**The Minnesota Forest Breeding Bird Project Database: Description and User’s Guide**

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**Foreward**

The Minnesota Forest Breeding Bird Project was initiated in 1991 by researchers at the Natural Resources Research Institute at the University of Minnesota Duluth in collaboration with staff at the Minnesota Department of Natural Resources and biologists at the Chequamegon, Chippewa, and Superior National Forests. Between 1991-2008, nearly 25,000 avian point count surveys in northern Minnesota and Wisconsin resulted in over 400,000 bird observations. A vast quantity of related data on bird traits, habitats, landscapes, etc… has also accrued throughout this project; these data are periodically used for various statistical analyses, e.g. bird population trends and habitat relationships. All project data are stored in a relational database in MS Access 2003 format. The purpose of this document is to describe this relational database and to provide background information for proper use and interpretation of these data.

**The Minnesota Forest Breeding Bird Project 1991-2009**

*Background*

Forests of the western Great Lakes region have among the richest diversity of breeding bird species in North America (Green 1995, Rich et al. 2004). An increased appreciation of this diversity, along with concerns about potential declines of some species led to a strong interest in monitoring forest bird populations in the region. For example, agencies such as the USDA Forest Service have a need for population trend data at the scale of an individual national forest to identify when and where population changes are occurring and to identify potential conservation problems. In response to the need for regional population data, the Minnesota Forest Breeding Bird Project (MNFB) was established in 1991. The overall goal of the project is to sustain forest resources and bird diversity in western Great Lakes forests. This goal is achieved through four primary activities:

1. Monitoring. An extensive, long-term monitoring program with over 1600 off-road sampling points designed to track regional population trends and investigate the response of forest birds to regional land use patterns.
2. Research. Intensive field studies designed to describe bird-habitat relationships and identify factors responsible for observed population trends.
3. Modeling. Use of geographic information system (GIS) techniques to spatially and temporally relate distribution and abundance of forest birds to forest habitat features at the stand and landscape levels.
4. Education and Management. Dissemination of research findings and development of educational and management tools to promote forest bird conservation.

Since its inception, the project has collected avian field data in five regional study areas, with each area having different start dates and sample sizes. Surveys began in 1991 on the Chippewa and Superior National Forests in Minnesota. In 1992, the effort was expanded to include sites on the Chequamegon National Forest in Wisconsin and the St. Croix River region of east-central Minnesota. In 1992, sites were also added in the Superior NF. In 1995, the project was further expanded to include southeastern Minnesota, although surveys on these sites were discontinued in 2001 due to funding cuts. Surveys in the St. Croix region were similarly discontinued in 2003 due to funding cuts. In 2008, an additional 75 sites were added in primarily lowland conifer stands in the Superior National Forest to add to the gain greater representation of that forest type. As of 2009, sites were still being surveyed in the three national forests.

Project staff provides an annual updates report as well as many other summaries and analyses at the project website: http://www.nrri.umn.edu/mnbirds.

*Sampling Design*

The monitoring program was designed to provide an accurate estimate of population change for forest bird species in each study area in northern Minnesota and Wisconsin (Figure 1). The spatial extent of the study areas is large, on the order of hundreds of thousands of hectares, and each area includes a mosaic of forest stand types. We distributed sampling locations across the forest mosaic in a stratified random manner. A list of forest stands was created for each study area, and stands with the same stand type according to dominant tree species and stocking density were grouped into strata. For the national forests, stands were ≥ 16 ha (40 acres) and were identified from the individual national forest stand inventories ca. 1990. Stands were large enough to accommodate three sampling points a minimum of 220 meters apart. For each national forest, a number of stands were selected from each stratum so that the final proportion of stands of each stand type was equal to the proportion of forested land area of each stand type (Hanowski and Niemi 1995). The sample of stands is therefore representative of the forest cover in each national forest. A total of 133, 135, and 169 stands were established in 1991-1992 the Chequamegon, Chippewa, and Superior National Forests, respectively, with approximately 20 new stands added in the Superior NF in 2008.

The sampling unit in the St. Croix and Southeast Minnesota study areas is different than in the three national forests. Because stands in these study area are generally small (≤16 ha), only one survey point could be placed in each stand. For these study areas, a stand had to be at least 4 ha (10 acres) in size. Stands were stratified in forest cover types in a proportional manner similar to those in the national forests with restrictions also based on access and travel time. A total of 171 points were established in the St. Croix area and 211 in Southeast Minnesota. All points in the St. Croix region were located on state-owned lands. In Southeast Minnesota, 85% of points were on state-owned land, 6% are on county-owned land, and 9% are on private lands.

Changes to forest cover through natural and anthropogenic disturbance have occurred on sampling locations since the beginning of the study and may have caused concomitant changes in bird populations. Because sampling locations are permanently marked, we are able to incorporate such changes into our descriptions of bird population patterns through time.

*Survey Design*

Point count sampling used in our program follow national and regional standards (Ralph et al. 1993, 1995, Howe et al. 1997). Ten-minute point counts are conducted at each point between June and early July (Reynolds et al. 1980). Point counts are appropriate for determining the relative abundance of most singing passerine species, but are inadequate for waterfowl, grouse, woodpeckers, and most raptors. In addition, because our surveys are conducted during the summer months, we may underestimate the relative abundance of early-nesting species (e.g. permanent residents that begin breeding in April, such as woodpeckers and chickadees).

Point counts are conducted by trained observers (see observer training section below) from approximately 0.5 hour before to 4 hours after sunrise on days with little wind (< 15 km/hr) and little or no precipitation. All birds heard or seen from the point were recorded with estimates of their distance from that point. From 1991 to 1994, all birds heard or seen within 100 m of the point were recorded. From 1995-2006, we included all birds heard or seen from the point regardless of distance so that our results could be compared with other monitoring programs in this region (see Howe et al. 1997). The number of individuals observed for each species can be summed for 3, 5, and 10-minute periods so that regional comparisons are possible with data gathered using 3 or 5-minute point counts. In 2008, the time intervals were expanded to include birds observed in an opening 2-min interal followed by eight 1-minute intervals (i.e. 0-2, 3, 4…9) to match national protocols (Knutson et al. 2008) and to allow estimation of detection heterogeneity with distance-removal methods (Etterson et al. 2009)

Each year, we attempt to have each observer sample a similar number of stands of each forest cover type. This is done to minimize bias due to observer differences in sampling different forest cover types. Weather data (cloud cover, temperature, and wind speed) and time of day were recorded before each count.

*Vegetation*

Vegetation characteristics at survey locations have been recorded on a number of occasions. In the ‘quick vegetation protocol’, a number of measures of tree and shrub cover, density, and foliage height profile are made with ocular estimates from the point count center. The quick protocol has been used on all site locations at least twice over the course of the study and in some cases points have been surveyed for vegetation multiple times. In summer 2006, more in-depth vegetation surveys were carried out by crews of 2 people using measured quantites rather than ocular estimates. The purpose of the in-depth protocol was to provide a basis of comparison to the quick protocol. However, as of this writing, comparison of the two protocols or analysis using the in-depth protocol has yet to be completed.

**Database**

The project database is Microsoft Access 2003 format. While the database is structured as a relational database, no relationships have been formally defined – defining appropriate relationships is the responsibility of the user. Thus, the user will minimally need familiarity with basic operations in MS Access to provide useful data for subsequent analysis or summary.

*Database Tables*

At this time, there are >40 tables in the project database. These tables have traditionally been referred to as ‘Data’ or ‘Lookup’ corresponding to the type of data they contain. This designation is used for convenience only and is included as a Description for each table. ‘Data’ tables tend to contain data that were collected in the field or from a statistical or landscape analysis, while ‘Lookup’ table tend to contain data that describe a coded field used in one of the ‘Data’ tables. For example, the lookup table named ‘Distance’ contains the descriptions for the coded values observers use to estimate the distance of a bird from the center of the point count station, while the data table named ‘Bird’ contains the coded value recorded in the field.

In database terminology, columns are typically named ‘fields’ and rows are typically named ‘records’. This database has been documented in a way so that all fields in all tables have been given a brief description about what the values in the field refer to, e.g. what units they are in, what source they are from, etc… To view these descriptions for fields in a table, click on the ‘Design View’ icon after highlighting the table of interest.

*Table Descriptions*

Although the database includes about 40 tables, the heart of the database consists of five tables that are routinely used to generate data for most applications. These tables are described first in greater detail than the other tables because of their importance. Further below, all other tables are listed in alphabetical order, followed by a brief description.

1. bird: a table that contains one record for each bird recorded on a field sheet during a survey. Accompanying data include bird-specific information such as distance from observer, time period during which it was observed, type of observation, etc… In most applications, database queries are used to aggregate individual birds in this table across surveys or species (e.g. to get a count of species per survey or to get total species richness per survey). Note that bird absences on surveys are not recorded nor included – this has implications in many analyses that may require filling-in of zero abundance, e.g. trend analyses.
   1. site Unique identifier for point count survey station.
   2. year Year corresponding to the observations.
   3. nrricode Numerical code for bird species; see 'nrri\_bird\_codes' lookup table for code descriptions.
   4. minutes3 Time period during which the individual was observed divided into 3 time intervals. This protocol was used from 1991-2007; see 'minutes' lookup table for code descriptions. For 2008+, this field is calculated and updated with an Update Query using data collected in the nine intervals described below.
   5. minutes9 Time period during which the individual was observed divided into nine time intervals. This protocol was implemented in 2008 and replaced the protocol using 3 time intervals. Statistical tools to model detection heterogeneity using time intervals can do a better job with more intervals.
   6. type Type of the observation; see 'type' lookup table for code descriptions
   7. outside Binary variable indicating whether the individual was greater than 100 m from observer; see 'outside' lookup table for code descriptions (1 = greater than 100 m). This field is routinely used to select individuals for trend analysis, where individuals outside 100 m are excluded.
   8. distance Estimated distance from point count center to bird; 5 categories (0-4); first collected in 2005; retroactively converted 1995-2004 outside=1 to distance=4; see 'distance lookup table.
2. site: a table that contains survey-specific information that applies to the birds observed during the survey, including date, time, observer, weather, etc…. In this table, a unique survey is defined by two fields, site and year. Thus, there should be one record in this table for every site\*year combination. This table also includes a field named ‘fstype’ that refers to the forest covertype present on the site during the survey. Fstype can change from year to year due to forest growth, disturbance, or more complete information.
   1. site Unique identifier for point count survey station.
   2. year Year corresponding to the observations.
   3. date Date of the survey.
   4. obs Coded field for observer, see lookup table ‘observer’ for listing of observer names.
   5. time Time of the survey, Central Daylight Savings format.
   6. fstype A three-digit text string coding the dominant USFS forest covertype designation at the site. First-two digit indicate dominant forest cover, third digit indicates age/stocking density; see table ‘forest\_type’ for descriptions of coded values. Note that in cases when the first digit is zero, the digit is displayed because the format is text rather than numeric. This format precludes some statistical calculations that can’t be carried out on text variables. This variable is updated to reflect changes to the fstype if they occur between surveys, thus a site may have more than one fstype value throughout the project duration.
   7. fstype2 Similar to fstype above, but indicating the second-most dominant cover type, if applicable.
   8. temp Temperature ˚F at the start of the survey.
   9. wind Wind code at the time of the survey; see lookup table ‘wind’ for description of coded values.
   10. sky Sky code at the time of the survey; see lookup table ‘sky condition’ for description of coded values.
   11. noise Noise code at the time of the survey; see lookup table ‘noise’ for description of coded values.
   12. squirrels Estimated number of squirrels, if any, observed during the survey.
   13. chipmunks Estimated number of chipmunks, if any, observed during the survey.
   14. thinned Coded value to indicate the stand has been thinned by harvest since the past survey (1=thinned, null= not thinned).
   15. pine Code for the dominant tree species on a stand, with emphasis on pine; see 'pine' lookup table for descriptions
   16. ftc\_defoliation Code for the amount of tree defoliation by forest tent caterpillars at the time of the survey; see 'defoliation' lookup table for descriptions
   17. worm\_pres Code for the presence/absence of earthworms in the stand; protocol suggested by Cindy Hale to estimate worm impacts.
   18. worm\_floor Unknown field related to earth worm presence on forest floor
   19. worm\_impacts Code for the severity of worm impacts on the forest understory
3. location: a table that contains identifiers for the location of each survey point, including coded designations from the Forest Service and GPS coordinates. This table is used in many queries to subset surveys by national forest or to link birds to their on-the-ground position using GPS coordinates. In the early years of the project, GPS coordinates were obtained by digitizing map-based estimated point locations. In 2000 and 2001, GPS locations of all survey points were collected in the field by Jim Lind and Jim Sales, former NRRI scientists. These coordinates are annually downloaded into hand-held GPS units and used to navigate to the survey points in the field.
   1. forest Four-digit numeric code identifier for forest study area; see lookup table ‘forest\_name’ for description of coded values.
   2. dist/cty USFS Ranger District or County (county indicated for St. Croix and Southeast MN study areas)
   3. comp/trs USFS compartment or Township/Range/Section designation (TRS for sites in Southeast MN study area only)
   4. stand Identifier for forest stand used during project set-up, not unique across the project and generally not used in any queries.
   5. standunique Unique identifier for forest stand. Stands in the NFs were originally ≥40 acres and contained 3 survey points, while in the St. Croix and Southeast MN study regions they were ≥10 acres and contained on survey site only.
   6. site Unique identifier for point count survey station.
   7. X\_COORD GPS x-coordinate in decimal degrees, UTM15, NAD83 spheriod
   8. Y\_COORD GPS y-coordinate in decimal degrees, UTM 15, NAD83 spheroid
   9. comment Comment about the source or quality of the GPS coordinates
4. NRRI\_bird\_code: a table that contains the common name, scientific name, and AOU listing order for species we have observed on counts. This table is used in most queries to translate the numeric code for bird species in the ‘Bird’ table into names. The AOU listing order is useful for creating tables that present birds in AOU order that reflects phylogeny instead of alphabetical order.
   1. nrricode Numerical code for bird species; see 'nrri\_bird\_codes' lookup table for code descriptions. Use this field to link to corresponding field in the ‘bird’.
   2. common Bird species common name (note: may require periodic updates to reflect changing taxonomy and nomenclature).
   3. scientific Bird species scientific name.
   4. abbrev Four-letter text abbreviation for species, standardized to AOU abbrev (note: should be periodically updated to reflect AOU naming changes)
   5. bbsaou Numerical code used to order the species by taxonomy (usually not used because outdated)
   6. taxorder Numerical code used to order the species by taxonomy/phylogeny (from AOU Checklist, 44th supplement)
5. guild: a table that contains species-specific information on life history traits. Most of the information was compiled through literature searches or by obtaining similar tables from other researchers. This table is a compilation of the species accounts written by former NRRI avian ecologists Jim Lind, Rita Hawrot, JoAnn Hanowski et al. that are listed on the MNFB project web page.
   1. abbrev Four-letter text abbreviation for species, standardized to AOU abbrev (note: should be periodically updated to reflect AOU naming changes)
   2. nrricode Numerical code for bird species; see 'nrri\_bird\_codes' lookup table for code descriptions. Use this field to link to corresponding field in the ‘bird’.
   3. weight Mean weight (mg) of an individual of the species.
   4. sdev Standard deviation of mean individual weight.
   5. nest1 Code for primary nesting strategy/location; see 'nest\_type' lookup table for code descriptions.
   6. nest2 Code for secondary nesting strategy/location; see 'nest\_type' lookup table for code descriptions.
   7. nest3 Code for tertiary nesting strategy/location; see 'nest\_type' lookup table for code descriptions.
   8. food1 Code for primary foraging strategy; see 'foraging' lookup table for code descriptions.
   9. food2 Code for secondary foraging strategy; see 'foraging' lookup table for code descriptions.
   10. hab1 Code for primary habitat; see 'habitat' lookup table for code descriptions.
   11. hab2 Code for secondary habitat; see 'habitat' lookup table for code descriptions.
   12. hab3 Code for tertiary habitat; see 'habitat' lookup table for code descriptions.
   13. hab4 Code for fourth habitat; see 'habitat' lookup table for code descriptions.
   14. hab5 Code for fifth habitat; see 'habitat' lookup table for code descriptions.
   15. hab6 Code for sixth habitat; see 'habitat' lookup table for code descriptions.
   16. hab7 Code for seventh habitat; see 'habitat' lookup table for code descriptions.
   17. mig1 Code for primary migration strategy; see 'migration' lookup table for code descriptions.
   18. mig2 Code for secondary migration strategy; see 'migration' lookup table for code descriptions.
   19. eqb1 Code for enviromental quality board primary designation; see env\_qual\_board\_group' lookup table for descriptions./
   20. eqb2 Code for enviromental quality board secondary designation; see 'env\_qual\_board\_group' lookup table for descriptions
   21. eqb3 Code for enviromental quality board third designation; see 'env\_qual\_board\_group' lookup table for descriptions
   22. eqb4 Code for enviromental quality board fourth designation; see 'env\_qual\_board\_group' lookup table for descriptions
   23. eqb5 Code for enviromental quality board fifth designation; see 'env\_qual\_board\_group' lookup table for descriptions
   24. endstatus1 Code for endangered/threatened primary status; see 'endangered\_status' lookup table for descriptions
   25. endstatus2 Code for endangered/threatened secondary status; see 'endangered\_status' lookup table for descriptions
   26. area\_sens Code for area-sensitive species; area sensitive (S), unknown (U), insensitive (I), null=not known to be area sensitive
   27. hab\_use Code for whether species prefers primarily forest interior (I), edge (E), or both (I/E); see Freemark & Collins 1992. Ecol. & Cons. of Neotropical Mig. Landbirds, Smithsonian

*Brief Description of Other Tables (alphabetical listing)*

1. best\_pts A table that contains a list of points from the NFs that are maximally separated. Each NF stand contains 3 points – each stand in this list contains the two furthest apart sites to avoid overlap. This table has traditionally been used to subset surveys for trend analysis.
2. current\_site\_ages A table created by Jim Lind in ~2006 to indicate the ages of forest stands in the NFs for habitat-based analyses. Age information provided by USFS GIS personnel.
3. logged\_sites Each year, field staff are to keep track of sites that have been logged since the last survey; these sites are entered into this table. However, it appears this table has not been updated since about 2005.
4. orig\_stand\_info Forest cover type information and stand age from the beginning of the project.
5. se\_age Forest age information for the Southeast MN study area ca. 1995.
6. utm\_old GPS coordinates in UTM15 decimal degrees from digitized estimated map locations. These coordinates were replaced with on-the-ground GPS locations in 2000 and 2001.
7. vegetation Data entered from quick vegetation protocol – see Design View for field descriptions. Each site has been surveyed for vegetation multiple times.
8. vegetation\_summary Summary of quick vegetation surveys on each site, primarily by arithmetic means.
9. vegetation\_trees\_shrubs Data collected from detailed vegetation protocol in summer 2006.
10. weather Weather data averaged for national forest regions individually for 1992- 1999, source unknown.
11. area\_sensitive\_species Lookup table for coded values of area-sensitivity designations found in guild table.
12. broad\_cover\_code Coded designations for broad forest cover classes.
13. defoliation Coded designations for forest tent caterpillar defoliation levels recorded in the ‘site’ table.
14. distance Coded designations for distance classes that observers estimate birds from point count center. Prior to 1995, only birds estimated within 100 m were recorded on field sheets. Due to the possible heaping effect (i.e. bias toward including edge birds as ‘in’), the protocol was changed to record all birds observed along with an estimated distance in two classes (<100 m and ≥100 m). In 2006, this protocol was further modified to include five distance classes and the outdated 2-class system was retroactively fit into the five-class sytem.
15. drop\_91-98 List of sites dropped from 1991-1998 surveys due to various reasons – this table is kept for archival reasons only and is not used in any analysis.
16. endangered status Endangered/threatened status code designations that appear in the ‘guild’ table. Source unknown.
17. env\_qual\_board\_group Environmental quality board group species designations that appear in the guild table; source unknown.
18. foraging Foraging guild descriptions that appear in fields food1—food2 in the ‘guild’ table taken from species accounts and other literature sources (e.g. Ehrlich et al. 1988).
19. forest\_district USFS Ranger district code designations that appear in the ‘location’ table
20. forest\_name Coded designations for forest study area name.
21. habitat Coded designations for habitat types used in hab1--hab7 in ‘guild’ table.
22. migration Coded designations for migration strategies used in mig1-mig2 in ‘guild’ table.
23. minutes3 Coded designations for time categories of bird observations in three intervals.
24. minutes9 Coded designations for time categories of bird observations in nine intervals.
25. nest\_type Coded designations for nest t ype categories used in nest1..nest3 in ‘guild’ table
26. noise Coded designations for noise conditions at the time of the survey found in ‘site’ table.
27. observer List of observers along with numeric identifier.
28. outside Coded field to designate birds outside of 100 m.
29. pine Coded field to describe stands dominated by pine.
30. sky\_condition Coded designations for sky conditions at the time of survey recorded in ‘site’ table.
31. stocking\_density Numeric code designations for the third digit in the USFS fstype designation that refers to stand stocking density and age. This value is referred to in the ‘forest\_type’ table and ‘site’ tables.
32. tree\_or\_shrub\_density Coded value for tree or shrub density used in the quick vegetation protocol and listed in the ‘vegetation’ table.
33. trees\_and\_shrubs Coded values for woody species listed in the ‘vegetation’ table.
34. type Coded values for bird observation types recorded during surveys and appearing in the ‘bird’ table.
35. wind Coded values for wind conditions at the time of the survey recorded in the ‘site’ table.

*Database Queries*

Acquiring the data to be used in a particular application will be accomplished through user-generated queries. MS Access has a built-in query wizard that allows the user to create queries using point-and-click rather than learning the computer languages (SQL) behind the scenes.

I have provided a few starter queries for routine types of data that may be desired from the database and that may be used to guide development of more finely-tuned queries:

1. birds\_minus\_flyovers\_outsiders: a list of all birds observed excluding those classified as flyovers and those estimated >100 m from the point count center.
2. birds\_minus\_flyovers\_outsiders\_count: count per survey of all species, excluding individuals classified as flyovers and estimated >100 m from the point count center.
3. all\_conw\_observations: an example query that returns all observations of Connecticut Warbler, along with GPS coordinates and habitat type.
4. count\_per\_migration\_type\_per\_stand\_yr: lists the total count of individuals in 3 migration categories for each stand\*yr combination. Thus, in the 3 NFs, each stand is comprised of 3 point count surveys in each year. Only individuals within 100 m from observer are included.
5. richness\_per\_survey\_post\_1995: lists the count of species present on each site in each year, including birds > 100 m from the observer and flyovers. Years prior to 1995 are not used because 1991-1994 surveys did not record birds estimated beyond 100 m.
6. the queries ‘current\_fstype\_for\_print\_field\_sheets’ and ‘max\_year\_for\_print\_field\_sheets\_report’ are input to the report that prints the field sheets (see below), do not delete.

Please take note that the database does not track absences of species on sites. That is, we enter only species observations per survey. In many applications, the user may want to have a zero abundance in their data matrix for statistical analysis. When the count of a species is zero for a particular site, MS Access will usually list a null (empty) value instead of a zero. While there are several ways to fill in the zeroes, the easiest is often generating your data matrix with null values and then pasting into and Excel sheet where empty cells can be replaced by zeroes.

*Issues for Querying and Analysis*

As with any project, it is wise to spend time prior to taking action reflecting on what it is you want to accomplish. In the case of the MNFB project database, it would be good to think carefully about what you want your data to represent exactly and what you do not want them to represent. A few issues summarized below are included to help you think about your data choices.

* What is your sampling unit, the stand or the site? Recall that in the three NFs, each stand is comprised of three sites (i.e. point count survey stations). However, in the St. Croix and Southeast Minnesota study areas, a stand consists of one survey site only. In trend analysis for the NFs, the project has typically used the stand as the unit of analysis by aggregating species occurrences on the three stands prior to running statistics. However, in other analyses such as habitat modeling, it may be more appropriate to use species occurrence on sites as the unit of analysis.
* What is the quantity or value you will be using in further analyses? Would you like to obtain a count of individuals, a count of species (i.e. richness), or perhaps a count of individuals (or species) belonging to a particular life history guild (e.g. nesting or migration strategy)?
  + For counting individuals, you may or may not want to remove from consideration all individuals recorded as unknown species (e.g. unknown woodpecker, etc…).
  + Similarly, for counting species (richness), unknown species would likely be excluded from consideration. Keep in mind that richness per site is the unique number of species on a survey or aggregated across time on the survey location, while richness per stand is the unique number of species in the stand (i.e. aggregated across the 3 sites per stand) and not simply a sum of the richness values per site.
  + How would you like to treat individuals recorded outside of 100 m? Those estimated by observers to be within 100 m have a much greater likelihood of being linked to the habitat (fstype) for the site. Individuals observed outside of 100 m do not have absolute distances values estimated, so they may be in an altogether different habitat than that on the site.
  + If you use birds within 100 m, then you could compute a density estimate by dividing the count of individuals or species by the size of the circular survey (3.14 ha)
  + How would you like to treat different types of observations, e.g. flyovers, calls, songs, visual observation, etc…?
  + How would you like to treat repeat observations through time on a site – you may deal with statistical autocorrelation issues if you use multiple temporal records of a species on a site as independent observations
  + Would you like to omit samples due to poor weather or noisy conditions?

*Updating the Database*

Following the field season each summer, the double-entered data are error-checked using a separate MS Access named ‘autocheck.mdb’. The result of this process is the creation of two tables that contain data from the current year only that are in the exact format of the ‘bird’ and ‘site’ tables in the project database.

To add the data to the project database, copy each table from the autocheck database into the project database and use an Append Query to add the new data from these tables to the bottom of the existing bird and site tables. It is very important that prior to paste/appending that you make a copy of the original ‘bird’ and ‘site’ tables in case of an error.

It is also critical during appending that each field is appended into the appropriate corresponding field. Make sure to add to the ‘minutes9’ field (9 time intervals used from 2008 onward) instead of the ‘minutes3’ field (3 time intervals used from 1991-2007). Use an Update Query to update null values for the current year in the ‘minutes3’ field based on the values in ‘minutes9’. For example, an observation during the 9th interval in the current year would be updated to a ‘3’ in the ‘minutes3’ field.

Similarly, run an Update Query to fill in null values of the ‘outside’ field to indicate that bird observations were greater than 100 m from the observer for the current year. Values in the ‘distance’ field of 4 should be updated to be ‘1’ in the ‘outside’ field, while all other distance values (0, 1, 2, 3) should be updated to ‘0’ in the ‘outside’ field. Preexisting queries in the database named ‘update\_minutes3’ and ‘update\_outside’ are designed to be used for these purposes. Use the Design View of the queries to change the values to be updated.

In addition to adding data to the bird and site tables, new observers may be assigned a number and added to the ‘observer’ lookup field. Also, changes to fstype recorded from the field (due to logging, stand growth, disturbance, etc…) should be made in the in the site table.

*Printing Field Survey Forms*

In the Report section of the database, there is one report that allows the user to print the field survey sheets prior to the field season. One sheet is printed for each point that will be surveyed. The report is designed to include the most recent forest type determination. Field survey forms are printed one forest at a time by double-clicking on the report and entering the forest name. Hit the print icon to print all sheets at once (note: this will be several hundred sheets for each national forest).

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