**How To Run Sightability Model on Annual Elk Inventory Data in R**

# Input Files

1. Data – an Excel file that includes observations, estimates, and effort data for each year of surveys. Each year should have three separate sheets labeled “Data”, “Summary”, and “Effort.” More info below.
   1. Annual survey data - an Excel sheet with rows for each group observed on survey (e.g. “2021 Data”)
   2. Annual summary – an Excel sheet that summarizes expert-informed (standard method) estimates for each EPU in that year (e.g. “2021 Summary”)
   3. Annual effort – an Excel sheet with areas surveyed in each EPU in that year (e.g. “2021 Effort”)
2. “EPU\_areas.csv” – area of living-in-winter (LIW) capable habitat in each EPU in square km
3. “beta\_binom\_model\_elk2022.txt” – text file of JAGS model code

# R Scripts

1. 00\_Create\_EPU\_areas.R
2. 01\_Load\_and\_clean.R
3. 02\_mHT\_analysis.R (optional)
4. 03\_Bayesian\_analysis.R
5. 04\_Results.R

# Output files

1. Raw outputs - .Rdata files with raw outputs from each model run
   1. Note: mHT analysis saves a separate file for each year analyzed, whereas there is only one jags output file that includes outputs from all years
2. “Results\_wide.csv” – a csv compiling estimates from all methods for all years surveyed (one row per EPU per year, separate columns for each model estimate)
3. “Results\_long.csv” – a csv compiling estimates from all methods for all years surveyed (one ‘estimate’ column, multiple rows to separate estimates for each EPU & year
4. “Agreement.csv” – a csv of measures of agreement between methods across all EPUs, separated by year (optional)
5. Results figures – summary figures comparing estimates from each method
   1. By year: one figure per year, including all EPUs surveyed that year
   2. By EPU: one figure per EPU, including estimates from all years that EPU was surveyed (includes trendlines)

# Input File Details

1. Data file – Save all of the sheets described below in one large Excel file (e.g. “example\_data.xlsx”). For every year of surveys, create one of each sheet described below.
   1. Data sheet: e.g. “2021 Data”, Each row represents an observed group, for which the following fields should be filled out (\*denotes required information for every sighting, other fields should be filled in if applicable).
      1. year\*: year of survey
      2. EPU\*: EPU where group was observed (MAKE SURE NAMES ARE CONSISTENT)
      3. date\*: date of survey in format: “yyyy-mm-dd”
      4. cow: count of cows in group
      5. calf: count of calves in group
      6. spike: count of spikes in group
      7. bull: count of bulls in group
      8. UC: count of unclassified individuals in group
      9. total\*: total count of elk in group
      10. survey.type\*: was group observed during inventory survey (i.e. along transect), telemetry search, capture/collaring survey, or was it an incidental sighting?
          * Currently 4 inputs allowed: inventory, telemetry, capture, incidental
      11. voc\*: visual obstruction (i.e. canopy cover) given as a decimal between 0 and 1
      12. habitat: habitat where group was sighted (if you’d like to stratify estimates by habitat)
          * Currently habitat entries are sorted into 3 groups based on words used (parentheses):
            1. No forest (road, landfill, gravel, slide, field, meadow, riparian, wetland, river, other)
            2. Young forest (block, powerline, NSR, FTG)
            3. Mature forest (mature, old, conifer)
      13. activity: activity of first elk spotted (can be tested for effects on sightability)
          * Currently 2 inputs allowed: standing/moving and bedded
      14. collars\*: count of **TRACKABLE** collars observed in group
          * If a collar is observed that is not working or is no longer in service (i.e., you would not be able to track the collar using telemetry), **do not include it in this count**
      15. collar.ID: if helpful for note keeping, enter serial no. (or frequency) of collars observed
          * This will not contribute to the analysis
      16. notes: other relevant notes about observation
   2. Summary sheet: e.g. “2021 Summary”; In the same Excel file, summarize your data for each EPU for that year in a new sheet. Each row corresponds to an EPU.
      1. year\*: self-explanatory
      2. EPU\*: self-explanatory
      3. min.count: the number of animals observed via all survey methods (i.e. minimum number of animals in population)
      4. estimate\*: sightability-corrected estimate according to expert analysis
      5. target: target elk population for EPU (used to make a reference line on trend graphs)
   3. Effort: area surveyed in each EPU that year (**only needed if running mHT analysis**)
      1. This is derived from survey flight paths, assuming 250m visibility on either side
      2. Steps to create “areas\_surveyed\_2021.csv” (insert relevant year):
         * Open ArcMap and import EPU\_all shapefile
         * Copy EPU\_all as EPU\_2021 (insert relevant year) and then edit out any EPUs that were not officially surveyed in that year
         * Import flight path files (convert to shapefiles if they’re not already) and edit out any duplicate records in each (keep only the ‘Replay’ records)
         * Use the intersect tool to create a geometric intersection of each flight path layer with the EPU\_2021 layer
           1. Edit the resulting layer to remove any portions of the flight path that intersect an EPU that was not surveyed on that day (i.e. we only want to count effort spent while actively surveying)
         * After intersecting and editing each flight path layer, merge them all to one layer called “Surveys\_2021” (insert relevant year)
         * Use the Buffer tool to add a 250m buffer to all features in Surveys\_2021
         * Dissolve Surveys\_2021 by begin\_date
         * Use the Table-to-Table tool to create a csv from the resulting layer
      3. Once you have a csv output, copy and paste the “Unit” and “Shape\_Area” columns into your excel sheet (e.g. “2021 Effort”). All columns must be filled out for all EPUs surveyed that year. Name the columns as outlined below:
         * year: enter the relevant year
         * EPU: this is your EPU (“Unit”) column
         * area\_surveyed: this is your area (“Shape\_Area”) column in meters squared
2. EPU\_areas.csv: estimates of available winter habitat area derived from Elk SBOT data (**only needed if running mHT analysis**)
   1. BEI\_by\_EPU.txt is the product of a geometric intersection of BC BEI data and EPU shapefiles
      1. BEI data is found here: <https://governmentofbc.maps.arcgis.com/home/item.html?id=6c7024eb73494a5f92e4d8b9d5968ebf> or through BC Arc library by searching “BEI” and scrolling to elk)
   2. Script “00\_Create\_EPU\_areas” converts this text file to “EPU\_areas.csv”, which gives the area of capable winter habitat in each EPU in square kilometers. This script does not need to be run again if you already have the “EPU\_areas.csv” file.
3. JAGS Model: “beta\_binom\_model\_elk2022.txt” is derived from Feiberg et al. (2013). Their dataset is identical format to our data and can be found online at <https://doi.org/10.5061/dryad.f8669>.