

## 8 Summary

### Infectious agents in zoo ungulates:

#### the first epidemiological study considering different types of husbandry

The concept of mixed species exhibits increasingly becomes important in European zoos. Nowadays, they are a common type of exhibitry, especially for ungulates. In zoological gardens and precisely in mixed exhibits, different types of species live in close direct and indirect contact with each other. There are a series of infectious agents that can be transmitted between them. Depending on the infected species, these infectious agents might possess a different degree of pathogenicity. Especially herpesviruses are often apathogenic for the natural host but may cause serious disease in other species. In the present study, the rate of exposure of bovids, cervids, and camelids against such infectious agents was analysed.

Therefore, eleven zoological institutions with a preferably high number of mixed species exhibits and a high number of ungulates were chosen: Berlin Zoo, Berlin Tierpark Friedrichsfelde, Dortmund Zoo, Dvůr Králové Zoo (Czech Republic), Gelsenkirchen Zoo, Hagenbeck Tierpark, Hamburg, Hannover Zoo, Karlsruhe Zoo, Leipzig Zoo, Tiergarten Nürnberg and the Wilhelma Zoological-botanical Garden, Stuttgart.

The infectious agents were selected for the following criteria: (1) They should be transmissible between different ungulate species. (2) They should be relevant for zoo ungulates.

In order to find out the relevance of infectious agents for zoo ungulates, the first part of the study included a retrospective overview of the archived veterinary data from 1998 to 2004 of all zoological gardens. It was found out that in the last six years the main emphasis was placed on the diagnosis of *Mycobacterium avium* ssp. *paratuberculosis* (*M.pt.*), *Coxiella* (*C.*) *burnetii* and *Chlamydia* (*C.*) *psittaci* and that *Chlamydia* and *Coxiella* (resp. specific antibodies) were detected the most often.

In the second part of the study, a total of 926 blood samples were tested by means of Virus Neutralisation Test or by ELISA for the presence of antibodies against selected infectious agents. Specific antibodies could be detected against all eight agents. The seroprevalences were as follows:

1,5% (14/926) for Bovine Herpesvirus 1 (BHV-1); 0,2% (2/926) for Caprine Herpesvirus 1 (CHV-1); 0,2% (2/926) for Cervid Herpesvirus 1 (HVC-1); 21,2% (180/850) for Malignant Catarrhal Fever Virus (BKFV); 1,4% (13/926) for Bovine Viral Diarrhea Virus (BVDV); 19,6% (165/843) for *C. psittaci*; 0,1% (1/754) for *C. burnetii*; 2,8% (19/667) for *M.pt.*

The results revealed the following:

- The prevalence of antibodies against both Alpha Herpesviruses (BHV-1, CHV-1, HVC-1) and BVDV is less than 3% (n=926). This means that zoo ungulates are currently not exposed to a significant degree to these infectious agents.
- The prevalence of antibodies against MCFV is 21% (n=850) and is highest in the subfamily caprinae (54%; n=219). This means that zoo ungulates are exposed to a significant degree to MCFV and that especially sheep and goats might be a source of MCF infection for susceptible species.
- The prevalence of antibodies against *C. psittaci* is 20% (n=843) and is highest in the family camelidae (32%; n=74). This means that zoo ungulates are exposed to a significant degree to *C. psittaci* and that especially camelids might be a source of *C. psittaci* infection for susceptible species.
- The prevalence of antibodies against *C. burnetii* and *M.pt.* is less than 3% (n=754 resp. 667). However, due to the limited available diagnostic tools for exotic ungulates we can not affirm their actual state of infection. Particularly animals infected with *M.pt.* remain seronegative until an advanced state of infection. Therefore, we can not define the risk of exposure of zoo ungulates against *C. burnetii* and *M.pt.*

In addition to the taxonomy (family, subfamily, species), age, sex, and origin of the animals, the influence of the following factors on the rate of exposure against infectious agents were examined: Type of husbandry (single species exhibit, different types of mixed species exhibits, petting zoo), exhibit size, population density, and season.

Evidence suggests that both exhibit type and population density have an important influence on the seroprevalence against MCFV. The highest seroprevalence was found in petting exhibits (61%; n=66) and in exhibits with a high population density (less than 45 m<sup>2</sup> per animal) (50%; n=109). The seroprevalence against *C. psittaci* showed no major differences between the different exhibit types.

Based on the results of this study, the following conclusions have been reached:

Infectious agents that can be transmitted between different cohabitant species do also spread across different enclosures. The risk of interspecies transmission between animals of a mixed species exhibit is not higher than between animals of different exhibits of the same zoological collection. Therefore each zoological garden should be regarded and treated as one single epidemiological unit.