APPLICATION OF A BAYESIAN WEIGHTED SURVEILLANCE APPROACH FOR CHRONIC WASTING DISEASE IN WHITE-TAILED DEER[1]

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ABSTRACT

Surveillance is critical for understanding the emergence and epidemiology of infectious diseases, and weighted surveillance takes advantage of heterogeneity in host disease risk to increase the efficiency of sampling efforts. We apply a Bayesian approach to estimate weights for 16 surveillance classes of white-tailed deer in Wisconsin, USA, relative to yearling hunter-harvested male deer. We use these weights to design a surveillance program for detecting CWD in white-tailed deer at Shenandoah National Park (SHEN) in Virginia, USA. Generally, apparent infection hazard increased with age and was greater in males. Clinical suspect deer were the highest risk class with weight estimates of 33.33 and 9.09, for community reported and hunter reported suspect deer, respectively, while fawns were the lowest risk class with an estimated weight of 0.001.

We used Wisconsin derived surveillance class weights to determine sampling effort required to detect a CWD-positive case in SHEN if prevalence in male yearlings ≥0.025. The sampling effort required to detect CWD at the 2.5% level in our reference class, male yearling deer, was 37–91 adult deer, depending on the ratio of bucks to does in the surveillance stream. We collected rectal biopsies from 49 and 21 adult female and male deer, respectively, and 10 additional samples from vehicle-killed deer. All samples tested negative and demonstrated with 95% probability that CWD prevalence in the reference population (yearling males) was between 0.0 to 3.6%. Our approach allows managers to estimate relative surveillance weights for different host classes and quantify limits of disease detection in real time, resulting in financial, resource, and personnel savings for agencies tasked with performing wildlife disease surveillance. Additionally, it provides a rigorous means of estimating disease prevalence limits when the disease/pathogen is not detected, and can be applied to other ecological questions of interest where data is available on heterogeneous probability of risk or occurrence.