

Day 2 MORNING: Remote Cameras and Telemetry - Panel Q & A

Asked To	Asked By	Q & A
FOR ALL PANELISTS	Rebecca Viejou (fRI Research)	<p>Given the extra image and data processing time required to estimate density for cameras, do you have any favorite tools you used to help improve efficiency?</p> <p>Sydney's reply: Mega Detector really helped with data processing. 60% of the images were blank due to blowing snow. Mega Detector saved me half the time to go through images.</p> <p>Marcus's reply: Build good tools and scripts for yourself to automate processes for yourself (e.g., R).</p>
FOR ALL PANELISTS	Rebecca Viejou (fRI Research)	<p>How much more processing time is required (orders of magnitude) compared to other survey methods?</p> <p>Marcus's reply: probably quite a bit to make sure data management is of high quality.</p> <p>Jon's reply: one of the challenges we have faced is that of feeling like we need to maintain all information that could be extracted from cameras (e.g., saving every single picture). This becomes overwhelming. We're now having to make decisions about what we can eliminate. Better to start with what are the questions we want to answer with the data and maintain that data only.</p> <p>With camera data, there's a delay in getting results (versus other methods like aerial surveys).</p> <p>Sydney's reply: it took me 200 hours to tag half million images, including for demographic information (which is notoriously slow).</p> <p>Mike Russell's reply from chat: We have the benefit of adopting a standard database framework (Hannah developed) early on, and our Alberta geospatial folks developed transect tools. We developed some Shiny tools for assessing precision etc. So that has been very helpful.</p>
FOR ALL PANELISTS	Rebecca Viejou (fRI Research)	<p>When labour costs/staff time are considered, is camera trapping less expensive than survey methods typically used in your study areas?</p> <p>Jon's reply: once you get the process down, it's cheaper to go with cameras vs. aerial surveys.</p> <p>Sydney's reply: One of the main take-aways from the divii project is that we don't have the option of surveying more frequently than every 3-5 years, so cameras offer a really important complement to the aerial program. Our array being so small does help limit costs, but it is quite limited in analysis options (e.g., density</p>

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		<p>estimations). So, we can't really speak to replacing an aerial program with the array we have, but we were able to fill this critical gap in the monitoring program.</p> <p>This totally depends on the resources you have access to (AI, technicians/grad students for data processing, etc.) your study area size and access, your monitoring goals, etc. but generally in the literature we see that cameras are more cost effective. We did not specifically compare this in the divii project, but the pros of camera trapping really make up for any potential gaps in the \$\$ reasoning (e.g., community involvement, monitoring of more than just demography, etc.)</p> <p>Steve's reply: Cost effectiveness depends in part on how far you're able to extrapolate the results from your camera array. (In other words, how large an area you can apply the results to.) Also, aerial surveys cause sheep a lot of stress. We're working with a sensitive population, so one of the major benefits of camera traps for us is that they're non-invasive. Lastly, as Sydney mentioned, our camera array and aerial surveys provide us with different data, so you couldn't really replace one with the other.</p>
FOR ALL PANELISTS	Paul Jones (ACA)	<p>Do you know if anyone has used camera trap images to do a mark-recapture population estimate where individuals are not marked (i.e., no ear tag or collar)? There are AI programs being used to ID individual dairy cows by just their muzzles. Could we apply these AI methods to other wildlife?</p> <p>Jon's reply: hope so, mark-recapture has a huge history. Would potentially be more precise & robust than unmarked models.</p> <p>There have been models developed for partially marked individuals where there's a good probability it's the same individual but can't be 100% sure. Ben Augustine (who has published on using SCR with partial identity) thinks this approach can be expanded (e.g., from only seeing left / right side of animal to wolf coat patterns where you can get probability it's the same individual).</p> <p>Jamie's reply: I will be testing one of Ben's models for partially marked populations (e.g., using antler points, coat colour). Will determine if it is better than Spatial Count. I've never seen AI applied to density estimates; though there was work on bears faced on facial recognition (https://onlinelibrary.wiley.com/doi/10.1002/ece3.6840).</p> <p>John Boulanger from chat: We did a review of the various mark-recapture, resight, unmarked methods for bears but this review also considers ungulate studies. https://doi.org/10.1016/j.gecco.2022.e02058</p> <p>Marcus Atkins BC Gov from chat: Bear facial recognition not really viable, change too much throughout seasons/years.</p>
Jamie/Marcus	Eric Neilson	<p>Has the performance of unmarked camera-based density estimators (spatial count, TIFC) been compared against benchmarks other than aerial surveys, such as genuine MRC or known densities?</p>

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		<p>Jamie's reply: yes, there are papers that have compared unmarked density estimates from cameras vs. genetic mark-recapture. Known densities comparisons are very rare in the real world; instead simulation tests for camera trap models have been compared. Unmarked density estimates are typically compared to each other, aerial surveys, or genetic mark-recapture.</p> <p>Marcus's reply: couple papers with known densities - e.g., from Yukon using different methods for lynx; paper where used human volunteers to compare methods.</p> <p>Jon's reply: Nick DeCaesare has a paper coming out that compares camera trap estimates to that of the known population of sheep and mule deer on Wild Horse Island in Montana. Hard because most known densities are from non-natural populations.</p>
Marcus Becker	Cassie	<p>Are there other calibration coefficients you plan to estimate?</p> <p>Marcus' reply: We have estimated and now actively use calibration coefficients for the following: camera age (Reconyx PC900s), camera model (Reconyx PC900s vs HF2s), scented lure (O'Gormans Long Distance Call vs None), and deployment height (1m vs 0.5m). I am in the process of working on a game trail vs random deployment coefficient, but it is a bit trickier and will require some more analysis and/or sample size than we currently have.</p>
Marcus Becker	Allicia Kelly (GNWT)	<p>What kind of moose density(ies) are associated with these results? Alicia Thanks - still about 5x the density we count in northern Canada (southern NT)</p> <p>Marcus's reply: moose densities are low, usually 0.25 - 0.5 moose/ km² average for the boreal region.</p>
Marcus Becker	Hannah McKenzie (GOA)	<p>You mentioned that some species are attracted to cameras. Have you seen any evidence in the data to suggest that some species avoid cameras?</p> <p>Marcus's reply: tricky, not sure how we would use cameras to estimate level of avoidance.</p> <p>Followup Q from Hannah: do you see a lower detection limit for cameras based on density, or maybe density of groups if a species is clustered? How much do you think density is related to detection on camera? Also if you've encountered evidence that certain species avoid cameras, maybe in cases where you have other methods which are detecting the species but cameras are not?</p> <p>Marcus' reply: I see detection probability with cameras as based on the technological capability of the camera unit (shutter speed, sensitivity, etc), the abiotic environment in the camera viewshed (e.g., how dense the veg cover is), and characteristics of the target species (e.g., body size, speed, etc). If a species is</p>

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		<p>clustered, there is a chance that an individual closer to the camera may trigger it thus capturing an image of a group of individuals, some of whom might not have triggered the camera by themselves and thus were outside of the calculated area sampled ... but those cases are rare, and I'm of the opinion that it's better to include those individuals and not lose information. Many of these camera density methods, including ours, make the assumption that there is a minimum distance in which critters are detected 100% by the camera if they pass through the field of view. In our method, that distance is 5m. We have a pretty good sense that this assumption is violated for a number of species, especially smaller ones, but it seems fairly safe for the bigger ones. What I described above is different than the concept of detection probability which is the idea that a species is in an area, or uses a certain habitat type, but just didn't happen to pass by the camera field of view (which, incidentally, are of course tiny relative to the landscapes they are meant to represent). This high measurement error is mostly an inherent limitation to camera surveys that only large sample sizes and modest expectations can alleviate :) Some methods, like occupancy, can explicitly account for this detection probability, giving some weight to this process as well as the ecological processes that shape the probability of a species "occupying" a certain area.</p>
Marcus	Phil Walker	<p>You mentioned >160 cameras were needed to estimate similar densities determined via aerial surveys. What was the density of cameras for those WMUs? Do you have a recommended number of cameras per km² (or 100km²) for the TIFC approach?</p> <p>Marcus's reply: 160 cameras to get to similar precision levels to that of aerial surveys. Then needed to calibrate 2 densities together. Can play with # cameras and/or deployment length (denominator in equation; e.g., half number of cameras for twice the time would give similar precision levels). We had spacing constraints- we did not want cameras closer than 600 - 1000m apart. Would be interesting to look at whether an area of interest impacts the density of cameras want or need.</p>
Sydney Gowan/Steve Anderson	Cassie	<p>Can you talk about capacity building in the community and what that means?</p> <p>Sydney's reply: capacity building is an interesting concept and people think about it in the wrong way. We think about capacity building as what kind of skills can you utilize to provide direct employment to people, and the hiring of individuals to service cameras. How can we inspire and increase capacity in youth? We did programs in schools (very beneficial) and community open houses to get youth excited about potential</p>

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		careers in resource management. GRB offers a summer school program to help with capacity building for data management.
Sydney Gowan/Steve Anderson	Tabitha Graves (USGS)	<p data-bbox="600 256 1507 289">What kind of training did you provide for the G'wichin team members?</p> <p data-bbox="600 305 2003 513">Steve's reply: half day (short) training including brief overview of project, plan for field work, things to do at each camera (e.g., walk-test/SD cards), things to watch for (e.g., batteries full), using safety devices. Very cold there so keep protocols simple and quick. Generally all stay together as a team in the field. Sydney has developed a tagging training program for GRB, detailed orientation of analysis scripts- well annotated- so can hand-off to locals from Sydney.</p>
Jon Horne	Embere Hall - WGFD	<p data-bbox="600 532 2020 597">I'm curious about the resources required to maintain the IDFG camera deployments. Can you speak to things like the man-power requirements, time to deploy cameras and SD cards, etc.?</p> <p data-bbox="600 636 2020 831">Jon's reply: for ungulate abundance estimates, done power analysis. It is dependent on the number of cameras, not size of study area. We needed cameras; typically deploy at the start of summer and deploy for 3-4 months for abundance estimates. Requires approximately a field crew of 3-5 people deploying for about a month (1 person can deploy 2-3 cameras/day in Idaho with sum road access but a lot of hiking). Person who manages camera data. Microsoft developed Mega Detector which helps tag vehicles, people, no animals which helps a lot.</p> <p data-bbox="600 889 2020 1052">Philip DeWitt (Ontario MNR) added from chat: For folks in boreal systems. Our team has been playing with MegaDetector and are estimating that we can remove about 80% of images in our workflow at a cost of missing <1% of wildlife images. Obviously tweaking the confidence level threshold moves the needle. Also most of those misses are smaller bodied species (albeit we did miss 3 black bears and 8 white-tailed deer out of a few 100k images).</p> <p data-bbox="600 1091 1982 1156">Jamie's reply in chat: https://www.sciencedirect.com/science/article/pii/S2351989422001068 great paper on MegaDetector for camera trap image processing!</p>
Randy Larsen	Anne	<p data-bbox="600 1205 1915 1269">Did Utah State hire additional staff to manage the telemetry project, from collaring field efforts to data analyses? Or is this outsourced? What is the funding source?</p> <p data-bbox="600 1292 2003 1455">Randy's reply: agency biologist has in their work-plan capture and pick-up of collars for mortalities. But this isn't enough. Have outsourced some to the Universities; some funding from the State for equipment etc. Combination of in-house and outsourced. Utah auctions more permits to the highest bidder than all the western States and provinces combined (receives criticism). A lot of funding comes from the auction/ sale of permits for all species and multiple permits / year.</p>

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Randy Larsen	Brett Sarchuk, Alberta Government	<p>Can you confirm that the reasons for the collaring project were the doubling of the human population and understanding the development and subsequent pressures on mule deer?</p> <p>Randy's reply: human population. 3 million people are now in Utah and expected to go to 6-7 million by 2050. Part of this effort is to inform land-use decisions etc. as the human population grows.</p>
Randy Larsen	Albert Chirico; WLRS, BC Gov	<p>Could you expand on how you manage the large amount of data you have collected? What tools did you use?</p> <p>Randy's reply: becomes overwhelming very quickly. Started with spreadsheets then developed 1) sequel database to track and manage capture data, 2) state Utah had google contractor to build out an online database in Google's Big Query database system; including front-end web enabled interface (cost million \$). Utah is willing to share software ("Wildlife Tracker") with any interested jurisdictions.</p>
Kanwar Johal	Dan Farr (EPA)	<p>Can a drone be programmed to linger (without an operator instructing it to do so? Drone doing autonomously)</p> <p>Kanwar's reply: completely doable.</p>

Others from chat:

- **Anne from chat: (not included above)** Philip Dewitt from Ontario added a schematic to [Day 1 - Room 5 - Miro](#) that shows an example of how he has been conceptualizing uncertainty, error, and bias in ungulate surveys. Although it focuses on aerial surveys, he thinks everything but the bottom left is applicable to other observation-based survey methods that use points, areas, or lines. Encourage you to have a look during break and to add to the Miro boards during this workshop. We will be sharing all the results
- **Philip DeWitt (Ontario MNRF) from chat (included above):** For folks in boreal systems. Our team has been playing with MegaDetector and are estimating that we can remove about 80% of images in our workflow at a cost of missing <1% of wildlife images. Obviously tweaking the confidence level threshold moves the needle. Also most of those misses are smaller bodied species (albeit we did miss 3 black bear and 8 white-tailed deer out of a few 100k images)
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- **Jamie (she/her) from chat (included above):** <https://www.sciencedirect.com/science/article/pii/S2351989422001068> great paper on MegaDetector for camera trap image processing!
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- **Marcus Atkins BC Gov from chat (included above):** Bear facial recognition not really viable, change too much throughout seasons/years.
- **Jamie (she/her) from chat (included above):** <https://onlinelibrary.wiley.com/doi/10.1002/ece3.6840> - IDing bears using facial recognition

