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The Tick Issue as a Reflection of Society–Nature Relations: Localized Perspectives, Health Issues and Personal Responsibility—A Multi-Actor Sociological Survey in a Rural Region (The Argonne Region, France)

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Abstract: Ticks are acarids that can transmit diseases, such as Lyme borreliosis, to human beings. They have often been considered from an ecological perspective (the environments in which they live) or from a medical one (diagnosis and treatment), while relational approaches to human–tick encounters that integrate the social sciences have remained less common. This article opts for a socio-territorial approach and a cross-analysis of different groups of actors faced with tick risk in a rural environment during their professional or leisure activities: foresters, farmers, hunters, environmentalists and hikers. The paper is based on observations and about thirty sociological interviews conducted in 2021–2022 in the rural Argonne region (France). The survey reveals the interconnection and tension between three types of approach to tick-related issues, i.e., a localized approach (based on a knowledge of place as well as everyday uses), a health-centered approach (medical knowledge as transformed and shaped by the respondents' own experiences of tick-borne disease) and an emphasis on taking personal responsibility instead of collective preventive health initiatives or awareness campaigns (as to the location of “tick areas” or of protective measures).

Keywords: tick risk; Lyme disease; society–nature relations; socio-ecological change; rurality; hunting; forestry; farming; outdoor leisure activities; knowledge/perceptions/social practices



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1. Introduction: Toward a Relational and Socio-Spatial Approach to Human–Tick Interactions

Ticks are acarids that can be found in natural environments all over the world¹. They feed on the blood of the hosts that they attach themselves to² (game, rodents, etc.). In Europe—where one of the most frequently found species is *Ixodes ricinus*—as well as in North America, they become carriers of the Borrelia bacterium if the host animals are infected; in particular, they can then transmit Lyme disease to human beings, inducing neurological, articular or cardiac disorders that can be severe and persistent and that have fueled debate in the medical field as to the existence of a “chronic” form of the disease (Forestier et al. 2018).

The social sciences have admittedly paid scant attention to tick-related issues as compared with other academic disciplines (Quine et al. 2011). For example, in a bibliometric study of the academic articles published in North America up until 2016, based on eight different databases, Judy Greig et al. (2018, pp. 248–49) found 2,258 articles on the subject, among which only 8.9% (202 articles) dealt with the knowledge on, attitudes to and perceptions of tick-borne diseases, while 32.6% analyzed the effectiveness of current screening tests, thus reflecting the primacy of a medical approach to the subject.

However, zoonotic diseases, which are transmitted from vertebrate animals to human beings, present major health threats and scientific and policy challenges, as they give rise to narratives that have social and political “lives” (Leach and Scoones 2013); the temporal, spatial and social differences that can be observed in the way these diseases are spread preclude the use of any single, reproducible model.

As a result, there may be a sense that there is a gap between the biological and medical knowledge derived from scientific research and the perceptions of the public, including the social groups that are the most concerned. This feeling has been compounded by ongoing debate among scientists, doctors and patients about the “social construction” of Lyme disease (Aronowitz 1991). Abigail A. Dumes (2020) has explored the conflicts that have arisen in the United States over claims about “chronic” Lyme disease and formulated the notion of “divided bodies”: the experience of the patient can be found to be in conflict with scientific, medical or social perceptions and become the basis for a battle of legitimacy between these different groups to impose their truth.

Similarly, from an environmental health perspective, a bibliometric analysis of the use of the “One Health” approach in articles published between 2003 and 2021, based on the Scopus database, i.e., 12,815 articles, reveals that scientific and technical approaches have remained prevalent over social sciences approaches (Miao et al. 2022). However, an integrated approach to risk assessment requires that attention be paid to the interactions between socio-behavioral factors and ecological factors in order to inform tick-borne disease management (Bouchard et al. 2023). In this respect, we are dealing with a relational issue: “The risk of contracting Lyme disease varies geographically due to variability in ecological characteristics that determine the hazard (the densities of infected host-seeking ticks) and vulnerability of the human population determined by their knowledge and adoption of preventive behaviors” (Bouchard et al. 2023, p. 1).

Therefore, preventive health programs cannot avoid taking into account the social, spatial and local epidemiological context (Aenishaenslin et al. 2015; Bouchard et al. 2019), all the more as individuals’ lifestyles may have differing effects on their health, depending on the individuals’ practices (Vallée et al. 2010). One conclusion can be derived from this: a relational approach is necessarily based on the study of the socio-spatial context.

That is why we have chosen to adopt a socio-territorial approach, enabling us to reconsider previous medical and ecological interpretations by exploring the concrete sites of human–tick encounters. This need has been convincingly argued in the literature. First, the vegetation can only be considered as indicative of tick activity at the local, rather than the macroscale, when considering physiognomic features (forests, pastures. . .) (Gilot et al. 1994). Second, it is impossible to assess the risk of tick-borne disease by merely looking at the density of infected ticks without taking into account the perceptions and practices of residents and users in the areas concerned. Studies have not uncommonly noted that there is a low level of preventive health behavior in regions where the measured risk of Lyme disease appears to be high (Aenishaenslin et al. 2022). A study conducted in the United States in Michigan, Minnesota and Wisconsin, where tick-borne diseases are a major issue, also observed that there was a discrepancy between the respondents’ very high awareness of these diseases (no less than 98% of the sample had heard about them) and their lack of realization that they could be directly exposed to the threat in their close environment (25%) (Beck et al. 2022).

A second lesson emerges from that: researchers focus their attention “not so much on representative as on specific environments, combining parameters that are likely to have an impact on tick density and infection rates” (Massart 2016, p. 25). We are looking at areas where tick reservoirs (fauna) abound and at the users of such spaces. The studies and methods mobilized are representative, but not in a statistical sense of the term, because they address the specificities of the environments studied and the residential knowledge (Kohler 2012) that provides the link between individual and configurational factors.

Although no systematic data are currently available on a European scale (Van Den Wijngaard et al. 2017), some climate scenarios predict the expansion of the tick range over

the continent. By 2040–2060, a 3.8% overall habitat enlargement is anticipated for ticks of the *Ixodes ricinus* species; but this does not take into account the impact of socio-economic changes (Semenza and Suk 2018). This leads to the third framing principle for our research: one essential challenge lies precisely in understanding better the interactions between ecosystem changes and the climate, i.e., connecting them with resource use and social practices, which are themselves changing (Lambin et al. 2010), knowing that risk factors are correlated with the local environments. For instance, in eastern Europe, Sarah Randolph observed a significant increase in tick-borne encephalitis during the 1990s, which she linked to changing poverty rates and to the socio-economic upheavals following the fall of “popular democracies”; the development of leisure activities and tourism increased the risk of human–tick encounters (Randolph 2001; Randolph 2011).

The tick issue thus reveals the transformations in the relations between society and nature as well as of society’s reflection on itself, as shown for instance by the construction of specific relations to and the perceptions of tick bite risk. Environmental psychology has shown that these perceptions depend on individuals’ lived experiences and on their spatial character; for instance, the natural areas or types of vegetation in which they occurred. They are therefore socio-spatial perceptions, not just collective ones. In this sense, there is no single, homogeneous system of risk perceptions. On the contrary, risk perceptions reflect both the relation of each individual or group with their environment and their personal and localized background (Dernat and Johany 2019b, pp. 19, 23–24). Public health messages therefore cannot be delivered without understanding localized social perceptions and practices in order to reach specific audiences. Starting from a psychological perspective, this fourth general conclusion drawn from the literature also calls for the use of sociological tools to go further.

2. A State of the Art: Sociologizing the Tick Issue

From the existing literature in the social sciences, sociology in particular, we draw the following research frameworks and questions, which we will link together from a relational perspective.

First, two PhD dissertations have been defended in France on the subject of ticks and tick-borne diseases: one in the field of geography and the other in sociology. The first one develops a spatial and environmental analysis, which has traditionally been the favored approach in geography, and asks how prevention measures might better target forest users, taking better into account the sites and modes of human–tick encounters (Méha 2013). The second dissertation focuses on Lyme disease by surveying the arenas of expertise and related “practitioners” (Massart 2013). Both partly survey the same site—the forest of Sénart, in the Paris region—to study the conditions of human–tick encounters. They both show that sociological analysis is essential to define the notion of tick risk: in such situations, the groups concerned are involved in the process (rather than simply being exposed to risk). Two possible, potentially conflicting, research perspectives result from this: first, the need to delve into the social context; namely, into individuals’ socially embedded knowledge, practices etc.; second, the need for research about how to design effective public action through management initiatives, regulations or public policies (Méha 2013; Massart 2013). Both directions require taking local contexts into account, which justifies embracing a socio-territorial approach.

Second, in her PhD dissertation, Clémence Massart points out that Lyme disease can be understood as “an intermediate case, defined both by a process of emerging media coverage which is turning it into a controversial issue, diffusely but permanently and increasingly present in the public space, and by another definitional dynamic by which it is framed as a health issue defined by scientists alone, in the shadow of the mainstream audience. Between these two dynamics, the influence is neither linear nor univocal” (Massart 2013, p. 18). This raises the following question: to what extent does the scientific construction of tick-borne disease have an impact on individuals’ perceptions, if not practices? This question involves the study of three interrelated aspects: scientific or vernacular knowledge,

individuals' more- or less-established perceptions of ticks and tick-borne disease and their more- or less-localized uses. These three aspects provide us with an analytical framework that help to assess individuals' perceptions of increasing tick activity and tick risk and their preventive health behavior when exposed to tick risk in the context of professional or leisure activities. On this subject, the literature suggests that there is no systematic correlation between the gradual perception of risk and the correspondingly heightened precautions, as has been mentioned before ([Aenishaenslin et al. 2022](#); [Beck et al. 2022](#)). The interest in taking a sociological approach is that it can reveal that "lay perceptions [...] are socially differentiated, influenced by 'optimism bias' and personal narratives" ([Peretti-Watel et al. 2019](#)). This second form of social embeddedness needs to be taken into account and linked to the local embeddedness we have noted above.

This leads to a third stage in our sociological reflection based on the existing literature: we need to reconsider the prevailing binary—ecological and medical—approach to tick-related issues. Clémence [Massart \(2013, pp. 32–34\)](#) views zoonotic diseases such as Lyme disease as "new environmental diseases [...] also favored by human activity but [whose] space of reference [is] nature. [...] These new environmental diseases also involve different target audiences and experts: instead of toxicologists and chemists, ecologists of wild populations are taking over while users of nature and professionals in farming and forestry are replacing local residents". She therefore suggests using the term "ecological diseases". This shows how important it is to consider together the substantive (*what* is at stake?) as well as procedural (*how* are they being dealt with?) aspects of health and environmental issues and their interrelations.

Scholars in the field of sociology have discussed the relations between ecologization and localization. Marc Mormont, in particular, has described the process of the "emergence of multiscale territories resulting from widening emphasis on ecological issues" ([Mormont 2009, p. 159](#)). We embrace this double focus, paying attention to climate change as well as to localized individual practices, and link this to the need for a multiscale governance of sustainable development ([Hamman 2020](#)). In this fourth stage in the construction of our theoretical framework, the need for a relational analysis becomes even clearer. We need to recognize the role played by local knowledge, as underlined in the field of ethnoacarology ([Herrera-Mares 2022](#)). But this is not all: we more particularly pay attention to the connections between different forms of knowledge; for example, the possible tensions and porosity between expert and lay knowledge: their scope of validity and degree of "legitimacy" differ depending on the specific groups of actors, as shown by the study of social practices understood in their socio-spatial and socio-temporal contexts.

Focusing on an exemplary area, the Argonne region—a rural area located in eastern France that is widely affected by the presence of ticks—can help raise further questions from this sociological perspective. We advocate using a relational approach exploring different groups' local perceptions of ticks at the same time as their localized social practices in the face of tick risk. To sum up, the existing literature reveals the interconnection and tension between three types of approaches to tick-related issues, i.e., a localized approach (based on knowledge of place as well as everyday uses), a health-centered approach (shaped by individuals' relation to medical knowledge and to their own and others' lived experiences, especially of Lyme disease) and an emphasis on taking personal responsibility (in assessing tick-bite risk or adopting adequate preventive health behavior). This signals a "governmentalization" of tick-related issues, as defined by Michel Foucault ([Foucault 1991](#)): the emphasis on personal responsibility raises questions about society's and the collective responsibility, about the role of socio-economic and local area development models and the role of public health action. Interestingly, the aspects of content (who the hosts are, what sites are most favorable for tick activity, what policies or human activities there are that may have encouraged their proliferation, etc.) are still not well established (see the above-mentioned controversy over a "chronic" form of Lyme disease). They cannot be analyzed separately from procedural aspects (*how*?) if we mean to rethink these from an ecosystemic perspective of human/non-human relations (in forestry, hunting or farming or

in outdoor leisure activities) as well as preventive health measures and policies and their social reception.

Using this sociological approach, we can go beyond socio-cognitive perspectives that aim to determine adequate preventive health behavior. They are widely represented in the literature (Bayles et al. 2013; Butler et al. 2016; Zöldi et al. 2017), especially focusing on what awareness-raising strategies on the subject of Lyme disease would most effectively impact personal behavior (Quine et al. 2011, pp. 2016–17). However, as Gavin Bridge and Thomas Perreault have underlined, “accounts of eco-governmentality show how resources, ecosystems and bodies (both human and non-human) are subject to calculative procedures and practices” (Bridge and Perreault 2009, p. 489).

Specifically, we intend to pay close attention to the complexity of the social context; this is the fifth stage in the construction of our theoretical and methodological framework. The significance of choosing the Argonne region as our survey area, compared to the “model forest” of Sénart studied by Christelle Méha (2013) and Clémence Massart (2013), is that it makes it possible to consider, at the same time, forest and open environments, users for professional (foresters, employees of hunters’ federations, farmers etc.) and/or leisure purposes (hunters, members of local outdoor organizations, hikers etc.), i.e., to consider a wider and more complex range of possible human–tick encounters.

What is more, this also brings to the fore the role of some mediating actors that act as “go-betweens” (Hamman 2011) within the different professional and social groups concerned by tick-related issues in a given local area, and who even take part in the implementation of prevention policies or measures. As has been shown, “some forms of social exchange and transaction presuppose relationships based on sharing, reciprocal involvement, short-range solidarity [. . .], the mobilization of resources, of flexibilities and adaptations, the making of visibilities and legibilities, all of which are virtually impossible on a global scale. They presuppose dense communication and information networks, permanent (including physical) contact and a common experience that is more easily shared within a restricted environment” (Alvarenga 1994, p. 80). We take inspiration from this observation but also wish to go further by taking concretely into account the plurality of human and non-human mediations. We designed our methodological framework accordingly.

3. Materials and Methods

3.1. Fieldwork and Survey Design

The Argonne region is one of the most rural areas in France, with few communes over 500 inhabitants; over 60% of the area is covered by farmland and about 37% by forest³. This is interesting in two ways. First, it is therefore an ideal site to analyze the human–tick exposure as a possible consequence of the different uses of natural spaces. Second, it ensures the relevance of our case study. While the literature has so far mostly focused on periurban forests and on the urban encroachment on surrounding natural spaces, which is thereby increasing the likelihood of human–tick encounters (for example Randolph 2001; Méha 2013; Massart 2013), we are paying extensive attention to a rural area, so that our findings may also more broadly be applied to so-called “ultra-rural” spaces. Indeed, in the North-East of France, the Argonne region marks the start of the “diagonal of emptiness” (*diagonale du vide*), which stretches across France down to the Pyrénées mountains and is still emptying today (Oliveau and Doignon 2019).

We start from the following hypothesis: tick-borne pathogens circulate widely in forest ecosystems, and it has been shown that the relative proximity of a forest to a populated area increases the risk of exposure (De Keukeleire et al. 2015). It is therefore essential to explore this environment, as well as to compare it with open environments, farmland or grazing areas.

This is why we selected four survey sites, based on the territorial grid we used during our work with the *Zone Atelier Rurale Argonne* (ZARG⁴), with whom we have been engaged in a medium-term partnership: (1) the forest of Signy-l’Abbaye, (2) the Estate of Belval,

(3) the area of Montfaucon-d'Argonne and (4) the Belval Ponds Nature Reserve (Figure 1). The choice of these four survey sites ensures the validity and relevance of our case study since we were thus able to compare contrasted environments and to consider different types of actors and activities involved in the specific areas under study: respectively, (1) foresters at the *Office national des forêts* (ONF—the French national forests office) and representatives from the Ardennes hunters' federation; (2) hunters and forestry managers, active in closed environments; (3) farmers; and (4) sports, leisure and wildlife organizations, operating in open environments. Our survey was designed to combine a territorial approach (the study of four specific sites) with a scrutiny of the challenges of public action and measures taken to deal with tick risk (through interviews with representatives of the four groups surveyed).

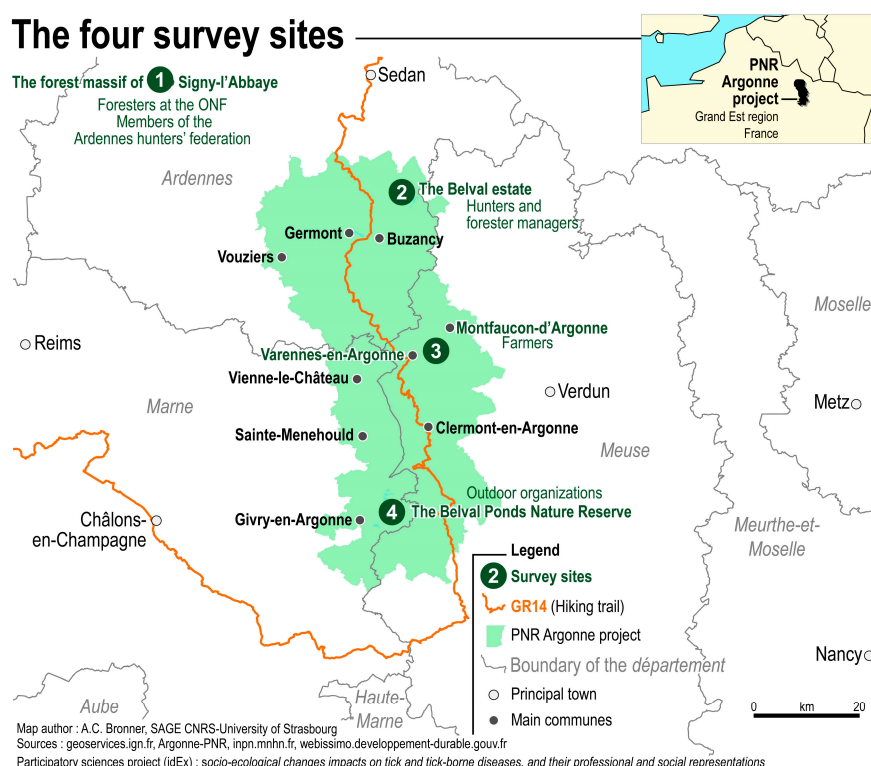


Figure 1. The four sites and social groups surveyed in the Argonne region.

The ZARG therefore provided a platform for facilitating contact with different actors involved in the Argonne region, enabling us to build upon the initial relationships we established and to put together our corpus. In order to ensure that all the people involved would be represented, we chose to follow an integrative approach in surveying representatives of the on-site organizations, who hold valuable knowledge, express the collective voice and can act as relays in the local area; in addition, so as not to confine ourselves to institutional discourse, we also interviewed several “grassroots” members, enabling us to capture different types of professional perspectives, uses and experiences from the ground.

Following an exploratory field visit in November 2021, we conducted 28 in-depth individual or collective sociological interviews up until, and including, the summer of 2022, supplemented by a few online interviews. In line with our sociological perspective, we aimed to grasp the knowledge, perceptions and practices among the different professional and social groups surveyed, as well as their uses of nature and the evolution of their perceptions over time. Based on these objectives, we subdivided our interview questionnaires into three sections, focused on (1) localized knowledge and experience; (2) health and medical knowledge; and (3) personal responsibility vs. public health measures.

We built our contact list by drawing on the partnerships established with the groups selected and thanks to mediating players. We used a similar approach in the four survey sites and among the four groups of actors selected (Table 1) to collect enough data for each site and group and to be able to compare them together.

Table 1. A cross-analysis of the different environments, groups of actors and types of material.

Environments	Groups of Actors	Empirical Material Collected
4 survey sites	First overview	Exploratory observations and contacts on-site and photographic material: fieldwork from 8–11 November 2021
Closed environments	Hunters	7 interviews + fieldwork from 7–9 December 2021 On-site participant observation on 16 February 2022: big-game hunt in a publicly owned forest
	Foresters	4 interviews + fieldwork from 18–20 May 2022 On-site participant observation on 19 May 2022: a typical working day of a forestry technician at the ONF
Open environments	Local sports, leisure and natural life organizations	7 interviews + fieldwork from 27–30 May 2022 On-site participant observation on 28–29 May 2022: three-day hiking journey in the Argonne region (<i>Grande Traversée de l'Argonne</i>)
	Farmers	5 interviews: 1st wave: fieldwork and on-farm observations from 4–8 July 2022 5 interviews: 2nd wave: fieldwork and on-farm observations from 15–19 August 2022. On-farm observations and collection of photographic material

In the case of the hunters, foresters and local organizations, we systematically interpreted their statements—which had been fully transcribed to allow for a thematic analysis—in reference to the ethnographic sequences during which they had been collected, as we took part in a big-game hunt in a publicly owned forest, accompanied a technician from the *Office national des forêts* in his daily activity and participated in a big local hiking event, the *Grande Traversée de l'Argonne*. From these three ethnographic immersions, we produced detailed accounts based on our logbooks.

In the case of the farmers, we adapted our methodology to the seasonal constraints (harvesting is required in the summer) and to their different types of activities (livestock breeding, grain growing, farm sanctuaries etc.) and organized our fieldwork in two sequences: in July and August 2022. This gave us the opportunity to conduct more interviews with the available farmers and to supplement them with data from on-farm observations.

These field immersions were, at the same time, an opportunity to observe the people in their daily activities, to become familiar with their environment and concrete practices and to gather a body of photographs making their experience visible, in order to confirm the interviewees' statements and establish the validity of our findings. Based on an inductive approach, we analyzed the interviews not only thematically—just as the interview questionnaire had been built around a few major topics based on a binary (ecological and health-related) approach to tick risk that we had identified from the outset—but we also endeavored to refer the interviews to our on-site observations and to adopt a similar methodology for all the groups surveyed.

3.2. Implementing the Relational Approach: Questioning Social Transactions and Boundary Work

Our survey methodology is original since it takes into account different types of environments as well as different groups of actors (Figure 2). Paying attention as it does to social ties and possible conflicts, our research makes a combined use of two theoretical approaches.

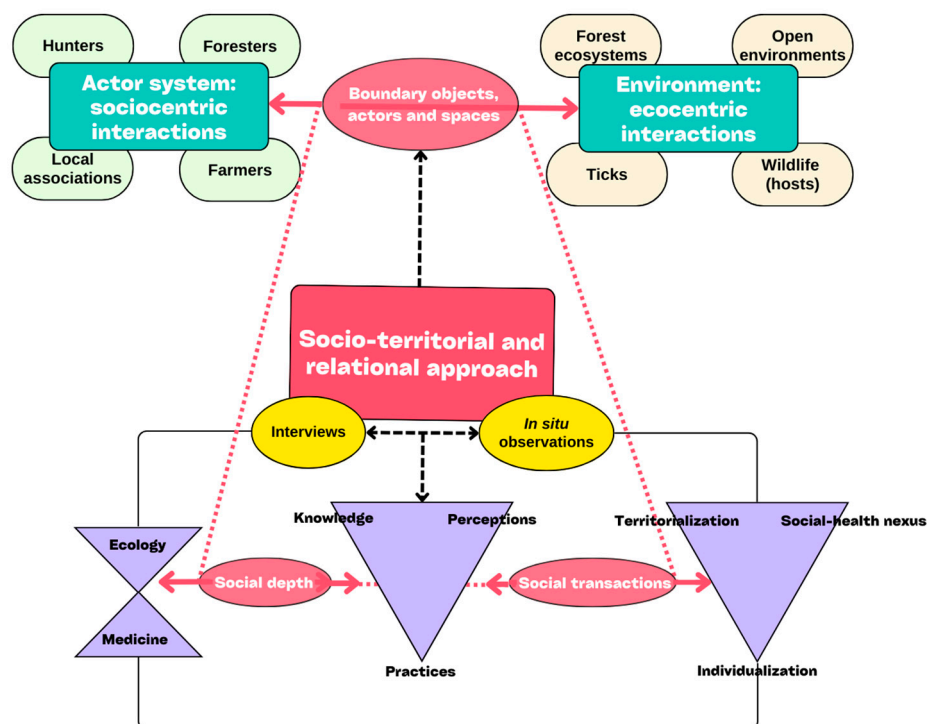


Figure 2. An overview of the survey methodology.

3.2.1. Building an Analysis upon Social Transactions: A Relational Approach between Interests and Values

First, we draw on the sociology of social transactions, i.e., the analysis of the processes by which practical compromises are worked out in concrete or even daily situations of “conflictual cooperation” (Hamman 2015). This is the case in the Argonne region, where different types of logics and uses—hunting, forestry and farming practices as well as nature-based leisure activities—may partly overlap or be mutually exclusive. Individuals’ social and professional relations to ticks are embedded in their socio-spatial reality.

Constantly bearing in mind the multiplicity of actors, processes and issues involved in a localized configuration, we are thus able to pay close attention to the social relations and possible tensions resulting from the different uses and logic at play. One of the main principles of the sociology of social transactions is that the different stakeholders involved should not be simplistically considered as likeminded, rational agents: “The complex relationships between agents, and the multiplicity of their goals, lead them to invent compromises for coexistence that result from a game of social transaction” (Remy et al. 2020, p. 15). The different actors’ perceptions and practices are made up of their relations to different interests (economic, social, professional) and values (their attachment to the rural world, to the environment, to health etc.). The actors’ interiorized conceptions have an influence and manifest themselves in formal and informal ways, through expressions of trust or distrust (Remy et al. 2020).

3.2.2. Bridging an Analysis through a “Boundary Work” Frame

Second, we also use the notion of “boundary objects”, defined by Susan L. Star and James R. Griesemer as objects that are both flexible and materially consistent enough to support communication between distinct, intersecting cultural worlds (Star and Griesemer 1989, p. 393). The issues at stake are permanently being reframed as these objects are being used or dismissed, depending on the current evolutions, by actors endowed with different (scientific, environmental, practical) expertise. This notion can shed light on the complex configurations created around ticks. Clémence Massart demonstrated its value for studying

Lyme disease and the disputes about its diagnosis and treatment among different medical specialists, the techniques for its detection or the involvement of patient organizations (Massart 2013, pp. 269–358).

Some aspects have been, however, little explored, such as the shaping of an “invisible infrastructure” embodied in mediating figures (Bowker and Star 2000), which convey a set of conventions and commanding common practices—for instance, the attention a hunter pays to his dogs in order to assess tick risk. We are more particularly interested in the localized forms of this infrastructure.

3.2.3. A Socio-Territorial Approach at the Crossroads of the Two Paradigms

Taken together, the two paradigms are useful in formulating and exploring the notion of “boundary spaces”, i.e., interstitial spaces, bringing together different—human and non-human—actors and different interests, whose interactions are made possible by territorial transactions.

The notion of boundary spaces has been used in the history and sociology of scientific knowledge: for instance, Robert E. Kohler (2012) described the “border zone” between laboratory science and field science. This notion has also been developed in the sociology of territory to draw attention to the fact that boundaries are not only lines to be crossed but spaces with social characteristics of their own. In these interstitial spaces, different actors and different perspectives come into contact, and these oppose or hybridize through territorial transactions.

In this respect, to grasp different social groups’ perceptions and practices in the face of tick risk, we need to understand the “dynamics of negotiation between objects of representation” from a systemic point of view (Dernat and Johany 2019a, p. 14). Boundary objects are permanently involved in their daily activities. It is by considering both boundary objects and boundary spaces that we can develop a new configurational approach to tick-borne disease prevention, “giving greater importance to the local area and environment in which people live” (Dernat and Johany 2019a, p. 16). The focus is thus made to move from ticks—which “may lead one to concentrate on the acarid itself rather than on its social and environmental integration”—to tick bites—a health-related/medical approach—and then to tick risk, which opens the way for a more holistic perspective, integrating “questions related to animals, to outdoor practices, and of course, to space and the environment” (Dernat and Johany 2019a, pp. 16–17). We situate this paper at this third level. It requires a relational approach in order to understand the relations and conflicts between social groups but also to grasp how their knowledge, perceptions and practices are being shaped by localized conceptions, health imperatives and the calls on taking personal responsibility in the face of tick risk (Figure 2).

4. Results and Discussion

Using the Argonne region as an example, we propose a sociological and relational reconsideration of the prevalent ecological (4.1) and medical (4.2) approaches to tick-related research, emphasizing the individual and social perceptions informing the actors’ concrete points of view. This will help better understand the social practices they display (4.3) when it comes to their preventive health behavior: personal responsibility seems to prevail over collective regulatory initiatives or intensive awareness campaigns. This result reflects a deep-rooted attachment to the positive values associated with natural spaces.

4.1. Localized Perceptions of Tick Risk: The Importance of the Socio-Environmental Context

Actors’ localized relations to ticks are not shaped through the incorporation of authoritative ecological or medical narratives coming from above. On the contrary, they are local constructions of boundary spaces, shaped through interactions with other residents. All the respondents referred to their confrontation with ticks as a shared experience. A technician at the ONF declared: “Real bites, I think I get between one and three on average every year. But if you’re talking about picking up ticks [...] when it’s the season, I’ll pick up 30 or 40 a

week" (interview, 20 May 2022). A hunter and the representative of a sports organization, respectively, added: "I think [it concerns] everybody: hunters, strollers, anyone that goes into the forest, in all the countryside" (interview, 15 February 2022); "We live in a very wooded and natural region, so we're always confronted to this. When we go mountain biking too" (interview, 9 May 2022).

These locally rooted perceptions raise questions, in particular, about a possible increase in tick activity and provide a basis for the actors' explanations of the phenomenon, in between ecologically and socially centered explanations for the extension of "tick areas".

4.1.1. A Longer Tick Season?

"Peak tick season" is in spring and autumn: "It's often in spring and autumn, that's when we do a lot of practice in the woods" (the head of a sports organization, interview, 9 May 2022). As a result of the cycle of seasons, ticks become a recurring issue, as suggested by a forester from the ONF: "When you don't see ticks for weeks, then the problem no longer exists in your head. And then, one day, you come back from work with seven ticks on your leg and then you think, 'ah, this is a real issue, we've got to talk about it!'" (interview, 15 June 2022).

We are talking here of perceptions, and they need to be further explored. First, they are shaped by a combination of factors. For example, while some of the hunters surveyed declared that there was stronger tick activity in the summer than in the winter, this was not only due to their seasonal impressions but also to the fact that less protective clothing is worn in the summer, as suggested by one hunter: "I feel more at risk in summer. There's tick activity but I also think we wear lighter clothing and I've been bitten twice!" (interview, 22 March 2022). Then, some think that the increase in tick activity all year long is a more marked process today than it was in the past. This is clearly expressed by the manager of a private forest estate:

"Let's take my dog as an example: before, it was treated in the spring, we knew that dogs got ticks between March and October-November and that in winter we were safe. It's not like that anymore. Dogs have to be treated almost all year long, otherwise they get ticks in the middle of winter". (interview, 3 March 2022)

Tick risk perceptions are thus shaped by a dual relation to time, short-term seasonal impressions and the perception of changes over the medium term.

4.1.2. What Reasons Have Been Given for the High Presence of Ticks in the Argonne Region?

In this context, the actors surveyed gave two main explanations for the high presence of ticks in the Argonne region: climate change and the proliferation of wildlife. This raises questions about the social transactions made between the perception of exogenous and endogenous factors, especially human beings' actions.

The first explanation insists on the impact of climate change, in line with the scientific literature on the subject. For example, some geoscientists have sought to identify tick-borne encephalitis virus microfoci in neighboring Germany for the purpose of predictive mapping; the two variables with the highest contribution to the model are linked to the environment and the climate, i.e., multi-annual evapotranspiration and multi-annual hot days, followed by recorded minimum air temperature (Borde et al. 2022). More generally speaking, it has been underlined in New Hampshire in the United States that "risk perceptions are closely associated with knowledge of climate change's impact on vector-borne disease" (Bolin 2022, p. 31).

Such explanations are endorsed by the groups surveyed in the Argonne region. Among others, a technician at the ONF working in a state-owned forest explained that current tree species are threatened both by bark beetles (Figure 3) and by ash dieback, which ultimately favors tick hosts, whether reforestation policies are carried out or not:

"Spruces: bark beetle attacks! [...] To replace spruce, we're reforesting with Douglas fir... Spruce is no problem, it doesn't attract. [...] On the other hand,

Douglas fir is the main food for deer. . . [. . .] All the ash trees along the river banks are dead, precisely because the fungus has developed better. [. . .] There aren't necessarily any trees to take over, so the herbaceous vegetation explodes, which favors the spread of ticks. [. . .] On plots with ash trees with ash dieback, as soon as they come into the light, there are ticks for you!". (interview, 20 May 2022)



Figure 3. A spruce forest in the Argonne region that has become vulnerable to climate change following a bark beetle invasion, encouraging the spread of ticks. When storms are not knocking down the weakened trees (b), foresters are cutting down the affected plots to contain the pockets of contamination (a). (Photographs by Aude Dziebowski, UMR SAGE, 19 May 2022).

Hunter representatives also concurred in pointing to the impact of climate change. Two heads of a hunters' federation thus agreed:

- “I think it's global warming. [. . .]
- It is an undeniable fact that 1° there are no longer any cold winters, 2° there are more hosts [i.e., animals that harbor ticks].
- Yes! [. . .] There's one thing for sure, global warming brings with it longer periods when ticks are present.
- Absolutely!". (interview, 8 December 2021)

The farmers surveyed similarly mentioned climate change as an explanation; for example: “The main link, it has to be said, is climate change! [. . .] [Ticks] also need damp areas to proliferate” (interview, 6 July 2022).

This has become a widely held opinion. Yet, this has not spread through the influence of scientific studies establishing the fact that climate change does have an impact on the expansion of tick range and the increase in tick bite risk (such as [Ostfeld and Brunner 2015](#)). For the respondents, the insights gained on the ground outweigh knowledge that is not rooted in direct perception, as a forester at the ONF explained:

“The forest of [X], one summer when it was really really hot, with fern tall like this and a rather clear forest stand—so it might not at all match what was said during the lecture [a lecture on ticks he attended]—but after I came back, there were something like 40 ticks! Which means spending one or two hours with a tick remover”. (interview, 20 May 2022)

The respondents often distanced themselves from generalized “expert” knowledge. They always insisted on the fact that their views were localized and based on experience defining a concrete boundary space, which means that they could easily recognize their limitations when there was a lack of material evidence. One example is provided by an officer from the ONF, when he referred to the influence of light in the undergrowth on tick populations:

“The impact of sunlight on ticks with clearcutting every 30 years. . . Clear cuts here only correspond to regeneration plots. It’s hard to say whether there are more stands in the light now than with coppice cutting in high forest, you’d have to make calculations I’ve never made”. (interview, 20 May 2022)

Climatic factors thus seem to be preferred as an explanation because the issue then appears to lie outside the scope of the local actors, unrelated to their interactions and possible conflicts about the upkeep and legitimate uses of the forest and natural spaces. That is why some of the people involved in local community organizations are not satisfied with this exogenous explanation, which removes responsibility from the local actors for their farming, forestry or hunting practices. For instance: “We’ve always had ticks. There were fewer than today, [. . .] but you can’t blame everything on climate change. [. . .] Do I make a link, yes and no, ‘cause we tend to always make a link with climate change about everything” (interview, 9 May 2022). Forests are thus boundary spaces where social transactions are being continually negotiated regarding the legitimate modes of expression.

A second reason is frequently given for the proliferation of ticks: the comeback of wildlife species, which can be hosts to them. Ticks are undeniably present on game today in the Argonne region. A technician at the ONF related a significant episode, which he dated from the autumn of 2017, involving a poached stag (Figure 4). The corpse presented a very high number of ticks and the stag’s head (which is sometimes considered as a trophy by poachers) had been confiscated and placed in a car, which led to memorable moments when it came to getting rid of the ticks:

“There had been poaching during the rutting season. [. . .] In the end we confiscated the head of the stag. [. . .] We’d tied a knot in the bag, we carried the head, it lasted 20 min, but there were ticks all over the car! [. . .] I had to go to a pharmacy to get an acaricide and I had to use it all weekend on the car. When I opened the car on Monday, there were dead ticks everywhere: on the seat, on the dashboard, everywhere! I had to take out all the clothes, shake everything out, empty and clean everything”. (interview, 20 May 2022)

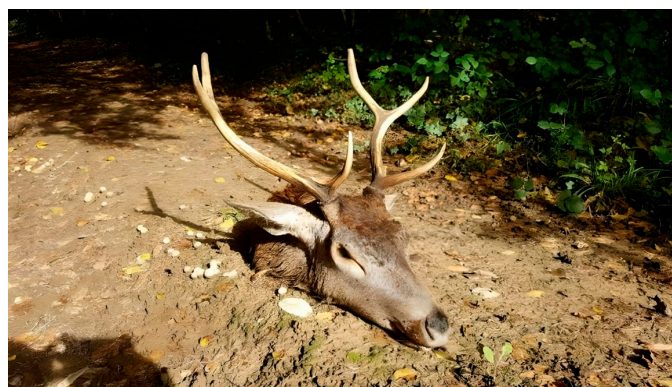


Figure 4. The head of a poached stag: the black spots are ticks, which are widely present on big game animals in the Argonne region (photograph by Romuald Weiss, a technician at the ONF).

Many respondents mentioned the correlation between the presence of big game and ticks in the region. The head of a hunters’ federation asked: “This idea has been cropping up: couldn’t it also be due to the increase in wildlife?” (interview, 8 December 2021). A forester working in a private estate shared the same view: “For me, today, the main challenge is to control big-game populations!” (interview, 3 March 2022). In a similar way, during a hike, we observed that the road verges had been turned over by wild boar. A farmer we interviewed explained the practical solutions he had found: “This happens when the grain becomes milky and doughy, wild boar love it! To avoid this, we sow bearded wheat because the beard scratches their throat. That’s a clever trick, except that bearded wheat does not have the best yield. But we have no other choice” (interview, 6 July

2022). The wheat field is a boundary space between men and wildlife, where partial and ever-renewed transactions are always being negotiated, such as the practical compromise found by the farmer.

Through the tensions and compromises involved, these concerns about big-game populations specifically suggest a third way to approach the issue of tick expansion. It is now generally accepted that human-induced climate change plays a role in increasing the risk of tick-borne disease. Sarah Randolph has shown that while the analysis of climate records since 1970 has revealed abrupt temperature increases just prior to the dramatic upsurge in tick-borne encephalitis (TBE) incidence in many parts of central Europe, this pattern of climate change does not account for the marked heterogeneity in the timing and degree of TBE upsurge in different areas within the Baltic countries. The author, instead, points to a range of abiotic and biotic environmental factors, together with changes in socio-economic conditions (Randolph 2011). To explore further the interactions between human beings and the environment, we should not just consider the macrosocial scale. Our fieldwork shows in greater detail that the question of human impact is a source of conflict between the different groups present in the same area which makes its understanding more complex at the same time as it demonstrates the human-made nature of the phenomena under study.

In the Argonne region, while it can be argued that there is a link between the proliferation of big game and tick expansion, the representative of a sports and leisure organization suggested that the responsibility largely lay in human choices and practices, and explicitly pointed to the hunters: “They are big tick carriers: wild boar are proliferating, and there is a huge number of deer and roe deer. [...] Hunters keep game populations up because they feed them. And shooting plans are very restrictive, especially for big game like deer” (interview, 9 May 2022).

The practice of feeding wildlife is a particular source of debate. A farmer pointed out to what is a fact: “[The hunters] feed the wild animals in the area. [...] And they feed them very very well” (interview, 5 July 2022). Another farmer underlined the permanent transactional confrontation between different perceptions. The practice of feeding wildlife can thus be understood as a boundary object between forest and farming spaces, between men and animals and between animals and ticks:

“There are two schools. Those who think that feeding wild animals is a good way to concentrate wild boar in the same place and to define a better shooting plan: you bring them together to avoid excessive breeding. Then, there are those who think that it just means providing them with good and the population is going to increase even faster. I think there’s a middle ground between the two views. But you can’t say that feeding wild animals is a good or a bad thing”. (interview, 17 August 2022)

A forestry technician suggested that the practice of baiting game increased tick presence:

“Where did I pick up ticks this week? I’ve got a machine running, it’s in a patch of beech trees, there’s very little vegetation, [...] we followed in the wake of the machines and it was enough to pick up ticks. It was not far from an old feeding area. [...] The animals know about the feeding areas and they always make the round”. (interview, 20 May 2022)

A volunteer from an environmental and heritage organization considered that the presence of wild boar was indicative of human intervention. When attempts are made to correct this through so-called wildlife regulation measures, these give rise to a vicious circle, attesting to the underlying influence of socially based realities:

“Wild boar proliferating, well we all can see the road verges being turned over. No doubt about that [...]. But I think that this business of correcting imbalances, when you kill the natural predators of some animals, you eradicate foxes because they’re harmful [...] you keep on destroying the balance”. (interview, 12 April 2022)

The feeding of wild game can thus be considered a boundary object in the conflicts between actors involved in the same area. A technician from a hunters' federation thus took issue at length with the fact that the current practices should cause concentrations of wildlife, taking up one by one the arguments used by the various parties:

"Where the landowners allow feeding, the way we do it is codified [...] we have to declare it, it is controlled. [...] It is talked about from a technical point of view, people say it encourages reproduction. That's not true! Really not true because the volume of food that's provided cannot change the physiognomy of the animal. [...] It's a false debate. On the other hand, there is an ethical debate. It's based on morals: it's not good to feed a wild animal. [...] We have no problem with that in the hunting world, where we believe that nature is on our side. But there are [...] some people who always want things to be whiter than white. [...] Now what causes concentrations is not feeding the animals, [...] it's the wild boar population: they're gregarious animals, gathering around the females, and then the males gather around. [...] I tend to think that morals is one thing, regulations are another and factual and technical elements are something else again". (interview, 9 December 2021)

On the other hand, some argue that the development of leisure and tourism activities is likely to make human-tick encounters more frequent by causing changes in social behavior (Randolph 2001, 2011), as a hunter suggests: "What I think is that there is a huge development in green outdoor activities and that [...] this is necessarily going to lead to more exposure and incidents, more tick bites" (interview, 22 March 2022).

In this context, rather than hesitating between environmental and social explanations, some respondents have developed a systemic theory. Their main point is that promoting biodiversity would help contain tick expansion:

"I'm no scientist but what I think is the more birds there are, the more different animals there are, the stronger the immune system of the forest. [...] The more diversity there is, the more capacity there is for resistance and for erasing the effects of tick concentration". (interview of a forester, 24 March 2022)

"Would that be an interesting idea to explore, to say: are meadows where there is no hedge, no copse, meadows where ticks multiply more and can't we see this at our very small scale? Because we have a population of wild birds: we also have swallows, sparrows, buzzards. ...". (interview of a farmer, 19 August 2022)

Here again, direct and localized perceptions are mobilized to provide the concrete proof of a correlation between biodiversity loss and the upsurge in cases of zoonotic diseases in human beings (Lesne 2021, p. 251).

What can be seen is that while some consider their relation to the environment in a systemic way, others have a more sector-based approach. This is important to consider when designing health awareness campaigns. A study of the communication tools focusing on Lyme disease aimed at rural and urban populations in Canada revealed that to increase the uptake of adaptive health and environmental behaviors, the communication messages had to be tailored to their specific audience: for some audiences, bridging climate change and health, while for others, strategically decoupling them (Cameron et al. 2021). Our fieldwork confirms this idea. In addition to pointing out that the actors involved do not share any common vision of the effects of human-made action on the environment (hence ongoing disputes and social transactions), we also want to insist that none of them can claim to have any panoptic understanding or control, nor, on the other hand, can they be singled out for blame when it comes to zoonotic disease management.

Expertise is indeed a relational property, i.e., it has to be recognized as such by the audiences addressed. This recognition process is connected and limited to each boundary space and its specific actors; thus, it has no general scope in a territory. For instance, hunters are not necessarily considered to have the most legitimate views in matters concerning

biodiversity or to be qualified to give tick prevention advice, as a volunteer from a local area development organization suggests:

“For regular hikers, hunters are a danger. When they talk about ticks when they are shooting lead bullets all over the forest. . . [. . .] when they claim to be protectors of biodiversity [. . .] that did not help the cause of biodiversity. [. . .] And using them as spokesmen about tick prevention, in my opinion, it’s better to have health professionals do it [. . .] and to post tips in bakeries”. (interview, 12 April 2022)

More broadly speaking, a facilitator at the *Ligue de protection des oiseaux* (the largest bird protection society in France) summed up well how difficult it is to produce a legitimate discourse; the views expressed by one group will be considered to be biased by the other parties:

“The local actors can act as relays but [. . .] you can’t ask local authorities to become experts in tick-related issues. We’re not legitimate either. [. . .] We’re not in the medical field. [. . .] We’re restricted to biodiversity preservation, and if we say that we’re preserving biodiversity for our well-being too, we’re accused of trying to scare people”. (interview, 25 May 2022)

Such a multiplication of different principles of legitimacy indicates that the relations to nature have become embedded in the social context, insofar as our contemporary societies are characterized by the presence of different, independent “spheres of justice” (as defined by [Walzer \(1983\)](#)), with no simple principle of equivalence or hierarchy between them. The transactions that take place are therefore necessarily spatially and temporally situated, always relational and relative, and it is this characteristic that defines the dynamic of boundary spaces.

4.1.3. “Tick Areas”: Forests, Wasteland and Tall Grass as Boundary Sites of Human–Tick Encounters

By the same token, it is not easy to objectively define what ecological areas are more particularly favorable to ticks, as this also involves various perceptions and beliefs. Forests first, and then wasteland and tall grass, can especially be analyzed as boundary spaces, as hazier perceptions are attached to open spaces.

Those who work in the forest consider that it is the most favorable environment for ticks. A manager at the ONF told us: “I’m fine because I work at least two days a week in front of a computer and generally only two days a week in the forest. [. . .] [The most dangerous area] is really the forest!” (interview, 20 May 2022). In a similar way, a farmer and a veterinarian pointed out that cutting down trees exposed farmers to the risk of tick bites:

– My husband [a farmer], it happens when he is cutting down trees.

– Yes, forestry work!

– When he goes to get some wood. Trees that are in the parks, because he always tries to have shady areas in the parks, and trees that need to be cut and are damaged, that’s when he gets ticks”. (interview, 5 July 2022)

The role of vegetation was often mentioned. Dense undergrowth vegetation is often perceived to be favorable to ticks. Several members of local sports and leisure organizations thus reported: “What I see is that you’re more likely to get ticks when you’re in thickets, in low bushes. It happens less when you walk in the paths. [. . .] When you go mushrooming for example, you sometimes rub against the low bushes, so then it’s simpler for ticks to settle on you” (interview, 9 May 2022); “It happens when you go through the fern, that’s when you get ticks” (interview, 12 May 2022).

Tick presence was often connected to abundant undergrowth vegetation, which depends on the stands of trees and their condition, on whether they let more or less light through:

“This is a damp area, there’s a lot of ash trees and besides, it’s a deer spot so you automatically get ticks! [...] When we look down at your pants, we find one, two or three ticks. On the big beech stands [...] it’s quite closed, quite dark, so there’s very little vegetation underneath. [...] There’s also the issue of the oak processionary caterpillar. Last year, in July, oaks looked like it was January, they had no leaves! So this brings more light to the ground, and the vegetation exploded even more. Different things have an impact at the same time and it has an effect on ticks”. (interview, 20 May 2022)

It has been shown that ticks are not only abundant in France in forest areas (Mathews-Martin et al. 2020), even though most people, including healthcare professionals (Bord et al. 2022, p. 8), tend to establish a link between them. Our survey respondents did not actually keep only to this point of view but also mentioned wasteland and tall grass as possible “tick areas”. Since wasteland seems to be less subjected to human intervention, it appears to be a favorable environment for ticks. The representative of a hunters’ federation referred, for instance, to military camps:

“I hunt at the military camp: 12,000 hectares where there’s nobody apart from the soldiers. It’s a dry grassland and it’s chock-full of ticks! I think that when I go hunting in October, I removed over thirty ticks from my dogs after a day’s hunting. [...] And I skinned a wild boar that came from the camp [in the middle of winter], the ticks were climbing up my arms!”. (interview, 8 December 2021)

The respondents commonly mentioned tall grass as presenting high tick-bite risk. As an example, a hunter told us: “I think that it happens more in the tall grass, in bushes, than on very low-cut environment” (interview, 8 December 2021).

On the other hand, the farmers surveyed rarely referred to farmland as a favorable site for ticks. Cereal growers, in particular, explained that their mechanized type of work preserved them, even more so than livestock farmers, from contact with ticks:

“Personally, I’m most of the time in my tractor. . . That said, I think that a livestock farmer, he can get bitten when he goes round his pasture. I have a cousin who regularly goes round on foot, I think that if you walk in a pasture wearing shorts and flimsy shoes there’s a risk”. (interview, 6 July 2022)

A pig and cereal farmer added: “Farmers spend half of their time driving a tractor, one fourth of their time doing mechanical work and one fourth looking after their animals” (interview, 8 July 2022). Tick risk perceptions thus reflect professional changes affecting people’s relationship to nature, which suggests that social factors are also relevant beyond purely ecological or medical approaches. Hence the question asked by a livestock farmer couple: “In the end, how real is the risk? [...] It was true in the days when people used to do work with their hands but it’s no longer the case” (interview, 8 July 2022).

Those tangible accommodations show that the boundary spaces of human–animal interactions are evolving. This raises the question of how relevant scientific studies can be to different types of local environments and professional fields and to their evolution. It is essential for research to be based on a “sense of place” and to be attentive to the socio-ecosystemic conditions that cannot be understood outside of “residential knowledge” (Kohler 2012).

4.2. Health-Centered Points of View: Awareness of Lyme Disease in One’s Close Environment

In addition to the socio-environmental theories we have unpacked above, there are also more health-centered approaches to tick-related issues, especially focusing on Lyme disease. The actors’ approach to Lyme disease is here again shaped in their social transactions by local perceptions and by the way they consider healthcare schemes and professionals.

All the respondents mentioned Lyme borreliosis, whether they were involved in hunting, forestry, farming, natural life or leisure activities. It is what immediately comes to mind when ticks are talked about, as the following discussion between two heads of a hunters’ federation shows:

“– In the upcoming issue of the federation’s journal, there’s Lyme disease. [...] It’s written by a doctor. [...] And during the meetings the hunters ask to be told about ‘Lyme disease, Lyme disease...’

– We all think, ‘I’m going to get Lyme disease!’” (interview, 8 December 2021)

Many respondents had the same feeling. For example, a forester at a private estate confessed: “Given the consequences on the medical level, we all end up thinking, ‘maybe I’m living with Lyme disease...’” (interview, 24 March 2022). And a sports leader concurred: “There’s a real risk, that’s for sure, more and more people are being diagnosed with it” (interview, 9 May 2022).

The interviewees’ understanding is informed by socially shaped perceptions of the health situation: their perceptions are based both on experiences that they lived themselves or that were reported by people close to them, and they are fueled by the fears and fantasies attached to severe illnesses. The role of very local intermediaries is essential in this process. From that perspective, representations of ticks are always in the making: the references individuals draw upon are based on the current state of medical knowledge and public discourse on the disease. The words of a sports club manager are quite telling. He was bitten two decades ago, and his awareness of the disease and the way it was treated were very different from now:

“There was a time, people didn’t know much. I had a little red spot on my calf all summer. But we didn’t know any better than that, that was over 20 years ago. [...] We had a blood test, [...] the result was I was positive. [...] A friend of mine is in the same case as me, he didn’t take anything, just like me, I didn’t take any [antibiotics]. At the time I was told that I was a carrier but did not have the disease”. (interview, 30 May 2022)

Things are different today. When we talked to the representative of a hunters’ federation about Lyme disease, he did not cite established knowledge on the subject but wondered about “chronic” forms of the disease, the source of medical controversy today ([Aronowitz 1991](#); [Dumes 2020](#)):

“Lyme disease is something I’ve been wondering about. [...] So much so that I invited a doctor to come hunting with us once. [...] And he told me, ‘we know a few things but we’re just learning about chronicity’. Before that, if you hadn’t got Lyme disease after one year, people would say, ‘well you didn’t catch it!’ But that’s not true! Because two years later, four years later, you can get it. [...] Fifteen years ago, no one talked about chronic Lyme disease, but people talk about it now”. (interview, 8 December 2021)

Almost every respondent said that they knew someone who had been affected by a severe form of the disease, switching from medical considerations to insights gathered from the perception of actual medical conditions, if not direct experience. The boundary space over Lyme disease is thus not theoretical (an abstract risk) but truly personalized (a real probability with visible consequences). The members of natural life and leisure organizations we met in the Argonne region provide a good example: they all had in mind a few severe cases of the disease, as confirmed by the leader of a hiking group: “People know of cases of Lyme disease that have been delicate, someone who was in intensive care at the hospital for two or three weeks” (interview, 27 May 2022). Similarly, the leader of a trail club mentioned acquaintances who had suffered from severe effects of the disease: “Among the people in my circle, I know a few who got Lyme disease, they’re OK now but they had a [difficult] time...” (interview, 12 May 2022).

Social perceptions of Lyme borreliosis are also reflected in the respondents’ relations to healthcare professionals and the protocols they implement. Another boundary space emerges, challenging the strictly medical gaze. The healthcare professionals that people are first in contact with are rarely provided with panoptic knowledge on the issue and might benefit from better continuous training programs. A study conducted in France in the Auvergne–Rhône–Alpes region showed that while pharmacists had solid knowledge about

preventive measures for tick bites and Lyme disease—i.e., health-related issues—their knowledge was less developed in the field of tick biology, i.e., they were less familiar with a socio-environmental approach to ticks, a localized understanding of tick hosts and of the conditions encouraging tick activity (Bord et al. 2022).

During our survey in the Argonne region, this more particularly applied to doctors consulted after a tick bite to make a diagnosis. The respondents sometimes expressed some distrust regarding local practitioners. An employee in an environmental organization stated: “I think Lyme disease is still so little known today, whether by laboratories or doctors, well the doctors are beginning to get trained, but not everywhere” (interview, 3 May 2022). A veterinarian we met remained very cautious about the information she was provided with: “We’re all a bit in the dark and like everybody else, we hear everything that’s being said everywhere” (interview, 5 July 2022). A hunter, expressing similar types of concerns, explained that he had broached the subject with his general practitioner, following a bad experience in his family:

“One of my cousins, with whom I started hunting, [...] over ten years ago, he got Lyme disease. But at the time, it wasn’t documented, at least not by GPs. He got bitten on his thigh and the erythema appeared: the doctor did not do anything about it and [...] he really started having health issues. [...] Today he still has very significant joint pains. [...] The other day I changed GPs. [...] Spontaneously I told him, ‘if I ever have symptoms that make you think it could be Lyme, don’t hesitate’: I kind of took the initiative”. (interview, 22 March 2022)

As can be seen, in this social–health nexus, grassroots perceptions are independent from theoretical knowledge and, rather, based on experiences that have been lived in the family or by relatives, which function as a boundary space. This was the case in the various groups surveyed. The head of a hunters’ federation told us: “My uncle got Lyme disease, he was really, really ill for one year, he couldn’t walk more than 500 m. He must have got it while hunting, I suppose. [...] So when I come back home, I check myself! Just to be sure” (interview, 8 December 2021). The foresters held the same type of discourse; for example, a forestry trainer at a private estate said he knew someone who had been infected by the disease: “I have a friend who has really been suffering for years from the effects of Lyme disease. She’s been identified now, but she’s suffering from the treatment. We’re obviously affected by this and we always have this in mind” (interview, 24 March 2022). In the local sports and leisure groups, which organize outdoor activities, similar things were reported: “In the group, there’ve been people with Lyme disease. [...] One of them has even been hospitalized”, the leader of a hiking club told us (interview, 27 May 2022).

Conversely, people are less sensitive to the issue and less careful when they have not been made aware of the situation of relatives or friends: they then do not feel personally at risk. For example, a hunter declared: “It only happened to me twice, so you know... [...] I’m not too concerned so I don’t attach much importance to it. [...] I don’t find them [ticks] and I don’t even pay attention to them” (interview, 17 February 2022).

That is not all: our survey showed that people had a much clearer awareness of tick-borne disease when their dogs or cats had been bitten by ticks. Here, pets act as a central intermediary in the boundary space between men and ticks, as they embody the porous nature of these spaces, for instance following the hunter on his hunt as well as to his home. We know that domestic carnivores can play a real role in the distribution of ticks in certain areas (Panayotova-Pencheva et al. 2021). But it is, above all, the perceptive effect that stands out here. The animals act as relays, conveying to them the concrete reality of tick risks—which have been demonstrated in the literature, for instance in a study focusing on military working dogs in Austria (Sonnberger et al. 2022). A farmer from the Marne region, also a hunter, thus explained that hunting dogs are often the first concrete indicators of tick presence: “You often see [ticks] on the dogs first. It’s the dogs that pick them up the most!” (interview, 7 July 2022).

In addition to the role of relatives suffering from Lyme disease, a second channel for the awareness raising of tick risk is specifically provided by pet animals as border hosts,

especially when they are affected by piroplasmosis. The disease is not perceived as only affecting dogs or cats; what the animal owners understand, above all, is that tick bites can transmit disease. Given the proximity between their hunting grounds and their everyday environment, the threat for human beings also materializes in more concrete ways. The head of a hunters' federation expressed his fears in the following way:

"I used to have a labrador retriever, she got piroplasmosis when she was eight or ten months old, I almost lost her. She stopped eating, she was out of shape and [the vet] gave her an injection that saved her. [...] I think it worries me even more when it affects my dog. But for myself as well of course!". (interview, 8 December 2021)

Moreover, pets can bring ticks into the home (Alvarez-Hernandez et al. 2022), which makes awareness of tick risk even stronger. A forester thus told us:

"My dog brings them home, [...] I see it rubbing its snout on the couch and often it's a tick. [...] I once found a tick on the living room table, ready to jump out again, waiting for its prey, [...] on the corner of the table. Anything's possible. Sometimes I see some running across the floor too". (interview, 20 May 2022)

On the other hand, in the farming world, tick risk is perceived to be limited. This is the case when intensive animal farming is being practiced. For example, a farmer stated that he had never found any ticks on his pigs, which are confined to a closed environment (interview, 8 July 2022). But the same perception is also widespread on smaller farms or where so-called "reasoned" agriculture is practiced. For instance, a farmer who raised cows daily until about ten years ago does not remember ever finding any ticks on cattle, whereas he did on his cats: "We never had ticks on the cows. I think it's mainly cats and dogs, they very regularly bring them home" (interview, 6 July 2022). Furthermore, tick-borne disease does not feature on the agenda in the farming sector, given that it does not have any significant impact on its activity. This is confirmed by a cereal grower who used to be a dairy farmer: "I've never heard of anything [concerning tick-related issues], I have no memory of it. [...] I don't think the trade unions or the farming profession have put their finger on the tick issue" (interview, 6 July 2022). Since there does not seem to be much economic or health impact when livestock is affected, little attention is paid to it, as confessed by a farmer: "Honestly, we've already seen [ticks] on our animals, but [...] we've never worried about it" (interview, 5 July 2022).

A clear distinction can thus be observed between the perceptions attached to pets (dogs, cats, horses, etc.) and cattle. While the former appear as border hosts and raise concern, the latter, lost in the anonymity of the herd, are not the object of individualized, particular attention. A farmer drew an explicit distinction between horses and cows, both in terms of perceptions and practices. This reveals a specific transaction about the farmer's subjective relation to animals, depending on whether he considers them collectively or as individuals:

"In the middle of a herd, you're going to have some good cows and sometimes I'll find one [a tick] and I won't have the tick remover with me. Because when my horse gets some, I go back home to get the tick remover. But for cows, never. [...] If it's a big one, I'll just pull it out. I know it's not the best thing to do. But most of the time, we just walk past the cows and we don't even see them". (interview, 5 July 2022)

In the end, individuals' relations to ticks are more or less determined by their perceptions of immediate tick-bite risk in their environment, by the fact that relatives or friends have previously been diagnosed with a tick-borne disease or the feeling that Lyme disease is prevalent in their community. In addition to drawing attention to these three factors—with a sometimes cumulative impact—which have also been identified in studies conducted in the United States (Beck et al. 2022), our research points to two important processes through which these perceptions are shaped: the feeling that the risks of exposure to ticks and to

Lyme disease have been increasing recently and the strong role played by pets and hunting animals in making their owners aware of the possible consequences of tick bites.

The localized perceptions of tick risk in the Argonne region thus reveal a double process of translation: from an ecological approach to a socio-environmental understanding of the issue and from a medical approach to more localized socio-health perceptions. These processes of socio-territorial incorporation involve a series of social transactions across different scales of understanding and action between the global and the local, nature and society and between the different groups involved, who can have common or differing perceptions and practices.

4.3. Social and Local Tick-Bite Prevention Behavior within Environmental, Health and Personal Responsibility Approaches

Tick-bite prevention behavior is the result of a threefold approach to tick-related issues, i.e., shaped by environmental and health concerns as well as by calls made on individuals to take personal responsibility. Emphasis on personal conduct rather than on collective regulations seems to prevail. Significantly, the leaders of leisure organizations all appeared to be guided by the same ideas, i.e., that the degree of tick risk should be assessed by each individual on his own rather than by those organizing the outdoor activities. According to them, there is no need to issue specific instructions or to establish collective “best practices”:

“Everyone knows about tick issues. [...] But it’s up to each individual to manage. [...] They do it on their own, [...] our members who have dogs are used to all this stuff. [...] We don’t do any particular prevention on the subject” (interview, 30 May 2022).

A forester at the ONF also claimed that individuals had to adapt to the forest environment and assess the risk on their own:

“We clearly don’t adapt the biotope to the user in terms of tick risk. For now we’re only doing the minimum, that is give people information that there are ticks, that they can cause difficult illnesses and that it’s up to them to adapt. This means that ticks are part of the natural environment: either the people [...] know they are taking risks and they do it in full awareness of the danger, or they can wear boots and stuff to go into the forest”. (interview, 20 May 2022)

Instead of reorganization of or restrictions on the collective use of natural spaces—for instance, defining specific times and places for hunting or hiking—personal responsibility appears to be emphasized. This trend can be observed in the way the respondents referred to specific boundary objects (used in exposure situations) and in the calls made on them to conduct ex-post body checks.

4.3.1. Clothing as a Boundary Object

Body-covering clothing can be considered a visible protection against ticks. It can be analyzed as a boundary object in three different ways: materially speaking, it is a boundary object between individuals and their environment; it is also an object of ever-ongoing transactions, throughout the year, about the specific clothes individuals are supposed to or accept to wear; and finally, when it comes to the reasons given by the respondents for choosing specific clothing, the desire to protect themselves against ticks should not be overestimated.

In the professional context, the foresters especially insisted on the role played by adequate clothing. A technician, for instance, praised the protective clothing provided by the ONF:

“I have a water-repellent softshell outfit, I have a red and black jacket, it’s the new gear for ONF foresters in the Ardennes. [...] It’s tight at the wrist, I wear gloves over it, [...] I’ve got into this habit. [...] In that respect, softshell jackets work

well: when I wear it and I close it, usually on the upper part of my body, I don't get ticks. You'll see them running all over the jacket". (interview, 20 May 2022)

Having incorporated the need to pay proper attention to his clothing, a private forester explained he did so not only in his professional activity but also took care at home and usually changed his clothes every day:

"Very often when you come back from the forest, you've had no tick bite on that day: you wake up the next morning, two days later and in the shower you feel, 'there's something. I've been bitten!' Actually, I realized we all made the same mistake in the forest: [...] after the day's work, we change our shirts, no problem; but we take off our pants and put them back on the next day. [...] If you really change the whole outfit every day, I think you won't be bitten. [...] If you put some clothes back on the next day, you can imagine that the thing [...] spends the night in your pants and the next day [...] it bites right into you!". (interview, 24 March 2022)

For a technician at a hunters' federation, this is also a self-evident matter: "If I go into the wood wearing pants with shorts and boots, I'll be less likely to be bitten than my neighbor who [...] goes wearing only shorts" (interview, 9 December 2021). Celebrating personal responsibility, hunting federations insist on the exemplary habits adopted by hunters. Their awareness of tick-bite risk is demonstrated by the clothing they wear in the forest, in contrast to occasional strollers:

"We work in the forest in July-August-September: I never see any hunter wearing shorts! They all wear pants, shoes, gaiters and all that. When you go for a walk in the forest in September, you'll see a lot of people wearing shorts. That alone shows that hunters are [...] becoming more and more aware of tick issues". (interview, 8 December 2021)

Outdoor leisure organizations also unanimously declared that their members wore body-covering clothes, even suggesting that this was a matter of pure common sense: "People know they have to wear pants. They make light summer hiking pants now, I for one don't go hiking wearing shorts anymore. Very few people go on a hike in shorts" (interview, 30 May 2022).

These responses show that regular users of forest and natural spaces often wear body-covering clothing to protect themselves against tick bites, as our on-site observations have also confirmed. However, these general statements need to be qualified and further explored in relation to various concrete situations.

For all the respondents, clothing precautions involve transactions which both reflect the fact that health-related considerations are embedded in a social context and that health-centered and socio-environmental understandings of the issue are also combined with a belief in personal responsibility, resulting in individualized practices.

In the hunter group, personal adaptations mostly depend on the season, as even individual summer hunting can cause a higher exposure to ticks than collective winter hunts:

"It's really less covering in summer, otherwise it's stifling hot! In general, just a T-shirt and canvas pants. Frankly, if I'm going to sweat and not even be able to see through my glasses. , twice, it's true, I've been bitten by ticks in the summer, and those were the only two times in my life". (interview, 22 March 2022)

Hunters are not the only ones to have a flexible approach to clothing recommendations. A territorial unit manager at the ONF confessed: "Honestly, I can't tell you that when it's 38 degrees outside, we're in the forest and we're dressed like I am today [on a cool and rainy day]. After a while we end up in a T-shirt, even walking through fern, it's not good but that's the way it is" (interview, 20 May 2022). Farmers also only partly take care, like a livestock farmer we interviewed in July, who explained she paid particular attention to the lower part of her body: "I have bare arms when it's hot like this, but I always wear pants and closed shoes, that I do" (interview, 6 July 2022). Similarly, the leader of a hiking

club insisted that they tried to make their members aware of the need to wear protective clothing while confessing that it actually all depended on the temperature:

“We also recommend wearing long pants. I always put gaiters on, it’s a protection, I almost never have ticks when I’m dressed like that. But then, from time to time, I wear shorts because gaiters, they’re too hot. During the Pentecost weekend, [...] the weather was good, so we leave our legs bare”. (interview, 27 May 2022)

The use of bug repellents is another subject for transactions. These kinds of sprays are used by hikers, as we observed when we took part in the *Grande Traversée de l’Argonne* in late May 2022. A veterinarian also said she used them: “I use spray in the forest, more and more... A spray I buy in a pharmacy, a real anti-tick spray. [...] I feel like I get fewer ticks” (interview, 5 July 2022). For some, this is an extra protection against tick bites, which they use in addition to body-covering clothing, while others believe this can dispense with them taking clothing precautions. The above-mentioned veterinarian added: “I still often go into the forest wearing shorts” (interview, 5 July 2022).

In some professional contexts, protective measures are also more or less adopted depending on the perceived benefit–risk balance. These decisions spring from institutional transactions, combined with a process of translation from a medical approach to socio-professional considerations. An occupational health and safety officer at the ONF mentioned the use of bug repellents over clothes as a telling example: “The only preventive measure, today, on which everyone agrees, is to cover your legs as much as possible. You can also use a repellent, but even then! Not in a professional context because it would not be good to use every day” (interview, 15 June 2022).

Through a double transaction, tick-related health issues have been resituated at the interface between principles and rules that neither spontaneously nor fully overlap. The resulting compromise is integrated into an institutional frame because it produces legal effects. We define second-order transactions as occurring within this institutional context in which the relations between actors in the field have already been initially defined, providing the legitimate principle of action and first-order transactions. These do not preclude other compromises on more localized principles. Second-order transactions open up some leeway in the institutional order, which is not only based on rigid, established regulations but is also shaped by ever-evolving processes of appropriation and standardization.

A first-order institutional transaction here resulted in recommendations by the ANSES (the French Agency for Food, Environmental and Occupational Health & Safety) about which products should be used, based on their composition. Then, a concrete second-order transaction was worked out at the level of the ONF health and safety department about the information to be given to its officers and workers. In the end, the decision consisted in suggesting the use of a repellent, but without as much urgency as the use of body-covering clothing and with the added provision that the repellents should not be used directly on the skin. As can be seen, “best practices” are nothing but the temporary result of a compromise involving current medical knowledge and controversies, healthcare professionals’ opinions and socio-professional conditions:

“Our approach, in the health prevention department, is we always go see the occupational physician, who is going to give us recommendations. Often, when the studies are not based on sampling, the physician [...] will say, ‘your employees are exposed to chemicals on a daily basis and the benefit-risk cost may not be in their favor’. [...] We have some repellent molecules, for instance we use product X because it has a molecule [...] that is authorized by ANSES. We advise our employees to use that type of repellent on their clothes, to avoid direct contact with the skin, and not on a daily basis. [...] So we don’t force people to use it, we just make it available”. (interview, 15 June 2022)

Finally, there are reasons for choosing body-covering clothing other than the desire to protect oneself against ticks. Such decisions must be understood in a broader context. A forester thus explained:

“It doesn’t require any particular effort. You realize that if you’re well protected against ticks, it’s easier to do your job without getting hurt or getting scratches. You don’t need special anti-tick equipment, it’s just common sense so as to feel good in the forest”. (interview, 24 March 2022)

Similar views were expressed among the hunters, who, during hunting, need to not only protect themselves but also to find ways not to be spotted by wild animals: “There’s also a practical reason. Because game can see color contrasts. [...] So the guys who hunt in summer put on gloves and hoodies. Against mosquitoes also by the way [...] and against processionary caterpillars” (interview, 8 December 2021). Tick-bite risks are thus considered to be only part of a wider range of issues that deserve attention. Likewise, organizers of outdoor and sports activities in the Argonne region reported that their clothing choices were not only meant to protect themselves against ticks but also, if not more, against mosquitoes:

“We pay more attention to mosquitoes than to ticks. They’re more annoying, well they’re less dangerous, but... Around the ponds, [...] there were little flowers that could be picked from around the trees, wow! When I saw the mosquitoes flying around... I wondered how the people who had come there for the weekend would be able to stay”. (interview, 12 May 2022)

4.3.2. Personal Responsibility in Practice: Body Checks

Even more clearly, the emphasis on personal responsibility is reflected in calls for carrying out body checks after work or after outdoor activities in all the groups surveyed. This can be considered another type of adaptation, meant to ensure that people can carry on with their hunting, professional or leisure practices while still taking tick risk into account—although proper attention to tick risk is then deferred to the time after exposure. Among others, a hunter described the body checks he was now used to carrying out as an end-of-day routine:

“When we sleep at the hunting lodge, last summer we went on individual hunts but, in the evening, [...] we would go for a stroll. [...] I would raise my arms, strip down to my shorts, ‘can you see some on my back or not?’ [...] It was a bit of a ritual we had”. (interview, 22 March 2022)

In the forester group, a technician at the ONF likewise explained that he had got into the habit of checking his own body for ticks, or asking another person to do it for him:

“I’ve got into the habit of automatically checking myself. [...] At the end of the day, I usually take a shower, so that’s when I check myself. The other day I had doubts about my back, [...] I had to go up to my parents’ house and ask them to check. [...] But otherwise most of my colleagues have a partner so their wives have a look”. (interview, 20 May 2022)

At the same time, attention paid to body checks can also result from second-order transactions about which practices should be adopted in the face of tick risk; they might be used to compensate for a lack of precaution during outdoor activities, or because the need for extra caution is felt. This was suggested by a sports club leader, a farmer as well as a rural veterinarian:

“I don’t use anything, no cream, no spray... Then I need to be careful when I come back home, look behind my knees, if I’ve got some attached, they’ll be there. The elastic band of my underwear, they get stuck in the elastic band, in the lower belly part. [...] When you come back from the forest, you can’t go three hours without getting a shower!”. (interview, 12 May 2022)

“Sometimes you get some [ticks] in parks but you don’t notice. Often you notice only when you’re home. It’s itchy and sometimes you even got bitten in the morning and realize it in the evening”. (interview, 5 July 2022)

“When I go into the forest, it’s true, I don’t necessarily use special equipment. But when I come home, it’s time for full-body inspection!”. (interview, 5 July 2022)

Attention to tick-bite risk should not, then, be considered a blanket phenomenon; it can be expressed in various concrete ways, depending on individuals’ perceptions. Like clothing, tick removers can also function as boundary objects. An increase in the use of tick removers indicates effective evolutions in tick-risk preventive behavior. The manager of an outdoor activity organization now sells some in the sports store he runs:

“I’ve pulled a lot out by hand, but it’s not great. With a tick remover it’s easy. [...] And I’ve just had another offer. Clips, for hikers, like carabiners. [...] I place them on the counter, I bought 20 last year, I’ve almost run out”. (interview, 12 May 2022)

A technician working at a hunter’s federation also clearly recommended using a tick remover: “Now that’s something you have to deal with [ticks]. [...] First you need a tool, if you have to pull them out. So I said, half-jokingly, we’re going to make some tick removers with *Fédération des Chasseurs* written on them for communication purposes!” (interview, 9 December 2021).

However, although some people might have heard about tick removers, or even bought one, this does not necessarily mean that they use it. We talked to a hiker who took part in the 2022 *Grande Traversée de l’Argonne*: “Some have tick removers, I didn’t have one. But we have some at home” (interview, 30 May 2022). A farmer also confessed: “I think you need to be careful when you pull the tick out: you can remove the tick and leave the most dangerous part in. [...] But I’ve never used [a tick remover], I used tweezers” (interview, 17 August 2022). There are, then, ever-evolving transactions defining individuals’ relation to tick removers, and the need they feel to take one with them or not. These can also be based on time considerations: “We use them [tick removers], I always have one. If we only go for a day or half-day [hike], I don’t take them, but when we leave for the weekend, for two or three days, we do” (interview, 27 May 2022). In that respect, tick removers function as boundary objects in the general discourse about personal responsibility.

4.3.3. The Political Dimension of an Environmental and Public Health Issue: Prudent Risk Communication

The management of tick-related risks raises issues of social “control”, both in terms of the governance of socio-ecological change (Hamman 2020) and of medical discourse (given the ongoing controversies around “chronic” Lyme disease). Public discourse tends to dismiss what might sound too alarming. An occupational health and safety officer at the ONF explained that he tried to be reassuring when talking about Lyme borreliosis: “What we tell people is that many people have caught Lyme disease and that, like a lot of bacteria that gravitate around our bodies, our bodies have an immune system that enables them to react and protect themselves against it” (interview, 15 June 2022).

This discourse is all the more significant as it develops across the three different types of approaches to tick-related issues we previously distinguished as boundary spaces:

- The socio-environmental approach: the goal is not to erode the positive values attached to natural spaces;
- The health-centered approach: the goal is to avoid raising more doubts about medical and scientific discourse, especially about the diagnosis and treatment of Lyme borreliosis: “It is by objectifying things that we’ll make progress, not by distorting them and making them sound alarming. And after all we know nothing about this, nothing!”, adds a private forestry trainer (interview, 24 March 2022);
- The emphasis on personal responsibility: in prevention messages, the calls on individuals to adapt their health behavior are also a way to avoid deepening possible localized conflicts between professional and social groups on the subject, as well as to avoid impacting local area development policies.

Even though some studies have demonstrated a causal link between the prevalence of Lyme disease and forest exploitation in Europe ([Wierzbicka et al. 2016](#)), both foresters and the leaders of local community groups in the Argonne region have avoided taking positions on tick-borne disease that might invert the meanings associated with the forest:

“We know the danger, we also know what we’ve got to do to limit it. [...] The tragedy would be if in the end, people thought, ‘we’re all gonna die’ and we must not go into the forest anymore ‘cause it’s a hostile environment. [...] When I’m in the forest, I feel good, it’s peaceful, it’s relaxing”. (interview, 3 March 2022)

“We came to take a breather, to make contact. ‘Be careful, there are ticks and you’re gonna catch Lyme disease and it paralyzes you, the nervous system is affected’... [...] There’s no need, if we go there one afternoon, to cause everyone to panic”. (interview, 27 May 2022)

An occupational health and safety officer at the ONF underlined that it was not easy to give advice on tick risk within the professional environment. If the measures taken against the consequences of tick bites appeared to be too limited, this could foster fear rather than alleviate it:

“When you talk too much about a threat and don’t know how to deal with it, it makes people feel afraid! [...] We prefer to talk about risks for which we can provide solutions. And unfortunately, tick risks, we’re a little short on suggestions, and especially when you know the consequences tick bites can have [...] it’s complicated to deal with”. (interview, 15 June 2022)

In the Argonne region, the messages aimed at the mainstream public are intended not to scare away nature lovers, children or tourists. We know that “the presence of ticks and the associated risk of tick-borne diseases significantly influence the choice of recreational area and have substantial welfare effects”, as more broadly shown, for instance, by a survey-based choice experiment among respondents residing in areas with different prevalences of ticks and tick-borne diseases in Sweden ([Slunge et al. 2019](#), p. 1). The leaders of natural life, sports and outdoor leisure clubs all used this argument, which shows once again that the localized perceptions of tick risk have a social, rather than a purely ecological or medical, basis:

“I’m always wary of too much prevention, because it scares people away and what we want is to attract people to our region. We don’t want to tell them there’s a danger, we’re not in the wilderness. [...] Our priority when we give information is to attract people. This is already a society in which everyone is afraid of everything”. (interview, 9 May 2022)

In the end, the rejection of alarming or even “infantilizing” (interview of the member of an environmental organization, 3 May 2022) messages confirms that risk communication about Lyme disease ([Quine et al. 2011](#), pp. 2016–17) is first and foremost based on calls for personal responsibility taking, as suggested by a forester:

“We need to keep this in the hands of medical professionals but we also need to focus on prevention and education measures. People need to understand that they can’t constantly be on edge because there are all kinds of parasites they have to learn to live with, that’s just the way it is. [...] People are not stupid, we can explain this to them”. (interview, 24 March 2022)

While public health or occupational health policies need to be careful not to foster overdramatic common risk perceptions that might make them less effective or even counter-productive, especially if forests become widely associated with danger, nonetheless, rather than encouraging the implementation of finely tuned localized preventive measures—as some scholars have been urging (see [Dernat and Johany 2019b](#), based on a survey led in the Massif central in France)—they have instead tended to shift attention to the individual sphere.

What this brings into view, in fact, is the multiplicity of possible relations to the forest and to nature. Significantly, an officer at the ONF mentioned that he had been suspected of not caring properly for the site around a pond—not cutting the grass often enough—because ticks were present there (Figure 5). Two different considerations come into play: in this case, forest management on the one hand, and local area and tourism development on the other. Transactions at two different levels can be observed. A first-order transaction resulted from the negotiation between the Community of communes (Comcom) and the ONF as to the areas that needed to be managed and the methods and objectives pursued:

“The Comcom is in charge of the upkeep of all the paths, the footpaths and mountain bike trails too. We only maintain the edges of the forest roads. [...] This means mowing the road verges, the grass and then down to the ditch and back ditch, to prevent the hazel trees from encroaching on the verges”. (interview, 20 May 2022)



Figure 5. Field observation: at the picnic area of the Héronnière pond (a), vegetation is taking over from the facilities (b), emboldened by a wet start to spring. On site, a sign warns of the tick risk, but maintenance work does not seem to be carried out regularly. (Photographs by Aude Dziebowski, UMR SAGE, 20 May 2022).

This agreement then led to a second-order transaction, similarly concerning the upkeep of the site. The choice of mowing the grass twice a year is a practical compromise, based on the parties’ differing interests. The Comcom is taking charge, rather than the ONF, to ensure that the site remains attractive:

“Depending on the period, on the day, there can be anywhere between 10 or 15 to hundreds of visitors. There are all kinds of activities: mountain bike tracks, trail running, there’s a tree climbing park on the outskirts, and a campsite just nearby. [...] Then there’s the pond where lots of people like to go for picnics. [...] At the ponds, [...] I’ve been attacked on this point: “you’re letting the grass grow too tall, we get ticks”. Except we can’t afford to come and mow the grass every week. Now the Comcom only mows the grass twice during the season, because we just don’t have the time anymore, so the Comcom has agreed to do it for tourism. But what between nettles, processionary caterpillars and ticks. . .”. (interview, 20 May 2022)

Marc [Mormont](#) (1992) underlined that transactions are detached from the law in the process of elaborating compromises while remaining integrated within the realm of the law, since they produce legal effects. The existing rules define limits as to what can be done; for example, limits on the areas of responsibility of local authorities or State departments. Yet, since they only define broad outlines, they leave significant room for the elaboration of

localized and partial secondary-order transactions. A manager at the ONF sums this up in this way:

“Against ticks, there are no specific mowing instructions. We used to mow. Now we’re in a period of change, [...] with less money for forest management. [...] Obviously where there are tables and benches, every summer from the month of June it’s visible if the grass has not been cut, whereas you can go cut wood in the forest for 60 years without anyone noticing anything. But if after 70–80 years the forest is not replaced, there’s going to be a problem. So with funds being limited, the choice we’ve made has been to maintain the forest and not the tables and benches for tourists. The mowing has been delegated to the Comcom, just so that the tables and benches would not be covered in 150-m-high brambles”. (interview, 20 May 2022)

This second-order transaction simultaneously occurs at three levels:

- at the organizational level: between a local government body and the ONF, concerning the type of maintenance to be carried out, given the financial means available;
- at the territorial level: based on principles covering different (more or less extended or restricted) areas of action (a state-owned forest, the ponds within the forest etc.);
- at the level of time: on the one hand, the priorities made are tied to different meanings and perceptions attached to time—whether the short term or the longer term is being favored and also depending on the forest users considered; on the other hand, the process of reaching a transactional agreement has been facilitated with the adoption of a middle-ground approach—mowing twice a year—which does not directly interfere with the uses of the different stakeholders, i.e., with the first-order agreements.

More generally speaking, the large number of requests for clearing and maintenance that the ONF has to meet is a reflection of all the different possible uses of forest spaces—by hikers, mountain bikers, schools, horse riders, etc.:

“There are foot races, so they don’t just use the forest roads but also the main paths. There’s also a long-distance hiking trail. [...] This year, there’s also someone who’s going to be doing some storytelling in the forest and he’s already asked if we could clear a bit the areas where he’s going to take [the people], especially if there’s tall vegetation, because of ticks. Then there are foot races, mountain bike races, schoolchildren also are coming, middle and high school kids. [...] We also used to have requests from horse riders. . .”. (interview, 20 May 2022)

As becomes clear, the tick issue needs, then, to be explored from multiple angles and at different levels: its local translations are carried out by different groups, with partly, but never entirely overlapping, perceptions and practices, establishing different types of relationships and compromises together. Differing uses of the forest space account for differing expectations and differing views as to what the right action should be. A territorial technician at the ONF thus described the criticism he will meet with:

“We’re going to be attacked about our cutting, we’re going to be attacked because the conifers and ash trees are dying, because there are processionary caterpillars and because we’re not doing anything! [...] Last time, a colleague was at the bakery, he was verbally attacked”. (interview, 20 May 2022)

When diverging interests and values come into play in the same space, there are limited resources for viewing the situation objectively, including expert reports; the reports may have been commissioned and, therefore, be perceived as biased. During an interview, a manager at the ONF referred to a study about the role played by wild boar in the forest ecosystem. He was far from convinced by the study, which came to conclusions at odds with his own on-site observations, and believed it to have been influenced by hunters’ interests:

“We can do studies too! I’m thinking of a particular study I saw on wild boar. When there’s an overpopulation of wild boar, they’re going to eat all the acorns falling from oak trees, so they’re going to jeopardize reproduction while we want

our adult oaks to reproduce naturally. [...] This study's been conducted more for the benefit of hunters, it says the wild boar are good for the forest, because there's a lot of mud around them and, in this mud, there will be different grass seeds [...], so when they move, they're going to brush up against other trees and [...] a different type of vegetation will grow. [...] No, no!". (interview, 20 May 2022)

The tick issue thus appears to be doubly complex, either because it makes different sense to different people, or because it is becoming confused and obscured in wider systems of action. Awareness of this is necessary in order to design and spread tailor-made messages in a specific local area.

5. Conclusions

This case study of human–tick interactions in the Argonne region can contribute to a better understanding of the complex relations between nature and society. The examination of tick-borne disease, as an example of zoonotic disease, can help reconsider previous research on risk perceptions, which is especially useful from an environmental health perspective.

In this socio-territorial and relational approach, the notion of boundary spaces coupled with that of social transactions (Table 2) proved particularly helpful for two reasons. First, it helped consider together public action (public health or forest management policies in the face of climate change) and ordinary everyday practices (for various groups of actors), including tick-bite preventive behavior. Second, we were able to study what occurred in those specific moments—specific moments that are still able to yield broader understanding—when the fields of established public policies and everyday practices intersect around issues that are socially constructed (for instance, Lyme disease) but have not yet reached a fixed definition (the treatment of the disease and whether there are “chronic” forms of it are still the subjects of ongoing debate). In this respect, the focus on ticks as a boundary object also helped in exploring similarities and differences between social groups with distinct relations to and uses of nature. For instance, changes in farming particularly stood out, resulting in less direct contact with the natural environment and less awareness of tick risk in the farming profession than among hunters, foresters or outdoor leisure organizations, for whom tick bites are indeed a major concern.

Table 2. Summary of the most relevant results of the study.

Socio-Territorial and Relational Approach	Knowledge	Perceptions	Practices
Boundary actors, objects and spaces	Local knowledge derived from direct observation rather than adhesion to expert knowledge.	Localized perceptions of “tick areas”, defined as such due to their wild-animal population (deer and wild boar in particular) and flora (tick activity is believed to be more intense in deciduous forests or fern and tall grass environments).	Increasing use of tick removers after exposure.
	Intertwined perspectives and forms of knowledge: tick-related issues are not only considered by themselves but in relation to other socio-ecological forestry issues (processionary caterpillars, bark beetles etc.).	Localized perceptions of Lyme disease inspired from one's own or close relatives' experience and from one's pets (rather than confidence in medical expertise); on the contrary, appropriation of the debates over “chronic” Lyme disease.	Body-covering clothing worn as a protection (water-repellent jackets, gaiters, gloves etc.).

Table 2. Cont.

Socio-Territorial and Relational Approach	Knowledge	Perceptions	Practices
Social transactions	The validity of actors' practical knowledge is continually redefined, as they are aware of their limited knowledge but also convinced of the primacy of direct experience.	Emphasis on the role of climate change in tick expansion rather than on localized explanations involving human action, since this would result in different groups opposing one another.	Mitigating the effects of tick bites rather than avoiding them. Emphasis on personal responsibility rather than collective regulations.
	Practical knowledge linked to familiarity with certain areas, leading to greater awareness or forgetfulness about the threat of tick exposure.	Avoiding inverting the positive values associated with natural and forest spaces or upsetting professional habits (for foresters): ever-ongoing transactions about how to communicate information about tick risks without sounding alarming.	Preventive behavior practices vary along a gradient of increasing awareness to tick risk: first, ex-post body checks; then, to a lesser extent, use of body-covering clothing; finally, to a still lesser extent, avoidance of "tick areas". Cumulative or alternative use of these preventive measures.
	Knowledge influenced by memories of place and their evolution over time.		
	Tensions between scientific and situated knowledge; for example, about how to diagnose Lyme disease or the use of alternatives to tick removers.		Flexible embrace of preventive measures: the use of body-covering clothing will depend on the season; a tick-remover will be considered more or less useful depending on the time spent in a natural area.

Studies have suggested that the effectiveness of health prevention policies in rural areas depends on the combination of four factors, i.e., knowledge of the spatial and temporal variation of tick abundance, what constitutes risky behavior, how countryside users respond to information of varying content, and an understanding of the social practices related to countryside use (Quine et al. 2011). Our concrete case study has helped us further identify the types of factors involved (Table 2). This reasoning precisely ensures the broader transferability value to rural areas. First, the variables at play relate to knowledge: whether knowledge is available or not (scientific or medical knowledge, knowledge on the correlation between the factors likely to cause tick range expansion, etc.), whether it has been disseminated or not (our respondents derived their knowledge from local direct perception mainly) and whether it is contested (by scientists, experts, patients, hunters, hikers, foresters or farmers etc.). Tick-risk perception and management therefore appear to be complex matters, with tick risk being often understood more as the result of individual behavior than as a societal threat. Yet, it is one such threat, as witnessed by the socio-spatial configurations favorable to tick expansion and the spread of Lyme disease. One might think, for instance, of the search for local attractiveness, as exemplified in efforts made not to scare away hikers or nature lovers and to avoid undermining people's positive perceptions of the forest. All of this can account for the differential level of knowledge or awareness of tick-bite risk that has regularly been mentioned in the literature (Butler et al. 2016).

Two social processes seem to be developing in opposite ways. On the one hand, the public health issue has been depoliticized, as can be seen in the calls made on individuals to take responsibility and to adopt "best practices". This process works against movements that have been developing to bring awareness on heretofore ignored "chronic" forms of Lyme disease and to call for public action on the subject—with emphasis being placed either

on the role of “whistleblowers” seeking to publicize unacceptable human situations or, conversely, of “merchants of doubt” working in favor of preserving the status quo (Oreskes and Conway 2010). On the other hand, local socio-environmental issues have increasingly been invested with political meaning, whether concerning the relations between economic actors, spaces, professional groups or users. Differing uses of nature and natural resources give rise to a situation of conflictual coexistence. Knowledge, therefore, cannot produce any effect of its own: it is dependent on individuals’ social acceptance, which is itself based on their perceptions and practices in the different social spaces surveyed. For instance, the notion of “tick areas” can be given a plurality of concrete meanings rather than provide a general concept for a better understanding of the exposure to tick risk. In this sense, by examining the three levels of knowledge, representations and practices, this study calls for a rethinking of tick-related issues through the consideration of localized concerns, health imperatives and the calls generally made on individuals to take personal responsibility. This threefold approach can help point to the challenges and adaptations paving the way for socio-ecological change in the Anthropocene. To move in this direction, transdisciplinary research resorting to social science approaches alongside health and natural science approaches needs to be not only called for but actively carried out (Talbot et al. 2021).

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Notes

- ¹ For more information, see for instance the journal *Ticks and Tick-borne Diseases*: <https://www.sciencedirect.com/journal/ticks-and-tick-borne-diseases> (accessed on 20 October 2023).
- ² Some authors and medical sources speak of tick stings, while others prefer to refer to tick bites. While the tick’s rostrum (the part embedded in the skin) is indeed its mouth apparatus (so that it would be justified to say that the tick bites), it functions like a stinger, piercing the host’s epidermis before drawing blood (the tick, then, can be said to sting).

- ³ See <https://oscahr.unistra.fr/diaporamas/largonne-r%C3%A9gion-foresti%C3%A8re-%C3%A9l%C3%A9ments-de-cadrage-avec-lifn> (accessed on 20 October 2023).
- ⁴ The ZARG cooperation network, which has been recognized by the French National Centre for Scientific Research (CNRS) and the Universities of Reims-Champagne-Ardenne, Strasbourg and Lorraine, brings together fifteen local government bodies, public organizations and community issue groups in the Grand Est region (including Argonne Pôle naturel régional), in order to discuss the region's socio-ecological issues.

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