Idaho Fish and Game PopR Website User Manual

Speedgoat

2020-09-22

Contents

Chapter 1

Introduction

This manual is intended to provide support and guidance for using the IDFG PopR Website to run population models. Models covered here include Survival, Sightability, and IPM.

You can contribute to this document via GitHub, where you can also make Suggestions for adding or changing content.

This manual was created by Speedgoat and IDFG using bookdown.

To get started, choose a section from the table of contents on the left or click here to start from the beginning.

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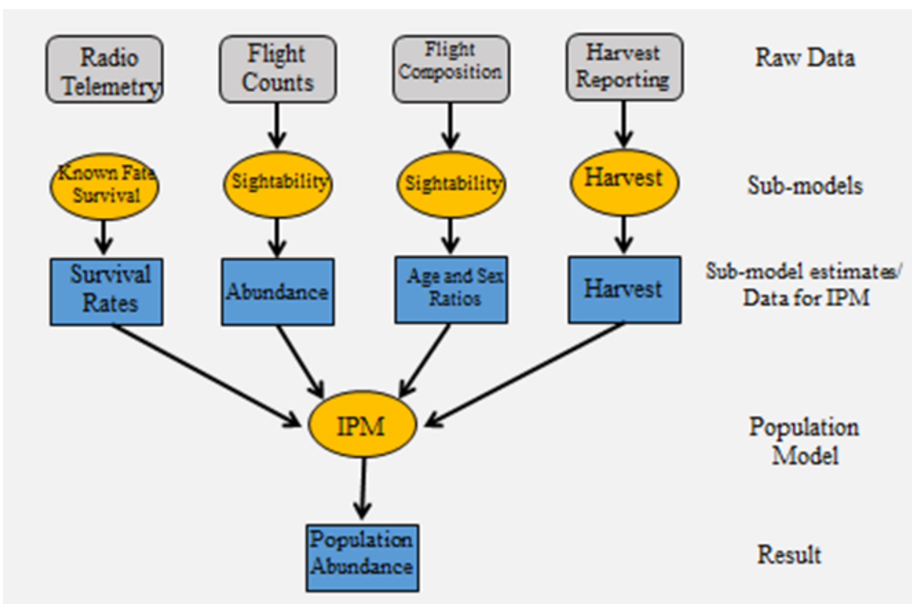
Chapter 2

General Information

To get started with PopR, visit the Speedgoat homepage and select Idaho from the login menu.

PopR allows you to combine data from various sources to model wildlife populations using an integrated population model (IPM), leading to more robust and defensible estimates. First the data from each source are modeled independently to estimate individual population parameters, such as sex ratio and survival. Then these results are combined in the IPM to find the best fit for all of the available data.



Chapter 3

Survival

3.1 Running a Survival Model

3.1.1 Loading Data

To run a survival model select **Survival** in the sidebar then click **Setup**. Select a species and DAU on the Overview tab and click the Download Data button to download data from the IDFG database. Once the download is complete a dialog will confirm that the data has been downloaded and alert you to any errors present in the data (see the errors section). Data will only be read for the species and DAU selected, so if you switch either selection later you'll have to repeat the process.

Once the data is downloaded you can review it in various formats in the pane to the right. Data is pulled from SADD, so if you find individuals that plot out in the wrong area or DAU, you'll need to fix them there.

- Captures: Shows a map of the capture locations of all the individuals used in the analysis. The table on the left shows any IDs that have bad or missing capture location information.
- Mortalities: Shows a map of the mortality locations for the DAU. The table on the left shows any IDs that have bad or missing mortality location information.
- Collared Animals: Shows a barplot of the number of collared individuals throughout the analysis years. You can hover over each bar with your mouse and at the top of the graph, it will show you the status of collared individuals by month. Categories include missing, other mortality, harvested, and alive.
- Raw Data Summary: Shows a summary of the raw data available to be for the selected DAU.

All the data available for the selected DAU can be viewed using the Captures, Monitoring, Mortalities, Encounter Histories, and Raw Data tabs in the bottom table. The Captures and Mortalities tables show information for *all* individuals, even if capture/mortality information is unavailable. You can sort using the arrows next to the headings and filter by entering names/values into the boxes under the headings.

You can also view the data loaded from SADD on the **Individuals** page, where you can view raw data, encounter histories, captures, and mortality records. You can also filter to a specific animal, which can be helpful in tracking down errors.

3.1.2 Model Options

After loading survival data for a particular species and DAU move on to the Subset tab to specify the parameters for your model. Select a sex (default is all) and age class (default is adult) to model, then select the range of years to include in the analysis (default includes all data available).

Move on to the Structure tab and use the inputs to define the model that will be run on your data. First select a known fate (simple survival estimation) or multi-state (estimate mortality rates by cause - currently unavailable) model. If you're running a multi-state model use the Censor Fate input to exclude a particular source of mortality from the analysis. For example, if harvest is selected the estimated survival will answer the question "What would survival be in the absence of harvest?" Finally define how survival is allowed to vary with sex, time, and space. You must select more than 5 years for analysis to model survival as varying through time, and modeling survival as spatially varying is only available for statewide models.

If you plan on adding your results to an IPM dataset you should use the default settings:

- Sex: All
- Age: One at a time, A then J
- Analysis Years: 2000-Current Year
- Model Type: Known Fate
- Covariates: None
- Censor Fate(s): Harvest
- Model sexes as: Different
- Model time as: Monthly
- Model space as: Varying
- Thinning Rate: 1
- Burnin Length: 35,000
- MCMC Iterations: 25,000

When you've loaded your data, selected the appropriate options, and defined your model structure, move on to the Run tab and click Fit Model to run the model. If no errors are encountered dismiss the dialog and click **Tables** in the sidebar to view your results. If the model fails to run check the errors section.

3.1.3 Model Output

Results are viewed under the **Tables** subheading on the left under **Survival**. Estimates can be viewed by year or by month. Mean estimates are accompanied by the standard deviation as well as the lower and upper confidence intervals. You can copy, print, or download the data using the buttons at the top right of the table. You can also sort and filter using the boxes below the column headings.

3.1.4 Adding Results to IPM

Use the **Admin** page to add the results of your survival model to the input data for the IPM. Only add the results to an IPM dataset if you're sure you used the correct settings and data. If there is already survival data in the IPM data file you select for the same species, year, and unit, that data will be overwritten with the results of your current model.

Select the IPM dataset to which you want to add your estimates, and verify that the estimates themselves look reasonable, then click Update DB to add the estimates to the database file. DO NOT add results to the IPM database if you didn't use the default settings outlined in the Model Options section.

3.1.5 Errors

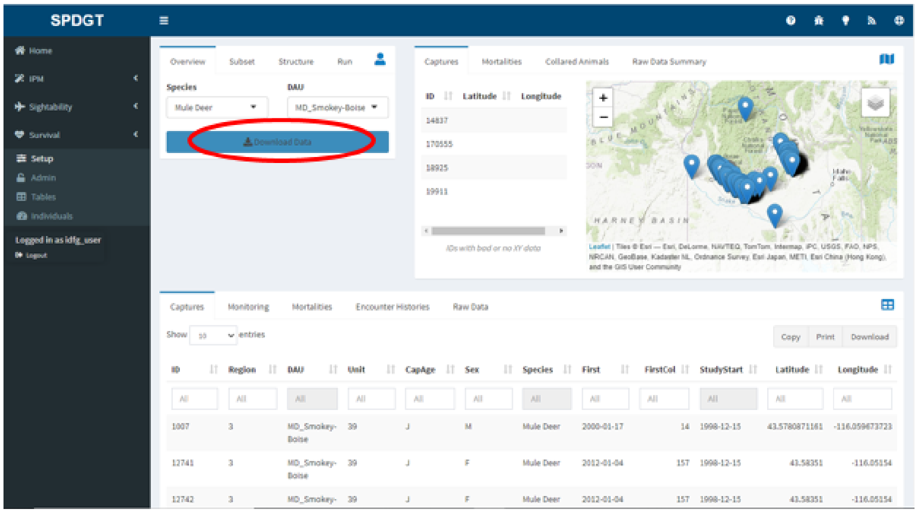
3.2 Step-By-Step Survival Model Example

This example shows how to run a survival model for mule deer in the Smokey-Boise DAU step by step, including screenshots of the website.

1. Start by clicking **Survival** in the sidebar.

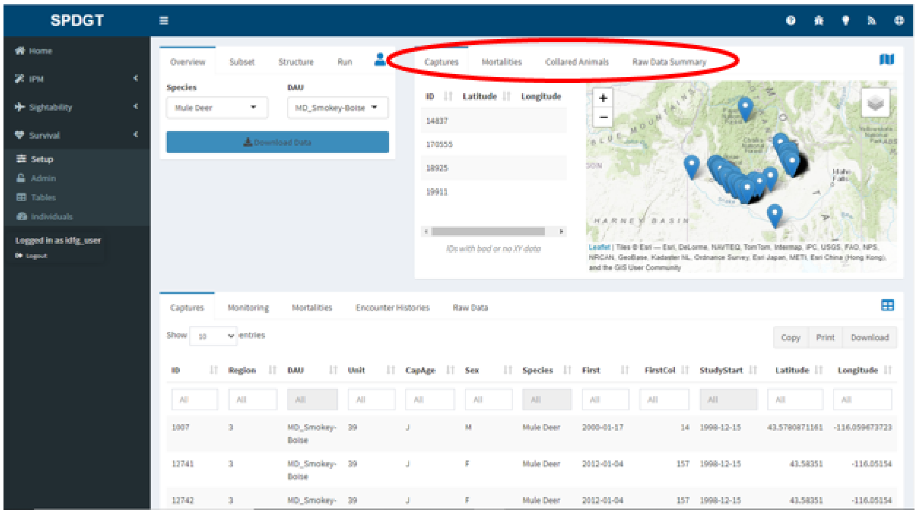
2. Select the **Setup** page in the sidebar, then select the species and DAU you want to model. In this example we use mule deer and MD_Smokey-Boise. Make sure to select the correct species and DAU before clicking the button to load sightability data.

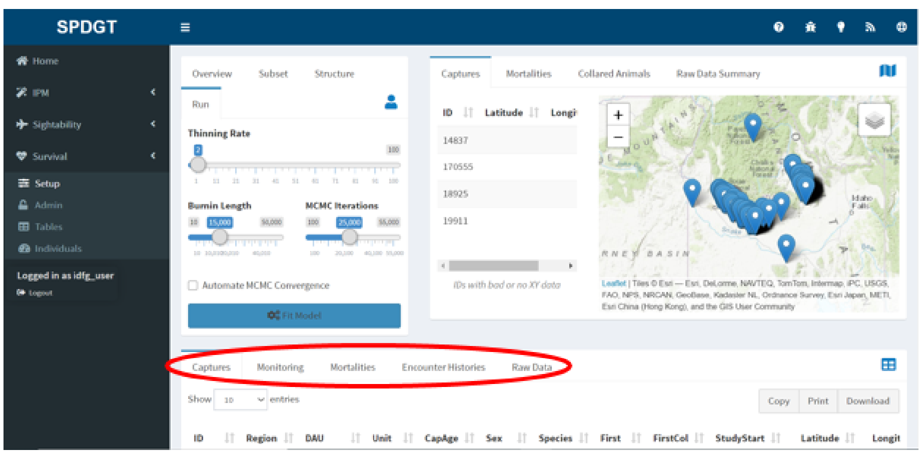
3. Click the button labeled "Download Data" to load the data for the species and DAU you selected.



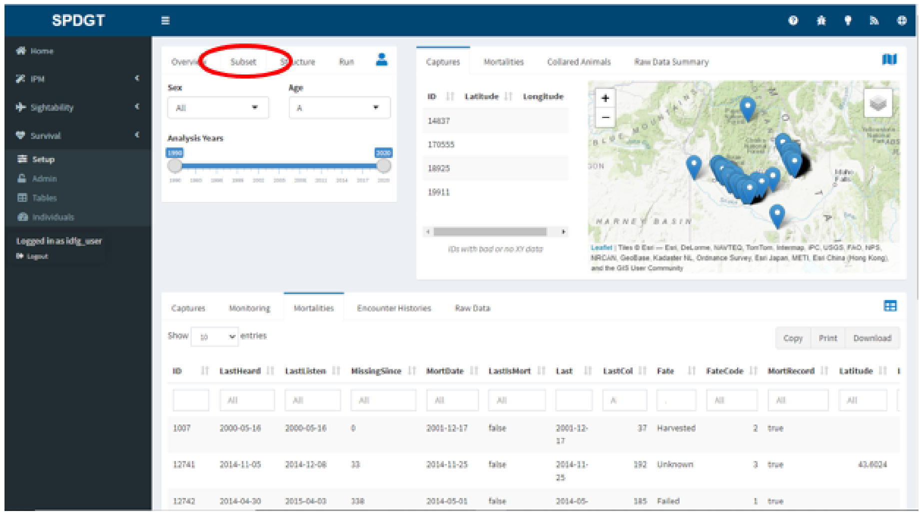
4. Once the data is loaded you should see a dialog indicating that the process was successful. Click Dismiss. If you receive an error see the errors section.

5. Review the data in the panes to the right and tables at the bottom (see Loading Data for details).

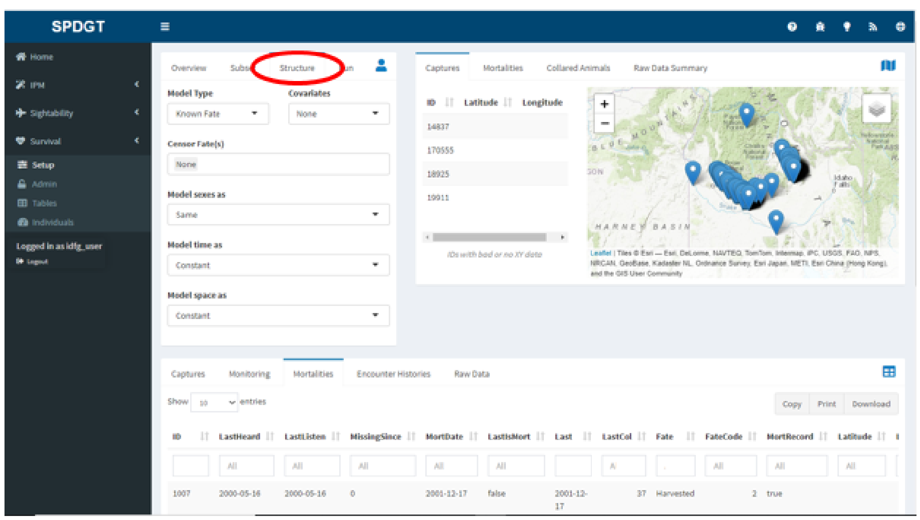




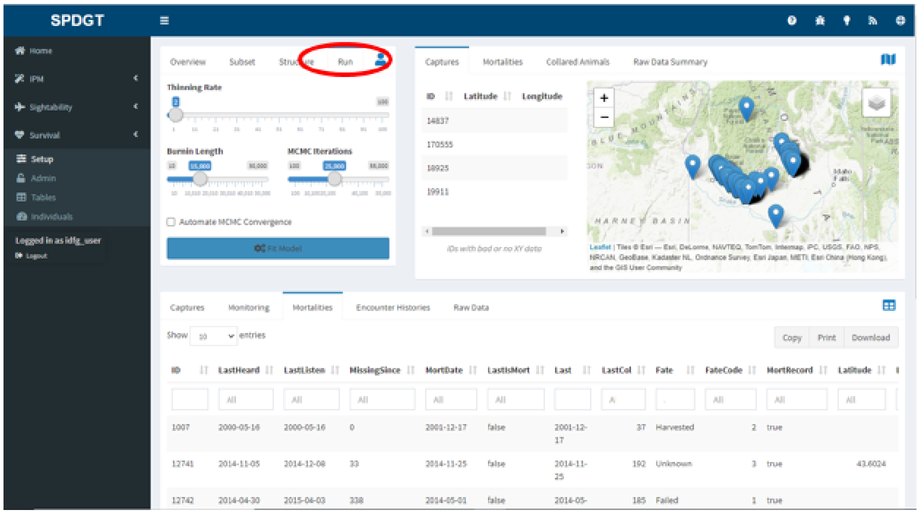
6. Move on to the **Subset** tab in the **User Inputs** pane, and make the appropriate selections. In this example we ran a model for adults of both sexes using data from 2000 to 2020.



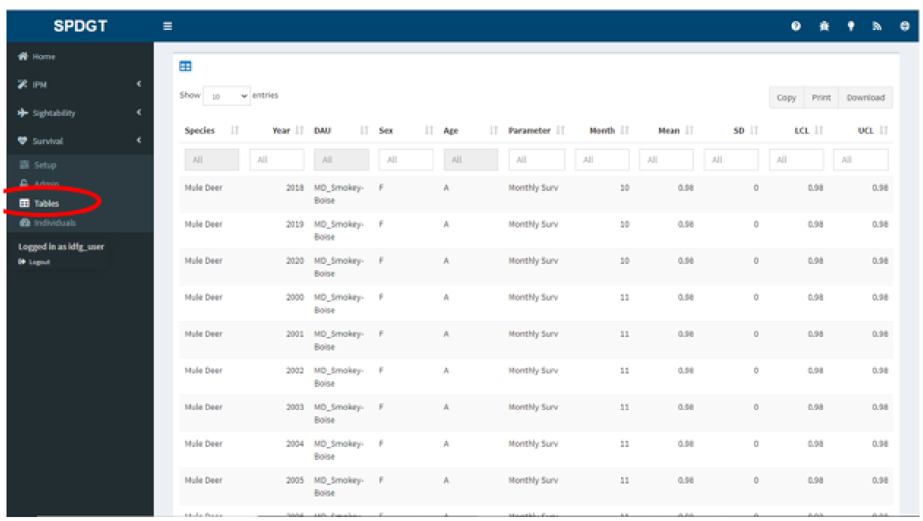
7. Move on to the **Structure** tab and define the model you want to run. Here we use a known fate model where survival does not vary with sex, space, or time.



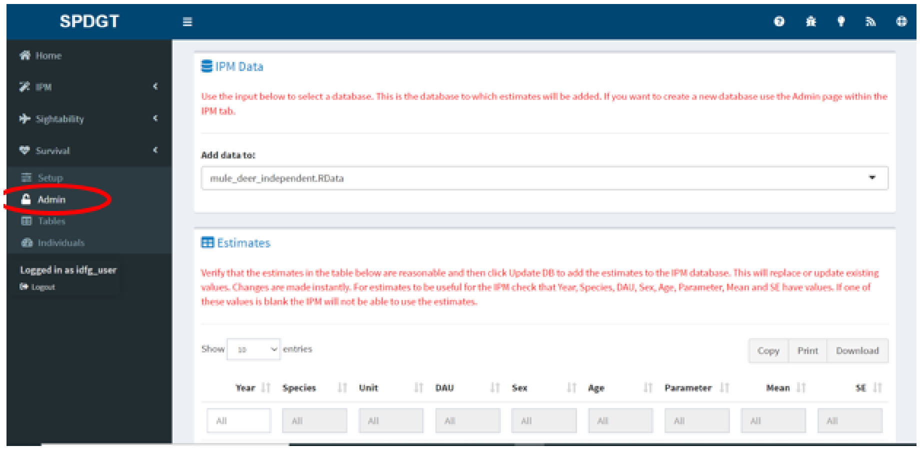
8. Now that you've selected the appropriate settings and reviewed the input data, switch to the **Run** tab and click Fit Model.



9. Once model fitting is complete select the **Tables** page in the sidebar to view the output.



10. If you're confident in the results and the settings used to run the model, you can add the survival results to an IPM dataset using the **Admin** tab in the sidebar. Be sure to read the instructions and understand the difference between the various IPM databases before using the admin tab.


SPDGT
Home
IPM
Sightability
Survival
Setup
Admin
Tables
Individuals
Logged in as idfg_user
Logout
IPM Data
Use the input below to select a database. This is the database to which estimates will be added. If you want to create a new database use the Admin page within the IPM tab.
Add data to:
mule_deer_independent.RData
Estimates
Verify that the estimates in the table below are reasonable and then click Update DB to add the estimates to the IPM database. This will replace or update existing values. Changes are made instantly. For estimates to be useful for the IPM check that Year, Species, DAU, Sex, Age, Parameter, Mean and SE have values. If one of these values is blank the IPM will not be able to use the estimates.
Show 10 entries
Copy
Print
Download
Year
Species
Unit
DAU
Sex
Age
Parameter
Mean
SE
All

Chapter 4

Sightability

Sightability models use aerial survey data combined with detection probability models to estimate total abundance within a sampling unit.

The basic idea behind sightability is a fairly simple process. First the sightability of the group is estimated by taking the covariate values and previously estimated coefficients. For example, if the model had one covariate called veg and the value of veg for a given observation was .8 then we can estimate sightability with something like:

$logit(sight) = 1.1 - 0.6 * veg$

Here the average sightability is something like logit(1.1) or 0.75 and the effect of veg is roughly -0.6, so if we plug in our observation of 0.8 we would get

$logit(sight) = 1.1 - 0.6 * 0.8$

The value of sight is then 0.65. Now let's say that the group had 10 animals that were observed from aircraft. The estimate for the group size is 10/0.65 or about 15 animals. That is the adjustment applied to each group. To conduct a sightability survey a manager would first define the desired scope of inference, say a DAU. Within the DAU there are GMUs and subunits. The area is then stratified based on previous observations and snow cover. For the sake of an example let's say we have 100 subunits and we have decided that 60 are in the high stratum, 30 are in the medium and 10 are in low. Within each stratum we have to decide how many to sample. If we decide to sample all of the highs and half of the lows and a quarter of the lows then we will have 60 high, 15 medium and say 3 low subunits to fly.

With data in hand we can estimate sightability as outlined above and then we will extrapolate those numbers to all of the areas that were not sampled. For simplicity, say our sightability adjusted estimates for each stratum were 250, 75 and 10 for high, medium and low respectively.

The general idea behind extrapolating is straightforward. To know what area was we simply divide the number of subunits flown by the population of subunits within a stratum.

High: 60/60 = 1

Medium: 15/30 = 0.5

Low: 3/10 = 0.333

Now to use this number we will divide the adjusted number of animals by the proportion of subunits flown

High: 250/1 = 250 animals

Medium: 75/0.5 = 150 animals

Low: 10/0.333 = 30 animals

This example hopefully shows the importance of sampling and how critical it is to know what stratum an observation came from. Without the stratum we cannot know the proportion of the area sampled and cannot make an estimate relate back to the population of subunits.

The extrapolation step also demonstrates that the density of animals is assumed to be constant. In the case of the mediums the area sampled produced 75 animals and it is assumed that the unflown subunits with the medium stratum are the same, which is how we get away with dividing by the proportion of area sampled. If a biologist only flies subunits where they know there are lots of deer then that number will be extrapolated to the remainder of the GMU and DAU.

4.1 Sightability Data Entry

4.1.1 GPS Data Entry

The first step in entering sightability data is to upload GPS data for your survey (if you don't have a .csv file containing GPS data for your survey you can skip this step). Click **Sightability** in the sidebar, then **GPS Data Entry**. Use the **Browse** button to select the GPS file on your computer, and the data from the file will appear on the map and in the table to the right. Review the data in both the map and the table to ensure that everything is accurate. If corrections need to be made open the file on your computer, make the necessary changes, and use the **Browse** button to upload the file again. Once everything in the Map and Table panes is correct, click the Write to DB button to save the data to the server.

4.1.2 Metadata Entry

The next step is to enter the metadata for your survey. Click **Metadata Entry** in the sidebar under **Sightability**, then select the species and survey type. Enter the date the survey took place, the type of aircraft used, and the number of observations (rows) recorded on the datasheet. Select the region and analysis unit, and if you uploaded a file in the previous step select it in the GPS Data File input. Enter the number of subunits sampled in each density stratum, and finally enter any comments or notes about the survey. Once the form is complete click the Submit Response button to continue. A dialog will appear confirming that the data were saved.

If you made a mistake on the Metadata form you can correct it on the Past Surveys tab. This tab presents a spreadsheet with all of the survey metadata entered to date. You can delete rows by right-clicking or edit the information in any of the fields. If you make changes on the Past Surveys tab make sure to click the Save Edits button when you're finished.

4.1.3 Observation Entry

Once the Metadata is entered correctly click **Observation Entry** on the sidebar, then click the Load button to get started. Use the inputs in the dialog that appears to select the survey you entered in the previous step, then click Load Data. A spreadsheet will appear with the Species, Survey Type, Date, and Area populated for you. Fill in the additional columns (beginning with Stratum) with the information from your datasheet. You may need to use the horizontal scroll bar below the spreadsheet to access all the columns if they don't fit on your screen. The number of rows available in the spreadsheet will match the number of observations you entered in the Metadata from, but If you need to add additional rows you can do so by right-clicking in the last row and selecting "insert row below." You can view a summary of the data you've entered below the spreadsheet.

Once all the data from your datasheet has been added to the spreadsheet click **Validate** to check for errors. If any errors are present a dialog will appear explaining what they are and how to fix them. Once any errors are corrected use the Save button to save the data to the server.

4.2 Running a Sightability Model

4.2.1 Loading Data

To run a sightability model select **Sightability** in the sidebar then click **Setup**. Select a species and DAU on the Load Data tab and click the Get Survey

Data button to download data from the IDFG database. Once the download is complete a dialog will confirm that the data has been downloaded and alert you to any errors present in the data (see the errors section). Data will only be read for the species and DAU selected, so if you switch either selection later you'll have to repeat the process.

Once the data is downloaded you can review it in various formats in the pane to the right.

- Flight record: Summarizes the data downloaded by survey type and bio year.
- Sampling: Summarizes the data downloaded by stratum, showing the population of units available and how many of those were sampled. This is a great table to check against your expectations - how many high, medium and low subunits did you fly? Does the data match? This is also a good place to make sure the stratum and unit were entered correctly for all of your observations - missing values in those columns are a common cause of errors.
- All Data: Shows all of the observation data downloaded for this species and DAU.
- Data to Model: Shows the observation data as it will be passed to the model for transparency.

If any errors appear in the data you can correct them through the **Metadata Entry** or **Observation Entry** pages in the sidebar. If you make any corrections be sure to load the data again when you return to the **Setup** page.

4.2.2 Model Options

After loading sightability data for a particular species and DAU move on to the Options tab to specify the parameters for your model. Select a year from those available in the data, then choose whether to analyze by area, unit, stratum, or sub-unit. It's important to note that your results cannot be used to extrapolate to a wider geographic area if you select unit, stratum, or subunit in this dropdown. Finally select a survey type and aircraft - the available selections for these may be limited based on the species selected.

Move on to the Sampling tab and review the values displayed. These values are taken from the data entered for the survey you selected. Subunits represent subdivisions within a stratum, so the minimum number of subunits in any given stratum is 1. If there are subunits within a stratum that weren't sampled you may need to adjust the numbers here to accurately represent the proportion sampled.

When you've selected the appropriate options and adjusted the sampling parameters (if necessary) move on to the Run tab and click Fit Model to run the model. If no errors are encountered dismiss the dialog and click **Tables** in the sidebar to view your results. If the model fails to run check the errors section.

4.2.3 Model Output

Once you've run a model you can view the results on the **Tables** page. The top half of the page shows the data used in the model, summarized by category:

- Sample: Displays how many subunits were available in each stratum, and how many of those were sampled.
- Activity: Displays the number of observations for each activity category.
- Vegetation: Displays the number of observations for each vegetation type.
- Snow: Displays the number of observations binned by snow cover.
- Group Size: Displays the number of observations binned by group size.

The bottom half of the page shows the model output:

- Detection: Displays the probability of detection (as a range) assigned to the input observations.
- N: Displays the abundance estimates produced by the model by demographic, including the variance for each estimate.

4.2.4 Adding Results to IPM

Use the **Admin** page to add the results of your sightability model to the input data for the IPM. Only add the results to an IPM dataset if you're sure you used the correct settings and data. If there is already sightability data in the IPM data file you select for the same year and unit, that data will be overwritten with the results of your current model. If you ran a model on composition survey data, sex and age ratios will be added; for sightability surveys abundance estimates will be added.

Select the IPM dataset to which you want to add your estimates, and verify that the estimates themselves look reasonable, then click Update DB to add the estimates to the database file.

4.2.5 Errors

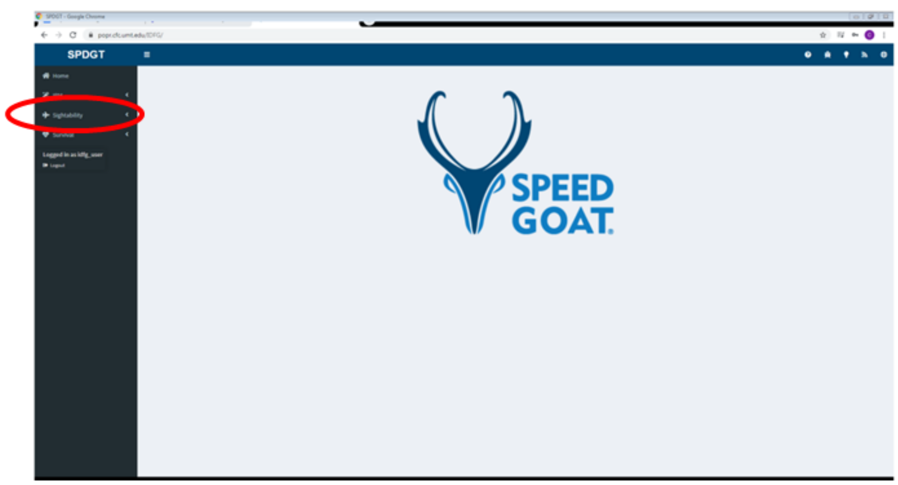
4.2.5.0.0.1 Missing values in the stratum or unit fields These errors should be apparent when reviewing the data in the **Sampling** tab of the **Setup** page. Missing values in these columns can cause data to be discarded or cause the model to fail. To fix them navigate to the **Observation Entry** page, load the data for the survey in question, and fill in the missing information. Don't forget to click the button to save your changes when all the values have been entered.

4.2.5.0.0.2 Empty rows at the bottom of the observation table Sometimes when the metadata and observations entered for a survey don't agree there can be empty rows at the bottom of the observation data entry table. If that happens load the survey data in the **Observation Entry** page and right-click on the empty row(s) to delete. As above, don't forget to save your changes.

4.3 Step-By-Step Sightability Model Example

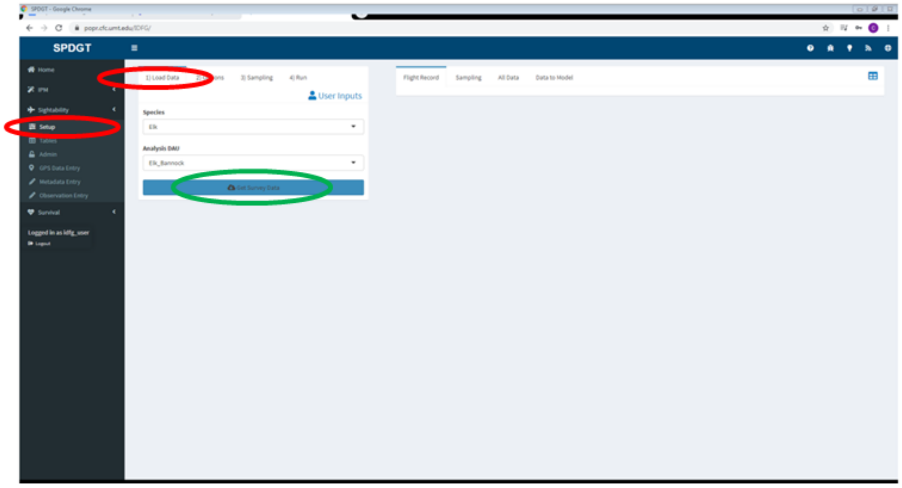
This example shows how to run a sightability model for mule deer in the Smokey-Boise DAU step by step, including screenshots of the website.

1. Start by clicking **Sightability** in the sidebar.



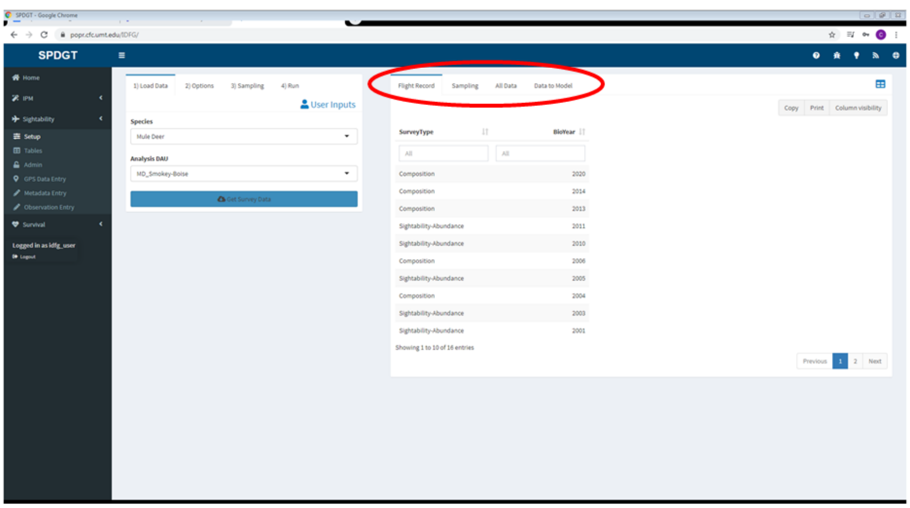
2. Select the **Setup** page in the sidebar, then select the species and DAU you want to model. In this example we use mule deer and MD_Smokey-Boise. Make sure to select the correct species and DAU before clicking the button to load sightability data.

3. Click the button labeled "Get Survey Data" to load the data for the species and DAU you selected.

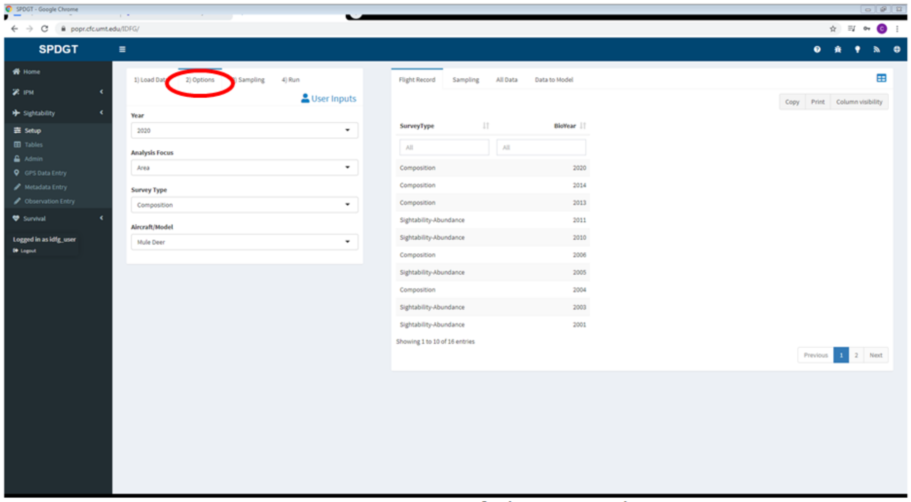


4. Once the data is loaded you should see a dialog indicating that the process was successful. Click Dismiss. If you receive an error see the errors section.

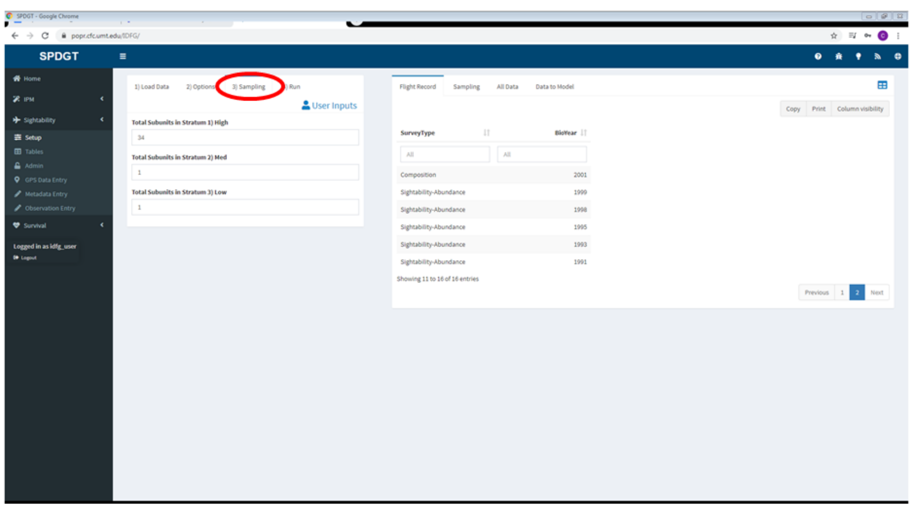
5. Review the data in the panes to the right (see Loading Data for details).



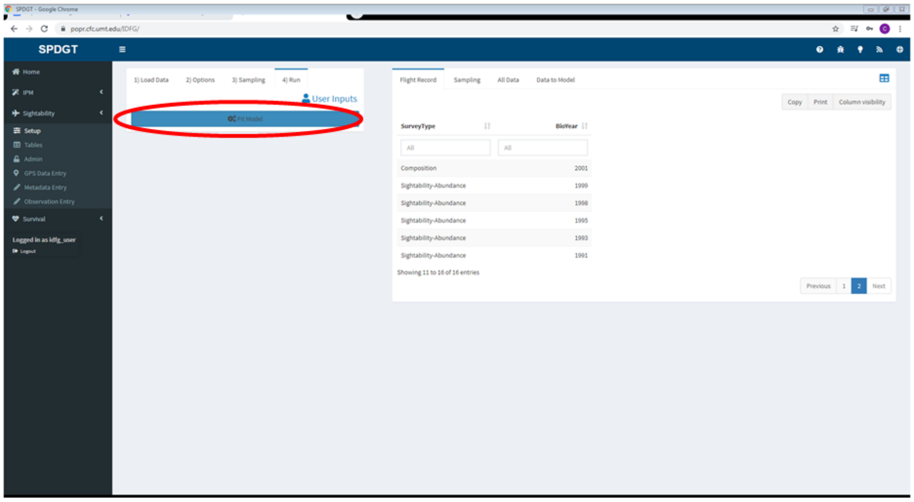
6. Move on to the **Options** tab in the **User Inputs** pane, and make the appropriate selections. In this example we run a model on 2020 composition data for mule deer, with area as the spatial focus of the analysis.



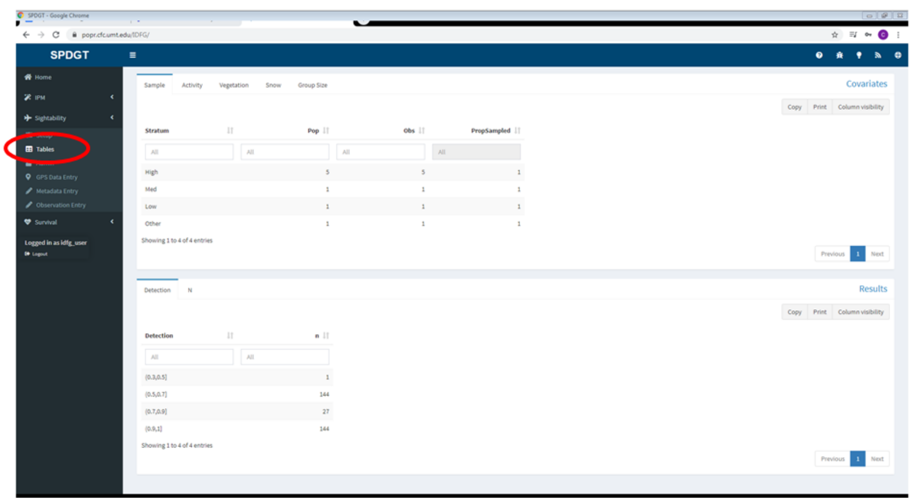
7. Move on to the **Sampling** tab and check that the data are accurate by selecting Sampling in the pane to the right. If the total population of subunits available in each stratum is incorrect you can fix it here.



8. Now that you've selected the appropriate settings and reviewed the input data, switch to the **Run** tab and click Fit Model.

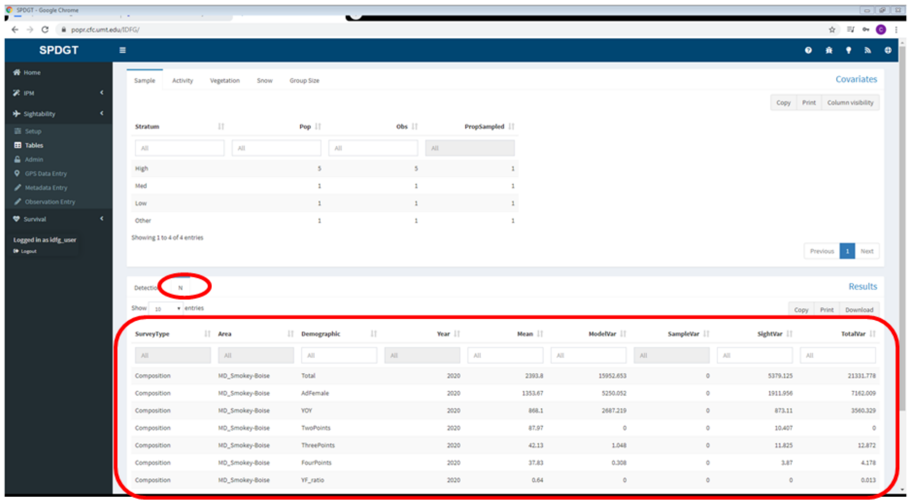


9. Once model fitting is complete select the **Tables** page in the sidebar to view the output.

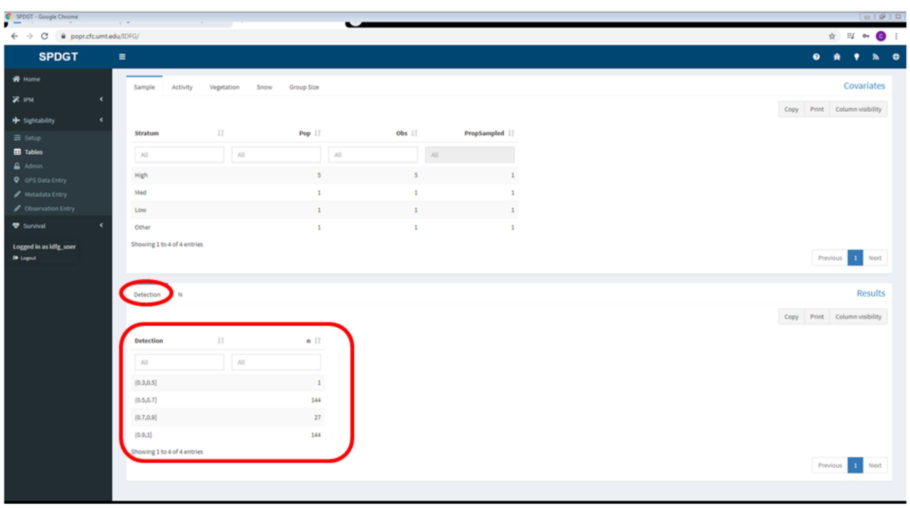


10. The covariates section on the top half of the page summarizes the observations used in the model and how they fall into the various strata, activity categories, etc. See Model Output for more details.

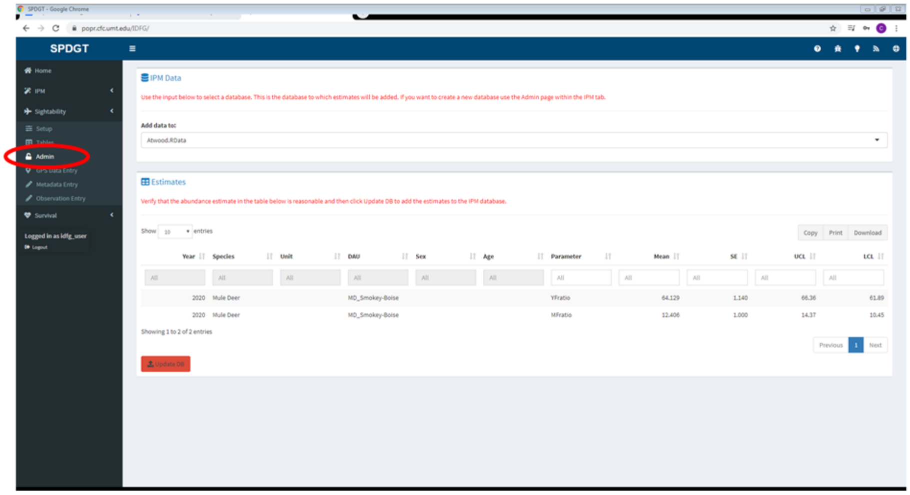
11. Select the **N** table on the bottom half of the screen to view abundance estimates.



12. Select the **Detection** table to view a summary of observations binned by probability of detection.



13. If you're confident in the results and the settings used to run the model, you can add the sightability results to an IPM dataset using the **Admin** tab in the sidebar. Be sure to read the instructions and understand the difference between the various IPM databases before using the admin tab.


SPDGT - Google Chrome
popr.cfc.umt.edu/IDFG/
SPDGT
Home
IPM
Sightability
Setup
Admin
Metadata Entry
Observation Entry
Survival
Logged in as idfg_user
Logout
IPM Data
Use the input below to select a database. This is the database to which estimates will be added. If you want to create a new database use the Admin page within the IPM tab.
Add data to:
Atwood.RData
Estimates
Verify that the abundance estimate in the table below is reasonable and then click Update DB to add the estimates to the IPM database.
Show 10 entries
Copy Print Download
Year Species Unit DAU Sex Age Parameter Mean SE UCL LCL
2020 Mule Deer MD_Smokey-Boise YFratio 64.129 1.140 66.36 61.89
2020 Mule Deer MD_Smokey-Boise MFratio 12.406 1.000 14.37 10.45
Showing 1 to 2 of 2 entries
Previous 1 Next
Update DB

Chapter 5

IPM

Information about running ipm models goes here.

Chapter 6

Glossary

6.1 General

6.1.0.0.0.1 Age Classes Age classes must be defined for each species to capture variability in parameters like survival and harvest rate, as well as to determine when animals begin to reproduce. Regardless of actual birth date animals transition to the next age class on December 15, the model anniversary used in the IPM. Assuming calves and fawns are born approximately mid-June each year, the age classes translate to roughly the following:

- Mule Deer
  - A (Adult) - 1.5 years and up
  - J (Juvenile) - 6 months to 1.5years
  - Y (Young of Year) - birth to 6 months
- Elk
  - A (Adult) - 2.5 years and up
  - S (SubAdult) - 1.5 to 2.5 years
  - J (Juvenile) - 6 months to 1.5 years
  - Y (Young of Year) - birth to 6 months

6.1.0.0.0.2 Bio Year Since winter surveys typically span a time period including two years the term BioYear consolidates the survey period into a single year. For example, surveys can start in December 2019 and run through January 2020 so the BioYear for this survey is 2020. The term was created for easier record keeping and does not have a biological definition. The biological year begins on December 15 and was intended to correctly align data collection with biological processes. Estimates from the models operate on this biological year.

6.2 Survival

6.2.0.0.0.1 Known Fate Survival Model Survival models attempt to estimate the probability that an animal alive at this time will be alive at some future time. A known-fate model does this in part by assuming that the fate of every animal is known. This name was chosen early in the development process. As time has passed we have tweaked and developed the model to relax assumptions and better meet the needs of our collaborators. The full model description is beyond the scope of this Glossary, but know that the Known-Fate model selection means that the results of running a model will show the user estimates of survival and mortality. This is in contrast to the multi-state models where multiple sources of mortality can be estimated, such as death by harvest or death by predator. See also: Multi-state Survival Model

6.2.0.0.0.2 Multi-state Survival Model The multi-state survival model allows users to estimate survival, harvest mortality rate and other mortality rate. The different estimates sum to 1 and so to be comparable to the known-fate models users should take 1 - other mortality as equivalent to survival in the known-fate context. See also: Known Fate Survival Model

6.3 Sightability

6.3.0.0.0.1 Aircraft/Model There are separate elk sightability models depending on the aircraft used for the survey. The aircraft types include a Hiller 12E, Bell 47G, and Super Cub. Mule deer sightability models do not have separate models for different types of aircraft.

6.3.0.0.0.2 Area A generic term used to catch the species specific differences in management area naming. Instead of elk zones and deer pmu/dau we simply use area to describe the spatial extent we are focused on for a particular analysis.

6.3.0.0.0.3 Composition Survey This survey type is used to gather data related to age and sex ratios and typically samples a smaller portion of the population in an area of interest. See also: Sightability Survey

6.3.0.0.0.4 Demographic The demographic field in the sightability output table denotes which age and sex classes are described by the estimated values. Classes are based on on sex and age class and vary by species and survey type.

6.3.0.0.0.5 Group size Refers to the number of individuals in a single observed group. The size of the group impacts the probability of detection and influences how the model estimates the true number of individuals. Group sizes include 1, 2, 3, 4, 5, 6, 7-15, 16-30, and >30.

6.3.0.0.0.6 Movement Categories The 3 movement categories are bedded, standing, and moving. This is based on the most active individual when initially observed. The movement categories impact the probability of detection and influence how the model estimates the true number of individuals.

6.3.0.0.0.7 Obs The number of observations in a given strata.

6.3.0.0.0.8 Pop The population of sampling units in a given strata. In other words, the total number of subunits in a strata.

6.3.0.0.0.9 PropSampled This is the proportion of units sampled in a given strata. This can be calculated by obs/pop, divide the number of subunits sampled in the strata by the total number of subunits in the strata.

6.3.0.0.0.10 Sightability Survey An intensive aerial survey methodology to estimate the entire population size in a given area. Data, in the form of raw counts, from this survey are analyzed using a sightability model to estimate true population size from direct counts. See also: Composition Survey

6.3.0.0.0.11 Snow The 3 snow cover categories are 0-20%, 21-79%, and >80%. The snow cover categories impact the probability of detection and influences how the model estimates the true number of individuals.

6.3.0.0.0.12 Stratum The landscape is divided into separate strata based on the probability of being occupied by the species being surveyed. Typically subunits are classified as high, medium, or low strata based on their suitability as habitat for a particular species.

6.3.0.0.0.13 Subunit Used to define the proportion of the unit that was sampled.For example, if a unit consists of 10 subunits and the survey samples 3 of the 10 subunits then 3/10 or .3 of the unit was sampled. This is used to extrapolate sightability estimates such that if this same survey produced a count of 100 then the estimate is 100/.3 or 333 animals in the unit.

6.3.0.0.0.14 Unit Synonymous with GMU.

6.3.0.0.0.15 Variance The variance components of the sightability output are of interest to the user because they provide clues as to how to improve their surveys.

- ModelVar: Model variance
- SampleVar: Sample variance
- SightVar: Sightability model variance
- TotalVar: Total variance is the sum of the model, sample,and sightability variances. The square root of the total variance is the standard deviation of the estimated value.

6.3.0.0.0.16 Vegetation There are 5 vegetation class categories including grass/open/agriculture, sagebrush, juniper/mtn. mahogany, mtn. brush/aspen, and conifer. Vegetation class represents the dominant vegetation within a 30m buffer around where an individual deer or group of deer is observed. The vegetation class categories impact the probability of detection and influences how the model estimates the true number of individuals. PopR has data columns for all habitat data collected on IDFG elk and mule deer sightability and composition survey forms. IDFG elk aerial survey data sheets contain only % screen and that is the only habitat variable used in the elk sightability model. IDFG mule deer aerial survey and composition data sheets contain data columns for % screen, screen type, and veg type and veg type is the only habitat variable currently used in the mule deer sightability model.

6.4 IPM

6.4.0.0.0.1 IPM Database IPM database files contain the estimates from survival and sightability models, and are used when running the IPM. As of September 2020 there are 3 IPM database files in use for IDFG:

1. Atwood.RData – DO NOT USE, this database is for development and research purposes only
2. mule_deer_independent.RData – This database will use survival data from the DAU you are modeling over multiple years when there is not any survival data for the DAU and the year in the database. Use this database if the DAU you are modeling has a large amount of data available and survival is relatively constant between years.
3. mule_deer_shared.RData - Strongly recommended. This database will use survival data from other DAU's in the state for the current year when there is not any survival data for the DAU and year in the database. Use this database if the DAU you are modeling has little to no data available or if survival is highly variable between years.

6.5 MCMC

6.5.0.0.0.1 Automate Convergence Users may choose to simply check the "Automate Convergence" box below the MCMC sliders menu in the PopR interface. This option will assure that an adequate Burn-in Length and number of MCMC Iterations have been used to produce a statistically sound estimate and error distribution.

6.5.0.0.0.2 Burnin Length "Burn-in" is a term for an initial process that gives the Markov Chain time to approach the solution to the problem by throwing away some less reasonable starting points at the beginning of a Markov Chain Monte Carlo run. In PopR, managers should simply use the default Burn-in Length setting when developing an estimate through the standard user interface.

6.5.0.0.0.3 Iterations PopR uses Markov Chain Monte Carlo (MCMC) methods to "fit" IPM population estimates to the available data. MCMC methods estimate parameters in complex models by systematically updating informed prior distributions with information gleaned from field data (e.g. observed harvest). Therefore, they allow us to describe each parameter in terms of a distribution and that distribution's shape. Typically, 25,000-100,000 MCMC iterations will be required to fit an IPM. If the number of MCMC iterations is set too low the uncertainty about an estimate is likely to be misrepresented.

6.5.0.0.0.4 Brooks-Gelman-Rubin Statistic (R) In PopR, we use the Brooks-Gelman-Rubin (BGR) statistic, often represented as R or Rhat, as an assessment of convergence and the criteria used when the "Automate Convergence" option is used. The BGR statistic suggests convergence when estimates of R are below 1.1 or more generally close to 1. This statistic is reported in the output tables for most models and highlighted in red when R estimates are above 1.1. The default settings will produce results that are unlikely to change even if run longer, but users should increase the number of MCMC iterations if R estimates are above 1.1 and computing time allows.

6.5.0.0.0.5 Thinning Rate Thinning tells the sampler to only retain every nth value from the chains. This technique is sometimes used to reduce autocorrelation in the chains, but comes at the cost of reduced efficiency of the sampler. A more reasonable use of thinning is when hardware limitations are being reached, which typically comes in the form of running out of memory. This will not be an issue in PopR and, therefore, the recommended setting for the Thinning slider is 1.