Ticks & Tick borne pathogens: about the importance of active surveillance

Magalie René-Martellet\textsuperscript{1,2}, Pascale Frey-Klett\textsuperscript{3}, Jean-François Cosson\textsuperscript{4,5}

\textsuperscript{1} Université Clermont Auvergne, INRA, VetAgro Sup, UMR EPIA Epidémieologie des maladies animales et zoonotiques, 63122, Saint-Genès-Champanelle, France.
\textsuperscript{2} Laboratoire de Parasitologie, VetAgro Sup Campus Vétérinaire de Lyon, Université de Lyon, Marcy l’Etoile, France.
\textsuperscript{3} Laboratoire d’Excellence ARBRE, 54280 Champenoux, France.
\textsuperscript{4} UMR BIPAR, ANSES, INRA, Ecole Nationale Vétérinaire d’Alfort (ENVA), Maisons-Alfort, France.
\textsuperscript{5} UMR CBGP, CIRAD, INRA, Institut de Recherche pour le Développement (IRD), SupAgro Montpellier, France.
Ticks : vectors of pathogens

- 2\textsuperscript{nd} vectors of pathogens in the world
- 1\textsuperscript{st} vectors of pathogens in Europe
- At least 989 species all hematophagous

2 families of medical importance: \textit{Ixodidae} (« hard » ticks) and \textit{Argasidae} (« soft » ticks)
Particularity of ticks biology that influence their distribution

**all hematophagous:** Length of blood meal

- Blood meal duration (several days for hard ticks)
- Secretion of cement to consolidate the fixation, painless bite
- Each stage need a blood meal on vertebrate host to moult to the following

  ➡️ Development highly depend on hosts availability

  ➡️ Transportation/dissemination from one place to the other through vertebrate hosts
Influence of climate and meteorological conditions on ticks development

- Most species needs humidity to survive (ex: *Ixodes* ticks)
- Others are more adapted to hotter and drier climatic conditions

Ticks biology and activity depend on several factors including climatic/meteorological conditions
In Europe, 3 main genus (*Ixodidae*):

- *Ixodes ricinus* → Lyme disease and other VBD
- *Dermacentor reticulatus and D. marginatus* → Canine and equine Babesiosis
- *Rhipicephalus sanguineus and R. bursa* → Babesiosis, Ehrlichiosis and Rickettsiosis (Mediterranean spotted fever)
56 tick species have been recorded in the Caribbean (Gondard et al. 2017)

4 genus of medical importance
adapted to warmer climatic conditions

<table>
<thead>
<tr>
<th>Tick genus (main species)</th>
<th>Medical importance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amblyomma</em> (<em>A. variegatum, A. cajennense</em>)</td>
<td>Anaplasmoses to cattle, Thelerioses to animals, Rickettsioses to human</td>
</tr>
<tr>
<td><em>Rhipicephalus</em> (<em>R. sanguineus s.l., R. microplus</em>)</td>
<td>Babesioses to cattle, Ehrlichioses and babesioses to dogs</td>
</tr>
<tr>
<td><em>Dermacentor nitens</em></td>
<td>Babesioses to Equids</td>
</tr>
<tr>
<td><em>Ornithodoros sp</em></td>
<td>African Swine fever</td>
</tr>
</tbody>
</table>

- Impact of ticks infestations on wild animals health?
- Role of wild animals as reservoirs of Tick Borne Pathogens?
- In Europe:
  - Species adapted to mild and humid climates: Northern expansion and altitudinal migration, possible disappearance in the south
  - Species adapted to warmer climates: possible expansion to the north

Global warming

Ticks distribution in Sweden

Altitudinal limit of ticks in Bosnia Herzegovine

(Jaenson et al 2012) (Omeragic 2011)
Evolutions in a context of global change

Increase in international exchanges
- Pets traveling
- Livestock trade

Wild animal migrations
- Modification of migration routes
- Modification of hosts availability
- Movements of animal populations

Introduction/local adaptation of new tick species
Methods to promote active surveillance

Flag Dragging / CO2 trapping

High time and financial costs
Methods to promote active surveillance

Ticks retrieval from infested hosts

Ekner-Grzyb et al 2013

http://www.irishwildlifematters.ie/animals/bat.html
Methods to promote active surveillance

Citizens involvement, a promising method to collect data?

Citizens and researchers mobilize to fight against tick-borne diseases

In 2017, INRA researchers and their partners launched a citizen science project named CITIQUE. Designed to fight against tick-borne diseases, it is based on a massive collection of data. Their analysis should help to establish risk maps and improve the prevention of tick-borne diseases.

Signalement-tique : Smartphone application

1. Report tick bites
2. Fill a database that delivers real-time accurate mapping of bites
3. Inform citizens on ticks and risk associated with tick bites
4. Collect Ticks that have bitten
**Tamia sibiricus** a new reservoir of *Borrelia burdorferi* spirochetes in french forests

The *Ixodes ricinus* life cycle

A. Development on the ground, under rocks or laefs
B. Questing on the grass or ground
C. Feeding on a vertebrate host
D. Dissemination

Vourc’h et al. 2016
2007-2016: very strong evidence for the presence of reproducing populations of *Hyalomma marginatum* in southern France

Considered the main biological vectors of Crimean-Congo Hemorrhagic Fever virus

2016: 2 human deaths in Spain due to CCHFV

Main hypothesis: introduction of *Hyalomma* through trans-Mediterranean bird or transportation of ticks on their mammalian hosts

*Vial et al. 2016*
The CC-EID project

Since 2014:
Network of 7 observatories
Ticks standardized collection method / 1 per month
Meteorological data

Variation in seasonal activity between regions

Karine Chalvet-Monfray (VetAgro Sup – INRA)
First results from ticks signalements by citizens

Map of the number of tick bites on humans recorded by department between 17 July 2017 and 18 May 2018 via “signalement-tique”
Conclusion

Great importance of the constitution of a network of active surveillance

One Health

Wild and domestic animals care centers

Citizens

Veterinarians

Physicians

Scientists
Conclusion

Great importance of the constitution of a network of active surveillance

Our needs

The « signalement-tique » smartphone application can be used in metropolitan France as well as in the west Indies French islands

- Declare tick bites on wild or domestic animals or humans
- Send ticks to the « Tous Chercheurs » lab at INRA Nancy
- A local research team would be a plus

Contacts: magalie.renemartellet@vetagro-sup.fr
jean-francois.cossen@inra.fr
pascale.frey-klett@inra.fr
Aknowledgements

https://www.citique.fr/

https://www6.ara.inra.fr/epia/