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APPLYING A BAYESIAN WEIGHTED SURVEILLANCE APPROACH TO DETECT CHRONIC WASTING DISEASE IN WHITE-TAILED DEER[1]

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ABSTRACT

Surveillance is critical for early detection of emerging and re-emerging infectious diseases. Weighted surveillance leverages heterogeneity in infection risk to increase sampling efficiency. Here we apply a Bayesian approach to estimate weights for 16 surveillance classes of white-tailed deer in Wisconsin, USA, relative to hunter-harvested yearling males. We used these weights to conduct a surveillance program for detecting chronic wasting disease (CWD) in white-tailed deer at Shenandoah National Park (SHEN) in Virginia, USA. Generally, for surveillance, risk of infection increased with age and was greater in males. Clinical suspect deer had the highest risk, with weight estimates of 33.33 and 9.09 for community-reported and hunter-reported suspect deer, respectively. Fawns had the lowest risk with an estimated weight of 0.001. We used surveillance weights for Wisconsin deer to determine sampling effort required to detect a CWD-positive case in SHEN if prevalence in yearling males ≥0.025. The sampling required to detect CWD was 37–91 adult deer, depending on the adult male:female ratio in the surveillance stream. We collected rectal biopsies from 49 female and 21 male adult deer, and 10 additional samples from vehicle-killed deer. CWD was not detected and we concluded with 95% probability that prevalence in the reference population (yearling males) was between 0.0 to 3.6%. *Synthesis and applications.* Our approach allows managers to estimate relative surveillance weights for different host classes and quantify limits of disease detection in real time when only a sample of animals from a population can be tested, resulting in considerable cost savings for agencies performing wildlife disease detection surveillance. Additionally, it provides a rigorous means of estimating prevalence limits when a disease/pathogen is not detected in a sample set. It is therefore applicable to other wildlife, domestic animal and human disease systems, which can be characterized by surveillance classes with heterogeneous probability of infection. This methodology is also extendable to other disciplines such as invasive species, environmental toxicology, and generally any ecological question seeking to efficiently use scarce financial and human resources to maximize the detection probability of a rare event.

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