Occupancy Modeling of Hunter Sightings for Monitoring Moose in Montana

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Moose (*Alces alces*) are widely distributed across >100,000 km2 of Montana yet occur at low densities and garner minimal funding. Traditional monitoring methods present challenges of low precision and high cost. During 2012–2015, we tested the efficacy of applying patch occupancy modeling to moose sightings made by hunters of other cervids for cost-effective statewide monitoring. We used phone surveys to collect sightings and allocated each

spatially to grid cells and temporally to 1-week sessions within a 5-week hunting season. For each cell we estimated covariates with hypothesized relevance to occupancy by moose or detectability by hunters, including characterization of vegetation, topography, accessibility by humans, hunter effort, and spatial correlation. We sampled ≥45,500 hunters per year at a cost of $12,000–$15,000. Of responding hunters, 14% reported ≥1 moose sighting which accumulated to 4,800–6,800 sightings annually. Statewide occupancy estimates were robust and consistent across years of sampling, averaging $\Psi = 0.30$ (SE=0.005, range=0.30–0.31). Forested vegetation types reduced the probability of detection but increased the probability of occupancy, while shrub and riparian vegetation types increased both detection and occupancy rates. The amount of sampling effort expended affected detection rates but did not affect occupancy estimates. We expect occupancy estimates to be less sensitive to population changes in areas with higher abundance, making this approach better suited for monitoring change at the range periphery. Alternate count-based analysis techniques such as n-mixture models may offer an alternative to make best use of hunter sightings for monitoring statewide moose populations.