Operational Protocol

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LABO COORDINATORS

Jared Wolfe, Ph.D.

Co-director/Scientific Advisor

jwolfe5@tigers.lsu.edu

Erik Johnson, Ph.D.

Co-director/Primary Bander

ejohnson@audubon.org

Daniel A. Mooney

Primary Bander

birds@birdnerds.com

Donald M. Norman

Primary Bander

pugetsoundbird@gmail.com

We welcome you to the Louisiana Bird Observatory (LABO), a project of the Baton Rouge Audubon Society. This is a cooperative effort involving Louisiana State University's School of Renewable Natural Resources, Louisiana Office of State Parks, Audubon Louisiana, Biodiversity Research Institute, University of Louisiana at Lafayette, Woodlands Conservancy, and the Recreation and Park Commission for the Parish of East Baton Rouge (BREC).

Our mission is to provide opportunities for science-based learning and outreach to the public while collecting and disseminating data on factors that limit bird populations in Louisiana. This volunteer-based effort in collaboration with and support from academic research institutions, state and federal agencies, and other non-profit organizations strives to better the understanding of birds and their populations to conserve and improve habitats on which birds and human communities depend.

WHERE WE WORK

Bluebonnet Swamp Nature Center

Owned and operated by the Recreation and Park Commission for the Parish of East Baton Rouge (BREC), we have been studying birds on this 103-acre property since March 2010. Dominated by lowland hardwood forest and cypress-tupelo swamp, a visitor's center and trail system quickly get you into nature in the middle of Baton Rouge, Louisiana. This was the site where the project began and remains one of our most popular sites in which to volunteer because of its central location.

We operate nets twice a month, year-round and often on weekends. There are a total of 38 net lanes, and we typically operate 15-23 on any given day. Property manager: Claire Coco (ccoco@brec.org).

Palmetto Island State Park

Owned and operated by the Louisiana Office of State Parks, this salt dome "island" of lowland oak-palmetto forest and cypress-tupelo swamp along the Vermilion River near Abbeville, Louisiana provides about 1300 acres of opportunities to hike, camp, and take canoe trips. We have been studying birds here since May 2013.

We operate nets once a month, year-round almost always on weekends. There are a total of 18 net lanes, and we typically operate all 18 nets each time. Property manager: Marcelle Guidry (palmettoisland_mgr@crt.la.gov).

Woodlands Conservancy

This non-profit land trust has secured and protected nearly 800 acres of lowland hardwood forest, and is performing invasive species removal on some parcels to restore natural ecological processes. There are two parcels of land near Belle Chase, Louisiana; the Woodlands Trail tract has more than 10 miles of hiking trails and there are plans to open the recently acquired Delacriox tract for public use in the near future. We have been operating nets at both tracts since December 2013.

We operate nets twice a month (once at each tract), usually on weekends. There are a total of 32 net lanes, and we typically operate 10-15 nets on any given day. Property manager: Katie Brasted (Katie@woodlandsconservancy.org).

INTRODUCTION

Every constant-effort mist-netting station should have a Station Management Procedures document such as this. This document is designed for stations operated through the Louisiana Bird Observatory (LABO). 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. This document is intended to be an authoritative companion for operating LABO monitoring stations to USDA Handbook of Field Methods for Monitoring Landbirds (Ralph et al. 1993) and the North American Banding Council (NABC) manuals. This document is not meant to replace those established and standardized operating materials, but instead provides additional logistical details and considerations for how we operate banding stations. Necessary minor deviations from this document may be expected depending on logistical considerations from site to site and day to day, and should be documented in the journal record at each station, and preferably written up for a permanent record.

CHAIN OF COMMAND

The Primary Bander is the logistical and organizational manager of each banding station. Primary Banders are authorized through the USGS Bird Banding Laboratory (BBL) and the Louisiana Department of Wildlife and Fisheries (LDWF) to band wild birds for research. The Primary Bander is responsible for all aspects of human and bird safety, as well as ensuring maximum data quality during collection in the field. The Primary Bander is also responsible to ensure the data are reviewed immediately after field work is completed, as well as entering the data into the LABO Banding Database in a timely manner (typically after a datasheet is completely filled out, and/or after a banding session, and/or at the end of each calendar year). Scheduling of data entry into the LABO database is dictated by the LABO co-directors, property managers, or the Master Bander.

There are two types of Primary Banders, from a permitting standpoint.

1) *Master Bander* – this designation by the BBL is considered the maximum certification needed to band birds. A Master Bander is responsible for reporting their banding data back to the BBL as well as ensuring he or she has requested the appropriate number of bands of a variety of sizes in order to operation the local station.
2) *Subpermitted Bander* – this designation by the BBL may be thought of as an apprentice to a Master Bander, and is listed by name on the Master Bander's BBL permit. A Subpermitted Bander (Subpermittee) is authorized to band birds independent of the Master Bander, but must report their data to the Master Bander (in order for the Master Bander). The frequency in which the Subpermittee reports data to the Master Bander is dictated by the Master Bander, which in turn satisfies reporting requirements by the Master Bander to the BBL.

Assistants and volunteers that support field operations are expected to follow all instructions of the Primary Bander, although we also encourage an open dialog between Primary Banders, assistants, and volunteers to ensure that nets are checked in a timely manner, that birds are processed quickly and safely, and that all aspects of the banding station run smoothly.

WHAT DATA WE COLLECT

We focus our efforts on two important types of bird monitoring techniques: 1) passive mist-netting, and 2) audio-visual surveys. Both types of data collection methods importantly complement each other and are designed to get around the issue of "detection bias" in bird monitoring.

Much of the focus of this document is on the operation of a banding station. In addition to operating the banding station, on each day that mist-nets are operated, the Primary Bander should also coordinate (perhaps using an assistant or volunteer skilled in bird ID by sight and sound) two Area Searches (see Appendix D for details). Each Area Search is a 20-minute audio-visual survey conducted near half of the nets, thus 40 minutes of each mist-net day should be dedicated to these surveys. Ideally, they should be conducted early in the morning, such as immediately after the nets are open and before the first net check begins. An Area Search route should be standardized so that it can be repeated during each banding day.

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 (APPENDIX A). 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 multiple bird bags with them while nets are open (or being opened). With the raw/frayed edges facing out, each bag should have a 1-2" of masking tape where the capture time, net number, and species code should be written. Avoid placing more than one bird into a bag at a time (see NABC manual for the rare exceptions). After each bag is used once, it should be turned inside out and segregated from the rest of the bags. Only when absolutely necessary should a bag be used more than once. At the end of a banding period, bird bags should be laundered. 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 minimal amount of detergent and chlorine bleach and/or vinegar. Leave bags inside the washing bag for drying. After drying, reverse the bags so that the raw/frayed edges of the seams are again on the outside. Trim excess frayed or loose threads to reduce tangling on the birds. 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. A description of common net repair techniques is included in this document to supplement training. Realize that nets cost about $75 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 LABO operates in conservation areas, we try to limit vegetation destruction by utilizing "natural net-lanes." As a result, net-lanes may be relatively narrow, it is imperative that *nets are centered in each net lane*. Net lanes must be maintained throughout the year, particularly the growing season (approximately March – October). 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 more appropriate for a quick-station set up (often and endearingly referred to as "guerilla banding") or where poles can easily be shoved about 2–4" into the ground and quickly removed; this technique requires less equipment (and money), whereas the other method is used at more permanent stations or where the ground substrate is hard, rocky, or sandy, and requires more equipment and time to set up and maintain. Given the terrain and soft substrates in Louisiana, we recommend following Option 1.

- *Option 1*: you will need thin-gauge three sections of ¼" diameter nylon (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 or two half-hitches to tie all rope to poles when using this set-up methodology.

- *Option 2*: 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 90° at one end, three 8' sections of ¼" diameter nylon (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 storing nets in plastic bags and one of two arrangements described above, a net can be set up in about two minutes or less. As the net lane is approached, locate and lay out the poles and guy lines at each end of the net lane. Starting at the fixed end, insert the pole through the net loops and then attach the pole to the fixed nylon cord either using two half hitches or a clove hitch (typically with three loops above and two loops below above the cord, although this may vary depending on topography). Once the first pole is tied off, walk to the other 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 on the pole and fasten the pole using two half hitches or a clove hitch. 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 at one end of the net and out of sight. It is important to stash

the bag so that it is not free to blow in a breeze and disturb nearby birds. Replace plastic bags as necessary.

Net-site Trails

Trails at each station must be kept cleared of hazards such as sapling stumps (trippers), holes, low branches (eye-pokers or head-knockers), loose stones or branches, 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 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

The Primary Bander and any assistants operating stations should have read and thoroughly understand these station management procedures, The USDA 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 hours. Banders should be at the station 20–30 minutes prior to local sunrise (account for time it takes to walk into a station), 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 or sharpie (for documenting net-site and time on bird bag) and a walkie-talkie (to communicate to the rest of the crew).

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 place the processing table in a location 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. Having a table to work on will greatly enhance your

ability to maintain order and speed. Portable tables or the tailgate of a truck could 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 examine skulls. 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 reduce confusion.

Rainy Day Procedure

Do not net in steady or heavy rain. With mobile technologies, it is possible to regularly check the radar. During a passing shower, nets can be left open IF there is sufficient crew to check all nets and remove birds the instant it begins to rain, and if radar indicates that the shower will pass in 30 minutes or less. Birds do not fly in moderate to heavy rain, but will begin flying immediately as the rain stops; thus, if you close the nets for rain, and plan to reopen, you may miss an important pulse of activity. The trade-off is clearly bird safety, and if there is any doubt, close nets and stop operations BEFORE rain begins.

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 must 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. 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.

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 considered unsafe 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. Personnel should always be in communication with each other, such as with walkie-talkies, at the station to ensure that all nets are checked in each round.

An efficient extractor should take <1 minute to extract each bird. If the bird is excessively tangled, this may take longer, but if a bird takes more than 5 minutes to extract or if the bird appears stressed, then cut the bird out of the net or have a more experienced extractor take over (which still may require cutting the bird out). Personnel should always carry the small pair of scissors provided in the banding kits, as well as a dropper bottle of sugar water (4 parts water to 1 part sugar) to revive stressed birds. Most importantly, schedule the next net round and it can be good practice to 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 one hour (or some hardy species in ideal conditions for two hours) due to a backlog. Always keep in mind and plan for the next net check to result in a lot more birds, so be pro-active in processing birds quickly, even when "ahead of the curve." 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; 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 (see more details in next section), and releasing birds unbanded. Specifically, we want banders to consider the following options.

- Remove birds from nets as quickly as possible, as they can remain quite comfortable in shaded bags for one hour or longer under ideal conditions (except sensitive species);
- Process sensitive species first, which include, but are not limited to, hummingbirds, kinglets, warblers, winter wren, and towhee;
- Take minimum data until the capture rate slows down. Be sure to maintain high quality data collection, especially of species, wing, weight, age, and sex determination. If necessary, release birds without banding; try to age and sex these birds, if possible, and always record them on the 'Unbanded Birds' datasheet.
- If too many birds are captured even with taking minimum data, then close several 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 continue to remain in bags after 1½ hours, close additional 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 of capture, or sometimes up to two hours for some hardy species in ideal conditions.

DATA RECORDING AND MANAGEMENT

Data Recording

It is imperative that all appropriate datasheets (banding datasheet, daily journal, area search) are completely filled out. Some fields may get inadvertently omitted during data collection, so after each banding event, all data sheets should be checked for quality and completeness.

Daily Journal

Although fields in Daily Journals (APPENDIX E.) seem obvious, mistakes are very common. Please completely fill out the forms and 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. Spell out the month; do not use numbers for months.
- 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 Fahrenheit. (4) Wind using the Beaufort scale.

- Notes: record any unusual or interesting occurrences, the number of visitors, 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 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.

Sequence of Data Collection

"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. An efficient data recorder is also imperative to be able to keep up with an efficient bird processor. The order is as follows:

1. Report species, band size and band number to the recorder. Make sure the recorder reads the band number back to the processor.
2. Cloacal protuberance and brood patch.
3. Fat. Gauge the amount of fat in the furculum, and adjust if necessary by examining the flanks.
4. Body molt. Make sure to check flanks, tail coverts, back, nape, crown, and throat.
5. Wing molt. Check by blowing at a slight angle above underwing coverts to see the base of the primaries and secondaries.
6. Wing wear. Average the last four visible primaries.
7. Wing chord (unflattened). If wing is bent, excessively worn, or the longest flight feathers are molting, 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 weighed, report age and sex.
9. If there is time and reason, record any other details or special notes regarding the bird (pox lesions, plumage abnormalities, extent of molt limits, etc.)
10. Photograph and 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 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., kinglets before sparrows, before thrashers, etc.). Banders should always collect and record data following the sequence on the banding data form to maximize processing efficiency. The Pyle Guides I and II (1997 and 2008) serve as our primary source of aging/sexing criteria. Fluency in all aspects of nomenclature used within both guides is mandatory for all LABO banders.

Priority and Quality of Data

When time allows, record all data listed in the banding datasheet. If the banding station gets a particularly high volume of birds, then move to the "Busy Day Procedure" (see above). 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 aging and sexing birds are included in each banding kit (laminated reference sheet) and in (Appendix G). As our knowledge of aging 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”; etc. Banders should record all molt limits found (e.g., “V, A”).

Recording Wing and Tail Molt and Feather Generations

Wing molt should be recorded as symmetrical or asymmetrical in the data fields on the front of the form. Do not record adventitious feather loss as molt. The presence of tail molt should be recorded only in the notes on the back of the form. In the notes, the extent of molt should be recorded; for example, “p1 = 90%, p2 = 40%, p3 = pin, p4 = missing, p5-9 old”. It is only necessary to note one side of the wing. Be sure to include a note indicating if you were aware that feathers were lost during capture or processing.

Recording Notes

Notes can 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’. 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 width, a bander determines that a size other than recommended should be used, then a note that includes minimum and maximum tarsus width (to the nearest 0.1 mm) should be recorded. Bands can be placed on either the right or left leg, whichever is handy and available. Banders must be in the habit of inspecting both legs for an existing band.

Bands that are determined to be unreadable or unsafe should be replaced (Band Code C=Changed) and the old band must be taped to a sheet of paper with the readable digits, species, station, date, and replacement band number written and saved. It is very likely that the Bird Banding Laboratory will be able to discern the original number through an etching process. 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.

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 at an absolute minimum must at least record the band number (if banded), species, age, sex, and net number of the bird. The next “level” of necessary data may include breeding condition, wing, and weight. The last “level” of detail would include details of molt or molt limits, and other ancillary details. In any given situation, the need to

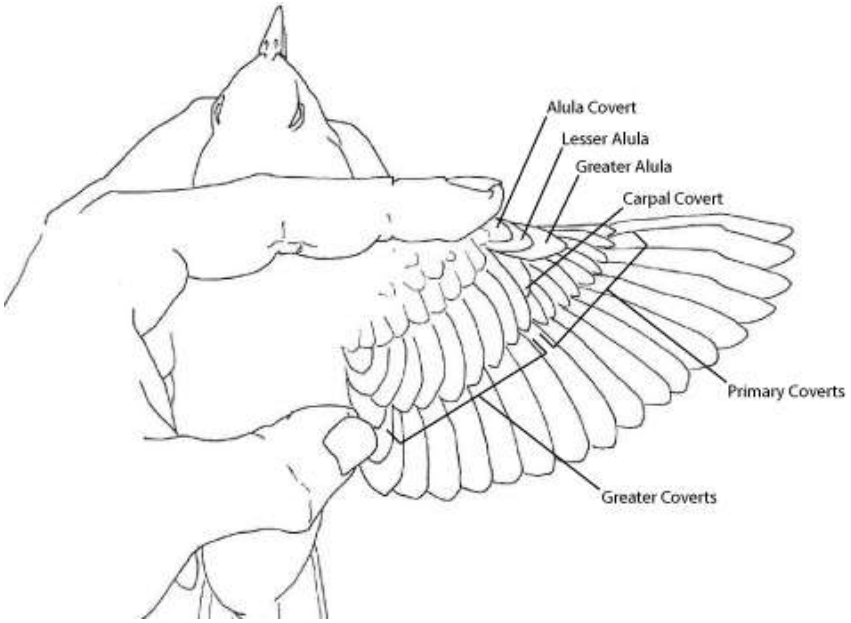
collect minimal data will vary with numbers and experience of the banders. Just remember, the safety of the netted birds is paramount.

It is very tempting to treat the capture effort as the primary reason for being at a monitoring station. However, allocating time between the netting effort and area search censuses is 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 release a few, or even several, birds with minimum (or even no) data, than to pass up the area search census. Banders will find that with increased skill level of personnel present, the area searches can be completed quite easily in course of checking nets.

Importance of Age

Virtually all analyses of banding data first divide birds into age classes, usually just HY/SY vs. AHY/ASY. However, LABO employs new methodologies to micro-age captured birds by categorizing age using plumage and molt cycle (Appendix A). Understanding molt can be difficult and overwhelming at first for many volunteers, and as such, we recommend all banders thoroughly study contemporary molt theory followed by discussions concerning molt with a primary bander. Although 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 fall months unless molt-limits are obvious. 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" or "FAJ" if the plumage was examined, but it was unknown as to if plumage is juvenal or not. Use a "-" when the data field was not examined, which is different from a U, indicating unknown.

Bird Hold, Topography and Molt Limit Example



Yellow-rumped Warbler (below) 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 below are typical of formative-plumaged (HY/SY) warblers.

Rare Birds

The Primary Bander should be familiar with the diagnostic characteristics of the top 30–50 species commonly captured, and they should be aware of similar, less-common species. When you capture an unfamiliar, unusual, or uncommon bird, document it and its diagnostic characters with a photograph. 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 (or photograph the banding datasheet with the pertinent information). 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 cannot be readily identified should be processed completely, and photographed. The pictures should be noted in the notes section on the banding sheet.

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 that you require to arrive at an 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 congeners. You can stop measuring and recording when you feel confident about your decision. If you are

inexperienced with the flycatchers, or you have 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! And take many photographs of any capture of these confusing identification problems.

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, or simply release without taking any data except for species if necessary. Be certain to release such birds at ground-level and be ready to recapture the bird if it does not fly. If a bird is stressed to the point of being unable 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, offer the bird a drip of sugar water, 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. The sugar water solution could 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. A 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.

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, prior to point of release the bird 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.

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, and we donate salvaged specimens to Louisiana State University Museum of Natural Sciences. 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. 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. 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, soft part colors like iris, maxilla, mandible, tarsus, foot, and foot pads, as well as the collector's name.

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.

Visitors and External Relationships

All relevant federal, state, and local permits must be in each kit and can be referenced when discussing banding as a research tool. When visitors are encountered, banders should introduce themselves and the netting work ongoing. If an adverse situation is perceived or anticipated, the Primary Bander 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. If possible or necessary, 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.

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. See also our document "What to Expect as a Volunteer" for more details.

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. Data recording. Trainees should first 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).
3. Processing. Trainees should first be proficient in recording data before learning to process birds. Time made available for training to process birds should depend upon the number of birds, e.g., (a) when only a few birds are waiting to be processed the Primary Bander records, while the trainee bands); (b) with moderate numbers of birds waiting, the Primary Bander records for the trainee, while also banding; and (c) when it is busy, the trainee records for the Primary Bander, who is banding. This enables the trainee to make progress continuously, not just as a spectator.

4. 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.

Closing the Nets and Leaving the Site

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, 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. 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. If necessary, bring a copy of the station map with you when opening and closing to ensure that the poles are stashed in the designated locations.

SUPPLEMENTAL STUDIES AT LABO

To augment the capture data at our stations, we are collecting various additional data. These data include species daily lists, area search censuses, advancing a universal age categorization system, blood sampling for mercury and disease studies, and a geolocator study with Prothonotary Warblers, 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, if bird captures have slowed down by mid-morning, run a second 20-minute census if feasible. The area search census data are 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.

Cycle-Based Age Classification Code

LABO now uses an improved age classification system designed to solve an aging nomenclature problem with resident tropical landbirds, but has important applications for temperate species as well. All banders must be familiar with this new age categorization system (see Appendix A).

Blood Collection

A small blood sample (<1% body mass) is collected from some birds to measure mercury (Hg) concentrations and inspect for diseases, thanks to partnership with Biodiversity Research Institute and University of Louisiana at Lafayette. Blood is taken from the brachial vein and stored in a variety of ways (frozen in capillary tubes, Queen's Lysis Buffer, and smears on glass slides). It is not safe to bleed birds in adverse conditions (excessive cold or heat) or without sufficient training.

Prothonotary Warbler Working Group Research

Additional feather samples should be collected from Prothonotary Warblers, including crown, breast, and p1. Confirmed recent arrivals (present on site for < 1 week) should also have a single 2-4 mm piece of toenail collected. See Prothonotary Warbler Working Group Protocol for details.

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)

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.

APPENDIX A – Checklist and Inventory of Banding Equipment

Station set-up

- ☐ 10’ x ½” aluminum conduit (2 per net)
- ☐ Nylon cord (1/4” – 1/2" diameter)
- ☐ Rebar (optional)
- ☐ 3# mallet (optional)
- ☐ PVC pipe (optional)
- ☐ Table(s)
- ☐ Chairs
- ☐ Clothes-line
- ☐ clothes-pins

Equipment list

- ☐ Mist-nets
- ☐ Bird bags
- ☐ Masking tape
- ☐ Loppers/vegetation trimmers
- ☐ Extra string/cord
- ☐ Extra plastic bags
- ☐ Scissors
- ☐ Fresh sugar-water (quick energy for stressed birds)
- ☐ Hand-warmer packets
- ☐ Hand sanitizer
- ☐ Sharpies
- ☐ Pencils
- ☐ Walkie-talkies
- ☐ Feather envelopes
- ☐ Camera
- ☐ Datasheets/data binder
  - Daily journal
  - Banding datasheet
  - Area search sheet
- ☐ Banding kit
  - Bands
  - Wing ruler(s)
  - Scale/pesola(s)
  - Banding pliers
  - Band removers
  - Optivisors
- ☐ Blood kit (optional)

APPENDIX B – Journal Form

FRONT

Louisiana • Bird • Observatory

Daily Banding Journal

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 (F)			
Wind/Beaufort			

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

Precipitation:
N = None F = Fog M = Mist D = Drizzle R = Rain S = Snow

Wind/Beaufort:
0 = calm 1 = light air 2 = leaves rustle 3 = small branches sway
4 = large branches sway

Number of Visitors (running tally): _____

Notes: _____

_____

_____

_____

_____

Data entered: _____ Data checked: _____ if found: ejohnson@audubon.org

APPENDIX B – Journal Form

BACK

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

BIRDS CAPTURED:

Species Code	Recaptured	Newly Banded	Unbanded
TOTALS:			

BIRDS DETECTED:

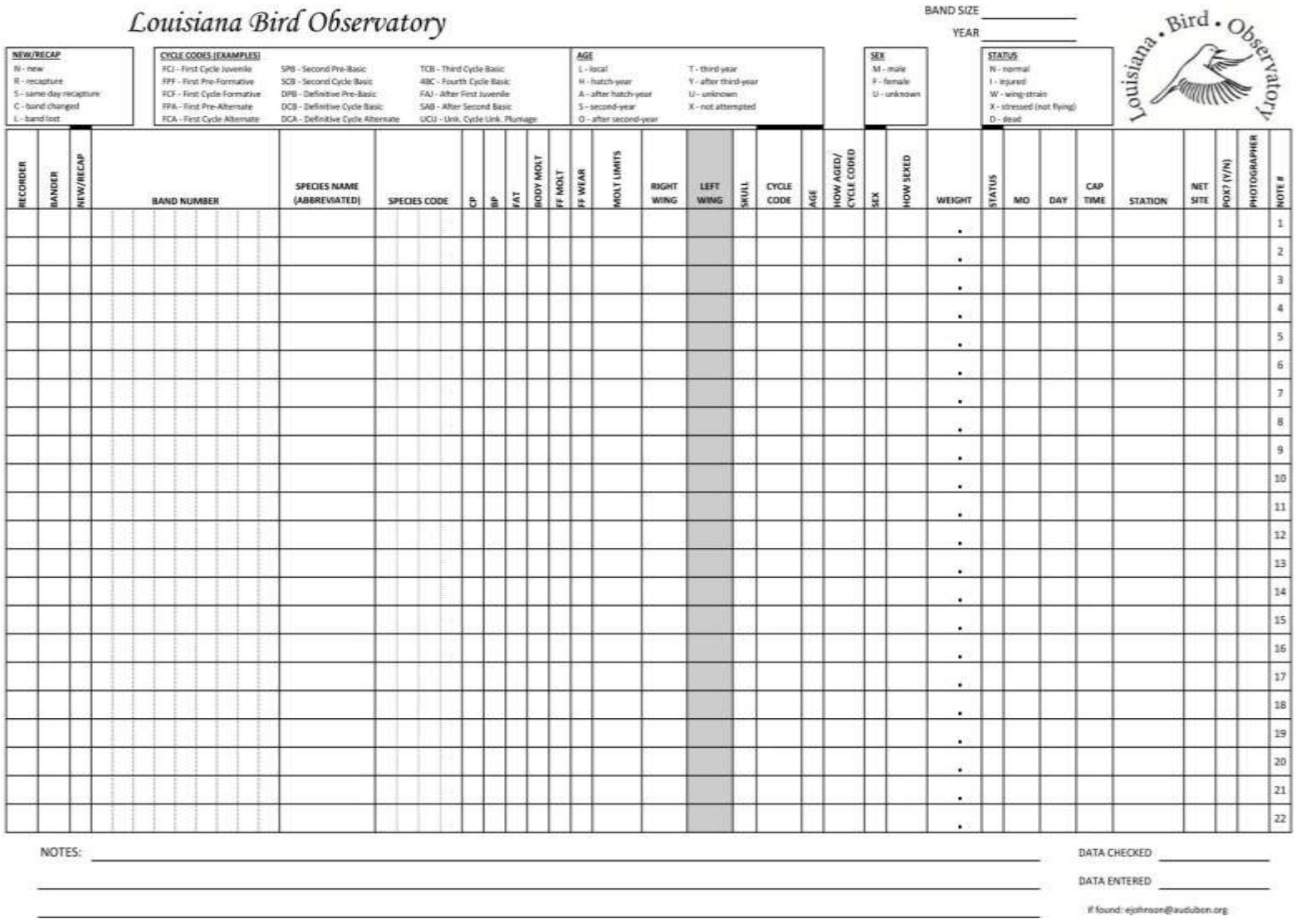
Species Code	Detection	Species Code	Detection

Detection (choose one, in sequence): V = Visual, S = Song, C = Call, D = Drumming, W = Wing, F = Flyover, B = Banded

Data entered: ____________________ Data checked: ____________________ if found: ejohnson@audubon.org

APPENDIX C – Banding Form

FRONT



Louisiana Bird Observatory

BAND SIZE _____

YEAR _____

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NEW/RECAP
N - new
R - recapture
S - same day recapture
C - band changed
L - band lost

CYCLE CODES (EXAMPLES)
FCJ - First Cycle Juvenile
FPF - First Pre-Formative
FCF - First Cycle Formative
FPA - First Pre-Alternate
FCA - First Cycle Alternate
SPB - Second Pre-Basic
SCB - Second Cycle Basic
DPB - Definitive Pre-Basic
DCB - Definitive Cycle Basic
DCA - Definitive Cycle Alternate
TCB - Third Cycle Basic
4BC - Fourth Cycle Basic
FAJ - After First Juvenile
SAB - After Second Basic
UCU - Unk. Cycle Unk. Plumage

AGE
L - local
H - hatch-year
A - after hatch-year
S - second-year
O - after second-year
T - third year
Y - after third-year
U - unknown
X - not attempted

SEX
M - male
F - female
U - unknown

STATUS
N - normal
I - injured
W - wing-strain
X - stressed (not flying)
D - dead

RECORDER	BANDER	NEW/RECAP	BAND NUMBER	SPECIES NAME (ABBREVIATED)	SPECIES CODE	CP	BP	FAT	BODY MOLT	FF MOLT	FF WEAR	MOLT LIMITS	RIGHT WING	LEFT WING	SKULL	CYCLE CODE	AGE	HOW AGED/ CYCLE CODED	SEX	HOW SEXED	WEIGHT	STATUS	MO	DAY	CAP TIME	STATION	NET SITE	POX? (Y/N)	PHOTOGRAPHR	NOTE #
																					.									1
																					.									2
																					.									3
																					.									4
																					.									5
																					.									6
																					.									7
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																					.									17
																					.									18
																					.									19
																					.									20
																					.									21
																					.									22

NOTES: _____

DATA CHECKED _____

DATA ENTERED _____

If found: ejohnson@audubon.org

APPENDIX C – Banding Form

BACK

NOTE #	RIGHT TARSUS	LEFT TARSUS	NARES TO TIP	EXP CULMEN	TAIL	POOP (Y/N)	ECTOS COLL. (Y/N)	ECTOPARASITE COUNTS	NOTES
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									

APPENDIX D – Area Search Form

Area Search Form

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

Obs. Initials | Temp (F) | % Cloud Cov. | Ppt. | Wind | Start Time | Duration (Minutes)

Species Code	Species Name (Abbrev.)	Detection Type – ON AREA	Total	Detection Type – OFF AREA	Total

Notes: _____

Precipitation: **N** = None **F** = Fog **M** = Mist **D** = Drizzle **R** = Rain **S** = Snow

Detection Type: **S** = Song **C** = Call **V** = Visual **F** = Flyover **D** = Drumming **W** = Wing

Wind: **0** = still **1** = light air **2** = leaves rustle **3** = small branches sway **4** = large branches sway **>4** = don't band

Data entered: _____ Data checked: _____ if found: ejohnson@audubon.org

APPENDIX E – Banding Codes

HOW AGED AND SEXED FIELD

Physical Differences

B	**B**rood Patch
C	Cloacal protuberance
@	Egg in oviduct
E	Eye color
I	Bill/mouth color or striation on bill (e.g., in hummingbirds)
G	**G**ape
T	Fee**t** or legs
S	**S**kull ossification
Q	Measurements (e.g., quantification of any part)

Plumage Characters

M	Aged by **m**olt limits
N	Aged by **n**o molt limits
K	Definitive Basic
A	Definitive **A**lternate
F	**F**irst cycle (**F**ormative or **F**irst alternate)
J	**J**uvenile
P	**P**lumage - only use for sexual dichromatism
L	Use in combination with second code based on plumage color patch **L**ength or extent - put in notes the specific measurement on C (crown), W (wing), T (tail), S (spot on center of feathers), or G (gorget in hummingbirds); e.g., LC, LW, etc.

HOW AGED AND SEXED FIELD

Feather Characters

W	Feather **w**ear
V	Feather shape
R	**P**rejuvenile (1st prebasic) molt
=	Fault bar alignment
#	Growth bar alignment

Other and Undetermined

O	**O**ther (e.g., behavior, copulation - put in notes)
U	**U**ndetermined after examination
Z	Less precise age (<95%), but high certainty - put suspected age code in notes

MOLT LIMIT FIELD

Molt Limit Characters

N	None
P	**P**rimary flight feathers
S	**S**econdary flight feathers
D	Primary coverts
G	Greater/secondary coverts
V	Primary **v**s. greater coverts
R	**R**ectrices
L	**L**esser coverts
M	**M**edian coverts
E	Median vs. gr**e**ater coverts
I	Median vs. lesser coverts
B	**B**ody plumage
C	**C**arpal covert vs. alula covert/lesser alula
A	**A**lula 1 vs. **a**lula 2 or **a**lula 2 vs. **a**lula 3
&	Underwing coverts

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 clavicles; 67-100% filled	Covering pad; slightly mounded
B	Bulging slightly over clavicles	Well mounded
G	Greatly bulging over clavicles	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 Asymmetrical molt (not including adventitious)

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 F – 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.

APPENDIX G – 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 North America 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 year of hatching is termed "hatching year" (HY) and older birds are termed "after hatching-yr" (AHY) until 1 January, when these individuals become "second year" (SY) and "after second-year" (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 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 pre-basic molts and evolved inserted molts. Pre-basic 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 (2003) revision is rooted in the assumption that juvenal plumage is homologous to later basic plumages. Howell et al. (2003) thus

redefine the “pre-juvenal molt” as the “first pre-basic molt” and they replace what was formerly considered the “first pre-basic molt” of most species with the “pre-formative molt.” This inserted molt produces the “formative plumage” and lacks counterparts in later age groups.

Using this terminology, molt cycles are defined based on pre-basic molts; therefore, the "first molt cycle" can be defined as the period from the beginning of the first pre-basic (pre-juvenal) molt until the beginning of the second pre-basic 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 (2003) 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 age determination. For example, many tropical oscines and sub-oscines in their first molt cycle (i.e., in juvenile, 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

Under this cycle-based age-classification system, the initiation of pre-basic molt is treated as the definitive marker that indicates advancement in molt cycle. Thus, in most oscines and suboscines, it is easiest to identify the end of one molt cycle and the initiation of the subsequent cycle 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 pre-basic molt, an inserted molt, or replacement of accidentally lost feathers (adventitious replacement). 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. Other possible plumages within the first cycle include first alternate (FCA), and first supplemental (FCS). 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) in place of 'C', which alternatively indicates stasis in a plumage. For example, an individual undergoing a second pre-basic molt can be coded as SPB (Second Pre-Basic). An individual leaving a definitive basic plumage for the subsequent basic plumage should be noted as DPB (Definitive Pre-Basic) and so on. Similarly to the prefix 'P', a prefix 'A' can be substituted 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 FAJ (for after-First cycle Juvenile).

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, although often banders with familiarity of juvenal plumage characteristics can determine that the plumage at whether the plumage is juvenal or not, thus FAJ is often a more accurate age code. 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.

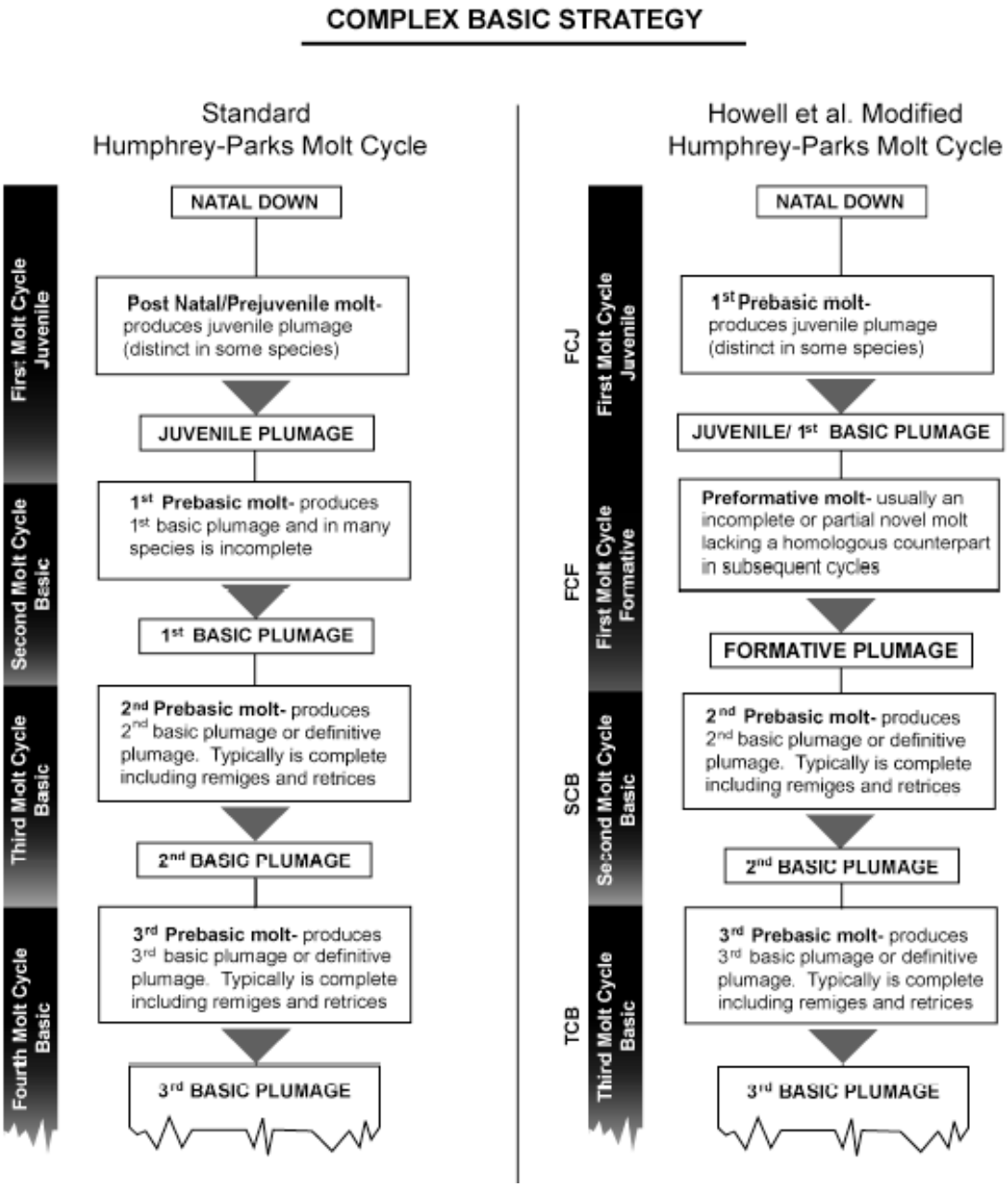
An age bracket can be coupled with each determined cycle-based age code for each species, thereby providing an estimation of age in days or months for each individual. Age brackets will be perpetually refined as more research pertaining to bird molt becomes available. Due to intraspecific temporal variation 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

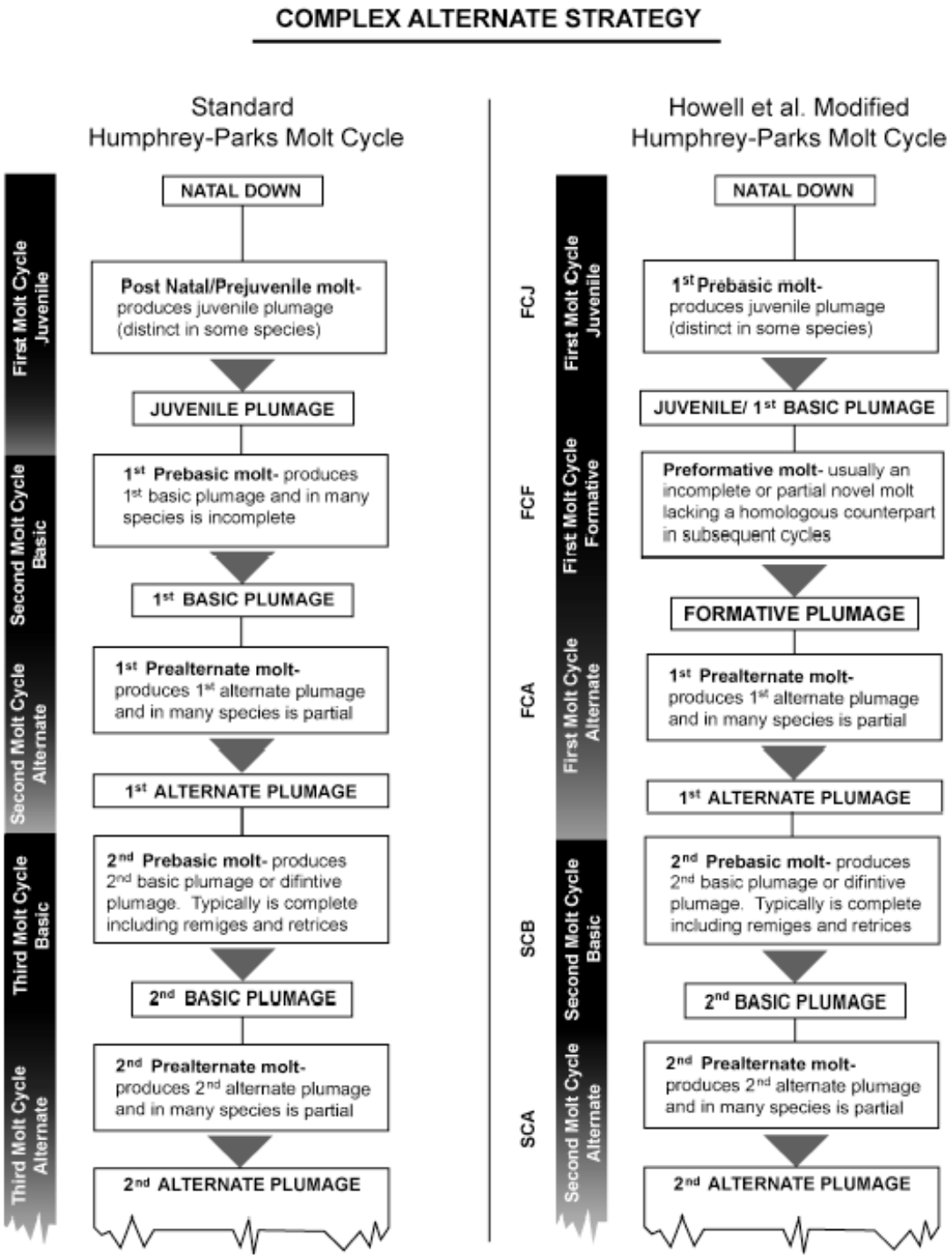
One Red Crossbill (*Loxia curvirostra*) was captured by Klamath Demographic Monitoring Network cooperators in northern California on 1 July 2005. This crossbill had mixed juvenal and formative feathering, indicating that it was in formative plumage. Red Crossbills can breed across 1 January (Pyle 1997b) 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 age classification 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 age-classification system. Because the formative plumage occurs prior to the definitive pre-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 months old. Even so, the extent of skull ossification may better refine age brackets.

Complex Basic Strategy – Howell Augmentation and Standard H-P



Complex Alternate Strategy – Howell Augmentation and Standard H-P



Comparison of common 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 USGS Bird Banding Laboratory.

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