

Emerging risk of malignant catarrhal fever in European bison

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Abstract: Sheep-associated malignant catarrhal fever (MCF) may be fatal to European bison. The gammaherpesvirus that causes the most devastating MCF is transmitted from asymptomatic, latently infected sheep causing high mortality in large ungulates including E. bison. Therefore, the main risk of contracting MCF is the presence of sheep where the European bison are reared. Not many reports on MCF in the wisent exist, however the high impact on American bison was well documented as reviewed hereby. Quite recently, MCF with high mortality was reported in Switzerland with connection to the introduction of clinically healthy sheep. MCF is present worldwide. Therefore, the knowledge on the risks of MCF in European bison should be spread internationally. We postulate the high relevance of MCF testing in European bison as well as other ruminants reservoirs of the virus including sheep as an important part of *Bison bonasus* protection strategy.

Key words: malignant catarrhal fever, MCF, gammaherpesvirus, risk, European bison

Malignant Catarrhal Fever (MCF) is an infectious, viral disease of many species of even-toed ungulates, both domestic and wild. Antelopes, cattle, sheep, goats, buffaloes, American bison, European bison, many deer species and pigs are sensitive. At least 10 closely related viruses causing this disease have been identified so far. They belong to the genus *Macavirus* family Herpesviridae, subfamily Gammaherpesvirinae. MCF viruses are usually named after their reservoir hosts (Rola *et al.* 2005; Spickler 2019).

In reservoir hosts, viruses are carried and shed asymptotically throughout the entire life. Reactivation of the virus, e.g. by a decrease in the host's immunity, leads to the transmission of the virus from one individual to another and promotes the maintenance of the asymptomatic carrier in the population. Only when the virus is transferred to a natural susceptible host,

i.e. one in which disease symptoms appear, it may lead to death as a result of infection with MCF virus. There is no evidence for virus transmission between susceptible hosts. The best known MCF viruses are *Alcelaphine herpesvirus 1* (AIHV-1), which causes wildebeest-associated MCF and *Ovine herpesvirus 2* (OvHV-2), which causes sheep-associated MCF. Wildebeest-associated MCF occurs mainly in Africa, where free-range gnu antelopes (*Connochaetes* sp.) are the reservoir host. Migrating antelopes are a source of infection for freely grazing domestic cattle, causing local outbreaks of disease. Asymptomatic infection with this virus has been found in antelopes kept in European zoos.

The most dangerous to European bison is however the sheep-associated MCF which cases have been reported worldwide particularly in zoos where susceptible species have been kept close to sheep and is a serious concern in countries with European bison and cervid farms. The main reservoir host of the OvHV-2 virus is domestic sheep (*Ovis aries*). The OvHV-1 virus was found in mouflon (*Ovis aries orientalis*), a species displaced to Poland as a game animal. Naturally susceptible host of the OvHV-2 virus is domestic cattle (*Bos taurus*), multiple cervid species, moose (*Alces alces*), American bison (*Bison bison*), European bison (*Bison bonasus*), domestic pigs (*Sus scrofa*), water buffalo (*Bubalus bubalis*), banteng (*Bos javanicus*), and domestic goat (*Capra hircus*).

In a zoological garden or animal park, in which reservoir hosts and susceptible species are often kept in close proximity, the disease can prove fatal and mortality is 100% (O'Toole & Li 2014).

American bison were reported to be a species particularly sensitive to the sheep-associated MCF. So far, the epidemiology of MCF has been best reported in commercial American farms in North America. From November 1990 to April 1991, 300 of the 900 bison died of MCF, contracting the infection from sheep grazing on the same land (Schultheiss *et al.* 2010). Between 1998 and 1999 a 150 American bison died of MCF, primarily the alimentary form (O'Toole *et al.* 2002). In 2001, another 45 of 163 American bison died submitted for sale at a public auction market where they had only 1-day contact with lamb herd (Berezowski *et al.* 2005). In 2003, an outbreak of malignant catarrhal fever occurred in a American bison feedlot where 825 of 1610 animals died after being exposed to sheep for 19 days (Li *et al.* 2006). First clinical signs can occur from 14 day to 7 months after exposure. Clinical onset are acute, and most affected bison died within 1–3 days after clinical signs occurred (O'Toole & Li 2014). The cases show the importance of aerosol transmission and the particular susceptibility of American bison to infection.

Although direct contact with sheep can be confirmed in most outbreaks of MCF in American bison, some outbreaks occurred in herds located up to 5 km from sheep. The exact mechanism of transmission of the virus from sheep

to susceptible species is unknown, direct contact with sheep is not necessary for infection. The main hypothesis is the airborne transmission of aerosolized virus particles from sheep's nasal discharge, equipment, contaminated feed and water, or birds that are likely to facilitate virus transmission (Li *et al.* 2008).

These outbreaks illustrate the devastating impact that MCF virus can have on European bison under certain exposure conditions. There is no effective treatment known for MCF and there is no vaccine against MCF. The only currently known way to avoid disease in susceptible species is to avoid contact with sheep, including wild species. One of the ways to avoid the appearance of the disease may be to test sheep for the presence of MCF viruses in susceptible host neighborhoods.

Almost no reports on MCF in European bison exist. The reports of clinical pictures of MCF in the species kept in zoos are not recent (Straver & van Bekkum 1979; Hänichen & Bekkum 1998). So far, several cases of MCF have been confirmed in European bison (*Bison bonasus*) in zoos, where sheep have turned out to be the source of the infection. The course of the disease and high mortality suggest that the epidemiology of MCF in European bison (*Bison bonasus*) is similar to that of American bison (*Bison bison*) (Straver & van Bekkum 1979). MCF is considered more emerging and non-endemic in Poland; therefore, no current data exists. In 2018, an outbreak of fatal MCF in European bison enclosure in Switzerland was consulted with European Bison Pedigree Book at the Białowieski National Park; however no report was published officially (Baumgartner, personal communication).

Globalization, increasing sheep populations in many areas or transfer of European bison to distant locations in the process of rewilding Europe may be prone to exposure of the species to MCFV. The number of European bison and the area in which they occur in Poland is steadily increasing.

At the end of 2020, 2316 individuals lived in Poland; in captivity 212 individuals in 24 enclosure-based breeding centers and 2104 individuals in free-ranging populations. There are 6 free-living herds of European bison located in various places in the country: Bieszczady mountains (707 individuals), Augustowska (17), Białowieska (715), Borecka (117), Knyszyńska forests (214) and West-Pomeranian herds (334) (European Bison Pedigree Book 2020). The sheep population in Poland at the end of 2020 was 277850 heads. The largest share in the domestic sheep population was in the following voivodships: małopolskie 28%, podlaskie 10%, wielkopolskie 8%, lubelskie 6%, warmińsko-mazurskie 6%, pomorskie 6% and podkarpackie 5% (GUS 2020).

No reports on European bison and sheep contacts in the country were reported so far. However, sheep grazing is used to actively protect nature and

biodiversity in landscape and national parks. Sheep graze also on land that is not suitable for agriculture, on sports facilities, airports, young forests, forest crops and flood embankments. The presence of sheep in voivodeships with European bison breeding centers and free-living European bison herds indicates a possible risk of transmission disease from sheep to European bison. Another possible risk is the introduction of sheep into the areas where European bison are reared or *vice versa*. In Bieszczady Mountains, where the population of European bison exceeds 700 individuals, free sheep grazing is practiced from spring to autumn. This creates the possibility of close or direct contact between the European bison and the sheep, and should be considered one of the highest risks of MCF in the wild species.

We have started evaluating the epidemiological situation of MCF exposure in European bison in Poland based on the available serological tests. Despite, not a single positive seroreactor was found until now, sensitivity of the tests in European bison is a key issue. The work is being carried over in order to overcome the problem of diagnostic tools to detect MCF antibodies in European bison as well as to include as many individuals as possible. We believe that the monitoring of European bison and sheep kept in their neighborhood should be a part of the protection strategy for the species.

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Rosnące zagrożenie złośliwą nieżytną gorączką u żubrów (*Bison bonasus*)

Streszczenie: Złośliwa nieżytna gorączka (*malignant catarrhal fever*) w polskim piśmiennictwie określana również jako głowica może być śmiertelna dla żubrów. Wirus OHV-2 związany z owcami, który wywołuje ostry i często śmiertelny przebieg choroby, przenoszony jest z bezobjawowo i latentnie zakażonych owiec, powodując wysoką śmiertelność dużych kopytnych, w tym żubrów. Dlatego głównym ryzykiem zarażenia głowicy jest występowanie owiec tam, gdzie znajdują się żubry. Istnieje niewiele doniesień o występowaniu głowicy u żubra, jednak duży wpływ na bizona amerykańskiego został dobrze udokumentowany, co omówiono w niniejszym dokumencie. Całkiem niedawno w Szwajcarii odnotowano ostry przebieg głowicy u żubrów z wysoką śmiertelnością w związku z wprowadzeniem do ogrodu zoologicznego klinicznie zdrowych owiec. Głowica występuje na całym świecie. Dlatego wiedza na temat zagrożeń tą chorobą u żubrów powinna być rozpowszechniana na arenie międzynarodowej. Postulujemy o szerokie wykonywanie badań w kierunku obecności głowicy u żubrów, a także innych przeżuwaczy będących rezerwuarami wirusa, w tym owiec, jako istotnej części strategii ochrony *Bison bonasus*.
