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Temporal and spatial features of tularemia in the Czech Republic's Southern Moravia

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ABSTRACT: Not only has the number of sick people and positive hares increased in the last decade, but natural tularemia foci have begun to extend into northern parts of Southern Moravia in the Czech Republic. The purpose of this article was to use a geographic information system to assess the spatio-temporal evolution of tularemia in Southern Moravia, specifically within a chosen study area of 130 x 90 km. Using a correlation analysis, we found that from 1994 to 2001, there was a correlation between the geographic distribution of tularemia natural foci and the distribution in any other year. From 1994 to 2001, there are a total of 3,700 potential distribution combinations with correlation values ranging from 0.38 to 0.96 (P = 0.01). The degree to which the spread of tularemia is correlated increases as the years become closer together. It can be said that tularemia was found in the same places in the research region during the eight years, but because the correlation coefficients were not equal to one, there was some change in the distribution.

Keywords: Natural foci, geographic distribution, Francisella tularensis, and the geographic information system

Introduction :Tularemia is a zoonosis occurring in natural foci throughout the Northern Hemisphere with the milder biotype B prevailing in Eurasia (Quinn *etal*., 1994). In Southern Moravia it has been known since autumn 1936 when 290 humans contracted the external ulceroglandular form of the disease due to handling tularemic hares. During the 1960s, severe epidemics of the professionally-acquired pulmonary form of tularemia in workers in “cold divisions” of sugar factories occurred. There was a 25-year period of low occurrence of this disease in humans interrupted by another epidemic in 1978. In autumn 1994, the number of tularemia casesrose again and, during the season of 1998–1999,115 human cases of tularemia contracted mainlyby handling tularemic hares were reported (Cerny,2001). These increased numbers of human cases of tularemia coincide with the rise of seroprevalence of hares positive for tularemia from the common value of about 1% to 5.75% in 1994 (Treml *et al*., 2002). In the last decade, apart from the rise ofnumbers of positive hares, we have been witnessing some spread of natural foci of tularemia into more northern areas of Southern Moravia.

It was, therefore, our aim to evaluate this spread of tularemia and its spatio-temporal development in Southern Moravia using a geographic informa- tion system.

MATERIAL AND METHODS

Aspects of geographic distribution of natural foci of tularemia in Southern Moravia (Czech Republic) were evaluated using source data of monthly reports on infectious diseases in animals by the State Veterinary Administration of the CzechRepublic. We selected a study area of 130 × 90 km encompassing districts that harbour most natural foci of tularemia in the Czech Republic (Znojmo, Břeclav, Hodonín) as well as parts of districts wheretularemia has occurred recently or its natural foci have not been so numerous (Třebíč, Brno-venkov, Brno-město, Uherské Hradiště, pported by the Ministry of Education, Youth and Sports of the Czech Republic (Project No. 2101 VZ 191241 1310)Blansko, Žďár nad Sázavou, Prostějov, Přerov). The time perspective included years 1994–2001. In these years there were 128, 161, 164, 171, 173, 185, 197 and 180 natural foci of tularemia, respectively, in the study area. Using the above source data,databases on spatial distribution of natural foci of tularemia in the study area in individual years were created. Geographic computer databases on tularemia in individual years were stored and processed by the KORMAP GIS program (Pikula and Beklova, 1987; Pikula *et al*., 2002, 2003). The study area was divided into 3 700 unit areas of ap- proximately 3 162 km^2 which were classified either as being free of tularemia or as harbouring natural foci of tularemia in the given year. The analytical tools of the KORMAP GIS program were employedto evaluate the spatial distribution of natural fociin individual years. All possible combinations of databases of years 1994–2001 were evaluated. One can imagine the evaluation as employing a multi-di-mensional (layered) map (database) in order to findout whether tularemia is present or absent in each unit area. Individual layers represent individual years. Comparing two databases (layers represent- ing separate years) we get a frequency table from which it is possible to evaluate the correlation of spatial distribution of tularemia in the study area during the two years.

RESULTS

Table 1 presents results of correlation analysisof the geographic distribution of natural foci oftularemia in the study area of Southern Moravia in years 1994–2001. Geographic distribution of naturalfoci of tularemia in any year correlated with the distribution in any other year of the study period. The coefficients of correlation of all possible combi-nations of distribution in years 1994–2001 vary from
0.38 to 0.96 (n = 3 700, P = 0.01). It is clear that the closer the years, the greater the correlation. It canbe stated that, in the study area during the period ofeight years, tularemia persisted rather in the same locations but, as the coefficients of correlation do not equal 1.0, some variation in the occurrence couldbe observed.
Despite persistence of tularemia in more or less the same geographic areas in the Southern Moravia,disappearance and new findings of natural foci could be noticed during the study period of 1994to 2001. Distribution of tularemia has been moving into more northern parts of Southern Moravia.

DISCUSSION

One of the basic concepts of landscape epidemi- ology mentions the long-term persistence of the disease in distinct geographic areas (Pavlovsky, 1964). Pikula *et al*. (2003) evaluated the long-term

persistence of natural foci of tularemia over thewhole territory of the Czech Republic. It was found that there is a close correlation between the geographic distribution and numbers of natural fociof tularemia in the Czech Republic in the periodof 1971 to 1985 and 1986 to 2000 (r = 0.91, n = 1814,
t = 92.50, P = 0.01). It means that the natural foci

Table 1. Results of correlation analysis of the geographic distribution of natural foci of tularemia in Southern Mora-via in individual years of 1994 to 2001

	1994		1995		1996		1997		1998		1999		2000	
Year	*r*	*t*	*r*	*t*	*r*	*t*	*r*	*t*	*r*	*t*	*r*	*t*	*r*	*t*
1995	0.53	38.11												
1996	0.51	36.44	0.95	202.49										
1997	0.49	34.91	0.92	149.63	0.96	234.45								
1998	0.43	29.33	0.80	82.50	0.84	96.95	0.88	113.24						
1999	0.42	28.23	0.79	79.15	0.83	90.82	0.85	101.27	0.93	162.81				
2000	0.39	26.28	0.75	70.98	0.79	79.27	0.82	88.12	0.88	117.32	0.94	173.61		
2001	0.38	25.53	0.71	62.68	0.73	66.83	0.76	71.56	0.74	68.09	0.79	79.36	0.82	90.09

r = coefficient of correlation; t = t-test; n = 3 700; P = 0.01of tularemia have been persistent over the period of 30 years, but not stationary, and the geographic area of tularemia natural foci occurrence has not grown or diminished considerably in the Czech Republic. There were, however, some changes in the geographic distribution of tularemia. For pur- poses of the above study, two 15-year periods and means of geographic distribution of tularemia wereemployed. Results of the current paper can thus be considered as more accurate because of employ-ing a smaller geographic area (study area of 130 × 90 km), a shorter period of time (eight years) and databases on tularemia distribution in individual years without distorting the reality by computing the mean geographic distribution for some period. The results concerning the study area of Southern Moravia are, however, comparable to those ones found for the whole territory of the Czech Republicand the 30-year period of 1971–2000 even though thecoefficients of correlation of all possible combina- tions of distribution in years 1994–2001 vary from 0.38 to 0.96.

The scale of maps is another point of view that hasto be considered when using GIS data processing. For the purpose of evaluation of the whole terri- tory of the Czech Republic Pikula *et al*. (2002, 2003) used data scaled down to unit areas of 24 384 km^2 and as such presented some generalisation of the prevailing value of the phenomenon studied. The current study of tularemia in Southern Moravia in the period of 1994–2001 employed a more precise scale of unit areas of 3 162 km^2.

Geographic distribution of natural foci of tu- laremia in any year correlated with the distributionin any other year of the study period. The coeffi- cients of correlation of all possible combinationsof distribution in years 1994–2001 vary from 0.38to 0.96, but it is clear that the closer the years, the greater the correlation. The fact that correlation of tularemia distribution is greater in neighbouring years than elsewhere can be explained by the rateof persistence of natural foci as

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opposed to their disappearance and the way the State Veterinary Administration of the Czech Republic treats naturalfoci of tularemia. After finding infected animal(s) the State Veterinary Administration of the Czech Republic considers the natural focus to be active fortwo years even though no other infected animals arefound. Due to this administrative approach, persist-ence (correlation of distribution) of natural foci of tularemia within any two neighbouring years must be the highest.Despite persistence of tularemia in more-or-less the same geographic areas in the Southern Moravia,disappearance and new findings of natural foci canbe noticed during the study period of 1994–2001 (there were 128, 161, 164, 171, 173, 185, 197 and 180
natural foci of tularemia, respectively, in the study area). Distribution of tularemia has been moving intomore northern parts of Southern Moravia. As somenew natural foci of tularemia were quite far from the previously known ones, it cannot be explained by migrations of reservoir animals represented by small rodents and European brown hare (*Lepus europaeus*). Small rodents such as common vole (*Microtus arvalis*) are not capable of such long dis- tance migrations (Zapletal *et al*., 2001) and Europeanbrown hare is a species maintaining the so-called home range of about 30–100 ha (Broekhuizen and Maaskamp, 1982; Reitz and Leoanrd, 1994; Kunst*et al*., 2001). Tularemia is either present in the givenarea or the territory is tularemia-free. In the latter case tularemia can be brought to such a disease- free territory either by transfer of animals whenre-populating the area or by the migrating reser- voir host – the wild boar (*Sus scrofa*). As far as the wild boar is concerned, Hubalek *et al*. (2002) found up to 17% of seroprevalence for tularemia and the home range of this species is much larger (about35 km^2; Saunders and Kay, 1996) than in other res- ervoir hosts of tularemia. The wild boar is a spe- cies preferring riverine woodlands (Choquenot andRuscoe, 2003) and as natural foci of tularemia are most frequent in alluvial areas (Pikula *et al*., 2003), the wild boar could be the species responsible for the spread of tularemia to new areas. As there havenot been any transfers of wild animals which wouldhelp to explain the spread of tularemia in the studyarea, there still remains a rational explanation that in these areas natural foci of tularemia existed long prior to their discovery.

Since it was proved by the analysis that tularemiapersists in specific areas, it is clear that it is a diseaseoccurring in natural foci. Knowledge on the generalenvironmental conditions and geographic distribu-tion of existing natural foci of tularemia makes it possible to predict the possible occurrence of tu- laremia in other suitable areas where it has not yet been found because, for example, no one tried. It is also possible to use this knowledge for the purposeof preventive and control measures such as ban- ning transfer of wild animals from areas of existingnatural foci to geographic areas which are prone to become natural foci.

REFERENCES

"Clustering, home range, and movement in the European hare (Lepus euro-paeus Pallas) in the Netherlands" (Brokhuizen & Maaskamp, 1982). Publication: Z. Saugetierkd., 47, 22-32.

Variations in the clinical presentation and epidemiology of tularemia in the Czech Republic's Southern Moravia from 1936 to 1999, Cerny Z. (2001). The article is published in the European Journal of Epidemiology and published on page 637-642.

Choquenot and Ruscoe (2003) found that big herbivores have challenges when trying to find food due to the complexity of their landscapes and the limitations imposed by their habitats on how

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efficiently they can forage. Wildlife Research, 72, 14–26.
Brucellosis and tularaemia serological surveys in wild boars (Sus scrofa) in South Moravia, Czech Republic (2002) by Hubalek Z., Treml F., Juricova Z., Hunady M., Halouzka J., Janik V., and Bill D. Vet. Med. - Czech, 47, 60-66. (2010). Fine art Brown hare home ranges in a natural salt marsh: comparisons with agricultural systems (van Wieren, 2001; van der Wal, 2001). Therol. Acta, 46, 287-294.
The natural nidality of transmissible illnesses, with a focus on the landscape epidemiology of zooanthroponoses (in Russian), Pavlovsky E.N. (1964). Vladimir Nauka, Moscow, Leningrad. 211 pages.
Phasianus colchicus ecological distribution in Czechoslovakia, per Pikula and Beklova (1987). Brno: Acta Sci. Nat., 1991, 21, 1-47.The use of GIS in epidemiology: a study of the common vole's ecology and the location of natural tularaemia foci (Pikula et al., 2002). This article is from Acta Vet. Brno, volume 71, pages 379-387.
This sentence is paraphrased from an article published in 2003 by Pikula et al., which discusses the ecological circumstances of natural foci of tuberculosis in the Czech Republic. The citation is from the European Journal of Epidemiology, volume 18, pages 1091–1095.
In Clinical Veterinary Microbiology, Quinn, Markey, and Carter (1994) discuss several topics. Pages 259–260. London: Wolfe Publishing.
In a French agricultural zone characterized by intense farming, Reitz and Leoanrd (1994) examined the spatial habits of European hares (Lepus europaeus). Therol. Acta, 39, 143–157.
"Home ranges and movements of feral pigs (Sus scrofa) in Kosciusko National Park, New South Wales," by Saunders and Kay (1996). Animal Behavior, 23, 711–719 (2018).
"Monitoring the activity of tularemic foci in the Southern Moravia" (in Czech) was written by Treml, Hubalek, Halouzka, Pikula, Juricova, and Janik in 2002. Volume 12, Issues Related to Zoonoses, pages 124–127.
Basics of biology, ecology, and population management of the common vole (Microtus arvalis) in the Czech Republic (in Czech) by Zapletal, Obdrzalkova, Pikula, Zejda, Beklova, and Heroldova in 2001. The CERM academic press.

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