

## Day 1 MORNING: Ungulate Monitoring Methods & Manned Aircraft - Panel Q & A

Asked To	Asked By	Q & A
Anne Hubbs	Moderator	<p>When will the jurisdictional survey results be available?</p> <p><b>Anne's reply:</b> target date end of August. We will be following up with jurisdictions who have not yet responded.</p>
Anne Hubbs	Philip DeWitt (Ontario MNRF)	<p>Anne, do the methods cost comparisons include staff time?</p> <p>Some jurisdictions don't track staff time associated with field work (but obviously there are lost opportunity costs)</p> <p><b>Anne's reply:</b> no, the estimates I showed did not explicitly track include staff time, though I agree that this is very important to include. Includes per diem, cost for time delays.</p>
Anne Hubbs	Sultana Majid (WLRS, BC Gov)	<p>Is the use of several methods (i.e., type of data collected and estimated) for a single species within a jurisdiction partly due to the fact that there are different objectives?</p> <p>And is this potentially a way of addressing imperfect detection?</p> <p><b>Anne's reply:</b> yes ties to different objectives (e.g., hunting allocations using harvest data; multiple methods for sight-ability correction; if evaluating management actions). Other considerations - spatial scale, frequency (e.g., aerial surveys every 5 years, remote cameras in-between).</p> <p>Imperfect detection- example telemetry and aerial surveys.</p> <p><b>Kayla's reply:</b> double observer capture-recapture (can estimate detection probability for each observation)</p> <p><b>Mike's reply:</b> sight-ability trials often done on a quadrat area-level base but if use Distance-Sampling protocol with collars you're able to differentiate perception bias of moose missed (e.g., further from aircraft) to availability bias (never going to be detected) = bias correction. Incorporate concept of D-S important for imperfect detection.</p>
Anne + others	Embere Hall - WGFDD	<p>It can be difficult to get the public and decision-makers to understand the importance of accounting for imperfect detection (i.e. the public doesn't always "believe" abundance estimates adjusted for imperfect detection).</p> <p>Any tips you or others have found helpful to help impress the importance of accounting for imperfect detection?</p> <p><b>Anne's reply:</b> suggest reaching out to human dimensions / social scientists to help with messages. Scale up for consistent messaging across jurisdictions (e.g., through WAFWA).</p> <p><b>Emily added:</b> suggest influencing influencers who hold weight with the public.</p>

		<p><b>Mike's reply:</b> context by which we incorporate estimates is important. Bias tends to be low. Use surveys to calibrate trend and demographic patterns. We often don't make dramatic changes in our estimates. Frame as calibration. Sight-ability correction factor won't change estimates much.</p>
Kayla Davis	Moderator	<p>How can methods for collecting digital and autonomous data help resolve issues with aerial surveys?</p> <p><b>Kayla's reply:</b> with digital data you have a replication of data; can have different people / algorithms count / conduct species id; you can also apply different detection probability approaches; all of which should help reduce error.</p>
Kayla Davis	Moderator	<p>Are digital methods immune to the common pitfalls?</p> <p><b>Kayla's reply:</b> if humans are processing data the same issues will occur. The reason digital data is thought to be better is that one can review it multiple times. Machine learning algorithms have the perception of being better, but these need to be "fine tuned" and may have assumptions that could lead to common pitfalls.</p> <p>Brett Furnas's additional question: how about state-space models that account for uncertainty in machine learning?</p> <p><b>Kalya's reply:</b> state space models can characterize uncertainty so could be useful.</p>
Kayla Davis	Moderator	<p>How do you determine the biggest issues / sources of error for your survey and how people can identify them?</p> <p><b>Kayla's reply:</b> think about survey systems (e.g., vegetation) and biology of animals (how affect ability to see or identify them). Use a double-observer if you want to get handle on potential issues, secondary data type (e.g., telemetry data to compare with aerial survey data).</p> <p><b>Emily O'Donovan (BC - Kootenays) added in chat:</b> Poor survey design leading to non-detection could relate to failure to define an accurate elevation cut-off (e.g. many moose above the defined survey unit that is supposed to represent a WMU).</p>
Mike Russell	Brett Furnas (CDFW)	<p>Are "hierarchical distance sampling" or "distance decay" being used/considered as alternative ways to address availability?</p> <p>This generally requires some level of transect replication on different days.</p> <p><b>Mike's reply:</b> hierarchical D-S models I have seen use a similar approach to what I described of pooling detection functions across different strata / existing survey data in Bayesian 2-staged approach to estimate detection probability (inferred detection rate relative to covariates) &amp; applying encounter rate variability associated with that. Could be useful for low abundance or highly clumped species where precision estimates are very wide (e.g., elk).</p>
Mike Russell	Brett Furnas (CDFW)	<p>How about state space models that account for uncertainty in ML?</p>

		<p><b>Mike's reply via email:</b> We are looking at developing the hierarchical approach in Oedekoven et al. (2014) using our long-term dataset, to improve the reliability and precision of detection probability for new surveys. Our survey program is built around infrequent but relatively intense sampling that provides discrete estimates of small areas (i.e. wildlife management units), instead of more frequent sampling across larger areas. There are often 5-7 years between surveys of one area. It is a work in-progress but we think this approach will improve precision, better reflect true detection (such as adding replicates to vegetation covariates) and reduce flight hours/costs of new surveys.</p> <p>We are less familiar with state-space models, but think it is a similar concept and approach to hierarchical modeling. By separating the elements of detection probability models and abundance/count models and integrating across many survey units/estimates, we can definitely improve estimates across all components. We have estimated variance in detection probabilities across strata (including repeated measures) and we were thinking we could integrate this mixed effects detection model to improve precision going forward. We assume the integration of the detection models using hierarchical random effects (by survey/time strata) models would be similar to how state space models would handle these relationships in an ML framework, but maybe not? As we move to spatially-explicit methods this integration of models might be even more useful for modeling intrinsic growth rates inferred from density at finer scales, for example with finer scale covariates etc. This could facilitate more frequent, less wildlife management unit-centric sampling to infer population status at broader-scales; like what I understood CA is doing for deer.</p>
Mike Russell	Embere Hall - WGFD	<p>The stratified adaptive transect sampling approach that you described is interesting.</p> <p>Is this included in the "Peters and Hebblewhite" publication? I'm specifically interested in details on the analysis</p> <p><b>Mike's reply:</b> It isn't a new concept and is covered in the Buckland chapter. We have found the applied approach useful to evaluate encounter rates as fly to determine if we should use alternative stratification etc.</p>
Mike Russell	Philip DeWitt (Ontario MNRF)	<p>Similar to what you mentioned, we've been tracking CV progression and Encounter Rate between strata (i.e., assessed daily with random draws in proportion to variation)</p> <p>How are you handling representation coverage? Habitat models, vegetation, other?</p> <p><b>Mike's reply:</b> re representation coverage, we typically fly more than we statically need to. We haven't fine-tuned / optimized that. Fly until we see CV level out and then look at alternative species. For representation of area, one could use sampling fraction - we haven't fine-tuned that. There may be an issue with random strata pull, you might see big problems with stratification. OK to pull max 3 times but then need to fly more.</p>
Pauline Priadka	Emily Herdman	<p>You mainly used aerial survey data. How robust is your approach to adding different data sources to support in between years if you have partial datasets for example in that modeling approach?</p>

**Pauline's reply:** You could use camera traps, ground-based counts for example; each will have different levels of uncertainty but IPMs can be a good approach for filling information gaps. Recommend using a prioritization tool to determine when you need to use more expensive survey methods vs. cheaper alternatives.