Chapter 3: Canine Distemper virus in wild mesocarnivores in the South-eastern united states

# INTRODUCTION

Urbanization is occurring at an ever-increasing rate worldwide and indeed plays a large part in changing the composition of wildlife communities with some species suffering and others thriving under the new conditions. Not only does this altered landscape influence the macroscopic species, but this consequently has a huge role to play in the pathogen landscape at this wildlife-domestic-human interface (Bradley and Altizer 2007, Gottdenker et al. 2014). There are a number of specific features that are altered by anthropogenic land changes. Urban areas possess abundant resources for anthropophilic species, such as raccoons, that are not prone to seasonal fluctuations. These resources include food supplies (e.g., household waste) but also shelter. As a result, urban and suburban areas are capable of supporting much greater raccoon population densities (Prange et al. 2003). In addition to there being a greater quantity of resources in urban areas there tends to be greater aggregation of resources. This clumping of resources, for example at a large landfill site, results in two factors which are of importance in disease transmission; they result in migration of individuals into the area and in exceptionally high contact rates between not only member of the same species but between members of different species. Contact rates play a vitally important role in disease transmission with higher population density resulting in greater contact rates and consequently greater rates of disease transmission (Hu et al. 2013). One particular study showed this higher population density in response to resource availability resulted in higher parasite richness and increased B. procyonis prevalence in raccoons(Wright and Gompper 2005). And canine distemper virus cases are more prevalent in urban and suburban counties than in rural counties, which support a much lower population density of raccoons (Taylor et al. 2021). There is an added potential layer of complexity to additional resource provision as increased birth rates in this situation increase the abundance of susceptible juvenile hosts compared to a natural environment. Finally there is the question on how the quality of this diet (Schulte-Hostedde et al. 2018) affects the immune response of these individuals and whether this may also result in greater amount of pathogen shedding.

With habitat fragmentation, local extinctions occur resulting in a reduced local biodiversity of urban wildlife. This can influence the transmission of some vector-borne diseases through a process termed the ’dilution effect’(Keesing et al. 2006). In this process, high host species richness can lower parasite transmission if vectors feed on multiple host species varying in competence as a pathogen host. The reverse situation could occur in urbanized areas if low host diversity increases the abundance of particular hosts that serve as highly competent reservoirs. Essentially low competent hosts dilute the competent hosts in a highly biodiverse ecosystem resulting in lower pathogen abundance.

There is also the issue of how urbanization brings native wildlife species into contact with novel pathogens to which they are immunologically naïve. As undisturbed ecosystems reach a state of equilibrium, the same can also be said for their host-pathogen systems. In the face of urbanization, another source of disturbance to this equilibrium is the introduction of “novel” pathogens to that system. This can occur in a number of ways. Either through the accidental introduction or release of invasive species (e.g., gray squirrels in the UK) or through domestic species. Any of these new species introduced to an area have their own set of pathogens with the possibility of transmitting these into the local wildlife population and threatening their health and survival. It’s been demonstrated that wild carnivores often suffer as a result of coming in contact with domestic cats and dogs and the pathogens they harbor (Riley et al. 2004).

Canine distemper virus (CDV) is a significant cause of morbidity and mortality in a wide range of species but particularly carnivore species. This makes this virus of is a major conservation concern. CDV has been implicated in severe population declines in multiple species, including the near extinction of the black-footed ferret in the US (Williams et al. 1988). It is also an important disease in domestic dogs. Additionally the virus has been shown to pass back from wildlife to dogs (Kapil and Yeary 2011). CDV has also been proposed as a risk to human health, it has been hypothesized that waning population level measles immunity will leave humans susceptible to CDV infection.(Martinez-Gutierrez and Ruiz-Saenz 2016). Morbilliviruses have a tendency to have a narrow host range, but CDV goes against this trend by its ability to infect a wide variety of carnivore hosts. However, there is an incomplete understanding of the dynamics of CDV infection within multi-host systems, such as carnivore communities. The role that particular species plays in the maintenance and spread of the disease in this system is not understood and consequently the targeting of mitigation measures is not well informed. The southeastern US is one such multi-host system, containing a wide variety of potential host species. Raccoons are frequently the most reported wild carnivore species in distemper outbreaks and have been suggested as the possible reservoir host (Roscoe 1993). Preliminary work from necropsy data of wild carnivores diagnosed with CDV has demonstrated that CDV is widely spread in the SE USA with at least 9 carnivore species experiencing mortality as a result of infection. In the most commonly infected species, raccoons and gray foxes, there appeared to be a trend of cases clustering in suburban areas with fewer cases occurring in highly urbanized and in rural areas(Taylor et al. 2021). Studies in other parts of the world have suggested that the dynamics of CDV outbreaks can vary over time and space (Bianco et al., 2020). Given the propensity of CDV to infect anthropophilic mesocarnivores it raises the question of whether there are human land use features which affect the likelihood of the virus occurring in wildlife.

Here, we analyze the CDV genetic diversity int wild mesocarnivores in the Southeastern US. Additionally, we explored the spatiotemporal distribution of CDV in free-ranging mesocarnivores from the same region from 2019 to 2022. Finally, we the investigated the environmental/ecological factors which may increase risk of CDV outbreaks..

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