The Blubonnet Bird Monitoring Project Operational Protocol

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Drafted 12 August 2010

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updated 25 May 2011

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We welcome you to the Bluebonnet Bird Monitoring Project (BBMP). This is a cooperative effort, involving Louisiana State University's School of Renewable Natural Resources, the Recreation and Park Commission for the Parish of Eastern Baton Rouge (BREC) and Baton Rouge Audubon Society (BRAS). Keep in mind that everyone is contributing their best to this effort in order to provide the community of Baton Rouge with sound bird monitoring practices and unique outreach opportunities. Most of all, have fun, and enjoy the birds as they reveal themselves to you in this pioneering effort!

INTRODUCTION

Every constant-effort mist-netting station should have a Station Management Procedures document such as this. This document is designed for stations operated by the Bluebonnet Bird Monitoring Project (BBMP) and associated projects. Many years of a wide variety of experiences have gone into these procedures and every word is considered important to the operation of a bird monitoring station. Please make every effort to become very familiar with its contents. Also, study this document with a critical eye and note any inconsistencies or omissions to BBMP support staff. This document is intended to be an authoritative companion for operating bird monitoring stations by BBMP to Ralph et al. (1993) and the North American Banding Council (NABC) manuals. We intend it to be also used at various stations in BREC conservation areas. Necessary deviations from this document are to be expected, and should be documented in the journal record at each station, and preferably written up for a permanent record.

EQUIPMENT AND MAINTENANCE

Equipment

Each banding kit should have an equipment checklist that includes everything that is taken into the field, including net lane clearing and maintenance tools. Please keep in mind that all the equipment and materials used in this program are expensive and difficult to replace. Banders should use and maintain everything gently and with respect. If any equipment is needed or requires replacement, the primary bander should be notified as soon as possible.

Bird Bags

Banders should always have some bird bags with them while nets are open (or being opened). Avoid placing more than one bird into a bag at a time (see NABC manual for the rare exceptions). Using a bag more than once is fine, but as it becomes overly soiled, it should be turned inside out and segregated from the rest of the bags. At the end of a banding period, bird bags should be laundered. Turn the bags inside out and shake debris away. Loosely fill a mesh (lingerie) washing bag with the soiled bird bags (so they don't unravel or become severely tangled together) and wash on the gentle cycle in hot water with a small amount of detergent and chlorine bleach. Leave bags inside the washing bag for drying. After drying, reverse the bags so that the raw edges of the seams are on the outside. Trim excess frayed or loose threads to reduce tangling on the birds. Fresh masking tape should be applied to each bird bag once space on the existing tape becomes limited – making tape is used to write the net and time of each capture during net runs. Be sure to remove damaged bags (without strings, with holes or unraveled seams) that cannot be wrapped shut, or from which a bird could escape, from the kit. Repair them if possible, or else dispose. If a suspected diseased or bleeding bird is captured, it is important to put that bag aside until it has been washed and disinfected. Also take the time to wash and disinfect your hands with the antiseptic towelettes or lotion provided in the banding kit before handling other birds or any tools and equipment. Periodically take the time to clean your hands during the banding session.

Net Repairs

Mist nets are quite expensive, but, with proper handling and regular maintenance, they should last a long time. It is very important that damaged nets be repaired as soon as possible or be removed from the kit until such time they can be repaired. Damaged nets pose a danger to birds that become entangled in them. Mesh holes and broken or undone trammel lines can cause extreme tangles that unnecessarily threaten bird safety and take much longer to untangle. Net repair kits are included in each banding kit and should be out and used as frequently as is necessary. A description of common net repair techniques is included in this document to supplement training. Realize that nets cost about $60 each, so a half-hour of repair more than pays for itself. A good rule of thumb for deciding whether a net should be repaired immediately (during a netting session) or afterward, is estimating the time necessary to complete the repair. If the repair will take about five minutes (about the time that one would spend extracting a couple birds), then repair it right away; if a longer time is necessary, then wait until after the netting session so that capture rates are not affected by net location disturbance. If banders do not have time to repair the net immediately, or sometime during the banding session, then while closing the nets, mark any damaged nets with flagging with notes written in sharpie pen indicating the size and location of the damage. Then, as soon as possible, repair it! Primary Banders (the bander in charge) have the responsibility to make sure that net repair, instruction, and practice are a regular part of the banding effort schedule, whether during the banding session, afternoons, or on office/maintenance days.

Net Lanes

Net lanes should be cleared of vegetation to approximately one meter to either side of the net and at least one meter above the height of an open net. Given that BBMP operates in BREC conservation areas, we try to limit vegetation destruction by utilizing "natural net-lanes." Because BBMP net-lanes may be narrower relative to recommended protocol, it is imperative that *nets are centered in each net lane*. Net lanes must be maintained throughout the season. Cut back any new growth so that it does not become entangled in the net. Net lanes should be discreetly marked with flagging labeled with the station code and net number written in permanent ink. At most stations it will be necessary to set up and remove the nets for each banding session. One end of the lane should be established as the fixed end and one end as the moveable end. This allows for adjustment to accommodate variations in net length and adjusting net position within the lane.

STATION SETUP

There are two variations of station setup. Generally, one is used for quick-station set up (often and endearingly referred to as "guerilla banding") and requires less equipment (money) while the other method is used at permanent stations and requires more equipment and time.

- Quick station set-up: you will need thin-gauge three sections of ¼" diameter unmanila (3-strand twisted polypropylene) rope and two 10' x ½" diameter conduit section poles. Fastened rope several inches from a tree trunk provides a solid "fixed end" for a net lane. This fixed end rope should be parallel with the ground, thereby creating the shortest distance possible between the tree and the pole. Mist-nets will become unstable if the length of rope between the pole and tree is longer than 3'. Once the fixed end is established, move to the opposite end (called the "floating end") and install 2 guy lines at approximately 120° angles to the pole forming a triangle with the pole. In heavily wooded areas, these guy lines can be anchored to tree roots, large rocks, logs or trees. Importantly, if the ropes on the floating end are not anchored low to the ground nets may be unstable. We recommend using Clove hitches to tie all rope to poles when using this set-up methodology.

- Permanent station set-up: you will need two 10' x ½" diameter conduit section poles, one 1' x ¾" diameter PVC pipe section, three 2' x 3/8" (or ½") diameter steel rebar sections bent 90º at one end, three 8' sections of ¼" diameter unmanila (3-strand twisted polypropylene) rope, and two ¾" swivel snaps for each net. Install a PVC section at what will be the fixed end of the net lane. This should be placed at the end where there is the least public traffic. The PVC should be installed at a slight angle away from the direction the net is running. This will help maintain the pole in a vertical position against the tension of the opened net. At the fixed end, install one guy line directly in line with the net. Using the 3# mallet, drive the rebar into the ground approximately 1.5 m away from the PVC at an angle facing away from the net. Tie a section of rope to the rebar and make an adjustable slipknot at the net pole end of the rope. Measure the length of the lane using an old net, a net-length section of rope, or by pacing. Install 2 guy lines at approximately 120° angles to the pole forming a triangle with the pole. The rebar stakes should be driven in at angles of 50° to 60° to the substrate, away from the net and poles at each end. If it is not possible to drive the rebar stake into the ground, as will happen at areas with a rocky substrate, the stakes must be buried, or an appropriately situated stone or tree used to anchor the guy line(s).

Net Set-up

Using the method involving the plastic bag and the pole-guy line shackle and/or clove hitch arrangement described above, a net should be set up in about two minutes. As the net lane is approached, locate and lay out the poles and guy lines at each end of the net lane. If using shackles, locate two ¾" shackles (aka swivel snaps) and attach them to guy line ropes. Starting at the fixed end, insert the pole through the net loops and then put the shackle on the pole and attach it to the fixed guy line (typically with three loops and two loops below above the shackle, although this may vary depending on topography). If not using shackles, insert the pole through the loops and tie a clove hitch to the pole from the fixed end (typically with three loops above and two below the clove hitch, although this may vary). Set the pole into the PVC or on the ground. Walk to the moveable end, feeding the net out of the bag as you go, being sure to keep enough tension on the net to keep it from dragging on the ground. When you reach the moveable end of the lane, place the net then the shackle, on the pole. If you do not have a shackle, simply place the net on the pole. Attach the two guy lines to the shackle, or fasten them to the pole using a clove hitch, pull the net taut and slide the shackle/clove hitch up the pole to tighten the guy lines. Nets made of nylon stretch out after opening and will most likely need to be tightened on the next net check. Since two people set up a net only slightly faster than one, it is much more efficient for banders to split up (rather than leap-frog) and work toward one another from opposite ends of the net array. However, factors such as a bander who is unfamiliar with net locations or a planned area search census may make other arrangements desirable. What is important is that the nets are opened as rapidly as possible and that banders at the station are in communication with one another. The plastic (grocery) net storage bag should be left at the net, bunched up and secured under a rock or under the rebar stake at the moveable end of the net and out of sight. It is important to stash the bag so that it is not loose to blow in a breeze and disturb nearby birds.

Net Site Trails

Trails at each station must be kept cleared of hazards such as sapling stumps (trippers), low branches (eye-pokers or head-knockers), loose stones, and thorny vegetation. The trails should be safe to move quickly through without tripping and ducking. Banders should be aware that brushing against thorny vegetation such as blackberry or hawthorn could possibly injure a bird in a bag. Diligence in trimming new growth during the late spring and summer vegetation-growing season is necessary to maintain safe

conditions at netting stations. If a treefall or other event causes a trail (or net lane) blockage, notify the support staff as soon as possible so that the problem can be resolved.

RUNNING THE STATION

All banders running the stations should have read and thoroughly understand these station management procedures, The Handbook of Field Methods For Monitoring Landbirds (Ralph et al. 1993), The North American Banders' Study Guide (North American Banding Council, 2001a), The North American Banders' Manual for Banding Passerines and Near Passerines (North American Banding Council, 2001b), and the Introduction section (pp. 1-40) of the Identification Guide to North American Birds, Part I (Pyle 1997). The importance of the information contained in these documents cannot be stressed enough. Understanding this information will ensure consistency in station management and data collection, and will protect the health, safety, and well-being of the birds. The objective is to operate each net for 5 (or 6) hours. Banders should be at the station 20- 30 minutes prior to local sunrise and begin opening the nets 15 minutes prior to local sunrise, and shut down so that each single net is operated the appropriate number of hours. Be sure to have cached at each banding station (or otherwise have on hand) spare equipment (poles, rope, stakes, etc.) to get every net set up promptly every session. Banders must have bird bags and hand nipper-shears on their person at the opening and throughout the banding session for early captures and minor vegetation trimming.

Before you start

Before opening nets all banders must have scissors (for removing problem or stressed birds), a felt tip pen (for documenting net-site and time on bird bag) and a walkie-talkie (to communicate to the rest of the crew).

Rainy Day Procedure

If the scheduled banding session is interrupted by rain or other events, please use the following guidelines. The major objective of a constant effort station is to usually run each net for a certain number of hours each week or 7-day period, starting 15 minutes prior to local sunrise. If you have to close nets shy of the magic number of hours, we suggest the following, in order of priority.

1. Attempt to operate each net for the standard number of hours, within the first 7 hours following local sunrise.

2. We suggest that you operate each net for at least one hour within the 2 hours following local sunrise to include the maximum capture rate.

3. If possible, operate each net for a minimum of 60% of the standard number of hours during the first 7 hours following local sunrise. For example, at a station normally operated for 5 hours, 3 hours would provide the minimum of 60%.

4. If a net or nets cannot be operated (e.g., flooding, treefall), then a temporary replacement(s) should be set up as near as possible until such time the detriment to the original net(s) is removed. Secondarily, other nets should be operated for the minimum 60% of the standard number of hours during the first 7 hours following local sunrise. Every effort should be made to restore the original net array as soon as possible.

5. If you can't meet the above criteria, we suggest that you operate the nets on the next available day, during the hours missed.

At times it is impossible to complete the netting at a station within the prescribed period.
In this case, we strongly suggest that you do a make-up, by operating very early in the next period, rather than not take a sample at all for that previous period. Then, to get in the netting session for the current period, wait at least three days before operating the nets again.

Checking Nets
Several factors should be kept in mind when checking nets. Nets should be checked every 20-40 minutes depending on environmental conditions, numbers of birds, and the experience level of the personnel. Environmental conditions to be considered include: wind, rain, and temperature extremes (see Ralph et al. 1993). If a bird is incidentally seen in a net, it should be removed immediately with the capture time recorded as the next scheduled net round. Personnel should always be in communication with each other at the station. Carry and use the 2-way radios provided in the banding kit. Personnel should always carry the small pair of scissors provided in the banding kits to use in the event of an extremely tangled bird, as well as a dropper bottle of sugar water to revive stressed hummingbirds. Bring along the hand nipper-shears for net lane maintenance pruning. Most importantly, schedule the next net round and write it down as a reminder on the journal page immediately upon returning to the banding station.

Busy Day Procedure
The purpose of a busy day procedure is to provide guidelines that clearly outline steps for a Primary Bander to consider when high volumes of birds are captured at a station. The primary concern for banders when faced with large numbers of birds is bird safety and this procedure should be implemented in order to avoid leaving a net unattended for more than 45 minutes and to avoid holding birds for more than 2 hours due to a backlog. When followed, these guidelines will allow banders to efficiently and safely deal with large numbers of birds, while assuring that the most valuable data are collected accurately. Examples of the considerations taken into account by this procedure include:

- Data collected from capturing the more uncommon birds is more valuable than taking complete data on, or even banding common species, certainly more than 10 birds of a species; and,

- Data collected on a recaptured individual is much more valuable than data collected on newly banded individuals.

Options to consider when faced with large numbers of birds include: making more frequent net rounds, adjusting the allocation of personnel, taking minimum data, and releasing birds unbanded. Specifically, we want banders to:

- Birds should be removed from nets as quickly as possible, as they can remain quite healthy in shaded bags for one hour, perhaps longer under ideal conditions.

- If too many birds are encountered in nets for processing before the next round, then take minimum data until the capture rate slows down. Be sure to maintain quality of data, especially of species, age, and sex determination. If more than 10 birds of one species are captured in a day, the remainder can, but only if you have quite a few birds that day, be released without banding; try to age and sex these birds, if possible, and always record them on the 'Unbanded Birds' sheet.

- If too many birds are captured even with taking minimum data, then close 2-4 nets, including those with high and low capture rates, and in different habitats, if possible. No matter which nets are closed, the normal net checking route(s) should be maintained in order to avoid confusion about which nets have been checked.

- Try to do net rounds as quickly as possible; every 15-20 minutes is not too often, in order to minimize each bird's net time and degree of entanglement.

- Use personnel effectively; two people working together can process much more than twice the number of birds than a single person, so long as one records for the other. If it is time for another net round, and there are still birds to be processed, it is best for both people to go on the net round, rather than just one. The birds are safer and less stressed inside of the bags than hanging in the nets.

- If more than about 10 birds are still in bags after 1½ hour, close further nets.

- Once the number of birds hanging in bags has reached about 10, then nets can be reopened. As a general rule, birds should not remain unprocessed in bags for more than one hour from the time they were brought to the processing station. Keep in mind that a bird could have been caught in a net immediately after the net was last checked, and the total time in a bag can be considerable.

Recording minimal data

Under certain conditions (see Busy Day Procedure section above) there may not be time to fully process each bird. In these situations, the bander must at least record the band number, species, age, sex and net number of the bird. In a given situation, the need to collect minimal data will vary with numbers and experience of the banders. Just remember, the health of the netted birds is paramount. Allocating time between the netting effort and area search censuses It is very tempting to treat the capture effort as the primary reason for being at a monitoring station. However, the area search census is every bit as important, especially considering that in 20 minutes you might process a few captured birds, but could record several dozen on an area search census. It is far better to let a few, or even several; birds go with minimum (or even no) data, than to pass up the area search census. Banders will find however, that with increased skill level of personnel present, the area searches can be completed quite easily in course of checking nets.

Efficient Banding Station Setup

One of the most critical elements in station management is setting up the banding station to run efficiently, so that you minimize any stress on the birds (and you!). There are many things banders can do to reduce confusion, and thus increase efficiency and bird safety, at a banding station. Try to locate the processing table in a spot that will be sheltered from the direct sun during the heat of the day, but not so shady that the lack of light in the early morning makes it difficult to make accurate assessments of plumage and skull. In order to determine skull ossification accurately, additional light is essential, and not optional. The banding kits are equipped with high intensity flashlights for skulling. Set up the light with the chemistry stand or hang it from a tree branch close enough to the table or vehicle tailgate so that the bander can use it without moving from the processing place. Having a table to work on will greatly enhance your ability to maintain order and speed. Portable tables or the tailgate should be used for processing. If the table is too small to hold all of the items, set up the essential banding tools on the

table, and set up the references within easy reach of the table. The birds should be hung in a sheltered place within easy reach of the bander. You should not have to get up from the table or walk to where they are hung or to get under a light to skull. This is to ensure that the birds are processed as rapidly as possible. Lay out the tools where you find them most accessible on a small towel or bird bag, and put them back in the same place when you are finished using them for easy access. Be sure to set up the scale within reach so that you do not have to get up to weigh the birds. When removing birds from bags, have a spot, away from the immediate processing area, where you pile the empty bags. This will keep the bags out of the way of the processing and they will be handy for the next net round.

Order of Processing Birds

"If you don't know what to measure next, you are doing it wrong" is our paradigm concerning rapid and accurate processing. Every bander must have the general order of processing memorized in order to expedite bird processing. In general, for spring-time banding, the order is as follows:

1. Report species, band size and number to the recorder. Make sure the recorder reads the band number back to the processor. Band the Bird and quickly ensure the band has been properly applied.

2. Cloacal protuberance/Brood patch

3. Fat. If furculum is unclear, check flanks.

4. Body molt. Make sure to check flanks, tail coverts, back, nape and crown.

5. Wing molt. Check by blowing at a slight angle above underwing coverts in order to see base of the primaries and secondaries.

6. Wing wear. Average the last four visible primaries.

7. Wing-chord (unflattened). If wing is bent or excessively worn, do not measure wing-chord and make a note briefly explaining why wing-chord was not measured.

8. Weigh the bird. While the bird is being inverted into the weighing cup, report age and sex.

9. Release the bird.

Note that no time was allocated for molt limit and/or plumage inspection. Ideally, age-related plumage criteria should be mentally noted during all phases of processing. Molt limits can be visually assessed while measuring wing chord for many species. Ideally, adhering to this system will allow banders to process birds in 60 seconds; any faster and recorders are prone to mistakes. During fall and winter months, birds should be skulled after wing-chord is measured but before they are weighed. The banding data sheet (Appendix B & C) have been designed in the same order facilitating processing speed.

Certain birds should be recognized as sensitive to the capture process and processed before other birds as a priority in processing order. Banders should be very familiar with which species possibly captured at their stations can be sensitive to the capture process. At stations in Louisiana, this group of birds includes hummingbirds, kinglets, winter wren, towhees, and any other bird that appears stressed. Other

birds that should be considered as potentially sensitive include juveniles (especially of small warblers and finches), adult females with fully developed brood patches, and individuals that are continually struggling and/or screaming). The bags containing such birds must be marked with a bold note stating "priority" and other banders must be informed of the bird's status. These bagged birds should be segregated at the banding table area and brought to the attention of whoever is processing birds at the time. After priority birds are completed, birds should be processed generally in order of their increasing size (e.g., Bushtits before sparrows, before tanagers, etc.). Banders should always collect and record data in the order that they are on the banding data form in order to maximize processing efficiency. Pyle guide I (1997) and Pyle guide II (2008) serve as our primary source of ageing/sexing criteria. Fluency in all aspects of nomenclature used within both guides is mandatory for all BBMP banders.

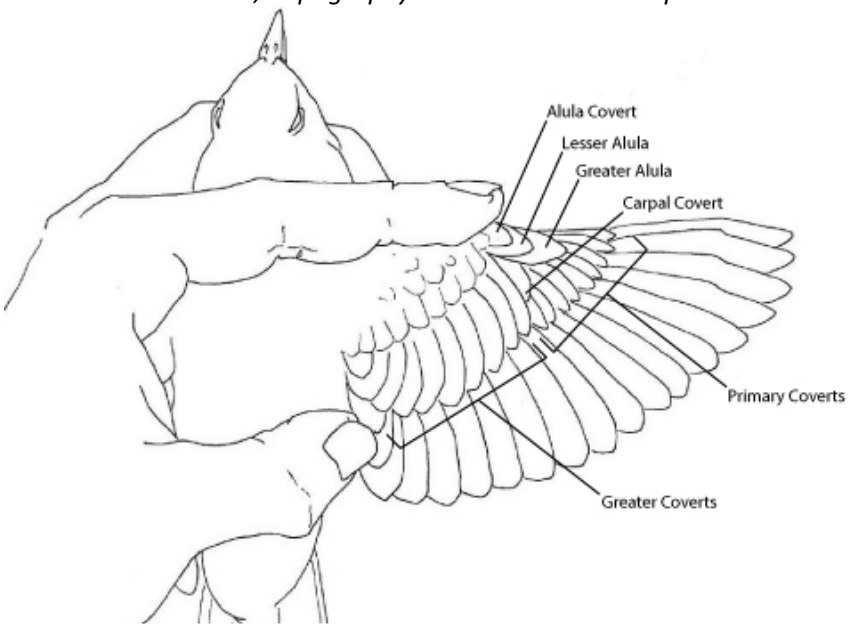
Empidonax flycatchers

Identifying *Empidonax* flycatchers can be challenging but fun. When using the Empidonax reference tables in Pyle (1997) note all distinguishing criteria used in identification in the banding sheet notes. It is not necessary to take all the measurements Pyle (1997) gives in his reference tables; rather, record just those characteristics which you need to arrive at a species' identification. We suggest this approach: if you have an educated guess about the species identification based on your experience, start out with those characteristics that separate that species from its conspecifics. You can stop measuring and recording when you feel confident about your decision. If you're inexperienced with the flycatchers, or you've captured a bird that refuses to fit neatly into our classification scheme, then more effort will be needed. Be prepared for waves of Empidonax flycatchers (and Catharus thrushes), and familiarize yourself in advance with the measurement techniques and special data requirements. Do not record a bird as "Empidonax species" or "Catharus species"! All of these birds can be identified to species with the required certainty. If you know in advance exactly which characters and/or measurements are required to separate similar species, and you are overwhelmed by a wave of birds, take the minimum amount of data, and later identify each bird to species based on the data you have taken. Do not put a band on a bird you will not be able to identify!

Importance of Age

Virtually all analyses of banding data first divide birds into age classes, usually just HY/SY vs. AHY/ASY. However, BBMP employs new methodologies to micro-age captured birds by categorizing age using plumage and molt cycle (Appendix A). Understanding molt is inherently difficult for many volunteers; we recommend all banders thoroughly study contemporary molt theory followed by a discussion concerning molt with a primary bander. While plumage, molt of wing feathers, feather wear, and breeding condition, can all contribute to your decision, or actually determine the age, the degree of skull ossification is often most certain for many species during spring, summer and fall months, unless molt-limits are obvious. All banders should wear and use Optivisors continuously whenever processing birds. Always use absolute criteria. Using questionable criteria will be less than useful and will introduce problematic variables into the data set when age or sex categories are determined with varying degrees of confidence. If the criteria are insufficient to make correct determinations at least 95% percent of the time, do not waste the time trying to make a determination. Use the code "U" and a cycle code of "UCU" if the plumage was examined, but it was unknown as to if plumage is juvenal or not. Use "9" if you didn't take data on plumage. Under no circumstances use a dash ("-"), as it could mean 'not known' (same as U), or "9" (data not taken). Use continuation lines (diagonal from upper left to lower right) where appropriate.

Bird Hold, Topography and Molt Limit Example



Yellow-rumped Warbler showing retained primary coverts (except for the adventitiously replaced inner primary covert), retained lesser alula (a2) contrasts with replaced alula covert (a1) and replaced greater coverts. The molt limits shown above are typical of formative plumaged warblers.

Recognizing and Treating Stress and Other Common Injuries

All banders must be familiar with the symptoms displayed by captured birds (see NABC Banders' Study Guide). If a bird is stressed, take minimum data and release. Be certain to release such birds at ground-level and be ready to recapture the bird if it doesn't fly. If a bird is stressed to the point of inability to fly, first try gently jostling the bird or tossing the bird in the air a few inches or so back into your hand. This often gets the bird's wings moving, stimulating its heart, and releasing it from shock so it flies away. If this does not work, then activate a hand-warmer packet (follow directions on package), place it inside a bird bag to one side of the warming box (e.g., a plastic-insulated cooler pack), and place the bird inside, but not next to the warmer. Cover the open box and set it away from the banding table in a safe, quiet place. Check on the bird after 10 minutes or so. Another alternative is to place the bird in the bag and put the bag under your shirt. Eyedropper bottles and a supply of sugar are in each banding kit for hummingbirds. If a captured hummingbird is displaying symptoms of stress, banders should consider giving it sugar water. The solution to be used is 4:1 water:sugar. The solution should be offered to the bird by squeezing a drop out of the dropper and held at the bill tip, inserting the bill tip or tongue tip into the drop no more than a millimeter. The hummingbird's tongue is frayed and sponge-like, and if it can take the sugar water, it will at this point. If it takes the sugar water, it will very quickly be energized and be able to fly. If it does not, consider treating it in the warming box. Keep in mind that hummingbirds go into torpor and may do so as a reaction to shock, appearing dead, but delay treating as a potential specimen. Birds other than hummingbirds should never be given sugar water, as it can act as a diuretic.

Wing Strain

Wing strain (described in NABC Banders' Study Guide) can occur in the net before and during extraction, and during processing. Banders can minimize this problem by following proper net check schedule procedure, using proper net extraction (especially the Body Grasp extraction method), and proper Bander's Grip handling. Wing strain will usually be evident by one wing held noticeably lower than the other. If wing strain is suspected, the bird, prior to point of release, should be momentarily held in the Photographer's Hold and allowed to flap its wings. If the wings do not readily flap, move the held bird up and down within a few inches a few times (this will usually prompt a bird to flap its wings). If the bird has not yet flapped its wings, it should be placed into a bird bag and set in a safe, quiet place away from the banding table. Check on the bird after 20 minutes and attempt to release as above. Holding the bird for up to several hours may be necessary. The NABC manuals describe other, less common, injuries and treatments.

Priority of Data

The most important data are: species, band number, age (at least to the degree of hatching year vs. after hatching year), sex, capture time, and net location. If time permits, other data in the following order are important: breeding condition (if not noted in determining sex), wing molt, molt limits, primary wear, body molt, wing length, weight, and fat. Recording How Aged and How Sexed The codes for characters used in ageing and sexing birds are included in each banding kit (laminated reference sheet) and in (App. G). As our knowledge of ageing and sexing birds develops, some characters may prove to be more or less useful than we now understand them to be. By recording at least two characters used in determining age and sex, we have found that age, and/or sex ratios, may be recalibrated by checking the data that have been recorded. Further, for data analyses, it may also be useful to note whether a spring bird was aged AHY based on inconclusive results after carefully examining the bird, or if it was not carefully examined and quickly processed due to a backlog of birds. The process of recording 'how aged and how sexed' codes provides increased flexibility and greater resolution in describing age and sex determinations. It also provides lesser-experienced banders a

simple and easily remembered basis for their data collection. The most definitive characters should be used and recorded. Banders should especially pay attention to the detail of what plumage is observed in birds and use the most precise code possible. Banders should note that the use of several codes requires an accompanying note, e.g., "Q, Y, L, W, V, M, O, and Z". Whenever molt limits are looked for, a code should be recorded in the 'Molt Limit" fields, e.g., no molt limits found, record "N"; molt limit in greater coverts found, record "G". Banders should record all molt limits found, e.g., if more than two limits are found, record in notes. The use of the "N", "U", "Z", and "9" codes are very helpful in analyses examining whether characters are useful for ageing and/or sexing. The use of "Z" should include a note on what the suspected age/sex is and what the conflicting characters are.

Recording Wing and Tail Molt and Feather Generations

Wing molt should be recorded as symmetrical or adventitious in the data fields on the front of the form. The presence of tail molt should be recorded only in the notes on the back of the form. The details of both wing and tail molt should be recorded using the standardized notion method. The letter 'P' denotes primaries, 'S' denotes secondaries and 'T' denotes tail. The letters 'L' and 'R' indicate left or right respectively. The feathers are also numbered in the standard manner as in the introduction to Pyle (1997). The letter 'G' indicates that the specified feather is growing and the letter 'X' indicates that the feather is missing. If the feathers missing or growing are in sequence, e.g., numbers one through five are growing, the numbers are recorded forwards ("15") to include all the feathers. If the feathers are not in sequence, e.g., numbers one and five are growing or missing but not the feathers in between, then the numbers are recorded in reverse order ("51"). For example, you capture a bird that has primaries one through five, secondaries three and six, and the left tail feathers one through three are missing. This would be recorded in the notes in the following manner: 'P15S63G, TL13X'. All molting or missing flight feathers should be recorded, including those that may have been dropped by the bird during capture or handling. If more than one generation of plumage is observed, please use similar numbering as above but note new 'N' or worn 'W'. For example, if primaries one through five were symmetrically replaced and six through 10 are old, it would be notes as 'P15N, P610W.' Be sure to include a note indicating if you were aware that feathers were lost during capture or processing.

Recording Notes

Notes should be made about specific plumage characteristics and measurements taken in addition to the normal data recorded on the front of the form, for example the length of the crown patch of an Orange-crowned Warbler, or other criteria used to make age and sex determinations. Make notes as concise as possible and use the standard abbreviations found in Pyle (1997) p 732. When referring to a figure in Pyle, record the note as 'Pyle Fig ### = X'. If a feather sample was collected or a photo taken, record this in the notes. Note any injuries, malformations, or deformities, especially if a status code other than N (Normal) is used. All unbanded birds should have a note explaining why the bird was released unbanded.

Bands and Band Sizes

Birds should always be banded with the best-fitting size band. Band sizes are listed in Pyle (1997) and the Tabular Pyle. The sizes listed are those recommended by the USGS Bird Banding Laboratory. If in doubt, and after measuring the tarsus, a bander determines that a size other than those recommended should be used, then a note that includes tarsus minimum and maximum width (to the nearest 0.1 mm) should be recorded. Bands that are determined to be unreadable and replaced (Band Code C=Changed) must be taped to a sheet of paper with the readable digits, species, station, date, and replacement band number written and this information given to the field crew leader as soon as possible. It is very likely that the Bird Banding Laboratory will be able to discern the original number through an etching process.

Bands that are determined to be unsafe to the bird should be adjusted or replaced accordingly. When a band is changed, the OLD band is recorded on the recapture page with band code = 'R'. The NEW band is recorded on the new band sheet with the band code = 'C'. Notes referencing the matching band numbers should be recorded on both sheets. The new sheet should reference the OLD band number and the recap sheet should reference the NEW band number. Bands should not be placed regularly on either the right or left legs, but on whichever is handy and available. Banders must be in the habit of inspecting both legs for an existing band.

Rare Birds

All Primary Banders should be familiar with the diagnostic characteristics of the top 30-50 species commonly captured, and they should be aware of any similar, less-common species. When you capture an unfamiliar, unusual, or uncommon bird, document it with a photograph with a camera with a close focus function. The bird should be held in front of a uniform background with a label with the date, location, and the last 3 digits of the band number. Be sure to show diagnostic characters. At the very least, take a side view with the back wing flared up to show molt and upper coverts. A top and bottom view would be advantageous. If you do not have a camera, a thorough written description covering all the major plumage areas (e.g., upper parts, undertail coverts, etc.) and color of body parts (including bill and legs) should be taken. Birds that can't be readily identified should be processed completely, and photographed. The pictures should be noted in the notes section on the banding sheet and the film rapidly processed.

Training

It is part of the responsibilities of the Primary Bander to instruct the assistant(s) in all of the procedures and techniques involved in running the station.

1. The trainer should have read and be familiar with The North American Banders' Study Guide (The North American Banding Council 2001a), The North American Banders' Manual for Banding Passerines and Near Passerines (The North American Banding Council 2001b), The Instructor's Guide to Training Passerine Bird Banders in North America (The North American Banding Council 2001c), and The Trainer's Syllabus (Ralph et al. 1993). Trainers should ensure that all trainees have read and understand these documents. Copies of these documents should be in each kit.

2. Removal from nets. Until trainees are fully competent, they should never be left alone taking out a bird. Instead, the trainer should watch; when a person has not made progress on a bird for about 10 seconds, take the bird, do the next step and return it to the trainee.

3. Recording. Trainees should rapidly become familiar with the data collected, to the point where they anticipate data, and do not have to be told the data appropriate for each column (e.g., when told the skull is full, they should automatically and correctly write down the age and how aged).

4. Processing. Trainees should quickly become competent in processing. Training in processing should depend upon the number of birds: (a) when only a few birds are to be processed, the Primary Bander should record, while the trainee bands; (b) with moderate numbers, the Primary Bander records for the trainee, while also banding; and (c) when it is busy, the trainee records for the Primary Bander, while also banding. This enables the trainee to make progress continuously, not just being a spectator.

Mortalities

In the course of capturing birds, and despite of every precaution being taken, some mortalities may occur. Also, while working in the field, or at other times, you may encounter dead birds, or be presented one by the public. While these birds' demise is unfortunate, it presents an invaluable opportunity to contribute greatly needed-study specimens to scientific collections and training programs. It is essential to take preliminary actions in order to preserve these specimens' value; otherwise, a great life is lost a second time. Specimens must be frozen, as soon as possible. If you are more than an hour or so from a freezer, keep the wrapped and bagged specimen in an ice chest or cooler (or, at the minimum, in the shade). Please keep in mind that these specimens are not of study value without the information listed below recorded on the wrapping and also on the outside of the plastic bag. In order to protect feather condition and shape, the bird must be rolled up in a piece of (appropriate-sized) clean paper with each end folded over toward the center of the bird, without disturbing the rectrices and head plumage. The carcass should be arranged with the wings at resting position and the legs directed towards the tail. If possible, fill the mouth with cotton (to absorb fluids). The wrapped specimen must then be placed into a plastic bag, preferably a sealed zip-lock freezer bag. Specimens derived of netting/banding activity should be recorded as Unbanded birds. Keep specimens in the field residence freezer and arrange with support staff, as appropriate, for transport to LSU. Information that must be recorded for each specimen (on paper wrapping and on plastic bag): species (write out common name); age and sex (if known); date (day/month (3-letter abbr.)/year); location (include County); cause of death (probable if not known); and your name.

Closing the Nets and Leaving the Site

Personnel should be familiar with adverse conditions that may require early closing of nets as described in Ralph et al. (1993). These include rain, high winds, strong sun, or predator presence. Be sure to remove all twigs, leaves, feathers etc. from the net before closing. This will greatly reduce the incidence of tearing nets while opening. Identify damaged nets with flagging marked with a permanent felt pen describing the extent and location of the damage. Be sure to disguise your presence as much as possible, by hiding ropes under rocks, using minimal flagging, and putting poles under brush, if they are left at a station. Wrapping and hiding the rope also keeps animals from becoming entangled. Place a stick into the PVC pipe to keep dirt and little critters out of the pipe. Count the bagged nets BEFORE stowing to ensure that all of the nets have been taken down. Be certain that this last step is followed, as it is the only way to be certain that no nets have been forgotten at the station before leaving (without walking the entire circuit again). The poles should be hidden in a standardized location at each station. This is to ensure that people filling in for the regular crew can easily find the poles. They should be cached at the end of the net lane, and on the side of the lane that is away from the trail that a visitor would be likely to see. If that location is not available for hiding the pole, choose the next least visible place. Be sure that all the hiding spots are well marked on the station map. Always bring a copy of the station map with you when opening and closing to ensure that the poles are stashed in the designated locations.

Visitors and External Relationships

Permits must be in each kit. When visitors are encountered, banders should introduce themselves and the netting work ongoing. If an adverse situation is perceived or anticipated, the field crew leader or support staff should be contacted and nets closed. Ninety-nine percent of encounters with the public will be very positive, and banders should take advantage of the situation to educate the public as to the work we do and how it benefits birds. Take visitors on nets rounds with two banders so that if one bird is difficult to remove, the other bander can move on ahead with the visitors. Confine visits to nets to the last half of the morning, and never when there are so many birds that you consider taking minimum

data. Make appropriate apologies, but under no circumstances should visitors go on net rounds alone, or when they may endanger the birds' safety.

Schedule
Get the stations done in the first few days of a given period. If it rains during the first two hours of a morning (making it impossible to get a minimum of one hour in – see "Rainy Day Protocol" above), take the rest of the day off. Sites that are open to public use should be avoided during weekends and holidays in the schedule.

SUPPLEMENTAL STUDIES AT BBMP
To augment the capture data at our stations, we are collecting various additional data. These data include species checklist, area search censuses, dropping samples and owl banding.

Area Search Censuses
Area Search Censuses are conducted at least twice during each banding effort (see Appendix D). Basically, an observer walks a 20-minute route, noting all birds seen or heard. The person who is the best birder should conduct these, and the other banders should practice as time allows. The area search census route for each monitoring station is described on each station's Map and Location Description. The first census is done as the nets are set up. If the temperature and/or bird activity is low, wait until it warms up a bit to begin the first area search. One person starts setting up the nets and the other person walks around a circle that includes at least part (but rarely all) of the net round. After 20 minutes, the censuser (back at the start of the net round) begins to also set up nets. Then, when bird captures have slowed down, often about 0930 or so, census a second 20-minute census is conducted. The area search census data is as important as the banding data. Be sure that at least one area search is completed each banding effort. If capture rates are slow, or extra persons are available at the station, multiple area searches should be completed. The order of routes conducted should be varied from effort to effort. Each day, the area search forms should be edited, cleaned up and placed with the other completed forms. Occasionally, the date and/or station are omitted while in the field, and this is much more easily corrected the day of area search rather than later. Be sure to fill in the species name field with a brief abbreviation of the species name for each species code. For any species that the code is unconventional or unusual, the entire name should be recorded. This is the censuser's responsibility, and the Primary Bander's responsibility to make sure that it is done.

Species Checklist
A Species Checklist, located on the back of the journal form (Appendix E & F), is to be completed for every banding and census effort. This checklist is used to account for all species encountered during the monitoring effort using breeding status indicative categories. The categories are codified and included on the checklist. All encounters should be included including captures, area search (and all other censusing efforts), and incidental observations.

Parasite Collection and Connectivity
We have begun a pilot project at BBMP collecting and quantifying ectoparasites. We hope to identify common bird parasites in Central Louisiana and establish connectivity between tropical parasites hitching-rides on Neotropic migrant birds.

Condition Indices
Within the dataform are fields for left wing, right tarsus and left tarsus. These fields are used to calculate 'condition indices,' or mass changes standardized by a physical metric, for individual birds. This data should be considered secondary and collected as time permits.

Owl Capture and Census (potential)
The purpose of this study is to gain information useful for analysis of owl population trends and characteristics. Very little is known about these difficult to monitor birds. Additional information about migration patterns and molt cycles, otherwise difficult or impossible to collect, will be made available through this study. We are targeting one small owl species, Eastern Screech-Owl, and one large owl species, Barred Owl. However, all owls and other nocturnal bird captures and detections are of great value. The census is conducted during the capture effort, both using an audiolure.

Rapid Ornithological Inventory (potential at other BREC sites)
The Rapid Ornithological Inventory (ROI) integrates the mist netting, area search census, owl capture and census, and vegetation survey procedures described above in a one-time effort. The ROI is designed to augment the data collected at regular monitoring stations on a landscape scale and quickly gains a measure of the relative value of nearby habitats. The procedure includes a schedule for completing a ROI, which takes just under 3 days for two people, at a minimum. Field crew leaders should be consulted for map(s), ownership information (with special permit, if needed), and special equipment required.

Bird Droppings and Gut Scarification
In the fall and winter months, captured birds will be placed in small paper bags in order to acquire droppings. Seeds will be obtained from captured bird droppings in order to determine germination success (gut scarification) of commonly consumed native and invasive fruit. In order to collect seeds from droppings, paper bags which held birds will be scrutinized for droppings. Seeds within droppings will be associated with individual bird data (derived from information written on the bag) within a database; seeds obtained from droppings will then be identified to species using a reference seed collection prior to planting each seed in labeled plots within the LSU greenhouse.

Cycle-Based Age Classification Code
BBMP now uses as improved age classification system. This system is designed for resident tropical landbirds but has important implications for temperate species as well. All banders must be familiar with this new age categorization system (see Appendix A).

DATA RECORDING AND MANAGEMENT

While fields in Daily Mist Netting Journal (APPENDIX E.) seem obvious, mistakes are very common. Please adhere to the following:

- Station name: the name of the station (e.g. Home).
- Station code: the four-letter code for the station name (e.g. HOME)
- Day and Date: Record the day of the week (e.g. Monday), as well as the date. Please spell out the month.
- Time open: record the time you commenced opening and the time opening was completed.

- Time closed: record the time you commenced closing and the time closing the nets was completed.

- Nets run: record each net opened noting any individual net locations that were not opened. Record in the notes section the reason for any nets not opened or the times nets were opened or closed if different from the general open and close times for the array.

- Total number of nets run: record the total number of nets opened in the array on that date.

- Net runs: record the time each net round was started.

- Banders: record the complete names of all banders and recorders.

- In each of the three time intervals (open, mid, close) record: (1) Percent cloud: estimate the percent of cloud cover to the nearest 10% in each of the three intervals; (2) Precipitation: None (N); Fog (F), Mist (M), Drizzle (D), Rain (R). See Ralph et al. (1993). Include any descriptors such as light, heavy, steady or intermittent. (3) Temperature: record temperature in centigrade using the thermometer provided with your kit. (4) Wind using the Beaufort scale.

- Notes: record any unusual or interesting occurrences, visitors names, problems encountered, etc. Also record plants flowering or fruiting, and all birds singing or seen carrying nesting material or food. Note when area searches were conducted and who did them.

- Number of birds captured: cross check totals on back of form with a second, approximate counts from data forms.

- Other species detected: record additional bird species not captured or detected on area searches.

Banding Data Form

Refer to the sample form (Appendix B & C). Be sure to completely fill out the headings on the top of each form. Please only record bands from a single string on a banding form. When starting a new string, always start a new form. This will help ensure that band numbers are recorded and computerized correctly and will facilitate data filing, band inventory, and reporting. Lost or destroyed bands should be recorded in sequence on the new band sheets. Please record the code ('L' for lost and' 'D' for destroyed), band number, date, and location. Record 'BALO' or 'BADE' in the species code field and write 'Band lost' or 'Band destroyed' in the notes section. After the last band of a string is used, the form should be discontinued with "end of string" written following the last band record. Never record bands from more than one band string series on a single form, no matter if is the same size (but different strings), or different band sizes. This causes great confusion in data management and record keeping – another data form must be used, even if it will have only one record on it.

Area Search Form

Refer to the sample completed form (Appendix D). Be sure to completely fill out the headings on the top of each form. All birds encountered during the search are recorded. The censuser must determine whether the encounters are 'On Area' or 'Off Area', i.e., within the search area or outside of it, or flying

over. If any breeding behavior is observed, the appropriate breeding status code should be recorded for that species. Be sure to include notes of any factor that may have influenced the results such as noise, weather, etc.

Species Checklist Form
Refer to the sample form (Appendix F). Be sure to completely fill out the headings on the top of each form. All encounters immediately before, during, and immediately following the banding effort are recorded on the checklist.

Checking Data Forms
It is required that the Primary Bander for the field crew check the day's data at the end of each field day when simple data recording errors may be caught and corrections can be made. Forms should be checked for completeness and correctness. Check that all boxes have been filled in and that the data are legible. Check that all notes on the back are referenced to the correct note number on the front. Ensure that the correct station and date have been recorded; check to be sure that the species and species code agree and that the how aged and sexed data agree with the age and sex designation recorded; check that the correct codes for data taken have been used and check that the weights and wing lengths are within reason for that species. Any errors found should be corrected only if there is 100% certainty of the correct information. The primary bander must initial each page in the right hand margin at the last row of data taken for the day. The reviews of the data should be discussed with the entire crew as an instructional exercise and to help avoid similar errors in the future.

WING PHOTO PROTOCOL

The Bluebonnet Bird Monitoring Project would like to help facilitate the collection and archiving of open-wing images from birds captured at Louisiana banding stations. These images are being housed on a web site and accessible by all researchers to study molt and aging criteria. We request, time permitting, banders operating banding stations in Louisiana obtain digital images from the species they capture. Examples images are shown below. In each case note that all or most of the secondary coverts (including all greater coverts), and all secondaries, alula and carpal coverts, lesser and greater alula, primary coverts, and primaries (including the tips to the outer primaries) are visible for analysis. Photographers should ensure tertials do not curve downward thereby making them less visible. Importantly, flight-feather tips should be included in all wing photos. Best images are obtained with brightish but even lighting conditions (direct sun can produce glare on the feathers) and with a "neutral" or even background color and lighting. Avoid contrasting lighting (both sun and shade) on the wing or in the background.

Naming Photos
Files should be named as follows:

<BandNumber>_<Species>_<Age>|<CycleCode>_<Sex>_<MonthDayYear>_<Station>|<SubStation>_<FirstInitialLastName>|<OtherInfo>.jpg

The vertical line '|' indicates that 'cycle code', 'substation' and 'other info' are optional fields. If age or sex is uncertain, square brackets can be used to designate uncertainty. Band numbers are used as unique identifiers; however, when band number is unknown and a series of photo names becomes

redundant (e.g. 5 photos of a single YRWA), photographers can add '1 out of 5' in the 'other info' section (see example below). Unknown codes are flexible. For example, if month and year are known (e.g. April 2011), but day is unknown, banders can code date as "AprilDayU2011". If only season and year are known (e.g. Fall 2010), banders can code as "MonthUDayUFall2010". Unknown fields are coded as follows:

BandU_SpeciesU_AgeU|UCU_SexU_DateU_StationU|SubStationU_NameU|OtherInfoU.jpg

Examples with Photos (below):
1680182106_INBU_ASY|DCA_M_Apr062006_BBS|Peveto_PPyle|eccentric molt.jpg
3271828494_SWWA_ASY_SexU_May122006_BRAG_PPyle.jpg

Other Examples without Photos:
4501402949_NOCA_[SY]_M_MonthUDayUSpring2011_BBS|Bambi_DMooney|possible SS molt limit.jpg
BandU_YRWA_SY|FCA_M_AprDayU2009_StationU_FOwens|1 out of 5 taken somewhere in LA.jpg

Photo Logs and Uploading Photos
All photographers must carry a personal photo log used to document all pertinent data, taken from banding forms, of the bird being photographed. Due to 'data drift', lost photo logs, accidental memory card erasure, etc., we ask that all participating photographers upload newly acquired photos within 48 hours to the BluebonnetBirdMonitoringProject.shutterfly.com site.

To upload your photos to shutterfly, you must be a "member." Only the site moderator can invite members. Once you are a member, uploading is simple. Follow these directions:

1. Click on the tab "Spread Wing Photos" to upload images of birds in hand. You will see a list of families in taxonomic order, each with one or more albums or the possibility to add a first album.
2. Find the species album and click on "edit."
3. Choose your file(s) to upload.
4. Rename your images so they adhere to the format above.

5. Ideally, also add 3 tags: one for age (e.g., SY), one for cycle code (e.g., FCF), and one for species code (e.g., RWBL). If you would like to add a description to the image (like which feathers are replaced and which are retained), you can do this under "description."
6. Hit "save" and your images will appear in the album. We will try to keep each album sorted by age (oldest first) and sex (if known; males first) to follow this format: adult male, adult female, immature male, immature female, juvenile male, juvenile female. Organization will largely be the responsibility of the moderator, but members can help with this.

Thanks to Peter Pyle and the Institute of Bird Populations for allowing us to use and augment their wing photo protocol. For more information, please contact site moderator, Dr. Erik Johnson (ejohn33@tigers.lsu.edu).

APPENDIX A - USING MOLT CYCLES TO CATEGORIZE AGE: AN INTEGRATIVE NEW SYSTEM

By Jared D. Wolfe, Thomas B. Ryder, Peter Pyle and Erik Johnson

INTRODUCTION

Detailed information on avian population demographics has enabled biologists to better understand variation in survival, reproductive success, recruitment, and habitat use (DeSante and Rosenberg 1998, Saracco et al. 2008). As our ability to monitor the annual life-cycle of birds improves, scientists should seek an improved theoretical framework to examine empirical questions about avian demographics.

A popular system for age-classification in temperate birds relies on a calendar-based age-classification system which uses hatching date in relation to 1 January (Pyle 1997b). Under this system, an individual in its calendar yr of hatching is termed "hatching yr" (HY) and older birds are termed "after hatching-yr" (AHY) until 1 January, when these individuals become "second yr" (SY) and "after second-yr" (ASY), respectively. The calendar-based age-classification system can lose the ability to accurately discriminate cohorts when breeding seasons overlap 1 January, a characteristic found in many Neotropical passerines (Snow 1976, Wolfe et al. 2009) and in several temperate landbirds (Pyle 1997).

Several attempts have been considered to augment the calendar-based age-classification system. They include: on a species-by-species basis, determining whether or not the breeding season peaks before or after 1 January and categorically place all birds of that species in the same age class according to the majority; or, redefining a separate calendar date (other than 1 January) in which all the age codes of a given species changes. These proposed solutions do not adequately apply to species with biannual breeding distributions (Wolfe et al. 2009), eruptive breeders (Snow and Snow 1964, Diamond 1974), or where some species show little or no seasonality to breeding. Our proposed solution is to use molt cycles and their inserted plumages, which are homologous across all taxa, as a means to classify age. Our objective is to present a coding system based on molts and plumages which, when combined with other information, can be used to accurately designate cohorts.

DEFINING AND IDENTIFYING MOLT CYCLES

Following Humphrey and Parkes (1959; H-P hereafter), molt and plumage cycles are based on the presumably ancestral prebasic molts and evolved inserted molts. Prebasic molts are regular (often annual) events which typically adhere to well-defined periods, even for tropical species with prolonged breeding seasons (Foster 1975, Prys-Jones 1982, Stutchbury and Morton 2001, Pyle et al. 2004). H-P were implicit in associating plumage with age; here, we explicitly anchor plumage to age using updated terminology (Howell et al. 2003).

The assumption of plumage homology following the H-P system and recent proposed revisions (Howell and Corben 2000, Howell et al. 2003) has resulted in useful nomenclature that can be

incorporated into age-classification systems. Howell et al.'s revision is rooted in the belief that juvenal plumage is homologous to later basic plumages. Howell et al. thus redefine the "prejuvenal molt" as the "first prebasic molt" and replace what was formerly considered the "first prebasic molt" of most species with the "preformative molt." This inserted molt produces the "formative plumage" and lacks homologous counterparts in later age groups.

Using this terminology, molt cycles are defined based on prebasic molts; therefore, the "1st molt cycle" can be defined as the period from the beginning of the first prebasic (prejuvenal) molt until the beginning of the 2nd prebasic molt, and subsequent cycles are similarly determined through the "definitive molt cycle," that in which plumage no longer changes with successive molts. The benefits of Howell et al.'s simple augmentation to the H-P system include the fixation of the first molt and plumage cycles, which is an important step for establishing non-ambiguous nomenclature. Thus, molt and plumage cycles can be used as accurate heuristic markers of seasonality and age.

Familiarity with molt limits, retained juvenal plumage, feather shape, feather wear and other essential plumage characteristics (cf. Mulvihill 1993; Pyle 1997a, 1997b) facilitates precise molt-cycle determination. For example, many tropical oscines and sub-oscines in their first molt cycle (i.e., in juvenal, formative, or first alternate plumages) can be distinguished from older birds in definitive molt cycles (i.e., definitive basic or alternate plumages). However, correctly differentiating a formative plumage following a complete molt from subsequent basic plumages is usually not possible (cf. Pyle 1997b). Our ability to distinguish plumages in later molt cycles (e.g. second basic from definitive basic plumages) is also not possible for most oscines and suboscines, although identification of some second-cycle, third-cycle, and fourth-cycle non-passerines, such as gulls and certain raptors, is possible by examining plumage, flight-feather molt patterns, and other criteria (Pyle 2008).

USING MOLT CYCLES TO CATEGORIZE AGE IN TROPICAL BIRDS

Under our cycle-based age-classification system, the initiation of prebasic primary molt is treated as the definitive marker that indicates advancement in molt cycle. Thus, in most oscines and suboscines, one molt cycle ends and the succeeding cycle is initiated when the first primary (P1) is shed (molt can initiate with other primaries in larger birds with alternate remigial-replacement strategies; cf. Pyle 2006, 2008; Rohwer et al. 2009). Even though initiation of body feather replacement may precede that of flight-feather replacement, it is often difficult to distinguish if body feather replacement is representative of a prebasic molt, an inserted molt, or replacement of accidentally lost feathers. Thus, the symmetrical shedding of P1 (or other primaries during certain molts in larger birds) represents an unambiguous marker for the succession of molt cycles. Within molt cycles, however, the initiation of body-feather replacement (e.g., as part of preformative, prealternate, or presupplemental molts) is treated as markers for succeeding plumages.

The first step in using our cycle-based age-classification system is to define the molt cycle as either the first (FC), second (SC), third (TC), fourth (4C), etc., or definitive (DC) cycle. In many oscines and suboscines the second basic plumage equates to definitive basic plumage; however, it can be coded as SC during the period of the second prebasic molt provided that this molt can be recognized as such.

Once a bird has been identified as in its first cycle, its subsequent plumage can then be defined as juvenal (J), formative (F), alternate (A), or supplemental (S). We use "juvenal" as opposed to "first basic" for this initial plumage, as suggested by Howell et al. (2003), due to the familiarity and wide use of the term juvenal. Thus, a first-cycle individual in complete juvenal plumage is coded FCJ, and once a preformative molt begins, it is coded FCF. Other possible plumages within the first cycle include first alternate (FCA), and first supplemental (FCS), although these are not commonly encountered in tropical oscines and suboscines. Individuals in their second cycle can be recorded as basic (SCB), alternate (SCA), or supplemental (SCS), and the same plumages can be found in the third (TCB, TCA, TCS), 4th (4CB, 4CA, 4CS), etc., and definitive (DCB, DCA, DCS) cycles.

Age classification is further refined by identifying molting using the prefix ‘P’ (for ‘pre’ indicating active molt) and the subsequent plumage as a suffix. For example, an individual undergoing a second prebasic molt (leaving formative plumage and entering definitive plumage) can be coded as PSCB (pre-second cycle basic). An individual leaving a definitive basic plumage for the subsequent basic plumage should be noted as PDCB (Pre-Definitive Cycle Basic) and so on. Similarly to the prefix ‘P’, a prefix ‘A’ can be added to indicate that a captured individual has at least surpassed a given plumage. For example, if a captured individual has at least surpassed the juvenal plumage banders can use the code AFCJ (for after-First Cycle Juvenal).

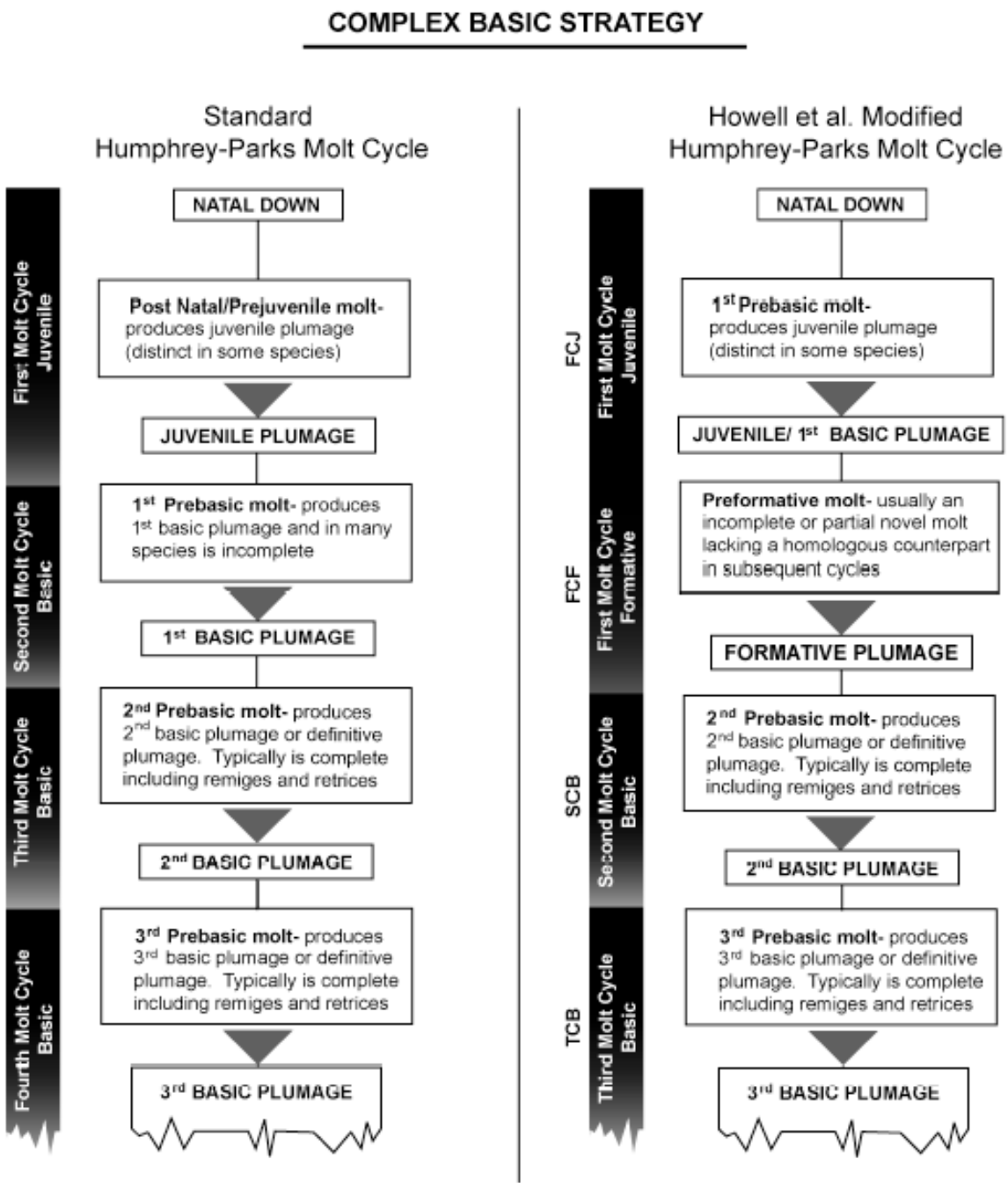
As with the calendar-based age-classification system, it will be important to indicate uncertainty when using the cycle-based age-classification system. The unknown code "UCU" is proposed for cases where both the cycle and the plumage within the cycle are unknown. If the plumage is known (i.e. basic, alternate, supplemental) but the molt cycle is undetermined, plumage-specific unknown codes (UCB, UCA, UCS) can be used. Alternatively, when the molt cycle is known (i.e. first, second, third), but the plumage is undetermined, cycle-specific unknown codes (FCU, SCU, DCU, etc.) can be used.

An age bracket can be coupled with each determined cycle-based age code for each species, thereby providing an estimation of age in days or mo for each individual. Age brackets, especially for tropical birds, will be perpetually refined as more research pertaining to bird molt becomes available. Due to intraspecific temporal variation within the duration of juvenal plumage, age brackets of juvenal and formative plumages typically overlap in order to encompass a margin of error. Additionally, species with inserted molts (prealternate molt, supplemental molt, etc.) provide greater refinement in the cycle-based age-classification system due to the greater number of plumages within a cycle, which refines age brackets. Similarly, the cycle-based age-classification system expands upon the utility of ‘unknown’ codes by utilizing specific unknown plumage or molt cycle codes (i.e. FCU, SCU, TCU or UCB, UCA, UCS). As such, molt cycles and associated age brackets provide a robust, non-calendar-based age classification system for tropical birds.

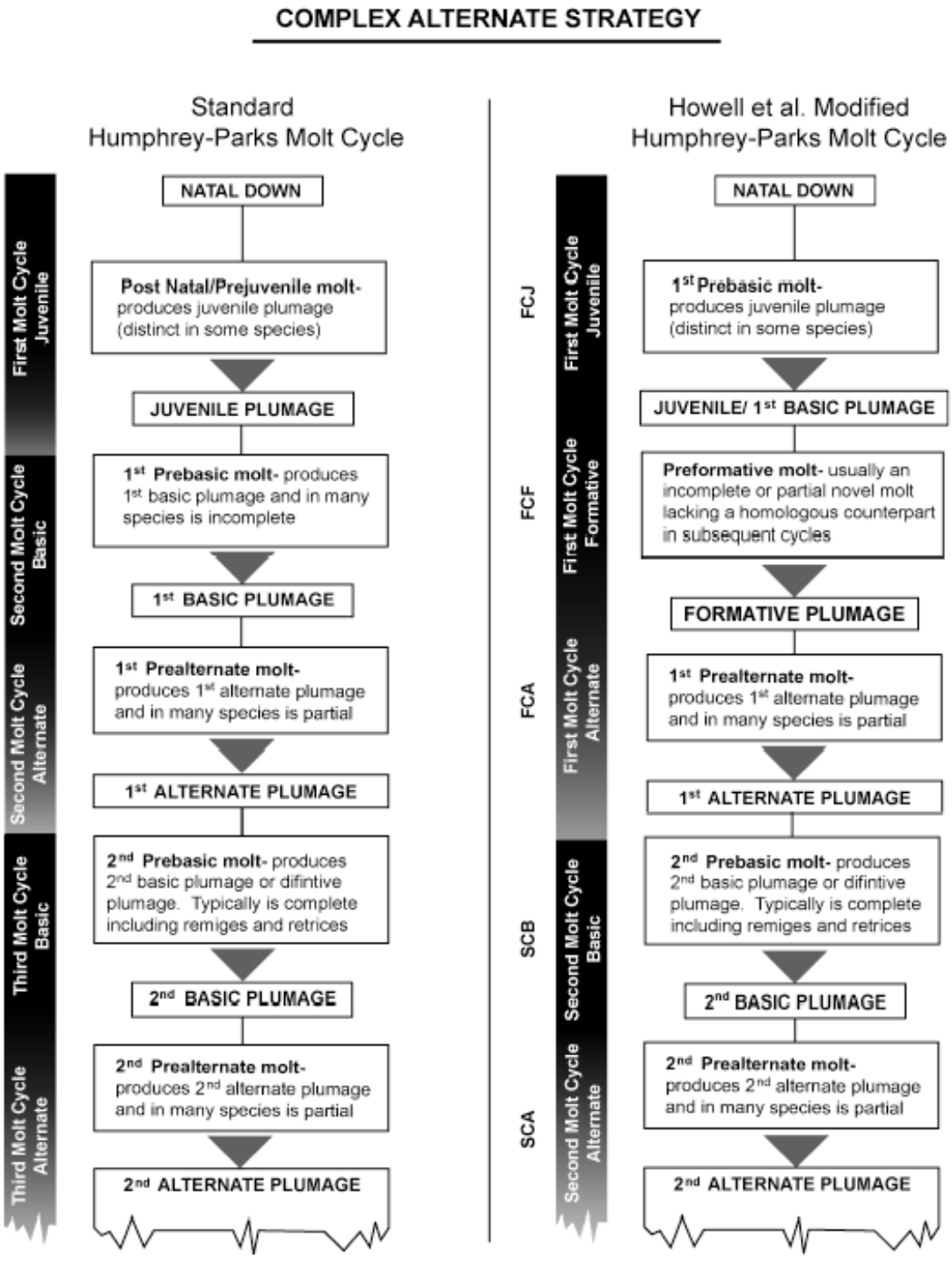
CASE STUDY

One Red Crossbill (*Loxia curvirostra*) was captured by Klamath DemographicMonitoring Network cooperators in northern California on 1 July 2005. This crossbill had mixed juvenal and formative feathering, indicating that it was in formative plumage. Red Crossbills can breed across 1 January (Pyle 1997b) so, not knowing whether it had hatched before or after 1 January 2005, determining the correct age of the crossbill was difficult using the calendar-based ageclassification system. As a result, the crossbill’s age was classified as “unknown.” However, recognizing that the captured crossbill was in formative plumage, it could be classified as FCF using the cycle-based ageclassification system. Because the formative phase occurs prior to the definitive basic molt in the Complex Basic Strategy, the associated age bracket is generally less refined for species adhering to the Complex Alternate Strategy. Thus, the associated age bracket for Red Crossbills indicates that an individual captured in formative plumage is between one and 12 mo old.

Complex Basic Strategy – Howell Augmentation and Standard H-P



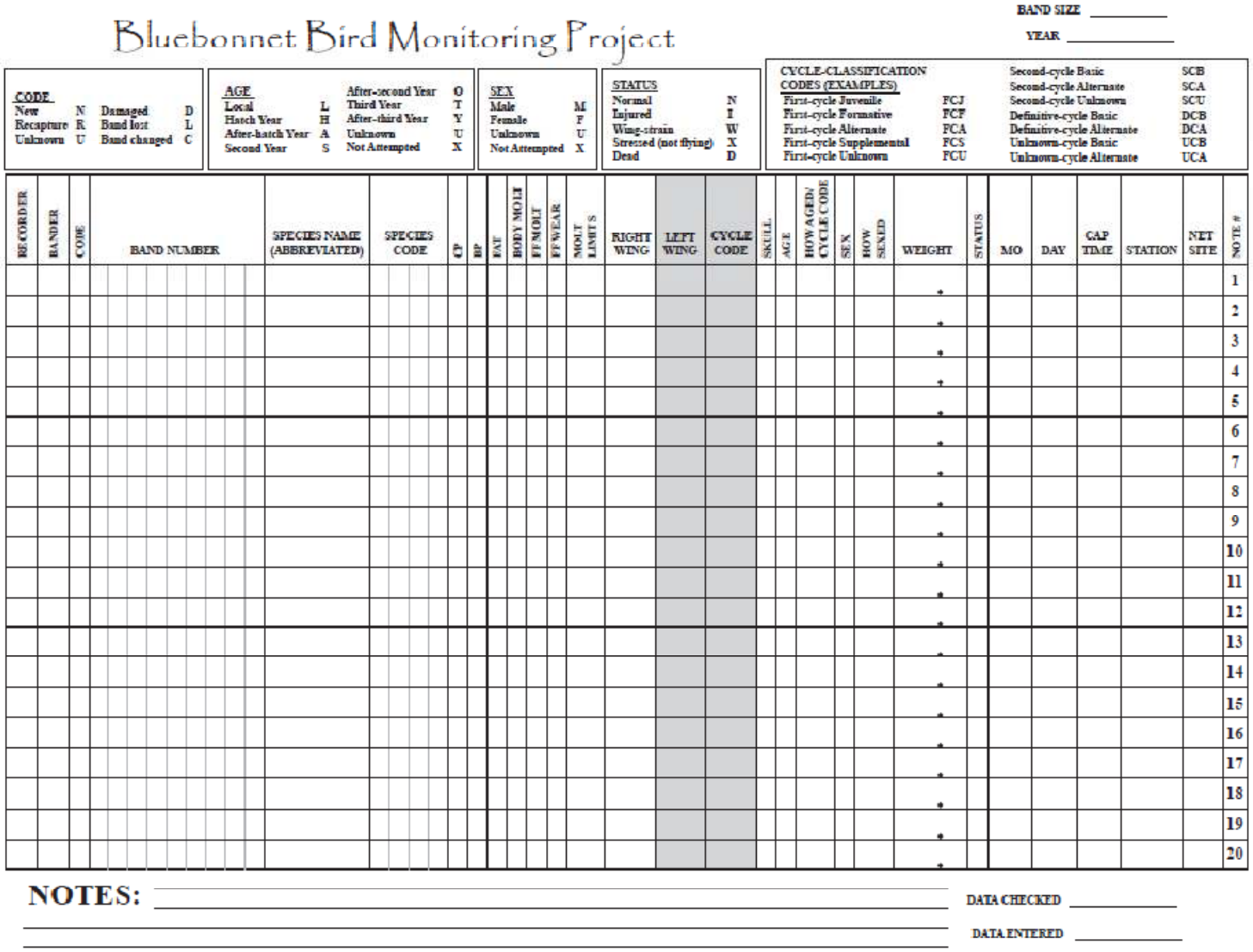
Complex Alternate Strategy – Howell Augmentation and Standard H-P



Comparison of *common equivalent* age codes implemented in the cycle-based age-classification system and the calendar-based age-classification system for the first, second, and definitive molt cycles. The following calendar-based age codes are currently recognized by the Bird Banding Laboratory (USGS).

Cycle-based age-classification system		**Calendar-based age-classification system**	
UCU	Unknown molt cycle, unknown plumage	U or AHY	Unknown or After hatching yr
UCB	Unknown molt cycle, basic plumage	U or AHY	Unknown or After hatching yr
UCA	Unknown molt cycle, alternate plumage	U or AHY	Unknown or After hatching yr
UCS	Unknown molt cycle, supplemental plumage	U or AHY	Unknown or After hatching yr
FCJ	First molt cycle, juvenal plumage	HY or SY	Hatch yr or Second yr
FCF	First molt cycle, formative plumage	HY or SY	Hatch yr or Second yr
FCA	First molt cycle, alternate plumage	SY	Second yr
FCS	First molt cycle, supplemental plumage	SY	Second yr
SCB	Second molt cycle, basic plumage	SY or TY	Second yr or Third yr
SCA	Second molt cycle, alternate plumage	TY	Third yr
SCS	Second molt cycle, supplemental plumage	TY	Third yr
DCB	Definitive molt cycle, basic plumage	TY or ATY	Third yr or After third yr
DCA	Definitive molt cycle, alternate plumage	ATY	After third yr
DCS	Definitive molt cycle, supplemental plumage	ATY	After third yr

APPENDIX B – Banding Form Front



BAND SIZE _____

YEAR _____

Bluebonnet Bird Monitoring Project

CODE			
New	N	Damaged	D
Recapture	R	Band lost	L
Unknown	U	Band changed	C

AGE			
Local	L	After-second Year	O
Hatch Year	H	Third Year	T
After-hatch Year	A	After-third Year	Y
Second Year	S	Unknown	U
		Not Attempted	X

SEX	
Male	M
Female	F
Unknown	U
Not Attempted	X

STATUS	
Normal	N
Injured	I
Wing-strain	W
Stressed (not flying)	X
Dead	D

CYCLE-CLASSIFICATION CODES (EXAMPLES)			
First-cycle Juvenile	FCJ	Second-cycle Basic	SCB
First-cycle Formative	FCF	Second-cycle Alternate	SCA
First-cycle Alternate	FCA	Second-cycle Unknown	SCU
First-cycle Supplemental	FCS	Definitive-cycle Basic	DCB
First-cycle Unknown	FCU	Definitive-cycle Alternate	DCA
		Unknown-cycle Basic	UCB
		Unknown-cycle Alternate	UCA

RECORDER	BANDER	CODE	BAND NUMBER	SPECIES NAME (ABBREVIATED)	SPECIES CODE	CP	BP	FAT	BODY MOLT	FT MOLT	FT WEAR	MOLT LIMITS	RIGHT WING	LEFT WING	CYCLE CODE	SKULL	AGE	HOW AGED/ CYCLE CODE	SEX	HOW SEXED	WEIGHT	STATUS	MO	DAY	CAP TIME	STATION	NET SITE	NOTE #
																												1
																												2
																												3
																												4
																												5
																												6
																												7
																												8
																												9
																												10
																												11
																												12
																												13
																												14
																												15
																												16
																												17
																												18
																												19
																												20

NOTES: _____

DATA CHECKED _____

DATA ENTERED _____

APPENDIX C – Banding Form Back

NOTE	RIGHT TAR.	LEFT TAR.	NARES TO TIP	TAIL	POOP	ECTOS	ECTOPARASITE COUNTS										
1							PP										
							SS										
2							PP										
							SS										
3							PP										
							SS										
4							PP										
							SS										
5							PP										
							SS										
6							PP										
							SS										
7							PP										
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8							PP										
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16							PP										
							SS										
17							PP										
							SS										
18							PP										
							SS										
19							PP										
							SS										
20							PP										
							SS										

APPENDIX D – Area Seacrh Form

Bluebonnet Bird Monitoring Project — Area Search Form

State | Station Name | Station Code | Area Letter | Month | Day | Year | Observer(s)

Obs. Initials | Temp. | Cloud Cover (%) | Ppt. | Wind | Start Time | Duration ____ minutes

Species Code				Species Name (abbreviated)	Detecion Type - On Area	Total	Detecion Type - Off Area	Total

Notes: ____

Precipitation: N = None F = Fog Mist = M Drizzle = D Rain = R Snow = S
Detection Type: S = Song C = Call V = Visual F = Flyover D = Drumming W = Wing
Wind: 0 = still 1 = light air 2 = leaves begin to rustle 3 = small branches begin to sway 4 = moderate breeze >4 = don't band

APPENDIX E – Journal Form Front

Bluebonnet Bird Monitoring Project

Station name: _____ Station Code: ☐☐☐☐

Month: ☐☐ Day: ☐☐ Year: ☐☐☐☐

Net site numbers: ____-____ Total # of nets: ____ Time open: ____-____ Time closed: ____ -____

Net Rounds _____ _____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____

USE FOR NETS OPENED LATE OR CLOSED AND REOPENED DURING THE BANDING SESSION

Net site #'s: _____ Time open: _____ Time closed: _____ Time open: _____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open: _____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open: _____ Time closed: _____

Net site #'s: _____ Time open: _____ Time closed: _____ Time open: _____ Time closed: _____

Area search letter ___@ _____ by: _____; Area search letter ___@ _____ by: _____;

Area search letter ___@ _____ by: _____; Area search letter ___@ _____ by: _____;

Area search letter ___@ _____ by: _____; Area search letter ___@ _____ by: _____;

Banders (full name, 3-letter initials, email):

_____ _____ _____

_____ _____ _____

_____ _____ _____

WEATHER	OPEN	MID	CLOSE
Cloud Cover%			
Precipitation			
Temperature C°			
Wind/Beaufort			

Precipitation: N = None, F = Fog, M = Mist, D = Drizzle, R = Rain, S = Snow
Wind (Beaufort): 0 = calm, 1 = light air - rising smoke drifts,
2 = leaves start to rustle, 3 = twigs start to sway,
4 = moderate breeze-small branches sway

BIRDS CAPTURED	
Recaptures	
New Birds	
Unbanded	
Total Captures	
Number of Species	
Number Stressed	
Number Injured	
Number Mortalities	

NOTES: _____

_____

_____

_____

_____

_____

_____

_____

If found please contact: jwolfe5@lsu.edu or pstouffer@lsu.edu

APPENDIX F - Journal Form Back

Month: ☐☐ Day: ☐☐ Year: ☐☐☐☐ Station Code: ☐☐☐☐

BIRDS CAPTURED:

Species Code	Recaptured	Newly Banded	Unbanded
Totals:			

BIRDS DETECTED:

Species Code	Detection	Species Code	Detection

Detection: B - Banded, S - Song, C - Call, V - Visual, D - Drumming, F - Flyover, W - Wingbeat; Include all codes that apply

If found contact jwolfe5@lsu.edu or pstouffer@lsu.edu

APPENDIX G – Banding Codes

HOW AGED AND SEXED FIELD

Physical Differences

B	Brood patch
C	Cloacal protrubrence
@	Egg in oviduct
E	Eye color
I	Mouth/bill color or striations on bill (in hummingbirds)
G	Gape
F	Feet or legs
S	Skull ossification
Q	Measurements (e.g. quantification of any part, tail length, culmen, bill depth, wing length : mass index; put specific measurements in notes
	Symmetrical flight feather molt

Plumage Characters

K	Definitive Basic
A	Definitive Alternate
F	Formative plumage (applies to first alternate plumage as well
J	Juvenal plumage
P	Plumage - use only for sexual dimorphism
L	Plumage color patch length or extent - put in notes the specific measurement of patch on; C = crown, W = wing feathers, T = tail, and S = spot on center of feathers, e.g. C = 15 mm 80% green (on WTWA), or gorget development on humming birds

HOW AGED AND SEXED FIELD

Feather Characters

W	Feather wear
V	Feather shape
R	Prejuvenal (1st prebasic) molt
=	Fault bar alignment
#	Growth bar alignment

Undetermined or Remaining

O	Other (such as behavior, copulation - put in notes)
U	Undetermined after examination
X	Age or sex determination not attempted
Z	Less precise age (<95%), but high certainty (e.g. AHY vs. SY)

MOLT LIMIT FIELD

Molt Limit Characters

M	Aged by molt limits (up to two codes can be used)
N	No molt limits found after examination
U	Molt limits are undetermined after examination
P	Primary flight feathers
S	Secondary flight feathers
D	Primary coverts
G	Greater coverts
V	Primary vs. greater coverts
R	Rectrices
L	Lesser coverts
M	Median coverts
B	Body Plumage
C	Carpal covert vs. alula covert/lesser alula
A	Alula covert vs. lesser alula

CLOACAL PROTRUBERANCE

N No protuberance evident
S Small; slight distention from abdomen; cloaca slightly enlarged at base, still narrow at tip
M Medium; obvious distention from abdomen; columnar shape (base and tip approximately equal diameter)
L Large; bulbous shape (tip greater diameter than base)

BROOD PATCH

N No brood patch present; breast and upper abdomen more or less feathered; non-feathered areas of breast and abdomen are smooth, without vascularization
S Smooth skin; loss of breast and some abdomen feathers, but most of the area is still rather smooth, dark red
V Vascularized; abdominal skin thickened (puffy) with increased fluid and vascularization; peak of brood patch development
W Wrinkled; abdominal skin thinning, wrinkly, scaly
M Molting; pin feathers emerging on breast and abdomen

FAT

	Furculum	**Abdomen**
N	No fat tissue present; region is concave	No fat tissue present
T	Trace fat tissue present; region concave; <5% filled	None or trace
L	Thin layer fat tissue present; 5-33% filled	Trace or thin layer
H	Half (34-66%) filled	Small patches present
F	Fully filled; level with clavicals; 67-100% filled	Covering pad; slightly mounded
B	Bulging slightly over clavicals	Well mounded
G	Greatly bulging over clavicals	Greatly distended mound
V	Very extensive fat pads; fat tissue contiguous from furculum to abdomen	

PRIMARY FEATHER WEAR

N No wear; feather edges perfect with entire edge light-colored, including the tips
S Slight wear; feather edges slightly worn with no fraying or nicks; edges often light-colored except at tips
L Light wear; feathers definitely worn, but with little fraying or nicks
M Moderate wear; considerable wear with definite fraying; nicks and chips obvious along edges
H Heavy wear; feathers very heavily worn and frayed; tips often worn completely away
X Excessive wear; feathers extremely ragged and torn; shafts usually exposed beyond the vane, with all tips usually worn completely away

BODY MOLT

N No molt present
T Trace molt; a few, perhaps adventitious, molting feathers in just one feather tract
L Light molt; more than one feather tract
M Medium molt; 1/3-2/3 of feather tracts with molting feathers
H Heavy molt; >2/3 of feather tracts with molting feathers

FLIGHT-FEATHER MOLT

N No molt
S Symmetrical molt
A Adventitious (asymmetrical) molt

SKULL

N No pneumatization (0% ossified)
T No visible skull to trace (<5% ossified)
L Less than 1/3 (<33% ossified)
H Half visible (33 – 66% ossified)
G Greater than half (67-94% ossified)
A Almost full (>5% ossified)
F Full (100% ossified)

APPENDIX H – Skull Ossification Diagram with Codes

N

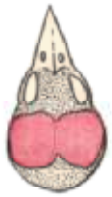
No pneumatization, only a single, thin layer of bone covers the entire brain, with no white spots showing

T

Trace of pneaumatization at the very back of the skull. Trace appears as an opaque, grayish crescent or very small triangular area. Between 1% and 5% of the skull is pneumatized.

L

Less than 1/3 pneumatized, but some is obvious. Generally, the posterior part of the cranium has triangular or circular shaped areas of small white dots, usually distinctly contrasting with non-pneumatized areas.



H

Half the skull pneumatized, between 1/3 and 2/3 complete. Typically, most of the rear half is complete,as well as part of the front, extending to the eyes (the front is usually difficult to see because of dense, short feathers).

G

Greater than 2/3 pneumatized, but at least a small area is not complete (less than 95% complete).

A

Almost complete pneumatization, between 95% and 99% complete. These birds show tiny dull, pinkish areas or "windows".

F

Fully pneumatized skull.