

The impact of global climate change on the spread of parasitic nematodes

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One consequence of global warming is the spread of insects into new areas. About 60 species of Culicidae mosquito can act as vectors of the microfilariae nematodes *Dirofilaria repens* and *D. immitis*. Although within Europe, *D. repens* is endemic in the Mediterranean, in 2005 it was found to have spread to dogs in Slovakia, then the Czech Republic, Germany and the Netherlands. In Poland, the first cases of endemic subcutaneous canine dirofilariasis attributable to *D. repens* were recorded in 2009 (Demiaszkiewicz et al. 2009), and *D. repens* DNA was found in blood samples from 44% of sled dogs examined during racing season in central Poland in 2014 (Bajer et al. 2014). In 2012, 20 cases of human subcutaneous dirofilariasis caused by *D. repens* were recorded in Poland; however, heartworm disease, induced by *D. immitis* infection in dogs, has not yet been noted in humans. A period of warm summers in 2002–2003 in Finland contributed to an increase in the pace of development of mosquitoes of the genus *Aedes*, which are vectors of nematode *Setaria tundra* (Onchocercidae) living in the peritoneal cavity of reindeer (Laaksonen 2010). This resulted in a peritonitis epidemic (prevalence 42%) and economic losses in reindeer herding. During the year, the disease moved about 100 km north of Lapland. Many mosquitoes studied in southern Germany (with the exception of *Culex* spp.) were found to contain the DNA of *S. tundra* (Czajka et al. 2012). Climate change has also hastened the spread of the insect eye worm, for example, the occurrence of human thelaziasis caused by *Thelazia callipaeda* (Spirurida, Thelaziidae) in European countries (Italy, France, Germany, the Netherlands, Switzerland) and carried by *Amiota variegata* (Diptera) (Otranto et Dutto 2008). The occurrence of animals infected with the nematodes *Aelurostrongylus abstrusus* and *Angiostrongylus vasorum* (Metastrongyloidea) transmitted by terrestrial gastropods has also risen (Travers 2012, Travers et al. 2013). In Poland, *A. vasorum* was recently identified (Demiaszkiewicz et al. 2014) in 5.2% of the red foxes (*Vulpes vulpes*) shot in the Augustow Primeval Forest and in 48.6% killed in Denmark, its endemic area (Saeed et al. 2006). The intermediate hosts include several species of slugs and snails: 29% of mollusca samples (*Arion* spp., *Limax* spp.) in Denmark and 43% in South Wales (UK) contained *A. vasorum* larvae (Aziz et al. 2016). *A. vasorum* is an emerging parasite in dogs with frequent new reports throughout Europe and beyond.