is no doubt that the climate change will have remarkable impact on the health situation for animals and humans in the coming years. Heatwaves and other extreme weather conditions are already affecting veterinary and human health and according to the climate forecast we will experience more in the future.

Although direct consequences of these events like heatwaves, flooding, and ozone increase are somehow predictable other subsequent effects as changing conditions for vector borne diseases (VBD) or zoonotic diseases are still unpredictable and a matter of discussion. The presence and spreading of several VBD like West Nile (WN), Chikungunya (CHIK), Tick borne Encephalitis (TBE), Hanta (HTN), Blue Tongue (BT), Schmallenberg (SBV) or zoonotic diseases like influenza are considerably linked to climate conditions.

However, since we lack the understanding of the complex interaction of all parameters involved a prediction of upcoming events is impossible. Knowing the requirements that allow an infection cycle to happen is important information. Knowing the requirements to keep such cycle for a longer period is essential for predicting future outbreaks. Beside the climate conditions there are several other parameters which contribute to the re-emergence of known, uncommon or new pathogens like the globalization associated with the tremendous increase of exchange of goods, animal's products and human travelling. These strong interrelations revive the idea of one health as vital connection of animal, human and environmental living conditions sharing and exchanging several pathogens of zoonotic origin.

To improve the knowledge of emerging pathogens which might become a threat for Europe if climate conditions keep changing we have to look carefully to those countries and regions where already those climate conditions exist which are expected to become reality here in 10-20 years from now. Since the analyses of the complex transmission cycles need long-lasting studies the remaining time should be used to get better prepared for the future events. The presentation will try to evaluate consequences of climate change for wildlife diseases.

Two divergent hantaviruses are simultaneously circulating in the European mole in Belgium

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Hantaviruses are the causative agents of hemorrhagic disease in humans and are transmitted by aerosolized excreta of rodents and insectivores. Although all currently confirmed pathogenic species have animals of the order Rodentia as their reservoir, ancestral hantaviruses appear to have been harbored by predecessors of shrews and moles or bats.

Since 2007, multiple new hantaviruses have been detected in insectivores, uncovering a complex evolutionary history with cross-species transmission events playing an important role. Hampered by a paucity of virus isolates and complete genome sequence data, research on mole-, shrew- and bat-borne hantaviruses remains limited.

In this study, we investigated the presence of Nova virus, a recently discovered mole-borne hantavirus, in the European mole in Belgium. Kidney tissue of 534 moles, captured at various locations in Belgium, was screened for the presence of hantavirus RNA. This resulted in a relatively high positivity rate of 51%. Positive samples covered the entire sampling area, indicating a widespread dispersion. An extensive phylogeographic analysis of 105 full S sequences demonstrated a distinct geographical clustering. Barriers in the form of rivers and canals appear to ensure a separate spatial evolution.

In 6 out of 534 samples a new hantavirus, named Bruges virus, was detected. Phylogenetic analysis of partial S, M and L segments revealed a highly divergent hantavirus with a different ancestry than Nova virus. In three of the samples a dual infection with Nova virus and Bruges virus was observed without any proof of recombination or reassortment.

These results question the previous hypothesis of virus-host specificity and raise attention to the possibility of reassortment events between these segmented viruses. Whether this newfound hantavirus represents a host-switching or a host-sharing event remains to be elucidated.

Harmful algal blooms in coastal waters

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Harmful algae blooms (HABs) are an increasing threat to coastal food webs, aquaculture and human health worldwide, with often considerable economic repercussions. Despite intensive research during the last decades, many questions remain about what factors cause HABs, and why there are apparently increasing on a global scale.

In this presentation, we present the main algal groups responsible for these blooms, the toxins involved and how they are monitored. We will discuss their ecological and economic impact on coastal ecosystems, and present an overview of the state-of-the-art of our knowledge about the factors regulating these blooms. Special attention will be paid to the occurrence of HABs in the North Sea, and along the Belgian coast in particular.

Finally, we will elaborate on the possible impact of global change phenomena (e.g. eutrophication, climate warming, ocean acidification) on HAB occurrence and intensity.

Impact on diseases in artic wildlife

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In the future, diseases will increase whether it gets drier or wetter, but just some diseases in some places. Other diseases, in other places, will likely decline. To assume otherwise is to suggest that infectious diseases are so poorly adapted to current conditions that any change will favor them. Some of the most important questions to understanding infectious disease dynamics and be able to predict changes are: how much is climate change likely to shift the suitability for infectious diseases, and how does this vary among diseases? Answering these questions is of critical importance in the Arctic where warming is occurring disproportionately. More, the Arctic consists of a vast ocean with a seasonally varying ice cover, surrounded by treeless permafrost. What does the future hold for the world' largest ecosystem – the oceans (and thus the Arctic) that have accumulated 22 times as much heat, as has the atmosphere since 1957?

These questions have been partly addressed for temperature sensitive infectious diseases (i.e. vector borne diseases like malaria) in endotherms (mainly mammals and birds), and for infectious diseases in ectotherms, i.e., organism in which internal physiological sources of heat are of relatively small or quite negligible importance in controlling body temperature.

Our research group is studying *Brucella ceti* and *Brucella pinnipedialis*, deciphering the dynamics of infection in marine mammals in their natural environment, in laboratory animal (mouse) and cell (macrophages) models, and recently in fish. The effects of climate change and other anthropogenic drivers like wildlife habitat encroachment and reduction, and pollution, will be illustrated by changes in dynamics of marine *Brucella* infections in polar bears (*Ursus maritimus*) and hooded seals (*Cystophora cristata*), two flagship species in the Arctic, and in Atlantic cod (*Gadus morhua*), one of the most economical important species for fisheries in the North Atlantic.

Increase in tick population abundance: host related factors and relation to climate change

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During the last decade several authors highlight a strong increase in population abundance and extension of distribution range in Europe for the tick species *Ixodes ricinus*. Because this species is an efficient vector for many diseases detrimental to humans, domestic animals and the wildlife, it is of upmost importance to identify the underlying factors which could explain those variations in population.

While many factors are cited in the literature, proper data on tick population in the past are generally lacking thus impeding the validation of most hypotheses. Climate change is one of them but host species related factors seem to play an important role. In this context, a public survey (www.tekentiques.net) has been launched in Belgium, France, Switzerland, Spain, The United Kingdom and Romania.

Questions include information about places of tick abundance, date of noticed change in abundance and potential reason for change. The analysis based on more than 4000 answers allow to highlight the following facts:

1) once tick have become abundant in a given area, they keep a high level of abundance in that place later

2) the increase in abundance occurred at different time according to location

3) In some places ticks were already abundant in 1945 while in other places the increase started later, or even last year

4) Current spatial pattern of tick population increase are not continuous

A review of factors cited in the literature or collected during the survey is presented and each factor is discussed under the highlight of the analysis results.

Poster presentations

A retrospective study of causes of mortality in free ranging red deer (*Cervus elaphus*) found dead or shot for sanitary reasons in Southern Belgium 2010-2014 (n=190).

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The objective of this retrospective study was to report the results of 190 red deer pathologic examinations. One hundred and nine of them were found dead whereas the others (n= 81) were shot for sanitary reasons and all of them came from southern Belgium. The study was performed from January 2010 to December 2014.

Postmortem examinations were performed at the Veterinary Faculty of Liège according to a systematic protocol on the basis of unusual gross lesions: targeted microbiological analysis, histopathological analysis and eventually Xrays examinations (for traumatic injuries for exemple).

Regarding the found dead animals transported at the Faculty (n = 109), the distribution of causes of death was as follows: traumatic 62/109, infectious 20/109, parasitic 10/109, miscellaneous 9/109 and undetermined causes 8/109. Traumatic injuries mainly involves road accidents and poaching trials whereas the main infectious cause includes paratuberculosis (14/20) far ahead from other infectious diseases (6/20) like enterotoxemia, Pasteurellosis, septic arthritis or meningo-encephalitis. The 10 cases of heavy parasitism mainly involve lungworms infestations.

Miscellaneous cases include intern foreign bodies (plastic) and intoxication suspicions.

Among culled animals (n = 81), two main causes are traumatic injuries (n = 40), and infectious diseases (n = 34) including 30 cases of paratuberculosis, whereas miscellaneous, including neoplasms, and undetermined causes remain minor causes.

Overall, traumatic injuries and infectious diseases are the major causes of mortality in red deer in Southern Belgium. Furthermore, selective culling of cervids suffering from paratuberculosis allow to eliminate potential excretors and in this way prevent the disease from spreading.

Exotic ticks in Belgium: an upcoming threat?

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In Belgium, as in many other European countries, ticks are an increasing problem because of their role as vector of pathogens with importance to human and animal health.

The meadow tick, *Dermacentor reticulatus*, has been detected in Belgium in 2010. It is a possible vector of *Babesia spp.* and *Theileria spp*. In Belgium, several cases of canine and equine babesiosis are known. This tick species is occasionally introduced by imported animals.

The distributional range of *Dermacentor sp*. is very broad (from the British Isles in the west to Central Asia in the east), and it seems that it's still expanding its territory. The surveillance project of ITM, funded by The Federal Agency for the Safety of the Food Chain (FASFC) aims to understand the expansion of this species in territory and in activity peak. Also, we aim to determine the infection rate of the ticks with endemic and exotic pathogens.

Climatic changes may have played a role in the spread of *D. reticulatus*, but it is not the major direct factor producing the increase in the population of the tick species. Probably, the increased national movement and exchange of cattle between nature reserves has played a major role in the spread of infections like babesiosis and theileriosis.

One of the largest known population exists in nature reserve "De Westhoek" near De Panne, bordering the North Sea. Tick-sampling (flagging) has been done in De Westhoek every two weeks from the beginning of 2013 on and is still ongoing.

During routine pathogen screening, several *Theileria spp*. infected ticks have been found in 2013 and 2014 and one *Babesia caballi* infected tick in 2012. The screening is ongoing for 2015.

Belgian wildlife as potential zoonotic reservoir of hepatitis E virus

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Hepatitis E is an acute human liver disease in healthy individuals but may become chronic. It is caused by the hepatitis E virus (HEV) and can have a zoonotic origin.

In this study, 383 sera from wild boars were selected for serology; for virology, 69 sera and 61 livers from young wild boars were used. A total of 189 and 235 sera of respectively red and roe deer were collected for serological analysis. For virology, 84 and 68 sera and 29 and 27 livers from respectively red and roe deer were sampled.

An apparent seroprevalence of 34% was found in wild boars, 1% in red deer and 3% in roe deer.

In order to assess the ELISA screening prevalence, Western blot (WB) analyses and a ROC curve analysis were performed. Different scenarios with varying ELISA specificities relative to WB were analysed. In wild boar, seroprevalence remained high whatever the scenario; 4 out of 69 sera and 4 out of 61 livers were detected as positive for HEV RNA. All sequences obtained from sera belonged to genotype HEV-3. HEV RNA, belonging to genotype HEV-3, was detected in one red deer liver.

Wild boar can be considered as a host reservoir of the virus in Belgium. However, the low prevalence in deer makes these species an unlikely reservoir. This evidence needs further investigation in order to determine in which situation deer can serve as reservoir and raise the question of the dynamics of HEV infection between wild fauna, domestic pigs and humans.

Secondary poisoning in polecat (*Mustela putorius*) and stone marten (*Martes foina*)

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The use of anticoagulant rodenticides (AR) can lead to secondary poisoning in non-target wildlife species like various predators. As in Belgium each year approximately 600 tons of AR are used, we examined the liver of 150 polecats (*Mustela putorius)* and 75 stone martens (*Martes foina*) for the presence of following 8 different AR-residues using a validated liquid chromatography-tandem mass spectrometry (LC-HESI-MS/MS) method: warfarin, coumatetralyl, chlorophacinone, bromadiolone, difenacoum, brodifacoum, flocoumafen and difethialone.

Almost all animals were road kills, collected from 2006 to 2012. About 77% and 81% of the livers of respectively polecat and stone marten contained AR residues. The maximum (median) concentration was 3.813 µg/g (0.133 µg/g) for polecat and 1.370 µg/g (0.213 µg/g) for stone marten, while the maximum number of different AR residues detected simultaneously in one animal was six. 42% of the animals reached the cutoff of 0,2 µg/g from which survival probability starts to decrease and intoxication could be expected.

Statistical analysis did reveal a borderline significant interaction effect between season and species (p=0.0409) on the sum of the residue levels, but no effect of sex.

For a subset of adult male polecats (n=54) found dead in spring we analysed their residue level against the fitness of the animal expressed as body-condition (function of eviscerated weight and total length), mesenterial fat (g), kidney- and subcutaneous fat index. None of the observed variation in these condition variables could be explained by changes in residue concentrations.

Secondary poisoning was not influenced by season, species nor age and did not affect the general fitness of the animals although over 40% reached the cut off from which mortality could be expected.

Application of the veterinary methods in the management of captivity of the brown bear (*Ursus arctos*) in Albania

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The population of brown bear (*Ursus arctos*) in Albania, during the last 20 years is damaged by some factors. Among them the most important have been: catching and keeping a great number of these bears in captivity and then their trafficking and the second factor has been damage of the aerials of the population as a result of demographic changes that our country has undergone during the 2 decades after joining the west.

Estimating the two principal factors, as important elements for the conservation of the bear population, RAF in cooperation with the staffs of the Agricultural University of Tirana, Faculty of Veterinary Medicine has realized some mini-projects in the benefit of the protection of the endangered population. During the period 2009-2011, with the support of the IBF, we realized the initial registering of the bears in captivity. Later on we realized the electronic matriculation with microchips of 50 bears which were in captivity during this period in all districts of our country. The matriculation of 50 bears was also supported by GEF, a programme for small grants, after IBF left Albania in the year 2012. Some of the data is being represented in the article published in News from International Bear Foundation , May 2009 Vol 2 Nr.2 Pag. 6-7

http://www.bearbiology.com/fileadmin/tpl/Downloads/IBN_Newsletters/IBN_May_2010_Low.pdf

During the period 2013-2014, RAF and the staff of AUT (Agricultural University of Tirana) have began to apply a veterinary method for the management of captivity and the reduction of the number of the bears in captivity. Considering the fact that after the registering, mounting of the electronic chips, beginning of the effects of the law on the protection of the fauna, the number of bears in captivity is reduced, we noticed that the reproduction of the bears in captivity was increasing their number, registered in the first phase.

List of participants on 01/10/2015

Adriaens Tim
Baert Kristof
Bicout Dominique
Bollen Jos
Boseret Géraldine
Brochier Bernard
Claes Leen
Clairhout Isabelle
Cloet Veerle
Cochez Christel
de borchgrave jean
De Craeye Stephane
De Regge Nick
De Vadder Stéphane
Deblauwe Isra
Demeulemeester Julie
D'hondt Liesbet
Di Silvestro Fanny
Evers Jacqueline
Godfroid Jacques
Graus Albert
Guilloux Gwenaëlle
Halet Koen
Hamdi Rafiq
Hanon Jean-Baptiste
Heyman Paul
Hoc Edith
Jacob Ann
Jansen Famke
Koppenaal Hetty
Korro Kastriot
Kyametis Melina
Laenen Lies
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Tavernier Paul
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Notes


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