

Hierarchical multi-method occupancy estimates inform disease surveillance from bats in Cambodia.

An important component of disease surveillance is the spatial habitat relationships of vertebrate pathogen reservoirs. We used a hierarchical multi-method occupancy model to understand habitat relationships of bats in Cambodia to augment disease surveillance efforts. Efforts to estimate habitat-host relationships don't often occur at such large spatial scales. Sites were selected from a stratified random sample based on habitat class. Bats were sampled using mist net arrays and acoustic detectors at 227 sites from each province and habitat type in Cambodia. Forty-five species were detected using mist net arrays, and 39 species were detected by acoustic detectors. We developed a bat call reference library for identifying anonymous call data to species or species group. We manually vetted acoustic data using Scan'R software and a R-language shiny app 'SZapp'. We estimated detectability for all species and survey method. Detectability varied among species and survey method. Model averaged estimates of detectability were then used to estimate probability of species occupancy by habitat class. Pathogen presence/absence was included as a covariate in the occupancy model and estimates of pathogen probability of occupancy by habitat were calculated. These estimates were used to develop predictive probabilistic risk maps of pathogen prevalence and a guide to inform future disease surveillance efforts. A hierarchical multi-method occupancy framework is a practical approach to estimating the spatial prevalence of pathogens, and averaged estimates of detectability allow more precise and accurate estimates of occupancy, especially with species where a single survey method only captures a small proportion of the species assemblage.