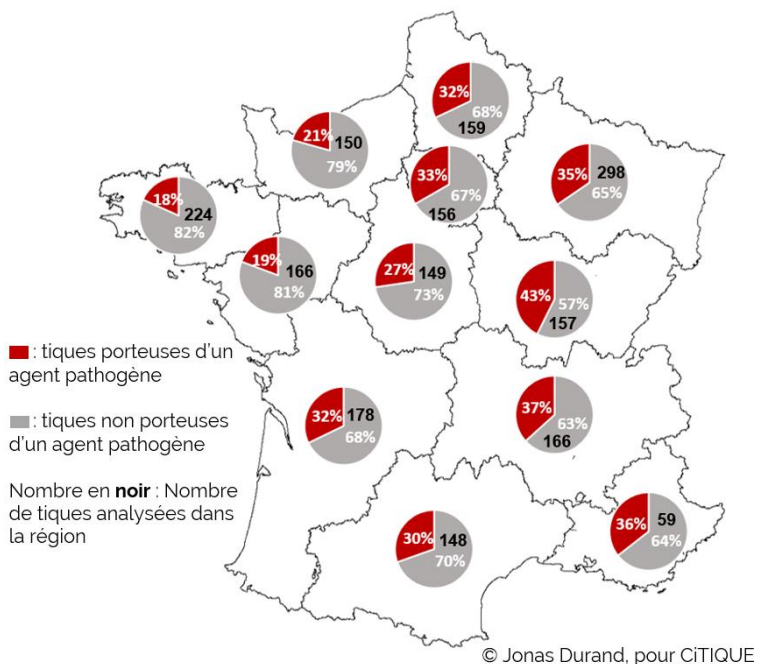


CARTOPIQTIQ



Mapping of the infectious risk linked to tick bite exposure in France to improve prevention: contribution of participatory research data

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Thematic actions concerned: WP5 et WP6

Context —

The prevention and control of tick-borne pathogens is a real health challenge for Western societies, as ticks are the primary vector of human and animal diseases in Europe. These diseases, including Lyme borreliosis, are the subject of much debate and controversy, particularly given the lack of current knowledge about the pathogens carried by ticks that can be transmitted to humans in France. It is to respond to the concerns of citizens that the Ministry of Health and Solidarity wished in 2016 to develop a plan to fight Lyme disease and tick-borne diseases, called "Plan Lyme". The first strategic axis of this plan aims to improve vector surveillance by federating projects to map the risk and distribution of ticks in France. In parallel to this initiative, drawing on its experience as a facilitator of participatory research projects and eager to support new projects that put citizens at the heart of the research process, Labex ARBRE launched the CiTIQUE participatory research program in 2017 with researchers from INRAE. This program allows citizens and researchers to work together to better understand the ecology of ticks and the pathogens they transmit, thanks in particular to (i) the "Signalement TIQUE" application, which allows citizens to report and georeference any tick bite on humans or animals, and (ii) the tick library, which collects all the ticks sent by participating citizens. These tick bites, which were previously inaccessible to researchers, now allow for an unprecedented study of the spatial variability of infectious risk related to exposure to tick bites.

Objectives — The objective of our study is to establish a fine mapping at different scales (region, forest vs. garden) of the infectious risk for humans related to tick bites in France.

Approaches — From tick samples archived in the CiTIQUE program tick library, we will:

- Describe the diversity of human biting tick species in France at the scale of territories (regions) and ecosystems (forests vs gardens)
- Evaluate the proportion of human biting ticks carrying pathogens at the scale of territories (regions) and ecosystems (forests vs gardens),
- Determine the diversity of pathogens present in human biting ticks at the scale of territories (regions) and ecosystems (forests vs. gardens).

Preliminary project highlights —

- *Ixodes ricinus* is the tick species that bites most humans in France
- 30% of the biting ticks analyzed carry at least one pathogen for humans.
- There is a significant geographical variability in the pathogen content of human-biting ticks across regions
- *Borrelia*, the bacterium responsible for Lyme disease, is present in human-biting ticks throughout metropolitan France
- 15% of human biting ticks tested are carriers of *Borrelia*
- Human-biting ticks from gardens in Grand Est Region were found more engorged than human-biting ticks from forest. This suggests that people bitten by ticks in their gardens take more time to remove their ticks than people bitten in the forest, and as such pay less attention to ticks (they don't perform auto-tick-check right away). This lack of preventive behaviour is more risky for their health, as we know that, for an infected ticks, the longer it feeder, the higher the risk of transmitting its pathogen(s).
- It appears that there is no difference in the proportion of human-biting ticks carrying at least one pathogen between garden and forest environment of the bite.
- There is significantly more *Borrelia garinii* (pathogen species linked with neuroborreliosis and found only in bird reservoir hosts) in human-biting ticks from gardens than from forest. The opposite is observed for *Anaplasma phagocytophilum*.

Main conclusions including key points of discussion — There is an infectious risk for humans linked to tick bites in all regions of France. This result has been communicated to the citizens via the CiTIQUE website and shared with the different Ministries concerned by the problem of tick-borne diseases. It is also shared with health actors at the territorial and national level, in particular the various Ministries concerned by the problem of tick-borne diseases. The proximity risk, associated with familiar environments such as private gardens, is (i) very present in France, (ii) is different from the risk associated with ticks present in the forest environment and (iii) is not sufficiently known and taken into account in France, as shown by the fact that people remove their tick later.

Perspectives — Further analysis is underway, particularly to better characterize the proximity infectious risk in public parks and private gardens, compared to forest environments. An article is being written on the risk in gardens, for the Weekly Epidemiology Bulletin, which should be associated with a press release

Valorization —

Durand J., Carravieri I., Marchand J., Galley C., Cappizzi S., Vourc'h G., Frey-Klett P., Brun-Jacob A., (2021) Mieux connaître les tiques pour prévenir leur piqûre et agir pour la science, Journée d'information sur les résultats de la R&D en santé des forêts, On-Line (Bordeaux), 10 Décembre 2021

Durand J., Carravieri I., Marchand J., Galley C., Cappizzi S., Vourc'h G., Frey-Klett P., Brun-Jacob A., (2021) CiTIQUE : notre expérience du crowdsourcing, conférence invitée pour l'école chercheurs sciences participatives, Angers, 18 Novembre 2021

Durand J., Carravieri I., Marchand J., Galley C., Cappizzi S., Vourc'h G., Frey-Klett P., Brun-Jacob A., (2021) CiTIQUE, un programme de recherches participatives sur l'écologie des tiques et des maladies associées, conférence invitée pour l'école chercheurs sciences participatives, Angers, 16 Novembre 2021

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Working with citizens to monitor tick-associated risk: lessons learned from the CiTIQUE project, European
Wildlife Disease Association Network meeting, On-Line, August 30 2021

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programme CiTIQUE, colloque Evaluation des Sciences et recherches participatives, Lyon, 5 Juillet 2021

Durand J., Galon C., Lapie C., Carravieri I., Palin B., Vourc'h G., Moutailler S., Brun-Jacob A., Cosson J-F., Frey-
Klett P. (2021) Evaluation de l'exposition humaine aux pathogènes transmis par les tiques en France grâce à des
données de science participative, GDR Tiques et Maladies à Tiques, On-Line, 22 Mars 2021 (Lyon)

Leveraging effect of the project — CARTOPICTIQ is part of the "Zoonotic risk prevention services" action of the
Des Hommes et des Arbres project, winner of the "Territoire d'innovation" investment program. This project, led by
the Metropolis of Nancy in partnership with the Metropolis of Epinal, brings together more than a hundred players,
including INRAE and the Labex ARBRE. CARTOPICTIQ has also had a leverage effect in obtaining fundings of
the National Environment-Health-Work Research Program (PNR EST), in partnership with the ANSES rabies and
wildlife laboratory in Maxéville.