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Review Article

IMPACT OF CLIMATE CHANGE ON ANIMAL PARASITISIM

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Abstract: Climate change leads to stress in the animals and thus reduces immunocompetence leading to severe outbreaks. The present article reviews the effects of climate change on animal parasitism.
Keywords: Weather-related disasters, altered hydrology, irradiation, animal parasitism.

Climate change is predicted to have important effects on parasitism and disease with consequence for human health and socio-economics (Marcogliese, 2008). Moreover, long-term changes in climate such as weather-related disasters and extreme weather events, such as droughts, heat waves, storms, and desertification will jeopardize the future of all animals-including those in oceans, on farms, in forests, in wilderness areas, and in our homes (Paudyal, 2015).

The incidence of mosquito-borne diseases, including malaria, dengue, and viral encephalitides, are among those diseases most sensitive to climate (Patz *et al*. 1996). Forman *et al*. 2008 reported that climate change affects animal health in four ways:

1. Heat-related diseases and stress
2. Extreme weather events
3. Adaptation of animal production systems to new environments
4. Emergence or re-emergence of infectious diseases.

To compensate the reduced opportunities for transmission during periods of adverse climate, parasites have evolved adaptations such as hypobiosis, the ability to remain in a state of arrested development within the protected environment provided by their hosts until transmission through the external environment proves effective (Paudyal, 2015). Some historical and paleontological studies of parasites suggest that host-switching behavior in parasites in response to ecological changes has been more common and global climate changes are likely to produce broadening of parasite host ranges even for long-lived, nominally specialized parasites (Brooks and Hoberg 2007).

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Effect of temperature and humidity:

Global warming has accelerated over the last hundred years (Fig. 1) with an average gain of 0.74ºC in 100 years (Semenza and Menne, 2009). Based on studies of vector and parasite development, warming and increases in humidity are predicted to open up new arena for malaria in Africa, parasitic nematodes in the Arctic, West Nile Virus, Lyme disease in North America, and Schistosomiasis in China (Brooks and Hoberg 2007). Rise of temperature (2°C) would double the metabolism rate of mosquitoes and expands domain of active infection from 42% to 60% of the planet (Baer and Singer, 2009). Helminth parasites of terrestrial wildlife, that release eggs or free-living stages into the environment or use invertebrate intermediate hosts to complete life cycle stages, are very susceptible to changes in temperature and humidity (Burek *et al*. 2008). Dobson and Carper, 1992 reported that 10 degree increase in temperature leads to about halving of the developmental time which enhances rapid multiplication of parasite populations. Temperature determines the rate at which mosquitoes develop into adults, the frequency of their blood feeding, the rate with which parasites are acquired and, the incubation time of the parasite within the mosquito (Patz *et al*. 2000). The infectivity of cercariae in the down-stream second intermediate hosts (invertebrate hosts) is also positively correlated with temperature (Studer et al. 2010). Since cercarial transmission is a crucial step in the trematode life cycle, it has been proposed that global warming might dramatically increase future infection levels in hosts (Marcogliese 2001, Poulin 2006).

Effect of altered hydrology:

Global warming resulted in reduction of water levels and their flow rates which ultimately led to alterations to aquatic host-parasite relationships. For example, reduction in water levels of the lakes and rivers would result in retention of free-living infective stages of parasites, increased incidence of summer’s itch and promotes the development of invertebrate intermediate hosts like molluscs.

Effect of seasonal changes:

Seasonality plays a crucial in transmission of parasitic nematode infections. For example, Teladorsagia/Ostertagia circumcincta and Trichostrongylus spp. may overwinter on pasture and the numbers of larvae decline in spring (Cooper et al, 2015). The length of rainy and dry seasons and the interval between seasons affects larvae and adult vector development and abundance.

The observed seasonal, regional and yearly changes in rates of diagnosis may be explained by the effects of rising temperature on parasite transmission (Cooper *et al.,* 2015). A warmer climate may affect strike incidence indirectly through changes to the seasonal pattern of sheep susceptibility and the timing of seasonal farm management practices (Rose and Wall, 2011). Cooper *et al.,* (2015) reported late season rise in Nematodirus spp. Infections unlike the normal pattern has reduced the relative importance of spring nematodirosis, shifting the emphasis towards autumn infections. McMahon *et al.,* (2012) reported that further increase in temperature would exacerbate this shift.

Moreover, precise prediction of climate effects on the incidence of ectoparasite infestations is uncertain due to subtle and conflicting interactions of humidity and temperature, free-living and host-bound life stages, and indirect effects on the host species and husbandry practices (Wall & Morgan, 2009). Climate change raises the possibility of changing patterns of veterinary drug administration to combat ectoparasites (Cooper *et al.,* 2015).

Effect of irradiation:

Increase in ultraviolet (UV) radiation causes direct damage to the parasites. For example, parasitic population which are sensitive to UV like eyeflukes would decline in their number.

Conclusion

If long-term climatic changes lead to the introduction of parasites into new areas when our ability to control them is rapidly diminishing, domestic livestock will face major disease problems (Paudyal, 2015). Thus, indicating the need for diagnosis of the emerging parasitic diseases and development of preventive strategies for these parasitic diseases in relation to climatic impacts.

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