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ONE HEALTH APPROACH IN FREE-RANGING SYSTEMS – BOVINE TUBERCULOSIS AS A MODEL

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ABSTRACT

Bovine tuberculosis (bTB) infection in wildlife represents one of the main animal health risks for free-ranging animal husbandry systems in Europe. A regular surveillance is essential for assessment the real problem and for determination of bio-security rules for these husbandry systems. Based on previous studies, we hypothesized that post-mortem examination on submandibular lymph node (smLN) of hunter-harvested wild boars can be a useful method to follow bTB epidemics and to assess the risk of a certain environment. During a hunting season between November 2015 and January 2016, we examined 287 wild boar carcasses inside a known bTB hot-spot and 214 ones outside of that. We found 92 and 25 carcasses with suspect bTB lesions, respectively. Only one carcass showed generalized symptoms and all of the others were detectable solely by section. Our results suggest that surveillance based on smLN section of wild boars can show bTB hot-spots and hereby, this is applicable to forecast epidemiological risk. Moreover, this study confirmed that visual-only game meat inspection would miss most of the suspect bTB lesions. Therefore, it is unsuitable to integrate into an epidemiological surveillance system.

Key words: bovine tuberculosis, wild boar, surveillance, One Health, visual-only inspection, risk assessment

1 INTRODUCTION

Bovine tuberculosis (bTB) in wildlife reservoirs is one of the most important animal health risks to free-ranging animal husbandry. Former control strategy, e.g. the test-and-slaughter method, which is based on the culling of bTB positive animals, is apparently not very successful. New outbreaks among cattle emerge from wildlife reservoir (Gortázar *et al.*, 2015; Fitzgerald and Kaneene, 2013). In these circumstances, conventional epidemiological strategies need to be updated.

In the last two decades, a completely new approach called "One World – One Health – One Medicine" (briefly One Health) evolved. The innovation of this new perspective was to combine the methodology of different disciplines including veterinary and public health, ecology, forestry, wildlife science, geography, meteorology and other professional fields that can provide data with epidemiological relevance (Zinsstag *et al.*, 2011).

Emerging infectious diseases (EID), which can be maintained by a wildlife reservoir, are the main objects for One Health. These diseases should be investigated by a holistic approach. During these epidemics, the ecology of the reservoir species, the environment in which it exists, the structure of the concerned ecosystem provides important features of the epidemiological analysis. The success of these complex analysing processes can be provided only by the contribution of different professionals. Multi-disciplinary research groups are therefore required (Zinsstag *et al.*, 2011).

Bovine tuberculosis provides a true One Health model. In Europe, the badger *(Meles meles)*, the wild

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boar *(Sus scrofa)* and the red deer *(Cervus elaphus)* are regarded as maintenance hosts of the disease. Inside an endemic area, the reservoir species constitutes a continuous epidemiological hazard for animal husbandry (Gortázar *et al.*, 2015; Fitzgerald and Kaneene, 2013). In Hungary, the wild boar proved to be a host of bTB, although its maintenance role has not been confirmed yet (Jánosi *et al.*, 2009). Former studies demonstrated that the submandibular lymph node (smLN) of this species could provide a valuable epidemiological information about bTB endemics (Csivincsik *et al.*, 2015).

In this study, we compared a known bTB hot spot and its surroundings by necropsy examination on boar carcasses collected within and outside the hot-spot; furthermore, we analysed environmental factors potentially relevant in bTB spread. Our aim was to verify that surveillance system based on the section of the boars' smLN could be able to determine the possible presence of bTB hot-spots. Our further aim was to demonstrate a method of One Health during epidemiological work.

2 MATERIALS AND METHODS

Our study was carried out in the south Transdanubian region of Hungary, in Somogy County between November 2015 and January 2016. This part of the country is sporadically infected with bTB. This region defines a real bTB hot spot. This is the Zselic Landscape Protection Area and its close surroundings, where four bTB outbreaks were detected in beef herds during the last decade. Outside of this hot-spot, bTB can be detected only in wildlife with sporadic emergence.

All of the studied areas keep dense wild boar populations. The hot-spot is a hilly, highly forest-covered area with a 6,000 ha forest block as a core. Matured, mast producing forest stands provide rich feed resource for wild ungulates. This hilly region is markedly characterized by pre-humid climate, which makes it a suitable beech *(Fagus sylvatica)* site; thus we considered the presence of extended beech stands as an indicator of humid climate. The occurrence of beech stands outside of the hotspot is not featuring, because of dryer climate (Fang and Lechowicz, 2006). On the other hand, the expansion of golden jackal *(Canis aureus)* can be observed through the less hilly and less forested regions of Somogy County. Therefore, expansive golden jackal populations indicated sandy-soiled flatlands with agricultural mosaic, in this context. The proportion of forest and agricultural areas is 45 % and 55 %, respectively.

We examined 287 wild boar carcasses inside a known bTB hot-spot and 214 ones outside of that. During the eviscerations, we carried out a visual-only game meat inspection (VOI; without any incision) and then we sectioned and categorised the smLNs of each carcass (Hill *et al.*, 2014).

The results of post-mortem examination inside and outside of the hot-spot were compared by Chi-square test while the real prevalence of suspect bTB lesions was calculated by the method described by Reiczigel (2003).

3 RESULTS AND DISCUSSION

Inside the hot spot we found 92 carcasses with suspect bTB lesions (N = 287); while outside of it 25 carcasses showed visible lesions (N = 214). Inside the hot-spot, a generalized case was detected. Despite the generalized case, none of the lesions (N = 117) could be detected by visual-only game meat inspection (Table 1).

Statistical comparison of the sites by Chi-squared test proved to be significant ($p < 0.0001$).

A remarkable difference between lesion prevalence of the two sites confirmed that a hot-spot can be detected by the section of smLNs in wild boars. Notwithstanding, it is obvious that VOI is inadequate to detect lesions in the smLN, whereas the only generalized case could be detected without any incision. In this point of view, VOI cannot be used as a tool for epidemiological surveys, although it must attend upon food-safety of game meat and consumers' health.

Post-mortem examination of smLNs cannot determine the true prevalence of bTB in a wild boar population but it can highlight the epidemiological risk of a certain environment. This can help animal keepers and animal health professionals in strategy development. Neither the causes of higher risk can be determined by this survey. The collaboration of different professionals is needed to discover linkage among environmental factors.

Inside our study sites, the hot-spot is characterized by recognizable forest-coverage and humid climate; oppositely the other part of the County, which is dryer and mainly agricultural area. Humid environment and the lack of direct sunlight exposure are confirmed to support survival of mycobacteria (Fares, 2011; Walter *et al.*, 2014). In these circumstances indirect contacts also contribute to the spread of infection. Outside of the endemic area, the expansion of golden jackal might affect the epidemiology of bTB by predation on wild boar piglets, juvenile adults, and weak individuals. This can decrease the density of the host species and furthermore, in the most susceptible classes of the population. Ecosystems, where apex predator, as the golden jackal within the study area, role is occupied, are more successful in fighting off EIDs (Ostfeld and Keesing, 2012). Without detailed ecological analysis on feeding habit, population structure and

Table 1: *Post-mortem findings inside and outside of the bovine tuberculosis hot-spots*

	Hot-spot	Sporadic bTB [a] area
Examined	287	214
Lesioned visibly	92	25
Generalized case	1	0
True prevalence of lesions (CI 95 %) [b]	32.1 % (26.8–37.8 %)	11.7 % (7.9–16.8 %)
Lesions detectable by VOI [c]	1	0
Percentage of VOI-detectable lesions (CI 95 %)[b]	0.9 % (N = 287 + 214) (0.1–4.6 %)	

[a] bovine tuberculosis, [b] confidence interval, [c] visual-only game meat inspection (without incision)

population dynamics of the golden jackal we cannot determine its epidemiological role. Our study claims for the necessity of organizing multi-disciplinary research groups, which are able to analyse deeper ecological–epidemiological coherence of certain factors that can affect bTB epidemics in a natural environment.

4 CONCLUSION

Free-ranging animal husbandry systems seem to be economically advantageous as those need low inputs; notwithstanding, these systems need multi-disciplinary knowledge from the management. In these multi-player situations, applying One Health concept is essential. Our results showed that animal health surveillance in wildlife could contribute to the safer food production and EID control. Within our study site humid forest climate seemed to worsen the epidemiological situation, while the presence of an apex predator seemed to be a potential solution for the problem. Notwithstanding, further research by a multi-disciplinary group can reveal the deeper epidemiological connections of this ecosystem.

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