



Global warming in relation to tick-borne diseases in sheep and goats

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Ticks and climate

Ticks, especially in the family *Ixodidae* occurs worldwide. The most important tick genera associated with small ruminants varies between continents, such as: *Ixodes*, *Dermacentor*, *Haemophysalis* and *Rhipicephalus* (Europe); *Amblyomma*, *Hyalomma* and *Rhipicephalus* (Africa); *Ixodes*, *Rhipicephalus* and *Haemophysalis* (Asia), *Amblyomma* (South-America) and *Ixodes*, *Dermacentor* (North-America). Ticks are spread within and between countries, but also between continents, especially by migrating birds. Transport / importation of domestic and wild mammals may also distribute ticks between areas.

Climate change may facilitate spread and establishment of ticks and tick-borne pathogens. In climate-warming models several important tick species are predicted to establish more northern permanent populations. Climate change is therefore likely to affect the survival, distribution, abundance and seasonal activity of ticks and increase the risk for tick-borne infections in several areas, also in the winter period. However, in areas with lower precipitation and raised summer temperatures, the survival, activity and distribution of for instance *Ixodes ricinus* is likely to be reduced because of their vulnerability to desiccation. The spread of ticks and tick-borne infections are also related to available hosts, biodiversity, migrating patterns of birds/mammals, land-use and land cover changes and socio-economic factors. This makes prediction of future scenario related to ticks and tick-borne infections difficult, especially since ticks, such as *I. ricinus*, may be extremely flexible and adaptable.

Tick-borne infections

Tick infestation may cause anaemia, paralysis, meat allergy, but the main challenge is their role as vectors of pathogens. The most important tick-borne infections in small ruminants in Europe are *Anaplasma ovis/phagocytophilum*, *Babesia ovis/motasi*, and *Theileria* spp. In addition, strains/variants of each microbe exist with various clinical and immunological characteristics. However, only scattered information is available concerning their distribution and their natural hosts.

Anaplasma spp.

Anaplasmosis caused by *A. ovis*, occurs worldwide and is one of the most widespread tick-borne diseases in small ruminants, for instance in the Mediterranean countries. The infection is spread by a variety of tick species, mainly in the genera *Rhipicephalus* and *Dermacentor*. *A. ovis* may cause haemolytic anaemia in small ruminants. However, subclinical infection is common. Clinical signs may be related to stress factors, such as hot weather, poor-health condition, long distance transportation and coinfections. In addition, infection with *A. ovis* may predispose animals to other infections / parasite infestation resulting in clinical disease or even death, and may also have an impact on health, milk and meat production. Anaplasmosis can therefore be a serious disease in small ruminants.

Tick-borne fever (TBF) caused by the bacteria *A. phagocytophilum* (formerly *Ehrlichia phagocytophila*) may cause severe economic and welfare challenges in the sheep industry especially in northern Europe. However, the infection has been detected worldwide and is mainly associated with *Ixodes* spp. ticks, but other tick species may be involved. *A. phagocytophilum* infection in *I. ricinus* ticks is widespread in Europe. The most characteristic clinical symptom is high fever, although clinical signs vary according to age, breed, variant / strain of *A. phagocytophilum* and immunological status of the host. Subclinical infection may occur. The infection causes immunosuppression in sheep making them vulnerable to secondary infections, such as tick pyaemia (caused by *Staphylococcus* spp.) or *Bibersteinia/Mannheimia* septicaemia. TBF is seldom fatal, unless complicated by other infections. Other complications include abortion, impaired spermatogenesis, and reduced weight gain in young animals. Genetic variants of *A. phagocytophilum* exist with variable degree of clinical reactions and cross-protective immunity. Recent investigations indicate that there are several natural enzootic cycles of *A. phagocytophilum*. The epidemiology of strains associated with small ruminants is unknown. Earlier studies indicate that red deer (*Cervus elaphus*) may act as a natural host for variants of *A. phagocytophilum* known to cause TBF in sheep.

Babesia spp.

Babesiosis is caused by protozoa in the genus *Babesia*. The main species associated with small ruminants are *B. ovis*, and *B. motasi*. *B. ovis* is the most pathogen species and an important tick-borne haemoparasite in small ruminants worldwide, including southern Europe. *Rhipicephalus* ticks, such as *R. bursa*, *R. sanguineus* and *R. turanicus* have been associated with the transmission of *B. ovis*. However, other tick species may occasionally be involved. *B. motasi* seems to be less pathogenic than *B. ovis* and is associated mainly with the ticks in the genus *Haemophysalis*, especially *H. punctata*. Acute babesiosis caused by *B. ovis* is characterized by apathy, fever, anaemia, jaundice and haemoglobinuria, and mortality may occur in some cases. The degree of severity is associated with the breed, age, immunity and health status. Infection is normally mild in indigenous sheep, whereas severe signs are mainly related to animals introduced from non-endemic areas. *B. motasi* produces in general mild clinical response characterized by fever, haemoglobinuria and anaemia and is rarely responsible for death losses.



FARM ANIMAL

ANOTHER CENTURY OF SMALL RUMINANT HEALTH CHALLENGES

Theileria spp.

Theileriosis is caused by protozoans that belongs to the genus *Theileria*. In small ruminants, *Theileria* genotypes comprise a heterologous group and consists of several types including *T. lestoquardi* (formerly *T. birvi*), *T. ovis*, *T. uilenbergi* and *T. luwenshuni*. In addition, *Theileria* species of small ruminants includes several new and uncharacterized isolates. The distribution of *Theileria* species in small ruminants is widespread, but only scattered information is available. A variety of tick vectors are involved in the genera *Haemaphysalis*, *Hyalomma* and *Rhipicephalus*. Only *T. lestoquardi*, *T. luwenshuni* and *T. uilenbergi* are considered highly pathogenic in small ruminants, although variation in their pathogenicity has been observed. *T. lestoquardi*, causing malignant theileriosis may introduce severe infection in sheep with high mortality rates. In malign theileriosis, an acute form is common, but subacute and chronic forms have been observed. Clinical signs in the acute form include fever, cessation of rumination, swelling of superficial lymph nodes, diarrhoea, jaundice and haemorrhages in submucosal and subcutaneous tissues. In chronic infections, intermittent fever, inappetence, emaciation, anaemia and jaundice may occur.

In general, management of tick-borne infections should include active surveillance, integrated control strategies such as host / breed resistance to the vectors and their pathogens, strategic vector control and the use of available vaccines against vectors and vector-borne infections. Climate changes are likely to affect the distribution and abundance of tick-borne infections in several areas.