

Detection of *Mycobacterium avium* subsp. paratuberculosis in Two Brown Bears in the Central European Carpathians

Authors: Kopečna, Marketa, Ondrus, Stanislav, Literak, Ivan, Klimes, Jiri, Horvathova, Alica, et al.

Source: Journal of Wildlife Diseases, 42(3) : 691-695

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-42.3.691>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Detection of *Mycobacterium avium* subsp. *paratuberculosis* in Two Brown Bears in the Central European Carpathians

Marketa Kopečna,¹ Stanislav Ondrus,² Ivan Literak,³ Jiri Klimes,³ Alica Horvathova,¹ Monika Moravkova,¹ Milan Bartos,¹ Ivo Trcka,¹ and Ivo Pavlik^{1,4} ¹ Veterinary Research Institute, Hudcova 70, 621 32 Brno, Czech Republic; ² Administration of the National Park Low Tatras, Zelena 5, 974 01 Banská Bystrica, Slovakia; ³ University of Veterinary and Pharmaceutical Sciences, Palackého 1/3, 612 42 Brno, Czech Republic; ⁴ Corresponding author (email: pavlik@vri.cz)

ABSTRACT: The incidence of mycobacterial infections was monitored in brown bears (*Ursus arctos*) in the National Park Low Tatras in the central European Carpathians in Slovakia. Tissue samples of 20 brown bears were examined microscopically and by culture for the presence of mycobacteria. Acid-fast rods were detected by Ziehl-Neelsen staining in a smear from the kidney of one brown bear, although the culture was negative for mycobacteria. *Mycobacterium avium* subsp. *paratuberculosis*, the causative agent of paratuberculosis in ruminants, was isolated from the intestinal mucosa of another two brown bears. The isolates were identified by polymerase chain reaction for the specific insertion sequence IS900. Using standardized IS900 restriction fragment length polymorphism (RFLP) analysis, the *M. a. paratuberculosis* isolates were classified as RFLP type B-C1, which also were detected in the infected cattle in surrounding area. This study describes the first isolation of *M. a. paratuberculosis* from a brown bear. Our results confirm that animal species other than ruminants can become infected with *M. a. paratuberculosis* and can act as potential vectors and/or reservoirs of the infection.

Key words: Carnivores, epidemiology, Johne's disease, *Mycobacterium avium*, paratuberculosis, wildlife.

Paratuberculosis, or Johne's disease, is a specific infectious granulomatous enteritis of domestic and wild ruminants (Ayele et al., 2001; Machackova et al., 2004) caused by facultatively anaerobic intracellular acid-fast rods (AFRs) of *Mycobacterium avium* subspecies *paratuberculosis*. Paratuberculosis is mainly a subclinical infection with a protracted incubation period. The major clinical signs of the disease in ruminants (particularly in cattle and red deer) are chronic diarrhea and progressive afebrile weight loss that consequently leads to emaciation (Ayele et al.,

2001). Factors that increase the likelihood of acquiring the disease are stress, non-balanced diets, intercurrent infections, parasitic diseases and others. *Mycobacterium avium* subsp. *paratuberculosis* has been isolated from other nonruminant wildlife such the European rabbit (*Oryctolagus cuniculus*; Greig et al., 1997, 1999), brown hare (*Lepus europaeus*; Beard et al., 2001; Machackova et al., 2004), brown rat (*Rattus norvegicus*; Beard et al., 2001), and long-tailed field mouse (*Apodemus sylvaticus*; Beard et al., 2001).

Mycobacterium avium subsp. *paratuberculosis* was likewise detected in carnivores such as red fox (*Vulpes vulpes*), stoat (*Mustela erminea*), and weasel (*Mustela nivalis*; Beard et al., 1999, 2001), and also in omnivores such as Eurasian badger (*Meles meles*; Beard et al., 2001) and wild boar (*Sus scrofa*; Machackova et al., 2003; Trcka et al., 2006). The infected wild animals originated from localities with paratuberculosis incidence in ruminants (Greig et al., 1997; Beard et al., 1999, 2001; Pavlik et al., 2000a; Machackova et al., 2003, 2004). Isolation of *M. a. paratuberculosis* from a wide range of hosts that constitute respective parts of the food chain supports the suggestion of a more complex epidemiology for paratuberculosis than is currently recognized.

In the literature, there are limited data regarding the isolation of bacteria from bears. Most studies have involved oral bacteria of bears or bacteria associated with bear bite wounds (Parry et al., 1983; Goatcher et al., 1987; Kunitomo et al., 2004). The only reported nontuberculous mycobacterium from any bear species is

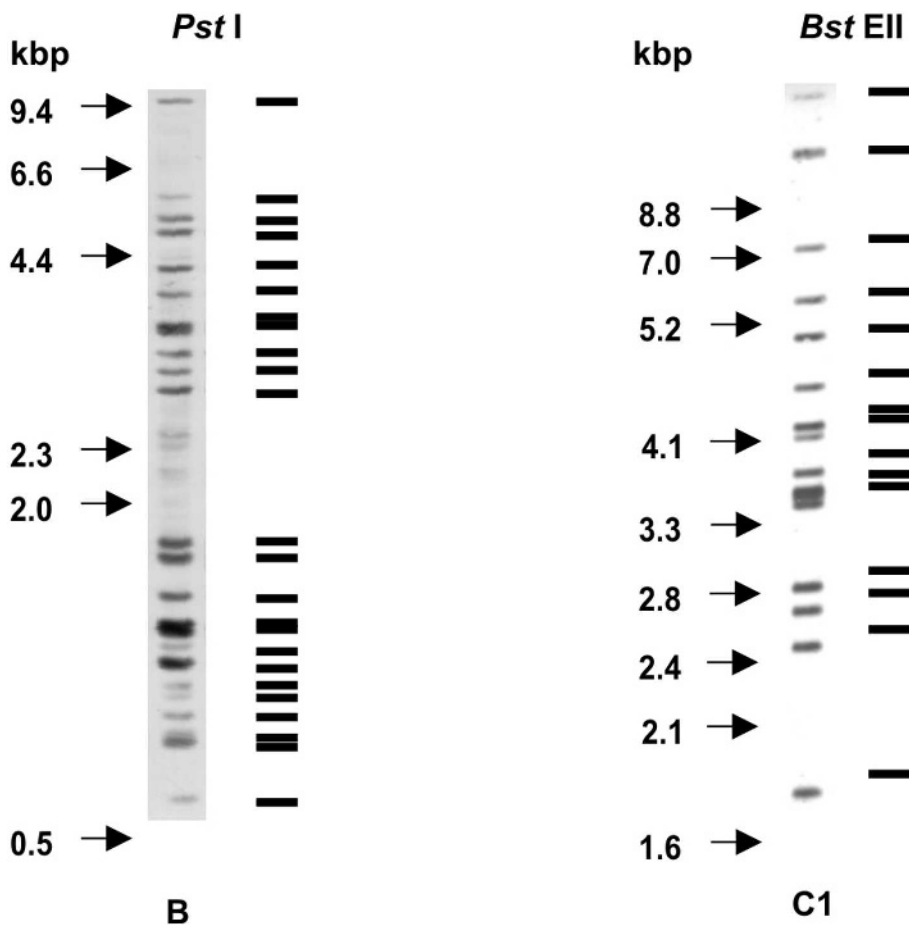


FIGURE 1. The patterns of RFLP types of *Mycobacterium avium* subsp. *paratuberculosis*: C1 (restriction endonuclease *BstEII*), B (restriction endonuclease *PstI*) according to Pavlik et al. (1999a).

M. fortuitum that was isolated from a brown bear (*Ursus arctos*) bite wound (Lehtinen et al., 2005).

The incidence of bacterial infections and parasites in different wildlife species was monitored in the National Park Low Tatras in central European Carpathians in Slovakia. Twenty brown bears were examined within the 4-yr period (2002–2005). There were 15 males and five females of various age and size with the average body weight of about 130 kg. Tissue samples (Table 1) were examined microscopically after staining according to the Ziehl-Neelsen method for AFR detection. Subsequently, 1 g of tissue was homogenized by a stomacher (Kleinfeld Labortechnik, Gehrden, Germany) and decontaminated

in 0.75% hexadecyl pyridinium chloride (HPC):*N*-cetylpyridinium chloride monohydrate (no. 102340 Merck, Whitehouse Station, New Jersey) for 72 hr (Pavlik et al., 2000b). Sediment (200 μ l) of each decontaminated sample was cultured on three slopes of different Herrold egg yolk media with Mycobactin J and incubated at 37 C for 12 mo (Machackova et al., 2004). Isolates of *M. a. paratuberculosis* were identified by IS900 polymerase chain reaction (PCR; Bartos et al., 2006). Standardized IS900 restriction fragment length polymorphism (RFLP) by using restriction endonucleases *PstI* and *BstEII* was used to further differentiate *M. a. paratuberculosis* isolates (Pavlik et al., 1999a).

TABLE 1. Mycobacteria detection in the organs of 20 brown bears (*Ursus arctos*).

Examined organ	No.	Microscopy ^a positive	Culture positive
Lungs	2	0	0
Liver	10	0	0
Spleen	10	0	0
Kidney	3	1	0
Mesenteric lymph node	11	0	0
Intestinal mucosa	16	0	2 ^b

^a Detection of acid-fast rods by Ziehl-Neelsen staining.

^b *Mycobacterium avium* subsp. *paratuberculosis* of restriction fragment length polymorphism type B-C1 was identified and typed by IS900 polymerase chain reaction.

Gross examinations did not reveal any lesions in gastrointestinal tract that are pathognomonic of paratuberculosis. Mycobacteria in the form of long AFRs were detected by microscopy of a smear prepared from the kidney of one brown bear; however, isolation from this sample was unsuccessful. Mycobacterial isolates were obtained from the intestinal mucosa of another two brown bears (Table 1), which were classified by IS900 PCR as *M. a. paratuberculosis* of RFLP type B-C1 (Fig. 1).

Mycobacteria detected by microscopy in the bear kidney could not be isolated because of loss of viability during processing, or they were already dead, or uncultivable. These pathogens were probably environmentally derived mycobacteria, and they are usually killed by HPC during sample processing (Machackova et al., 2002; Beran et al., 2006).

Infected brown bears included a male (120 kg) and a 5-yr-old female (90 kg). The male bear originated from a location in the National Park where a red deer (*Cervus elaphus*) with small intestinal lesions that were pathognomonic for paratuberculosis previously had been reported. The bear was killed in a collision with a truck on the main road; hence, the health status of the bear was not determined. The female bear was in good body condition and was shot on the other side of the National Park Low Tatras.

It is commonly known that brown bears

leave their den in spring (after 90- to 120-day winter rest) and feed on carcasses of animals that died during the winter (Nowak, 1999). The population density of brown bears in the Carpathians is approximately one bear per 20 km². Other subspecies of brown bear are generally known to roam hundreds of kilometers toward major food sources during seasonal movements. Conversely, at feeding sites, density may reach one bear per 0.05 km² (Nowak, 1999). Because of potential long-distance movements bears may associate with livestock, and both infected brown bears in the present study were killed in the buffer zone of the National Park where it is permitted to graze domestic ruminants. Sheep are mostly grazed at this area, but the status of paratuberculosis in sheep is unknown. Nevertheless, paratuberculosis was detected in cattle herds in this area in previous years (Pavlik et al., 1999b). It is therefore possible that these brown bears were infected by consuming the corpse of an infected ruminant.

Isolation of *M. a. paratuberculosis* from intestinal mucosa supports the suggestion that brown bears can be passive carriers of *M. a. paratuberculosis*. The RFLP type B-C1 is the most common RFLP type of *M. a. paratuberculosis* detected in domestic ruminants in Slovakia and other central European countries (Pavlik et al., 1999a, b), and the RFLP type B-C1 of *M. a. paratuberculosis* has been detected in

cattle in this area. Although *M. a. paratuberculosis* has not been isolated from wild ruminants in this area, they cannot be excluded as an alternative source of these infections (Machackova et al., 2004).

The present study described the first isolation of *M. a. paratuberculosis* from a brown bear, and these findings support an increasing body of evidence that indicates that a wide diversity of wildlife species as well as domestic ruminants can become infected with *M. a. paratuberculosis*. The significance of brown bears as a potential reservoir is difficult to assess because they are strictly protected; but based on these results, it may be reasonable to evaluate other species and populations of bears in other European countries or worldwide.

The authors thank Zdenka Gregorova and Anna Maslanova from the Veterinary Research Institute (Brno, Czech Republic) for literature survey. The research was partially supported by the grants QLRT-2000-00879 (Brussels, EC), MZE0002716201 (Ministry of Agriculture, Czech Republic), and by the grant MSM 6215712402 (Ministry of Education, Youth and Sports, Czech Republic). The translation of the manuscript by Ing. Ludmila Faldikova and critical reading of the manuscript by Kelly MacNeish (Aberdeen University, Scotland) are highly appreciated.

LITERATURE CITED

- AYELE, W. Y., M. MACHACKOVA, AND I. PAVLIK. 2001. The transmission and impact of paratuberculosis infection in domestic and wild ruminants. *Veterinarni Medicina* 46: 205–224.
- BARTOS, M., P. HLOZEK, P. SVASTOVA, L. DVORSKA, T. BULL, L. MATLOVA, I. PARMOVA, I. KUHN, J. STUBBS, M. MORAVKOVA, J. KINTR, V. BERAN, I. MELICHAREK, M. OCEPEK, AND I. PAVLIK. 2006. Identification of members of *Mycobacterium avium* species by Accu-Probes, serotyping, and single IS900, IS901, IS1245 and IS901-flanking region PCR with internal standards. *Journal of Microbiological Methods* 64: 333–345.
- BEARD, P. M., D. HENDERSON, M. J. DANIELS, A. PIRIE, D. BUXTON, A. GREIG, M. R. HUTCHINGS, I. MCKENDRICK, S. RHIND, K. STEVENSON, AND J. M. SHARP. 1999. Evidence of paratuberculosis in fox (*Vulpes vulpes*) and stoat (*Mustela erminea*). *Veterinary Record* 145: 612–613.
- , M. J. DANIELS, D. HENDERSON, A. PIRIE, K. RUDGE, D. BUXTON, S. RHIND, A. GREIG, M. R. HUTCHINGS, I. MCKENDRICK, K. STEVENSON, AND J. M. SHARP. 2001. Paratuberculosis infection of nonruminant wildlife in Scotland. *Journal of Clinical Microbiology* 39: 1517–1521.
- BERAN, V., M. HALELKOVA, J. KAUSTOVA, L. DVORSKA, AND I. PAVLIK. 2006. Cell wall deficient forms of mycobacteria: a review. *Veterinarni Medicina* 51: 365–389.
- GOATCHER, L. J., M. W. BARRETT, R. N. COLEMAN, A. W. HAWLEY, AND A. A. QURESHI. 1987. A study of predominant aerobic microflora of black bears (*Ursus americanus*) and grizzly bears (*Ursus arctos*) in north-western Alberta. *Canadian Journal of Microbiology* 33: 949–954.
- GREIG, A., K. STEVENSON, V. PEREZ, A. PIRIE, J. M. GRANT, AND J. M. SHARP. 1997. Paratuberculosis in wild rabbits (*Oryctolagus cuniculus*). *Veterinary Record* 140: 141–143.
- , ———, D. HENDERSON, V. PEREZ, V. HUGHES, I. PAVLIK, I. M. E. HINES, I. MCKENDRICK, AND J. M. SHARP. 1999. Epidemiological study of paratuberculosis in wild rabbits in Scotland. *Journal of Clinical Microbiology* 37: 1746–1751.
- KUNIMOTO, D., R. RENNIE, D. M. CITRON, AND E. J. C. GOLDSTEIN. 2004. Bacteriology of a bear bite wound to a human: Case report. *Journal of Clinical Microbiology* 42: 3374–3376.
- LEHTINEN, V. A., T. KAUKONEN, I. IKAHEIMO, S. M. MAHONEN, M. KOSKELA, AND P. YLIPALOSAARI. 2005. *Mycobacterium fortuitum* infection after a brown bear bite. *Journal of Clinical Microbiology* 43: 1009.
- MACHACKOVA, M., J. LAMKA, W. Y. AYELE, I. PARMOVA, P. SVASTOVA, T. AMEMORI, AND I. PAVLIK. 2002. Infection of ruminants by uncultivable strains of *Mycobacterium avium* subsp. *paratuberculosis* in the Czech Republic. In *Proceedings of the Seventh International Colloquium on Paratuberculosis*, R. A. Juste, M. Geijo and J. M. Garrido (eds.), International Association for Paratuberculosis, Inc., Bilbao, Spain, 11–14 June; Publication department, Madison, Wisconsin, pp. 191–196.
- , L. MATLOVA, J. LAMKA, J. SMOLIK, I. MELICHAREK, M. HANZLIKOVA, J. DOCEKAL, Z. CVETNIC, G. NAGY, M. LIPIEC, M. OCEPEK, AND I. PAVLIK. 2003. Wild boar (*Sus scrofa*) as a possible vector of mycobacterial infections: Review of literature and critical analysis of data from Central Europe between 1983 to 2001. *Veterinarni Medicina* 48: 51–65.
- , P. SVASTOVA, J. LAMKA, I. PARMOVA, V. LISKA, J. SMOLIK, O. A. FISCHER, AND I. PAVLIK. 2004. Paratuberculosis in farmed and free-living wild

- ruminants in the Czech Republic in the years 1999–2001. *Veterinary Microbiology* 101: 225–234.
- NOWAK, R. M. 1999. Walker's mammals of the world, Vol. 1. 6th Edition. The Johns Hopkins University Press, Baltimore, 836 pp.
- PARRY, R. G., R. ZIEMIS, H. REYNOLDS, AND S. MILLER. 1983. Brown/grizzly bear mouth cultures in Alaska. *Alaska Medicine* 25: 1–2.
- PAVLÍK, I., A. HORVATHOVA, L. DVORSKA, J. BARTL, P. SVASTOVA, R. DUMAINE, AND I. RYCHLIK. 1999a. Standardisation of restriction fragment length polymorphism analysis for *Mycobacterium avium* subspecies *paratuberculosis*. *Journal of Microbiological Methods* 38: 155–167.
- , ———, ———, P. SVASTOVA, R. DUMAINE, B. FIXA, AND I. RYCHLIK. 1999b. Homogeneity/heterogeneity of *Mycobacterium avium* subsp. *paratuberculosis* strains: Correlation between RFLP-type and source (animal, environment, human). In *Proceedings of the Sixth International Colloquium on Paratuberculosis*, E. J. B. Manning and M. T. Collins (eds.). International Association for Paratuberculosis, Inc., Melbourne, Victoria, Australia, 14–18 February; Publication department, Madison, Wisconsin, pp. 321–329.
- , J. BARTL, L. DVORSKA, P. SVASTOVA, R. DUMAINE, M. MACHACKOVA, W. Y. AYELE, AND A. HORVATHOVA. 2000a. Epidemiology of paratuberculosis in wild ruminants studied by restriction fragment length polymorphism in the Czech Republic during the period 1995–1998. *Veterinary Microbiology* 77: 231–251.
- , L. MATLOVA, J. BARTL, P. SVASTOVA, L. DVORSKA, AND R. WHITLOCK. 2000b. Parallel faecal and organ *Mycobacterium avium* subsp. *paratuberculosis* culture of different productivity types of cattle. *Veterinary Microbiology* 77: 309–324.
- TRČKA, I., J. LAMKA, R. SUCHÝ, M. KOPEČNA, V. BERAN, M. MORÁVKOVA, A. HORVATHOVA, M. BARTOS, I. PARMOVA, AND I. PAVLÍK. 2006. Mycobacterial infections in European wild boars (*Sus scrofa*) in the Czech Republic during the years 2002 to 2005. *Veterinarní Medicina* 51: 320–332.

Received for publication 7 October 2005.