The Next Frontier of CWD Models for Michigan

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Chronic wasting disease (CWD) is an emerging infectious disease that is potentially devastating to white-tailed deer populations. Like many wildlife diseases, understanding how to best manage CWD is challenging because of the complex interactions that occur between the host, the disease, and the environment. Given the limited resources available to research CWD and the widespread consequences associated with the loss of white-tailed deer, alternative approaches to field-based research efforts are needed to inform management and surveillance decisions. Disease simulation models, particularly agent-based models (ABMs), provide a unique tool to help researchers and managers better understand CWD dynamics and predict outbreaks because they are designed to link population demography and individual behaviors to disease dynamics. These models can be rapidly modified to assess specific questions.

ABMs are composed of three major components— the landscape, the individual agents, and decision-making rules. The modeling environment is like a video game environment, where the individual characters, deer in these models, have certain rules that govern their behavior and how they interact with other characters and their virtual world. In the model used by the researchers at MSU, the rules govern how CWD can spread and mimic what is expected to happen with deer populations in the real world. These ABMs explicitly account for variability in individual deer behavior and specific environmental or landscape contexts.

These models were informed using data gathered from comprehensive, on the ground, research initiatives that evaluated aspects of deer ecology and movement. White-tailed deer are a culturally and economically important species, so they have been a focus of wildlife research across the United States for decades. While a lot is known about deer ecology, CWD only recently emerged in the United States, so far less is known about CWD ecology. It is difficult to evaluate CWD transmission and spread because it takes years for the disease to run its course and manipulating CWD presence in free-ranging deer is impossible. Conceptually, ABMs allow for the quantification of what will happen given what is known about how the system works, even though the entire picture is not clear.

For projects related to CWD, researchers get one chance to answer their research question because the time and resources needed to do large-scale field experiments are limited. These models let researchers do their experiments in a virtual world and answer practical questions that help solve problems or make important conservation decisions. They provide a tool to ask ‘what if’ questions like “what if we increase harvest in certain age classes? or what if contact rates between deer increase?” Scientists can also use these models to ask theoretical questions like “how do different habitats

influence CWD spread or how do other common diseases interact with CWD to influence deer populations?" In simulated environments, these questions can be answered quickly with far fewer resources than needed in real-world experiments.

One major benefit of these tools is that they can be easily adapted to simulate CWD dynamics across the United States and even the world. Indeed, these models were initially developed in Missouri, and the researchers at MSU in collaboration with deer and disease experts at the Michigan Department of Natural Resources have adapted them to realistically represent Michigan deer populations. While the scientists at MSU are focused on ensuring these models mimic what is happening here in Michigan, their hope is that tools like these represent the next frontier of CWD management. It is important to remember, however, with complex diseases, like CWD, there is no single solution that will completely eradicate disease from the landscape. Models like these are just one of the many tools in the toolbox to help scientists and resource managers answer questions related to white-tailed deer management and wildlife conservation as a whole.