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Climate change effects on trematodiases, with emphasis on zoonotic fascioliasis and schistosomiasis

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ABSTRACT

The capacity of climatic conditions to modulate the extent and intensity of parasitism is well known since long ago. Concerning helminths, among the numerous environmental modifications giving rise to changes in infections, climate variables appear as those showing a greater influence, so that climate change may be expected to have an important impact on the diseases they cause. However, the confirmation of the impact of climate change on helminthiases has been reached very recently. Only shortly before, helminthiases were still noted as infectious diseases scarcely affected by climate change, when compared to diseases caused by microorganisms in general (viruses, bacteriae, protozoans). The aim of the present paper is to review the impact of climate change on helminthiases transmitted by snails, invertebrates which are pronouncedly affected by meteorological factors, by focusing on trematodiases. First, the knowledge on the effects of climate change on trematodiases in general is reviewed, including aspects such as influence of temperature on cercarial output, cercarial production variability in trematode species, influences of magnitude of cercarial production and snail host size, cercarial quality, duration of cercarial production increase and host mortality, influence of latitude, and global-warming-induced impact of trematodes. Secondly, important zoonotic diseases such as fascioliasis, schistosomiasis and cercarial dermatitis are analysed from the point of view of their relationships with meteorological factors. Emphasis is given to data which indicate that climate change influences the characteristics of these trematodiases in concrete areas where these diseases are emerging in recent years. The present review shows that trematodes, similarly as other helminths presenting larval stages living freely in the environment and/or larval stages parasitic in invertebrates easily affected by climate change as arthropods and molluscs as intermediate hosts, may be largely more susceptible to climate change impact than those helminths in whose life cycle such phases are absent or reduced to a minimum. Although helminths also appear to be affected by climate change, their main difference with microparasites lies on the usually longer life cycles of helminths, with longer generation times, slower population growth rates and longer time period needed for the response in the definitive host to become evident. Consequently, after a pronounced climate change in a local area, modifications in helminth populations need more time to be obvious or detectable than modifications in microparasite populations. Similarly, the relation of changes in a helminthiasis with climatic factor changes, as extreme events elapsed relatively long time ago, may be overlooked if not concretely searched for. All indicates that this phenomenon has been the reason for previous analyses to conclude that helminthiases do not constitute priority targets in climate change impact studies.

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Contents

1. Introduction

Climate change and global warming are now accepted facts. Changes in air and sea surface temperatures, as well as changes in precipitation, sea level, and ocean salinity and circulation patterns, are predicted for the future. Natural ecosystems will be impacted in one way or another by these environmental changes. Climatic factors affect several ecological processes at different levels, from the performance of individual organisms, to the dynamics of populations and community interactions, up to the distribution of species, because of the link between changes in ecosystem properties and functions with large-scale climate fluctuations (Poulin and Mouritsen, 2006). The ecological consequences of climate change in terrestrial and marine ecosystems are expected to be determined by complex cascading effects arising from modified trophic interactions and competitive relationships. The synergistic effect of climate change and parasitism on host population dynamics and community structure has recently been emphasized (Mouritsen et al., 2005).

The capacity of climatic conditions to modulate the extent and intensity of parasitism is well known since long ago. The development and transmission rates of parasitic organisms are particularly sensitive to weather conditions. The current climate change (global warming) will affect the distribution and survival rate of parasite vectors and intermediate hosts and also directly influence the reproduction and maturation rate of parasites carried by them (McCarthy et al., 2001). As early as 1990, the Intergovernmental Panel on Climate Change (IPCC) had warned that the climate change could affect the prevalence of vector-borne parasitic diseases (Houghton et al., 1990).

The potential importance of parasites and pathogens as mediators of host population dynamics under changing climatic conditions in general and global warming in particular has been recently reviewed (Harvell et al., 2002; Mouritsen and Poulin, 2002a). Any influence of climate on parasitism is potentially important for natural communities and ecosystems. Many recent studies have emphasized the causal relationship between climate change and parasitic diseases, whether emerging (new infections) or re-emerging (diseases rapidly increasing in either local prevalence and intensities or expanding their geographical distribution) (Harvell et al., 1999, 2002; Patz et al., 2000; Marcogliese, 2001; Lafferty et al., 2004). In recent years, the problem of emerging diseases has been a significant concern (Molyneux, 2007). There is also evidence that climate can act to synchronize cycles of host population abundance by directly affecting the survival and transmission of parasite infective stages (Cattadori et al., 2005). Thus, the many direct and indirect effects of temperature and other climatic variables on parasite transmission are bound to have community-wide impacts. For the interest of both human and domestic animal health, as well as of the preservation of natural communities and ecosystems, it becomes crucial to understand how parasites may respond to the climatic changes expected in next decades, according to results obtained with forecasting climatic models.