Electronic data collection and processing to improve precision and accuracy of perpendicular distance estimation in aerial surveys

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Aerial line–transect surveys are a conventional technique for obtaining density estimates. However, maintaining a predetermined centerline (*g (0))*, obtaining accurate perpendicular distances *(x)*, achieving precise survey–line length *(L)*, and recording accurate cluster sizes or species are frequently based on subjective and imprecise collection procedures. We developed an easy-to-use, electronic distance-estimation device and software (i.e. system) to mathematically calculate perpendicular distance to detections based on trigonometry principles. We tested the system using simulated point clusters of objects with data collection from a Raven II R-44 helicopter. Our objectives were to: 1) evaluate the precision and accuracy of the electronic distance-estimation device (i.e. laser-rangefinder, tablet Personal Computer, and Differential Global Positioning System) 2) determine the accuracy and practicality of our data-entry software, 3) determine observer bias in estimation of cluster size, and 4) evaluate the effect of helicopter flight pattern on the accuracy of the distance-estimation system. Two types of helicopter flights were evaluated: hovering after cluster detection to estimate distance (n = 47) and continuous linear flight (n = 40). We calculated 2 error measurements: Euclidean distance error (distance between actual location of the cluster and electronic estimation location) and perpendicular distance-to-transect error (|estimated distance – actual distance|). Euclidean distance error using the electronic system was lower for hovering (5.59 ± 1.62 m [95% CI]) than continuous flight (26.10 ± 8.14 m). Hovering also resulted in lower distance-to-transect error (2.91 ± 0.85 m) than continuous flight (9.68 ± 3.43 m). Cluster size bias (|estimated number – actual number|) was minimal (0.92 ± 0.33 individuals) by observers using the distance-estimation system. The electronic data entry system successfully (e.g., observer was prompted with data entry sequence) worked 100% (n = 47) of the time when hovering and 83% (n = 40) with continuous linear flight and took about 10 seconds (n = 47) to complete the data entry sequence. Effort expended for analyzing field data is dependent on the researchers ArcMap skill level (moderate skill level = 15 min/observer/survey/ site). Use of this electronic data collection and processing system allowed us to improve our northern bobwhite (*Colinus virginianus*) density estimates because precise perpendicular distances, line length, and covey-sizes were attainable from low effort aerial surveys.