



Dog Relocation and Rapidly Changing Parasite Threats [†]

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1. Introduction

Dog population control methods and commercial breeding regulations have resulted in real or perceived shortages of adoptable dogs and puppies in certain geographies. In response to demand for adoptable and often “rescued” dogs, a variety of dog relocation and rescue networks have evolved, which move hundreds of thousands of dogs and puppies from areas with abundant supply or fewer breeding regulations into areas with higher demand for pet dog adoptions or purchases. These dogs and puppies are often sourced from locations with relatively high parasite prevalence and relocated to areas where parasite prevalence is lower, or possibly to areas where some parasites have not been previously endemic. Parasites resistant to available treatments or preventives may also be transported to areas where resistance is yet to emerge. Organizations and individuals involved in dog relocation are often unaware or unconcerned with the risk of parasites being moved with dogs, as evidenced by a high percentage of organizations which do not test or treat dogs for parasites prior to transportation; in a survey of individuals involved in dog rescue organizations, 70% of the respondents either disagreed with or had no opinion about this statement: “I believe dog transfer programs can lead to the spread of animal disease.” [1]. A review of recently published examples of changing parasite prevalence or the introduction of new parasites to previously non-endemic areas is presented.

2. Dog Relocation Numbers

The total numbers of dogs being relocated or imported is very difficult to gather, as many agencies either do not collect or do not publish these data. A few examples regarding the scope of the dog movement issue have been published recently. For example, intra-European trade of approximately 46,000 dogs/month occurred in 2014 alone, with 68% of registered trade originating in Hungary, Slovakia or Spain, and 71% of registered trade destinations listed as France, Germany or the United Kingdom [2]. Approximately 300,000 dogs enter the United Kingdom annually via the Pet Travel Scheme [3]. This is a nearly three-fold increase since 2012, when about 100,000 dogs entered [4]. The state of Colorado, in the United States of America received approximately 114,000 dogs over a four-year period from 2014 to 2017, with the majority of these dogs originating in the southern parts of the USA, where heartworm and many gastrointestinal nematodes are common [5,6].

3. Recent Examples of Parasitic Infections with Potential Links to Dog Relocation

Dirofilariosis in Austria: Prior to 2008, there were never more than four cases per year diagnosed at the University of Veterinary Medicine, Vienna. Cases have increased dramatically since 2014, with more than 20 cases per year reported for the period 2016–2018 [7].

Dirofilaria immitis (heartworm) in Colorado: The prevalence of heartworm in Colorado increased by more than 67% from 2013–2017, during a period when more than 114,000 dogs



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were imported into Colorado primarily from the southern United States of America, which is highly endemic for *D. immitis* [6].

Dirofilaria immitis (heartworm) in Canada: Heartworm prevalence in dogs originating in the USA was double the rate of Canadian dogs, with 90% of heartworm positive dogs from the USA originating in either the states of Texas or Georgia in the southern USA [8].

Dirofilaria immitis (heartworm) in Italy: A study published in 2020 revealed a prevalence of 44.2% in dogs ($n = 385$) from two animal shelters in the previously non-endemic area of southern Italy [9].

Angiostrongylus vasorum (lungworm/French heartworm) in Australia: A two-year-old Cocker Spaniel was diagnosed with Angiostrongylosis four months after entering Australia, which is non-endemic for *A. vasorum*, from Surrey, England, an endemic region for this parasite [10].

Rhipicephalus sanguineus ticks imported into the UK: Forty importation events with brown dog tick have been documented since 2012, related to recently travelled or imported dogs [11].

Babesia canis in the UK: A number of cases of babesiosis had been previously reported in imported dogs and, in 2016, a cluster of babesiosis cases in untraveled dogs was reported [12].

Ehrlichia canis in Australia: Although no evidence of *E. canis* was found in dogs in northern Australia in 2003 [13], *E. canis* was identified in Western Australia in May 2020 and in the Northern Territories of Australia in June 2020, resulting in the implementation of conditions related to the movement of dogs within Australia [14].

Leishmania spp. transmission in UK: Leishmaniasis was diagnosed in a dog with no travel history outside the United Kingdom. The dog had lived with another dog which had been imported from Spain and had been euthanized due to severe leishmaniosis [15].

Haemaphysalis longicornis ticks in USA: A parthenogenic Asian tick species, *H. longicornis*, was first identified in 2017 in Virginia and has now been reported in 96 counties across 12 states [16].

Oncocerca lupi in Italy: A dog adopted in Italy in 2013, originating in southern Portugal, developed ocular discomfort and was diagnosed with *O. lupi* following surgical removal or anterior sclera [17].

4. Discussion and Conclusions

The relocation of thousands of dogs from areas of relatively high parasite prevalence has changed the prevalence of parasites at the destinations where the dogs are adopted, which may place local dogs, wildlife and people at increased risk from newly introduced parasites if climactic conditions and/or effective vectors are also present. As evidence grows, showing newly established endemic parasites in previously non-endemic areas, and autochthonous cases begin to emerge, veterinarians and dog owners must take greater precautions regarding to the control of parasitic diseases than may have been the standard of care in the past. Relocated dogs should be tested and, if necessary, treated for parasitic infections. As not all relocated dogs will visit veterinarians for the diagnosis and treatment of parasitic infections, veterinarians and pet owners should implement more aggressive parasite control strategies in the face of rapidly changing parasitic infection risks, regardless of an individual pet's travel history. Several veterinary parasitology organizations provide guidelines for internal and external parasite control in dogs, including the European Scientific Counsel Companion Animal Parasites (ESCCAP), the Companion Animal Parasite Council (CAPC), the American Heartworm Society (AHS) and the Tropical Council for Companion Animal Parasites (TroCCAP). Additionally, a consensus statement on the topic of rehomed dogs, parasites and vector-borne diseases from the Companion Vector-Borne Diseases (CVBD) World Forum was recently published [18]. Veterinarians should encourage pet owner adherence to these guidelines whenever feasible.

Conflicts of Interest: The authors declare no conflict of interest.

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