

**A MANUAL FOR
MONITORING BIRD MIGRATION
AT
LAST MOUNTAIN BIRD OBSERVATORY**

by

Alan R. Smith
Box 154
Avonlea, SK
S0H-0C0
alanrandi@sasktel.net

Revised 7 January 2025

Acknowledgements

Last Mountain Bird Observatory is indebted to numerous agencies and individuals for their assistance in its development. First and foremost, the operation of the Observatory would not have been possible without the collaboration and cooperation of Canadian Wildlife Service, Nature Saskatchewan and Last Mountain Regional Park. Major financial support has come from the James Baillie Memorial Fund, Canada Trust, Mountain Equipment Coop, Saskatchewan Sports Trust and Sask Energy Corporation.

TABLE OF CONTENTS

BANDERS CODE OF ETHICS	5
INTRODUCTION.....	6
1. Site selection	6
2. Species studied.....	7
3. Personnel.....	7
PROTOCOLS FOR MIGRATION MONITORING AND BANDING	8
1. MIGRATION MONITORING	8
1.1. Count Area	8
1.2. Count period	8
1.3. Count methods.....	8
1.3.1. Banding.....	9
1.3.2. Census.....	10
1.3.3. Incidental observations	10
1.3.4. Casual observations	11
1.4. Daily Log.....	11
1.5. Banding and observation sheet.....	12
2. BIRD BANDING	12
2.1. Mist nets	13
2.1.1. Setting the nets	13
2.1.2. Checking the nets	14
2.1.2. Extracting birds from mist nets.....	15
2.1.3. Closing the nets.....	17
2.1.4. Maintaining the nets.....	17
2.1.5. Pulling the nets.....	17
2.2. Processing captured birds	18
2.2.1. Bird handling	18
2.2.2. Banding	19
2.2.3. Information gathered.....	21
2.2.3.1. Standard protocol.....	21
2.2.3.2. Modified and rapid release protocols	21
2.2.3.3. Disposition.....	22
2.2.3.4. Band number	22
2.2.3.5. Species code	23
2.2.3.6. Age and sex; How aged and sexed	23
2.2.3.7. Cloacal protuberance and brood patch	24
2.2.3.8. Furcular fat	24
2.2.3.9. Wing chord	25
2.2.3.10. Other linear measurement.....	25
2.2.3.11. Weight	26
2.2.3.12. Primary Moults	26
2.2.3.13. Other information	27

3. DATA MANAGEMENT	
3.1. Computerization of CDT data.....	27
3.2. Computerized banding schedules	27
4. HABITAT MONITORING AND MANAGEMENT	
4.1. Photographs	27
4.2. Assessment of habitat structure	28
4.3 Habitat Maintenance	29
5. CHANGES IN STANDARDIZED DATA COLLECTION	29
REFERENCES.....	30

FIGURES

Figure 1. Count area, Census route and standard net locations at LMBO	9
Figure 2. Furcular fat scores.	25

TABLES

Table 1. Locations of nets and other sites from which photographs should be taken..	27
--	----

APPENDICES

Appendix 1. Rare bird descriptions.....	33
Appendix 2. Sick and injured birds.....	35
Appendix 3. Bander training protocol.....	36
Appendix 4. Species codes and band sizes	37
Appendix 5. Forms used at LMBO	43
Appendix 5.1. Census form	43
Appendix 5.2. Daily Log	44
Appendix 5.3. Banding and Observations form	45
Appendix 5.4. Banding sheet.....	46
Appendix 5.5. Rapid release Log.....	47
Appendix 6. Beaufort scale, sky condition codes	48

BANDER'S CODE OF ETHICS

More than anything else, banders are responsible for the safety and welfare of the birds they study. This means that stress and risks of injury or death need to be minimized. Some basic rules are as follows:

- handle each bird carefully, gently, quietly, and with respect
- capture and process only as many birds as you can safely handle
- close traps or nets when there are known predators in the area
- do not band in inclement weather
- frequently assess the condition of traps and nets and repair them quickly
- trainees must be properly trained and supervised
- check nets every 20 to 30 minutes
- check traps as often as is recommended for each trap type
- properly close all traps and nets at the end of the banding day
- do not leave traps or nets set and untended
- only double-bag non-aggressive birds of the same size and species
- use the correct band size and banding pliers for each bird
- treat all bird injuries in the most humane way

Banders must continually assess their own work to ensure that it is beyond reproach.

- reassess methods and your approach whenever an injury or mortality occurs
- accept constructive criticism from other banders

Banders must offer honest and constructive assessment of others' work to help maintain the highest standards possible.

- publish innovations in banding, capture, and handling techniques
- educate prospective banders and trainers
- provide feedback of any instances of mistreatment of birds to the bander
- if there is no improvement, then file a report with the Banding Office

Banders must ensure that the data gathered are accurate and complete.

Banders must obtain permission to band on private property.

INTRODUCTION

Last Mountain Bird Observatory (LMBO) is a charter member of the Canadian Migration Monitoring Network (CMMN), a nation-wide network of stations established to monitor the populations of migrating landbirds. As such LMBO's primary goal is to generate daily counts of migrant landbirds that can be used for long-term population monitoring. The station gathers other data used to study many other aspects of bird migration.

1. Site selection

Although there were several candidates for a Saskatchewan migration monitoring station, Last Mountain Regional Park was the final selection as it was the only one that fulfilled the most of the following site selection criteria (McCracken *et al.* 1993):

- The site is a proven concentration area for migrants, does not regularly "hold" numerous birds for more than a day, and has few resident species. Birds are concentrated because of LMBO's location on the shore of Last Mountain Lake (the second-largest lake in southern Saskatchewan) and because its hedgerows form the most extensive treed area in an otherwise nearly treeless plain.
- At 28 ha, the site is small enough that it can be watched reasonably and thoroughly by one or two people.
- The vegetation consisting of hedgerows of Caragana, Manchurian Elm and Manitoba Maple is not so dense as to preclude the easy detection of birds. An early to mid-successional "subclimax" is maintained by the poor soils and droughty conditions of the site.
- The census route is 1.4 km in length, covers 20 ha, and can be walked at a slow pace in less than an hour. Both census route and area are within the limits prescribed by (McCracken *et al.* 1993).
- The area has suitable sites for nets and traps.
- The array of nets and traps at the station allows the participants to visit all of them within 15 minutes when no birds are present.
- Working and living quarters of participants are on-site.
- LMBO is highly accessible to the public as it lies within Last Mountain Regional Park (LMRP) and Last Mountain National Wildlife Area.
- As the banding site is in the little-used overflow campground, the site itself is not normally frequented by the public. LMBO is in both the Regional Park and the National Wildlife Area, it is therefore well protected from any sources of development and disturbance.
- Tenure is secure as the site is owned jointly by Last Mountain Regional Park and the Canadian Wildlife Service; both agencies are full participants in LMBO.
- A long-term commitment to the monitoring program has been achieved through sponsorship from CWS, LMRP and Nature Saskatchewan.
- The station is within 200 km of both Regina and Saskatoon and within that distance of most of the population of the province.

2. Species studied

Although all birds noted within or flying over the Count Area (*see* section 1.1) are monitored, the emphasis is on songbirds that migrate through the area. Most of these breed in the boreal forests of western Canada and Alaska and winter either in southern North America (short-distance migrants) or in Latin America (long-distance or neotropical migrants).

3. Personnel

The number of people working at LMBO varies. Two people or more people are required on site. At least one of these must have a banding permit, and be well-trained in banding procedures and the identification of birds by sight and sound. This person is the Bander in Charge (BIC). The BIC is responsible for overseeing all facets of the day's migration monitoring schedule. He or she also helps with training, logistics and maintenance, and generally ensures that the program is being conducted to the high standards outlined in the protocol.

Volunteer assistants are an integral component of all activities at LMBO. They are trained and coordinated by skilled personnel, who are either experienced volunteers or paid employees. The personnel at LMBO should be both knowledgeable and talented but not "elitist." The success of LMBO is based on both its attractiveness as a birding area and the accessibility of the area to all manner of interested people. LMBO has an open-door policy, seeking to involve anyone who has an interest despite previous experience. Priority is, however, given to volunteers who make advance bookings.

PROTOCOLS FOR MIGRATION MONITORING AND BANDING

1. MIGRATION MONITORING

The protocols for migration monitoring at LMBO are based mainly on those of McCracken *et al.* (1993) updated and approved by the CMMN Science Committee in 2022.

1.1. Count Area

The Count Area (Census area) is defined as that portion of Last Mountain Regional Park (51.35, -105.21) from Southern portion of Circle Drive south to the Quonset, and from the shore of Last Mountain Lake east to the golf course (Figure 1). Birds flying over the area during the daily Count Period are recorded either on the census, or otherwise as incidental observations, but birds sitting on or flying over the lake or land outside the count boundaries are recorded as casual observations.

1.2. Count period

Counts include all birds detected during mist-netting operations (0700 to 1300 hrs, changing to 0800 to 1400 hrs after 30 September). This includes birds that are captured, censused or incidentally observed in the Count Area. Counts are conducted on all the days that the Observatory is open (from 7 to 31 May, and from 1 August to 7 October).

1.3. Counts

Counts consist of all birds detected during the Count Period that are inside the boundaries or flying above the Count Area. Since the fall of 1993, LMBO has gathered data for the calculation of a "Daily Estimate Total" (DET) to produce an estimate of the number of individual birds detected within the site. DET procedure includes a census conducted along a specified route at a set time each day and standardized mist netting. As LMBO does not have substantial diurnal movements of small landbirds, a visible migration watch is not included. Incidental and casual observations are not used in calculation of the DET but are recorded separately (see 1.33 and 1.34 for definitions).

As a strict protocol has always been followed in the location, number, design (mesh size and length) and hours of operation of the mist nets at LMBO, we use either mist-netted birds or the census for "In House" calculation of trend indices.

Figure 1. Count area, Census route and standard net locations at LMBO (see Table 1 for net coordinates); locations are also available from station contact.)



1.3.1. Banding

Mist netting has been conducted according to the following protocols since 1992. Nets are opened from 0700 to 1300 hrs. (0800 to 1400 hrs. after 30 September). If weather conditions are such that the nets cannot be opened, netting is delayed until the nets can be opened. If, however, the weather does not improve, netting is cancelled for that day (*see* 2.1.3. Closing the nets). The net design (mesh = 30mm, length = 12 m) and location are constant (Figure 1; coordinates shown in Table 1, section 5). Thirteen “active” nets, numbers 1-7, and 12-17, constitute the standard array and are always opened. In most situations total net hours should equal 78 (13 standard nets x 6 hours).

”Inactive” nets (Figure 1) may be used for ancillary studies, but any netting in these nets, or in active net outside of the standard daily netting period, are to be recorded as non-standard. (*see* 1.5. Completion of the Banding and Observations Sheet). Information on net hours is entered in the **Daily Log** (Appendix 5.3).

Situations will arise where variations on the above protocol may be necessary. Adverse weather or predators may require closing of the nets either temporarily (to allow for the passing of a rain shower, for example) or earlier than normal (if rain persists). In such events close all nets in the order they were opened and record the closing time. If they are reopened, reopen them in the same order as the original opening order and record the reopening time. **Unless the welfare of the birds is compromised, closing nets due to a heavy catch rate should be avoided.** LMBO has a protocol to deal with influxes of birds (*see* 2.2.3.2. Modified and rapid release protocols).

1.3.2. Census

At LMBO, a census is conducted every day the observatory is open. The census route is standardized and described below and shown in Figure 1. The census usually takes from one half to one hour depending on the number of birds present and is usually conducted at 0900 hours. The census may, however, have to be delayed if there is a backlog of birds waiting to be banded.

The census route begins at the banding station and runs due west along the north side of the caragana hedgerow to within 10m of the lakeshore. It then parallels the shore to the small aspen bluff near the life guard station. From there the census proceeds east along the south side of the row of trees that forms the southern boundary of the baseball diamond. When the row of caraganas bordering the west side of the main road is reached the route turns south along the west side of the hedgerow for 150m. The route then crosses the main road, follows along the net lane to net #1, then on the inside edge of the hedgerow north, west to the picnic hall entrance, and finally south down the hedgerow to the Observatory.

The census is conducted by a skilled observer who records birds whenever they are heard or seen, either within or over, the Count Area. The observer will carry binoculars, but not a scope. Except for the aspen bluff, stops are made only long enough to record observations. Because of the density of vegetation and the large number of birds using the bluff and nearby artesian well we recommend that the observer spend at least 10 minutes recording birds at that location. "Pishing" is allowed and encouraged in this area. Any rare sightings or large concentrations of waterbirds on or over the lake may be recorded as casual sightings (indicate these with brackets).

Special care should be made to avoid double-counting birds that have been pushed ahead or "rolled-up." For good estimation of large numbers (e.g., flocks of geese), count birds in a section of the flock, then extrapolate by counting the number of similarly-sized sections. If you cannot identify a species, do not guess, but try to identify it as closely as possible (e.g., *Empidonax*, warbler sp.). Write a note in the "Narrative" section of the Daily Log sheet if you feel you missed a large proportion of the birds because of exceptional circumstances (e.g., if they were flying over too high to identify accurately).

Census data should be entered as it is gathered in the untitled left column of the **Census** form (Appendix 5.1). When the census is finished, enter the total in the TOTAL column.

1.3.3. Incidental Observations

Incidental observations (I.O.) are birds observed within or over the Count Area during the Count Period, but not already recorded on census or through being captured. As the day progresses, note the species and number of birds, the direction and altitude of flights. Do not rely on mental notes for these observations, At the end of the day, Incidental observations that are considered to be "significant" are recorded on the **Banding and Observations Form** under I.O. (Appendix 5.3). Significant records include items of particular interest, such as a species not otherwise recorded that day, supplementary observations of any rare or unusual species, sightings of banded birds, large numbers or nests, etc. Use your best judgement in selecting those to report.

1.3.4. Casual observations

Casual observations (CAS) are birds detected outside the Count Area, either during or outside the Count Period. Again, only significant records (defined above) are recorded on the **Banding and Observations Form**, under CAS (Appendix 5.3).

1.4. Daily Log

Completing the **Daily Log** (Appendix 5.3) is straightforward and an integral part of the day's activities. Data to be gathered includes:

Personnel: Including initials, time of start/end of shift, number of hours on duty, type of activity: banding (b), recording (r), net monitoring (m), bird census (c).

Weather: The following weather information should be gathered at the beginning midpoint and end of each netting session: temperature (Celsius), wind direction, wind speed (on the Beaufort scale, Appendix 6), sky conditions (*see* Appendix 6), and synopsis or general description of weather phenomena that might affect migration monitoring.

Census: Record the time of the census and who conducted it.

Netting Effort: record the number of hours. If the standard 13 nets are open the standard six hours this number should be 78 net hours. Circle the "N" for normal if the standard procedures are followed. Deviations should be noted in "Other" column of the net log. If the nets were closed and later reopened, the net hours for that period should be deducted from the total net hours.

Narrative: including notes on:

1). Bird migration: include new arrivals, extreme early or late records, interesting retraps, returns or recoveries, unusual species, principal migrants, progression of events. Sightings of rare birds (especially those new to LMBO or the NWA) should be described according to criteria in Appendix 1. Significant sightings of locally resident birds should also be included, this includes incidental and casual observations.

2). Bird injuries or mortalities: indicate what species, the type of injury, or if it is a mortality the cause of death, and net in which the injury or mortality occurred. This aids us in our ongoing attempt to identify and reduce injuries and mortalities.

3). Non-avian flora and fauna: include flowering dates, insect hatches, butterflies, herptiles and mammals.

4). Management of the station: Equipment - notes on equipment needed or in need of repair. Techniques - observations on the adequacy of ageing and sexing keys. Personnel - notes on persons wishing to volunteer, and their expected arrival and departure dates. Visitors - notes on groups expected, when expected and how many are expected.

Don't forget to have visitors and volunteers sign the guest book.

1.5. Banding and Observations Sheet

The Banding and Observations sheet has 7 columns (Appendix 5.4):

- NEW: includes newly banded birds, birds that were not banded¹, returns from previous years, and in the fall, returns from the spring of the year.
- REC: for recaptures of birds banded in the same season, included are subsequent recaptures of returns.
- CEN: birds counted in or over the Census Area during the census.
- I.O.: (Incidental observations): birds seen in or over the Census Area during standard netting operations (excludes birds recorded on the census)
- NSN: new birds netted in non-standard nets or outside the non-standard hours.
- NSR: recaptures netted in non-standard nets or outside the non-standard hours.
- CAS: (Casual observations): birds seen outside the Census Area, or in or over the census area outside standard netting hours.

2. BIRD BANDING

Procedures for capturing, banding and processing birds are described in the following sections. There are several "Cardinal Rules." Of paramount importance are the bird's welfare and safety (*see* Appendix 2). Always release a bird unbanded if it is sick or injured or if you are uncertain of its identity. LMBO generally bands all other captured birds with the following except Gray Partridge, Sharp-tailed Grouse and Ruby-throated Hummingbird.

The participants at any banding station must be especially concerned with good public relations for banding. There is no reason visitors cannot be shown birds in nets that are properly set, operated and tended, or be allowed to watch a competent and experienced bander remove and band the birds. Some members of the public might understandably regard a bird in a net, or bags in the hand with a certain amount of concern. Make them aware that we check all nets every 20-30 minutes. A good banding operation is not a secretive affair.

Trainees should not, however, operate in public until they have developed the necessary skills. Trainees must spend enough time with an experienced bander so that they know exactly what to do when they net without supervision. A brief training protocol is outlined in Appendix 3.

2.1. Mist nets

Description: Mist nets are large panels of fine black nylon, terylene or monofilament netting, of varying mesh sizes and lengths. They are strung between two poles placed in the ground. Running horizontally across the top and bottom of the net and at three evenly spaced intervals are trammels

¹ These include escapes, mortalities and birds released unbanded due to injury or lack of bands.

or "shelf strings," which are stretched tautly between the two poles. These form the pockets of mesh within which the birds are captured. When birds fly into these nearly invisible nets, their weight forms the pocket, and they become entrapped.

The poles used by LMBO are 3.2m lengths of stainless steel electrical conduit. The standard net is 12m in length, 2.5m high with a 30mm mesh. Mesh size is measured by stretching the mesh taut and measuring along the diagonal from corner to corner. Larger mesh sizes are only used in special situations. Small passerines caught in nets with mesh larger than 30 or 35mm are liable to become dangerously tangled. If you are using larger than standard mesh-size nets, you must monitor them **constantly** and remove birds as soon as they are captured.

2.1.1. Setting the nets

Nets at LMBO are set in the same location every year. These are marked by orange fluorescent paint on the branches of the trees where the nets are to be placed. Nets should be set about 2 metres from the base of the hedgerows. In preparation for the opening of the net, some trimming of vegetation will be needed. Many twigs may have to be trimmed because of new growth, **but only some branches**. If you have to trim too many branches you are trying to put your net too close.

Setting of nets is easiest with two people. First pound a length of rebar into the ground until about 25 cm is showing. The rebar should not be pounded in straight but at a 15-degree angle away from the net. Nets are held in plastic grocery bags (the ones with handles) as described by Blackshaw (1993). Untie the handles, place the loops of one end of the net on to a net pole and set the pole onto the rebar. The top shelf string is usually identified by its white loop and doubled string. Pay the net out along its lane until it is **taut**, keeping it clear of vegetation and the ground. Repeat the process at the other end. The net should have the same shelf strings on top and its loops in the proper sequence, but check! Once the nets are in place, the net should pull the poles to a nearly vertical position.

Because of the very hard ground at LMBO only Nets 5 through 8 should need guy lines. Tie these to the poles above the second loop from the bottom, just above the mid way point on the poles, so that the net will be kept taut, not sagging, along the shelf strings. Anchor the guy lines about two metres back from the poles. Poles should now be vertical, not leaning in any direction. New erected nets are apt to stretch, so the poles may need to be reset to keep the net taut. This is done, not by tightening the guys (this merely splays the top), but by moving both one set of poles and guys.

At LMBO, most nets are left in place throughout the monitoring season. When not in use, they are furled (*see* Closing the Nets, 2.1.1.3) and the net is tied closed with flagging at each end and in the middle. To open the nets, undo any ties, and tie these to a loop for quick retrieval later when the net is to be closed. Push the loops apart on the pole to spread the net. If you are "vertically challenged," you may need a stick or hooked pole to reach high enough to spread the upper panel. Some net designs, however, work better if the loops are not spread too far apart. The amount of bag (the amount of netting hanging below the trammel) also depends on wind direction and speed, and the species you are catching. A rule of thumb is that 10-12 cm (4-5") of bag is ideal. Test the amount of bag by tossing a small bird bag into the panels. Too much bag and you sacrifice overall

height and the birds will become more entangled. Too little bag will result in far fewer captures, since the birds are apt to bounce out.

Ensure that the bottom of the net is about 0.3 metres from the ground, so that birds hitting low in the net do not rest on the ground. If netted birds do touch the ground, they can get wet or tangled. They are also at higher risk from predation. Test this distance by dropping a couple of bird bags into the lowest panel mid way along its length.

Nets can be safely used in moderate winds (up to and including Beaufort Force 3 in exposed sites). A little wind just means that you have to give the nets more bag and check them more frequently. Netting in moderate winds is rarely hazardous to birds, but it is more apt to reduce the number of birds caught, especially if the wind is perpendicular to the net.

Do not use nets if it is raining, very cold (below freezing or when your hands are too cold to band), very hot (about 25 degrees Celsius, but this depends on shade and wind) or exceedingly windy (Force 4 or more). The nets can be used if it is misty, spitting rain, or there has been a heavy dew, if they are checked very frequently.

Make sure that everyone at the station is aware of which nets you are going to open or close. Nets could be forgotten if there is confusion as to who has opened or closed certain nets; dead or injured birds could be the result!

2.1.2. Checking the nets

Once opened, nets **must be checked frequently**. This usually means every 20 minutes to half hour. That is, the net round should begin no longer than 30 minutes after the start of the previous round. Check nets more frequently when the weather is hot, cold, damp, or windy and when there are lots of birds. If you are catching more birds than you can process between checks, speed up the banding process (*see* 2.3.3 Modified and rapid release protocols). If you think you may be in for a big net run, do a quick check of the nets to determine if you've just had a couple of loaded nets or if they are all loaded. The size of the catch and the number of helpers on hand will influence which of the protocol you will use. Our objective is not to set records for banding; the health and welfare of the birds are always of greater concern. Do not allow birds to remain in nets any longer than absolutely necessary, no more than 1/2 hour. Always be aware of predators!

2.1.2. Extracting birds

Removing birds from the net is an art and a science. It must be learned under the supervision of an experienced person. Removing a bird from a net is normally a one-person proposition; two people trying to work together is seldom very successful. Resist the temptation to help unless specifically called upon by the person removing the bird.

When removing a bird it is best to visualize how it was caught and then imagine how you might reverse the process. With a few exceptions, a bird is caught in a bag formed in the netting between two shelf strings. As the net slows the momentum of the flying bird, the weight of the bird causes the bird and its bag to come at rest **below** the lower of the two shelf-strings. In getting caught the

bird normally gets entangled in up to five body parts: the head, the wings, and the feet. More rarely a bird will get tangled on the tongue (this creates a special problem, *see* below) and the tail.

The various extraction methodologies merely involve the sequence in which the five body parts (F-F-W-W-H) are disentangled. These include the "Feet First" (F-F-W-W-H), "Around the Clock" (F-W-H-W-F) and "Feet Last" (W-H-W-F-F) methods. Because of ease of learning, reduced injury to the birds and speed of removal, we prefer the Feet Last Method where possible.

The first step is to determine from which side the bird entered the net; it is usually impossible to extract a bird from the opposite side. Once you are experienced you can usually tell from a distance by the way the bird hangs, but until then try reaching for the bird through a seam between the first shelf-string **above** the bird and the netting. If you cannot, you are on the wrong side of the net. Do not assume that because one bird is on one side of the net, that they all are!

Once you have determined what side of the net has the bird, carefully look into the pocket and quickly assess the situation. If you are lucky the bird is simply "pocketed," and it can easily be removed by carefully slipping the first two fingers of the hand up the back of the bird and along the sides of the neck. These fingers are then brought together in front of the neck and the other fingers and thumb wrapped around the body to form the "banders grip". Carefully bring the bird out of the pocket ensuring that the feet are not entangled. Simple pocketing occurs most frequently with larger birds, so it is wise to remove large birds first before they escape.

Usually the bird is much more tangled, and netting seems to be everywhere! There is hope, however. With some manipulation you should be able to see a bare patch in the area between the legs. **Begin here.** If the tail is tangled, free it first, then work the netting up the body over the breast. If possible hold the bird in the bander's grip, if not slip your fingers up the back and gently hold the bird by pressing your thumb on its breast. Next lift the bird out of the pocket and away from net as far as the slack permits. This helps to pull loose netting away from the bird and keeps the bird from grasping more netting with its feet.

Next come the wings. In most cases, the wings are freed by peeling the threads over the underside of the bend of the wing. Place the thumb under the threads and push upward while using the forefinger on the bend as a fulcrum to push downwards. Sometimes the wing tip is also caught in mesh, remove this meshing before proceeding to the bend. As you free the wings, it may be necessary to shift your grip from one hand to the other. To free the head it is best to twist your wrist so that the bird and your palm are facing down. Work the mesh from the nape forward. You may have to make several attempts at this before you are successful. Be careful of the eyes.

Last come the feet. If you are lucky the bird will simply let go. You may also be able to fool the bird into letting go by blowing on it. Most often, however, you will remove the mesh from the feet. This should be done in a gentle teasing motion in a direction parallel to the length of the leg. The metatarsal or "knee" joints should be held whilst doing this.

Circumstances dictate many variations in the above procedure. It is often easiest to free the least tangled portions of the body and leave the most tangled to the last. For example, it is may be easiest to free the feet before freeing the other body parts (this is particularly true if there is netting above the metatarsal joint).

"Double pocketing" is a special problem wherein it is necessary to start on the side opposite to the entry of the bird and free the netting encompassing the original pocket before you can go back to the entry side of the net. Also, some birds especially House Wrens, pirouette in the net and cause particular difficulties. These can be solved by gently and carefully unwinding the bird and net.

Thrushes, blackbirds and a few other species have strongly arrowhead-shaped tongues that can often get thread caught in them. Handle these birds gently; avoid pulling on the caught thread. "Tongued" birds can be freed by removing the netting from the rest of the bird first. When only the strands around the tongue remain, relieve tension on them as much as possible, and keep the bird's mouth open with your fingers, so it does not bite its tongue. A seam-pulling tool or some other pointed gadget (even a pencil) is handy for lifting loosened thread back and over the tongue fork.

In a pinch, you can cut a thread or two with small scissors or nail clippers (a knife or thread puller pulls on the thread as it is cut and could hurt the bird). Holes in the net cause birds to become badly tangled, however, so you should avoid cutting as much as possible. Experienced people almost never need to do it. It is only used as a measure of last resort: seek assistance from more experienced banders if you are having difficulties in removing a bird. If you do cut any netting, be sure no pieces of mesh are left on the bird.

To reach birds caught at the top of a net, you may have to temporarily lower the top panel. Be sure to reset the net afterwards.

Banders quickly learn not to wear fancy jewellery or clothing with buttons. They can tear the net and are a time-consuming nuisance to unsnarl.

If the birds are exceedingly tangled, it usually means that the nets are improperly set or that you are not checking them frequently enough. While it is impossible to have 0% casualties, you must strive to have the lowest casualty rate possible.

Like the banding process itself, mist netting requires good eyesight, manual dexterity and the proper temperament. If you lack any of these qualities, or if you feel uncomfortable extracting birds we will find some other way for you to contribute to the banding operation at LMBO.

2.1.3. Closing the Nets

Close nets immediately if a hard and prolonged rain storm seems imminent. A light and temporary rain shower should not be cause for closing the nets. Always close, furl and tie all nets at the end of each banding session. Before closing nets, clean out any leaves, insects, and other debris. If you do not, they become tangled, and the net is much harder to open and may tear.

To close a net, bring all but the top loop together on the pole at chest height. Next, furl the netting into the remaining pocket by swinging the net in a circular motion until there is no excess of netting hanging down. Next close the net completely and continue swinging the net until it is completely close. If properly done it should look more like a rope than a net. Finally bind the loops with flagging and put at least three more along the length of the net. Without ties, the loops and shelf strings can separate, and birds can get caught. Birds caught when no one is checking nets usually die.

2.1.4. Maintaining the nets

Frequently check that guy lines are tight and that the net is taut and clear of the ground and vegetation. Remove any insects, vegetation or other debris. Bumble bees are particularly hard on nets as they chew large holes in the mesh. As distasteful as it may be, they must be immediately dispatched. Squash them with a canvas bird bag. Guy lines should be well flagged so that people do not trip over them or their stakes. All loops on all nets should be protected with duct tape; they will last much longer!

Make any repairs on nets quickly (e.g. broken loops, shelf strings), before the damage gets worse. Holes can and should be repaired with a shuttle and thread. Net repair is a little tedious, but it is fairly easy and prolongs the life of a net. Burn any nets that have become rotten and tear easily or that have too many irreparable holes. Portions of many such nets should, however, be salvaged. Nets can be cut down to 2, or 3 panels for netting grassland birds. Loops and shelf strings can be saved for future repairs.

When opening the nets each day, check to make sure that the netting is not caught up on the tethering knots of the top panel. Otherwise, the netting will become progressively more knotted, reducing the size of the top panel.

Keep net lanes trimmed of weeds and branches that can catch on the net especially on windy days. Also, periodically cut the grass under the nets as it may conceal birds caught in the bottom of the nets.

2.1.1.5. Pulling the nets

At the end of the spring or fall banding seasons the nets are taken down completely. First, open the nets and inspect them for condition and remove any debris. Allow the nets to dry completely if wet or damp. Next, collapse the nets completely but **do not** furl them! (If they are already furred, put them back up and re-close them unfurred. Nets are difficult to set up if they are stored furred).

Next remove the loops from one pole, and put them in sequence over one handle of a plastic grocery bag. Put the net in arm-length sections in the bag as you walk towards the far pole, being careful to keep the net taut and off the ground. Put the loops of the other end of the net on the other handle and tie the two handles with a double knot. Net should be stored indoors (away from mice), with a label noting condition (excellent, good, fair, poor). **Do not store wet or damp nets - they will rot.**

2.2. Processing captured birds

Birds are removed from nets and placed in soft, cloth bags for transport to the banding lab. Avoid leaving bags on the ground as they can be stepped or knelt on. It is better to temporarily hang them in the shade of a tree, **but don't forget them!** If you have to put more than one bird in a bag, place up to three non-aggressive birds of the same size in the bag. **Do not** double-up aggressive species

like hawks, flickers, grosbeaks, and orioles. Transfer the doubles as soon as possible to a separate bags.

Most bags used at LMBO are hem stitched canvas so there are no loose threads to tangle a bird's feet. Make sure that the bags are laundered at least once a week. Also, repair any holes or broken drawstrings. Try to keep the drawstrings knot-free and therefore easier to close. Birds taken from mist nets should be hung on the nail in the banding trailer that corresponds to the net location (Figure 1). Note that the nets are not actually numbered; in our experience it is easier to remember net numbers by their geographic location.

A bird should be returned to its point of capture and released if it is a dependent juvenile (indicated by a growing tail). Birds "waiting" to be banded in the banding lab should be released (unbanded) if they have been kept waiting for more than an hour. Treat these birds as if they were banded (*see* 2.2.3 Information gathered)

2.2.1. Bird handling

There are two important considerations when handling birds. First and foremost is the bird's safety. Of secondary importance is your safety. Nearly all birds bite and scratch, but only a few (e.g. raptors and shrikes) are capable of inflicting any real pain or injury. The best way to hold a small bird is to put its head between the first two fingers of your hand, and lightly grasp the body with the other fingers and your thumb. The bird's back lies against your palm. Close your two fingers (lightly!) around the neck to prevent the bird pulling its head between your fingers. The wings are restrained by your palm and the legs are accessible for banding. If you are right-handed, learn to hold the bird in your left hand, so you can band, measure and write with your right hand. If left-handed, do the reverse. You can restrain a small bird very effectively by using this very gentle grip.

A bird may be held by its legs, in what we call the "photographer's grip." In this grip the legs are held between the first and second fingers and as close to the body as possible. The third and fourth fingers may be used to restrain the wings so no injury occurs when the bird flaps. Legs are very fragile, and can break easily if the bird is not held properly. Make sure that everyone at your station is taught the proper grips.

There are special handling methods used for raptors. Perhaps the safest is to hold them by the legs in an "ice-cream cone" grip. In this grip, the legs are held fully extended along the wings and tail. A hawk or owl has practically no ability to grasp with its legs fully extended, and the bird cannot flap and injure itself. With hawks and owls, it is important to control their talons; their bite is usually not of much consequence. Falcons and shrikes can, however, inflict a painful bite. Control their heads as much as possible.

Hummingbirds must be handled with particular care in the standard bander's grip. They can also be held by the base of the bill for brief periods. Never hold them by their legs. Also, their body feathers pull out very easily. Because of the risks involved and the need for special bands, we simply release hummingbirds as soon as they are extracted from the net.

After banding a bird is simply released by opening your hand; it will usually fly away. **Do not throw a bird into the air.** If it is already injured, this will only exacerbate the problem. If it appears "hypnotized" blow on it; that should do the trick. Make sure the bird flies away safely. If it appears to have "wing strain," retrieve it and treat it as described in Appendix 2. Avoid releasing birds (except owls) after dark; they may have difficulty in finding a safe roost.

2.2.2. Banding

You must be fully acquainted with the banding sheets before banding a bird. Know how to fill the sheets out correctly and neatly. Learn how to use the age/sex keys. Know the acceptable codes for each item on the sheet.

Your next step is to identify the bird. **If you are not 100% sure what it is, let it go unbanded.** If you are sure of your identification but it is a rare bird documentation is required (*see* Appendix 1). To determine the appropriate band size of the species, refer to (Appendix 4). If a choice is given between two band sizes, use a leg gauge to determine the most appropriate size. You should routinely use a gauge for grackles and hawks even though their sizes are listed; their leg sizes are highly variable.

Then, take the next band of the correct size from the string and **read its number aloud** to the recorder to be sure it corresponds to the next number on the record sheet. Birds are occasionally let go without a band. Also, bands are sometimes out of sequence or missing from the string. This check for band number is thus important in preventing chaos in the records.

To open, place the band over the small posts on the side of banding pliers, with the seam along the axis of the pliers. Carefully, open the band evenly and just wide enough to comfortably slip over the bird's leg. Do not open bands with the posts only part way inside the band as this can break the posts and results in the band being opened unevenly.

Place the band with the seam facing out in the correct hole of the banding pliers. Size 0A, 0 and 1 bands fit in the first hole on the smallest pair of pliers; size 1B and 1A fit in the second hole. The next size of pliers accommodates sizes 2 and 3. The largest pair is used for sizes 3B, 3A and 4. Bands larger than size 4 can be opened and put on with a pair of regular needle-nosed pliers.

Grasp the bird's "knee" firmly between your thumb and forefinger, ensuring that the leg is well supported in case the bird struggles while you are applying the band. **Gently** close the band around the bird's leg, watching to make sure that it does not pinch the leg or overlap. Rotate the band 90 degrees and close it further. Rotate and pinch it again hard if necessary. Both ends of the closed band should abut, with very little or no gap between them. Among other things, gaps result in birds getting excessively tangled the next time they venture into a net.

Now that the bird has been banded, set the pliers gently down with the little posts facing up so that they don't break. Banding should be a quick and efficient but gentle and quiet process.

NOTES

1). **Do not overlap the ends of the band!** Overlapped bands (or ones that are not completely closed) can eventually injure the bird. Removing bands that are overlapped or too small is a hazardous procedure (legs are apt to break easily). Remove a band only if it is likely to injure the bird (e.g. if it will not comfortably slide up and down the leg without pinching it). Very old bands are also normally removed (and replaced) if they are exceedingly worn. The Cardinal rule in band removal is to ensure that all leverage is applied to the band and none to the bird's leg.

If the band is loose-fitting, it can be directly removed with a pair of pliers especially designed for band removal. Carefully, insert the tips of the pliers into the band, so that the tips are equidistant between the seam. Make sure that the leg is well supported. Gently squeeze the pliers and the band will open. If the band is too tight to allow the direct use of the pliers, it can be removed by using two strands of the wire that the bands come on. Gently insert a wire on opposite sides between the band and leg so that they are equidistant from the seam. Twist the wires to form two loops; these must be tight. Again, supporting the leg is critical to success. Insert one tip of the pliers into each loop slowly close the pliers while and slowly open the band. (Illustration available at banding lab). Once the band is loosened, you may decide to continue using the wires or switch directly to the pliers.

2). If you band a bird with the wrong band size, it too, may have to be removed. If it is too tight it will chafe the leg; too loose it will slip down over the foot. If neither of these is a problem it is probably safer to leave the band on. In the latter event you must make a note of that in the Additional Comments section of the banding sheet (e.g. "wrong band used in error but it fit OK" or "large leg hence this band size" or "small leg hence this band size").

3). For raptors using band size 4 or larger, a lock-on band is usually employed. These can be put on with a regular set of pliers and locked on. Open the band with a pair of needle-nosed pliers. Bend the flange backwards so that it is straight up and down (i.e. perpendicular to the rest of the band). Place the band over the leg, close it and round it off. Lock the flange in place by bending it over.

2.2.3. Information gathered

2.2.3.1. Standard protocol

During any banding operation, the following data must be recorded: band number, species code, age, sex, date, location, and bander. At LMBO, we also record how the bird was aged and sexed, wing chord, weight, fat score, presence or absence of a cloacal protuberance or brood patch, time weighed, trap (this is usually a mist net, MN), and mist net number. Brief notes on plumage aberrations, parasites, casualties, returns/repeats, and primary moult can be recorded under **Additional Information/Comments**. Finally, for certain difficult-to-identify species (*see* section 2.3.3.10) additional measurements are required.

Banding sheets (Appendix 5.5a) are filled in as you band. Instructions are given on the back of each banding sheet (Appendix 5.5b). Only pencil is acceptable on these sheet. Do not use ditto marks on the banding sheets when information is repeated on successive data lines; they can be misinterpreted as "11". Print everything legibly.

A line on the banding sheet should be used for recaptured birds, casualties, and birds that have been released unbanded as well as for newly banded birds. Process any casualties after live birds have been released. If the bird was banded and then expired, the band may be used on another bird, but be sure to amend the banding sheets accordingly. As bird specimens are always in demand by museums and other educational institutions, casualties should then be tagged and frozen. Make sure the tag has the following information: date, location, species and collector. Untagged birds are of little scientific value. **Do not leave casualties in public view!**

2.2.3.2. Modified and rapid release protocols.

The information gathered is ultimately dependent on the number of birds to be handled. The welfare of the birds is more important than gathering data. Under normal circumstances information to be gathered is as outlined in sections (2.2.3.3 to 2.2.3.12). In the event of a persistent backlog, the **Modified Release Protocol** should be instituted. If birds are coming in steadily at 25 or more per hour, a backlog is likely to develop and persist. In that event, record only those data as required by the banding office: species, age, sex and only those data needed to determine age or sex. For example, wing measurements need only be taken if it would help in sexing the bird; there is no need to measure the wing of a bird that is obviously a male.

If the backlog grows larger or if you are swamped with a wave of birds, you should use the **Rapid Release Protocol**. While you release the birds, have an assistant record this information: date, net number, time, species, age, how aged, sex and how sexed. This information should be filled into the **Rapid Release Log** (Appendix 5.6). If it looks like the wave has subsided you might want to save the last 20 birds for banding. Bring any banded birds in for rechecking. The use of these protocols requires sound judgement, try to anticipate how many birds you might have by scouting the nets before changing protocols.

2.2.3.3. Disposition

See Appendix 5.5b for disposition codes. This is always 1 for newly banded birds; there are other codes for lost/destroyed bands, casualties and retraps.

Retrapped birds fall into one of 3 categories: repeats, returns and foreign recoveries. A "repeat" is used to designate a short-time return of a bird at the original station and is used to indicate recoveries of banded birds that have apparently not left the neighbourhood since the last time they were handled (within 90 days of original banding). A "return" is used to designate a retrap from the same station more than 90 days after original banding. A "foreign recovery" refers to a bird that was banded elsewhere and recovered at your station.

Do not assume that a captured bird bearing a band has only recently been banded; there is always the possibility of a more exotic record. **Always** bring the bird to the station to have the band number checked. Read the number aloud, **twice!** Compare it to the current year's bandings. If it is not there, compare it to the complete historical record of LMBO bandings. If it is not there, we may have a foreign retrap - a bird that has been banded elsewhere! Release the bird if it has been banded

or otherwise handled the same day. If it has not, a new line will have to be filled on the banding form. A recaptured bird should be aged/sexed from what you observe, not on its banding/retrap history. Fill these out before you check its history. This serves as a check on the accuracy of the previous entries. If there is a discrepancy, get a second or third opinion and make a brief note under Additional Information: Comments. Examples are: "definitely not a male by wing chord; obviously a female by brood patch".

Members of the public may bring in dead banded birds or otherwise report banded birds to us. Obtain all pertinent details of these recoveries (species, age, sex, band number, when and where the bird was found, how it died, and the name and address of the person who reported it). Whenever possible, recheck the number on the actual band, for numbers are far too often misread. All recoveries must be submitted on the appropriate form to the Canadian Wildlife Service in Ottawa.

2.2.3.4. Band number

Record the band number in full on each line of the form. Each band number consists of a three or four number prefix a dash (-) and a five number suffix. If the prefix has only three numbers, add a zero before the first number to convert it to four numbers; this eases data entry.

2.2.3.5. Species code

Note that the species names and 4-letter species codes used in the banding operation are not necessarily the same as those used by some birders. Only the codes provided by the bird banding office are acceptable. These match up with the codes imbedded in the data entry program. Rules for formulation of species codes are outlined in Appendix 4. There are, however, many exceptions. Those relevant to banding at LMBO are listed on Appendix 5.5b.

2.2.3.6. Age and sex; how aged and sexed

Codes for Age and sex and how aged and sexed are listed on Appendix 5.5b. Never record the age or sex of a bird unless you are sure of your determination. Under age, "O" (zero) is acceptable only in the fall as all spring birds should be scored at least as "1" or preferably "5" or "6". When the sex is in doubt, use "U" (unknown), and record what you think the correct sex is under Additional Information/Comments. The banding sheet has two columns for how aged or sexed. Use the first for the primary method for ageing or sexing, the second for any additional method. A "9" is used to specify that a bird was aged on the basis of a previous banding history.

Manuals used at LMBO include **North American Bird Banding Techniques, Volume 2** (Canadian Wildlife Service and U.S. Fish & Wildlife Service 1977, hereafter called the Bird Banding Manual (BMM) and Pyle (1997). The BBM keys are dichotomous and usually easy to use. Merely start at the top of the page and work your way through the series of couplets until you arrive at the age and sex "answers." Note that the age "answers" are often paired (e.g. HY/SY). The

slash (/) merely represents the new calendar year. Choose the correct code depending on whether the season is post-breeding (e.g. fall), or after the new year and before breeding (e.g. spring). A bird of the year that is banded on 31 December might be aged correctly as HY. If it is banded on 1 January, however, it becomes a SY (i.e. it is in its second calendar year). Similarly, a bird that is aged as U in December automatically becomes AHY in January. The BBM age/sex sheets have a seasonal bar-graph summary of acceptable age/sex codes.

Subject to the limitations as outlined on page 37, age and sex determinations as reflected in the bar graphs in Pyle (1997) are also acceptable by the Bird Banding Office.

Skulling: One of the best methods of ageing birds in the fall is by skulling. The basis for skulling is as follows. Young birds have but one layer of bone in the skull. As they grow older a second layer grows beneath the first, and small pillars of bone connect the two layers to appear as small white dots. The second layer grows in a pattern which leaves two gradually decreasing "windows" until pneumatization is complete. As ageing a bird by degree of skull pneumatization takes a bit of practice, an experienced person should show you how and check your determinations until you are completely trained. At LMBO, skulls are coded as unpneumatized, partially or completely pneumatized (*see* illustration posted in banding lab).

To skull a bird, wet the feathers of the back of the head. Push the feathers aside to leave a clear patch of skin. **Under bright but suffused light conditions**, look through the skin to the skull. Move the skin around (it is loose and moves over the skull), sideways and back and forth, searching for the white dots on gray of pneumatized bone or pinkish of unpneumatized bone. Most birds in fall are immatures, and are easiest to identify by looking for the contrast between the pneumatized skull and the unpneumatized windows. In most species, the last place to ossify is the top-centre of the skull. Smooth the feathers of the bird's crown after you have skulled it.

Skulling is done routinely from mid June to 31 December, but check the various references to see how late in fall it is reliable; it varies between species. Birds with completely ossified skulls cannot be reliably aged after certain dates and they should go down as "U." The skulling practice must, however, continue beyond the skull-completion dates as there will still be many birds with incompletely ossified skulls that can be reliably aged as HY. Also, some species (e.g. thrushes and swallows) can often be reliably aged by skulling into the spring.

2.2.3.7. Cloacal protuberance and brood patch

Birds may also be sexed by the presence of a cloacal protuberance (CP) or brood (incubation) patch (BP). Absence of a BP or CP does not give you any definitive information about a bird's sex.

In breeding males of some passerines, the cloaca becomes swollen and protrudes posteriorly, forming a cloacal protuberance (See illustration posted in banding lab). A CP is present only in males that are sexually active; it is not often seen on birds that do not breed locally (e.g. migrating birds). Also, some females, while in the egg-laying period, appear to have a CP, but at that time it will not be very large, furthermore they will also have a brood patch.

If the bird has a brood patch, the skin on the belly will be completely bare of feathers, and the skin will often appear wrinkled and heavily vascularized (See illustration posted in banding lab). This technique is not useful for separating the sexes of doves, cuckoos, and woodpeckers. In these groups, both sexes incubate and thus have a brood patch. Male chickadees have a brood patch but it is smaller than that of the female. Many birds, especially recently-fledged young have reduced feathering on the belly, and this should not be mistaken for a BP. In general, only locally resident birds in the breeding season will have a BP. Therefore, most birds undergoing migration cannot be sexed by this method. *See* illustrations posted in the banding lab

2.2.3.8. Furcular fat

The amount of fat on a bird can be used as a measure of a bird's condition. During migration, bird physiology changes markedly, such that birds develop hyperphagia and put on tremendous quantities of fat. Fat is the fuel required to sustain migratory flight. A visual assessment of fat can indicate whether a particular bird has just completed a migratory flight (little or no fat) or is about to depart on one (large amount of fat). Measuring fat is also useful for gauging the condition of sick or injured birds.

Once you get the hang of it, measuring fat is an easy procedure. After banding, hold the bird in the customary grip and part the feathers over the hollow of the breast-bone (the furculum) by blowing on them. As you blow from the breast towards the head, the feathers will part along their natural tracts. This takes practise. You should not blow so hard as to make yourself faint from hyperventilation! Look at the amount of fat deposited beneath the skin. The fat deposits show up as distinct yellowish or orangish patches, contrasting with the red muscular areas. Do not stretch the skin across the breast as this will give you a higher reading. Score the furcular fat on the basis of illustrations (Figure 2, also posted in the banding lab.)

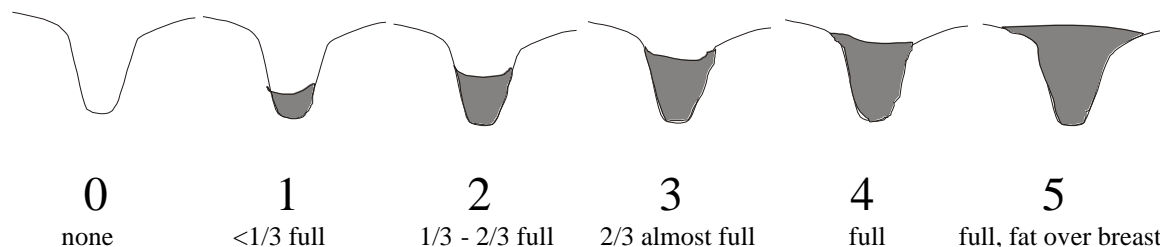


Figure 2. Furcular fat scores

2.2.3.9. Wing chord

Wing chord is important in 1) making sure you have identified the bird correctly, 2) in analysis of weights, where wing chord can be used to "correct" for the bird's fat-free body weight, and 3) in separating the sexes of some species.

Measure the right wing (if you are right-handed, and holding the bird in your left hand), from the "shoulder" to the tip of the longest primary, with the wing held in a natural position (*See* illustration posted in the banding lab). If you can tilt the ruler to a 45-degree angle to the plane of the wing, so much the better, since this keeps the feathers off the ruler and reduces friction and increases accuracy.

Do not flatten the wing! All wing measurements done in North America are based on the natural arc of the unflattened wing. This is an important note to European banders, who are accustomed to measuring the flattened wing.

2.2.3.10. Other linear measurements

For certain species other measurements are required. These include:

- 1). Measurements of the bill (more precisely the distance between the nostril and tip of the bill and the tail (*See* illustrations posted in the banding lab) help distinguish the various species in the genus *Empidonax*. Notes on the emargination of primaries and wing formulae should be included under Comments.
- 2). A measurement of tail and flattened wing to distinguish between Mourning and MacGillivray's Warblers.
- 3). A measurement of tail to distinguish between the juveniles of Chipping and Clay-coloured Sparrow.

2.2.3.11. Weight

LMBO weighs all birds in specially-made containers on an electronic balance. Pesola scales are used only in emergency or field situations. Birds are weighed with the band on. Before weighing each bird make sure the scale is tared at zero. Put the bird in the container head first. Weights are taken to the nearest 0.1 grams. Take care in fitting the appropriately sized can to the bird. Some species, especially the House Wren, are skilled at escaping from cans, so do the weighing as quickly as possible and with one hand over the top of the container.

It is best to weigh the bird as the last step in the banding process, so you can release the bird directly from the container. Do not try to remove a bird from the container by pulling on its tail (you will wind up with a handful of tail feathers). Grab the bird well down on its body. If a bird escapes before being weighed, make a note of that in the Additional Information/Comments column of the banding sheet (e.g. "not weighed").

2.2.3.12. Primary Molt

At LMBO we score only the molt of the primary flight feather. Even so, the presence of primary molt can be taken as evidence that the bird in question is an adult. Be sure, however, that the

moult is taking place sequentially and on both wings; if it is not, the bird may merely be replacing a missing primary.

When scoring wing moult, fill in the columns for all birds, whether new or recaptures, with evidence of primary moult. Although primaries are numbered from mid-wing outwards, they are most easily counted in reverse order from the outermost inwards. While most passerine families have 10 full-length primaries, the 10th primary in some families is either vestigial or missing. The following families should be treated as having only 9 primaries: larks, swallows, pipits, waxwings, vireos (some), warblers, icterids, tanagers, and finches. In all other passerine families as well as the non-passerine hummingbird and woodpecker families 10 primaries should be scored. Eleven primaries should be scored for the Mourning Dove. *See* Appendix 4 for the number of primaries for each bird species to be expected at LMBO. The method for scoring primary moult is posted in the banding lab.

2.3.13. Other information

Other information recorded includes time of banding (24 hour clock), type of trap (*see* Appendix 5.5b) and net number (*see* Figure 1).

3. DATA MANAGEMENT

3.1. Computerization of CDT Data. Data from the Daily Log are to be entered into the CMMN's **Daily Estimated Totals Program v 2.5**. The program automatically calculates a Combined Daily Total (CDT), consisting of the sum of new captures, birds recorded on census and incidental observations during standard operations. The data are submitted to Birds Canada at the end of each year.

3.2. Computerized Banding Schedules

Data from the banding sheets are to be entered into the Data File Template provided by the USGS in their Bander Portal. Banding data for the year should be submitted to Birds Canada along with the count data, as well as to the Bird Banding Office via the Bander Portal.

4. HABITAT MANAGEMENT AND MONITORING

4.1. Photographs

A regular schedule of photographs of each net lane, specific sites along the census route and a few that give an overview of the Count Area provide a very helpful record for data users. Habitat change affects the species and numbers observed, and the habitat records allow researchers to quickly assess whether their use of the data is likely to be adversely affected by changes that have occurred. Photographic recording began in 2022, and should be repeated in late May at least once every 5 years, but sooner if there have been big changes.

Table 1. Locations of nets and other sites from which photographs should be taken.

Photo ID	Direction to point camera	North or East end of net
Net 1	North	N 51°21'08.1180" W 105°12'57.6396"
Net 2	West	N 51°21'07.9596" W 105°12'57.8484"
Net 3	West	N 51°21'08.3088" W 105°12'59.4216"
Net 4	West	N 51°21'07.9776" W 105°12'59.7816"
Net 5	South	N 51°21'08.1504" W 105°13'02.9208"
Net 6	South	N 51°21'07.2180" W 105°13'03.5040"
Net 7	South	N 51°21'05.7996" W 105°13'03.5076"
Net 8*	South	N 51°21'04.9680" W 105°13'06.6800"
Net 9*	West	N 51°21'02.2320" W 105°13'07.5076"
Net 10*	West	N 51°21'02.2320 W 105°13'07.8000"
Net 11*	West	N 51°21'02.2320" W 105°13'08.5076"
Net 12	West	N51°21'02.2320" W 105°13'08.9200"
Net 13	East	N 51°21'01.8288" W 105°12'58.9932"
Net 14	East	N 51°21'02.1348" W 105°12'56.4624"
Net 15	East	N 51°21'02.2104" W 105°12'54.6444"
Net 16	East	N 51°21'02.2320" W 105°12'50.7888"
Net 17	East	N 51°21'02.4048" W 105°12'49.8060"

* Inactive net

When the image files are downloaded, rename them to define the location and date. The file name for each photo should follow this convention: '[DD] [MONTH] [YEAR] – LMBO (e.g., 16 Oct 2020 – Net 03 – LMBO).

Each set of photos from a given year should all be kept in one folder named 'Site photos [YEAR] LMBO'. A copy of this folder is to be saved to the LMBO laptop and on LMBO's external hard drive, and another copy is to be sent to Birds Canada along with the data submission for the year.

4.2. Assessment of habitat structure

A formal habitat assessment following the MAPS protocol is to be carried out once every 5 years beginning in 2023, and whenever there has been a significant change to the Count Area. Habitat assessments are to be carried out in June.

Habitat patches to be surveyed consist of areas with similar habitat that together made up at least 2.5 acres in the most recent assessment. However, do NOT base the current year's habitat assessment on the results of past assessments: each time, the habitat patches should be considered anew. If more than one observer is available to carry out the habitat assessment, they should each

complete a separate assessment and then collaborate on a consensus opinion that can be submitted to Birds Canada. On the map, designate the dominant habitat as A, the sub-dominant habitat as B, the first minor habitat as C (if applicable), and so on.

Once the habitats have been defined and delineated, complete a Habitat Structure Assessment (HSA) Form for each habitat type, available at <https://www.birdpop.org/pages/mapsDataForms.php> along with instructions.

The habitat assessment results are to be saved in a folder labelled 'Habitat assessment [YEAR] LMBO.'. Within that folder, save the habitat photographs (labelled according to the conventions above) and scanned copies of the Habitat Structure Assessment Forms (HSA). Each habitat will have its own HSA form: save each one as 'Habitat Structure Assessment form [YEAR] [HABITAT DESIGNATION] LMBO, e.g., for the dominant habitat in 2020, the file name will be 'Habitat Structure Assessment form 2020 A LMBO'.

A copy of the habitat assessment folder is to be saved on the LMBO laptop. Another copy will be submitted to Birds Canada along with year-end submission of bird data.

4.3 Habitat Maintenance

Ongoing habitat maintenance should be carried out as needed in the netting areas before and during both the spring and fall migration monitoring seasons. In the spring this usually only requires removal of branches that have fallen over the winter, while some new growth must be removed as the season progresses. In the fall much more maintenance is required. Before banding commences all fallen branches must be removed, and the grass mowed from Net 12 to Net 17 and from Net 16 along the path to Net 2. New growth should be trimmed back approximately a metre from the nets to a height of the nets (just over 2.6 metres). This will allow the nets to billow out in strong winds without catching any leaves, twigs or branches.

5.0 CHANGES IN STANDARDIZED DATA COLLECTION

Changes or interruptions to operations should be recorded here if they are likely to have affected the consistency of the long-term data set. The purpose is to alert researchers to issues that may affect the appropriate use and interpretation of the data set. Examples include change in dates or daily hours of coverage, or gaps of a week or more in coverage (e.g. due to lack of personnel or site access).

Instructions for record keeping

If any standardized operational change or notable interruption occurs, enter details into the table below under any previous entries. Refer to parts of the text that were changed (e.g. section number, altered locations on a map, new GPS points). Revise the 'latest version' date on page 1 of this protocol. If changes have been made to the protocol other than adding to the table below, submit a copy of the entire revised protocol to Birds Canada along with year-end data submission; otherwise, send only a copy of the table.

Year	Description of change and justification (if applicable)
1994	Nets 9, 10 and 11 dropped from standardized array.
2000	Net 17 added, at a new location to the east of net 16
2002	Net 8 dropped from standardized array

REFERENCES

This list includes all literature cited in the text as well as several other useful references.

Anonymous. 1991. Long Point Bird Observatory operations manual for volunteers and assistants. Long Point Bird Observatory, Port Rowan, Ontario. (unpaginated).

Berthold, P. and R. Schlenker. 1975. The "Mettnau-Reit-Illnitz-Programm" -- a long-term bird trapping program of the Vogelwarte Radolfzell with multiple goals. German, English summary. *Vogelwarte* 28:97123.

Berthold, P., G. Fliege, U. Quemer and H. Winkler. 1986. Change in songbird populations in central Europe: analysis of trapping data. German, English summary. 1. *Ornithol.* 127:397437.

Bleitz, D. 1957. On the use of mist nets. *News from bird-banders (Western Bird Banding Association)*. 32:22-25

Blackshaw, S.R. 1993. An improved method of net handling and storage. *North American Bird Bander*. 18:49-50.

Bleitz, D. 1970. Mist nets and their use. *Inland Bird Banding News* 42(2).

Canadian Wildlife Service. 1991. North American bird banding. Vol. I. Can. Wildl. Serv., Ottawa.

Canadian Wildlife Service and U.S. Fish and Wildlife Service. 1977. North American bird banding techniques. Vol. 1. Can. Wildl. Serv. Ottawa (parts revised, 1981).

DeSante, D.F. 1983. Annual variability in the abundance of migrant landbirds on southeast Farallon Island, California. *Auk* 100:826-852.

Dunn, E.H. and D. T. H. Hussell. 1995. Using migration counts to monitor landbird populations: review and evaluation of current status. Pp. 43-88 *in* *Current Ornithology*, Vol. 12 (D. M. Power ed.). Plenum Press, NY.

Eckert, K.R. 1990. Lakewood Pumping Station census of fall migration. *Loon* 62:99-105.

Fuller, M.R. and K. Titus. 1990. Sources of migrant hawk counts for monitoring raptor populations. Pp. 4146 In Sauer, J.R. and S. Droege (Eds.). Survey designs and statistical methods for the estimation of avian population trends. USF&WS Biol. Rept. 90(1).

Hagan, J.M. III, T.L. Lloyd-Evans, J.L. Atwood and D.S. Wood. 1992. Long-term changes in migratory landbirds in the northeastern United States: evidence from migration capture data. Pp. 115-130 In Hagan, I.M. III and D.W. Johnston (Eds.). Ecology and Conservation of Neotropical Migrant Landbirds. Smithsonian Institution Press, Washington, D.C.

Hussell, D.I.T. 1981. The use of migration counts for detecting population levels. Studies in Avian Biology 6:92- 1 02.

Hussell, D.J.T. and J. Woodford. 1961. The use of a Heligoland trap and mist-nets at Long Point, Ontario. Bird-banding 32:115-141.

Hussell, D.J.T., M. Mather and P. Sinclair. 1992. Trends in numbers of tropical- and temperate-wintering migrant landbirds in migration at Long Point, Ontario, 1961-1988. Pp. 101-114 In: Hagan, J.M., III, and D.W. Johnston [Eds]. 1992. Ecology and Conservation of Neotropical Migrant Landbirds. Smithsonian Institution Press, Washington, D.C.

Keyes, B.E. and C.E. Grue. 1982. Capturing birds with mist nets. a review. North American Bird Bander 7:2-14.

Low, S.H. 1957. Banding with mist nets. Bird-banding 28:115-128.

McCracken, J.D., D.J.T. Hussell and E.Dunn. 1993. A manual for monitoring bird migration. Long Point Bird Observatory, Port Rowan Ontario. 65 pp.

McClure, H.E. 1984. Bird Banding. The Boxwood Press, 183 Ocean View Blvd., Pacific Grove, CA 93950.

Pardieck, K. and R.W. Waide. 1992. Mesh size as a factor in avian community studies using mist nets. J. Field Ornithology 63:250-255.

Pyle, P. 1997. Identification Guide to North American Passerines - Part I *Columbidae* to *Ploceidae*. Slate Creek Press, P.O. Box 219, Bolinas, CA 94924. 732pp.

Ralph, C.J. 1967. Taking data at a banding station. Western Bird-banding Association Workshop Manual. Point Reyes Bird Observatory, Bolinas, CA.

Ralph, C.J. 1976. Standardization of mist net captures for quantification of avian migration. Bird-banding 47:44-47.

Ralph, C.J. 1981a. Age ratios and their possible use in determining autumn routes of passerine migrants. Wilson Bulletin 93:164-188.

Ralph, C.3. 1981b. Appendix I. Terminology used in estimating numbers of birds. Studies in Avian Biology 6:577-578.

Ralph, C.J., G.R. Guepel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of Field Methods for Monitoring Songbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA; Pacific Southwest Research Station, Forest Service, U.S. Dept. Agric. 41 pp.

Roberts, T.S. 1955. A Manual for the Identification of the Birds of Minnesota and Neighboring States. Univ. of Minn. Press, Mineapolis. 738 pp.

Shreve, A. 1965. Preventing net casualties. Eastern Bird Banding Association, Workshop Manual 4:1-22.

Spencer, R. [Ed.]. 1984. The Ringer's Manual. 3rd Edition. British Trust for Ornithology. Tring, U.K. 138 pp.

Thomas, B.T. 1979. How to mend a mist net. North American Bird Bander 4(4):161-163.

Yunick, R.P. 1979. Variation in skull pneumatization patterns of certain passerines. North American Bird Bander 4(4):145-147.

Wood, M.S. 1969. A bird-bander's guide to the determination of age and sex of selected species. College of Agriculture, the Pennsylvania State Univ., University Park, Pennsylvania. 181 pp.

Yunick, R.P. 1984. Toward more effective age determination of banded birds. North American Bird Bander 9(1):24.

APPENDIX 1. RARE BIRD DESCRIPTIONS

Rare birds are exciting to see or catch, but to be accepted as by the Bird Banding Lab, or as official station or National Wildlife Area records they should be thoroughly documented. If possible, photograph the bird. If not, then make a sketch and detailed field notes, outlining the bird's identifying features. If the bird is captured, one or two diagnostic body feathers could be pulled and saved.

The following information should be written as soon as possible after a sighting, or while the bird is in the hand:

1. Name(s) of all the observers.
2. Date, time of day and place of the observation.
3. Circumstances of the discovery.

Duration: how long the bird was under observation

Distance: distances from which the bird was observed.

Optics: power of binoculars or telescope.

Lighting Conditions: lighting conditions under which bird was observed.

Habitat: habitat used by the bird especially when foraging.

Behaviour: foraging habits, posture, etc.

Jizz: first impressions as to its identity.

Description: as much description as possible (*see* item 4).

4. A full description of the bird.

If possible, do this before looking in bird guides to check your identification and before discussing it with other observers. Each observer should write an independent description before comparing notes. Otherwise you may be influenced to think you saw some characteristic not actually observed.

Use the following guidelines (some are unnecessary for certain birds that can be positively identified by one or a few characteristics, but it is safer to err on the side of over-documentation):

Size: of body, bill, legs, wings.

Shape: of bill, body, wings, legs and feet.

Plumage: describe colour and pattern of each body part: head, breast, belly, back, rump, wings, tail. Note eye rings, head stripes, breast spotting/streaking, etc. If in-hand, describe feathers on different parts of the body (e.g. "back feathers olive with brown base and black spot in centre.")

Soft Parts: describe colour of eyes, bill and legs.

If in-hand, give complete measurements. Write down how you measured, from what to what, as follows:

Wing: wing chord length, number of primaries, wing formula.

Tail: length of inner and outer rectrix. Describe the shape of tail tip (e.g. rounded, notched).

Legs: length of tibia, tarsus and of toes with and without claws.

Bill: length from nares to tip (nalespi), depth at nares.

Body: width and length of head, body length from base of tail to tip of bill.

Attach the descriptions of individual observers (each on a single form), making it clear who saw what, and being candid about any disagreement (whether on overall identification or on specific field marks).

5. As some rarities may be escaped captives, make special note of condition of feathers, feet and bill. Look for fraying, split feather shafts, excrement on feathers or legs, scaliness of legs or bill, etc. Also, note degree of tameness of bird.

6. Do not forget to inform others of a rare bird. Do not hold a captured bird for more than an hour.

APPENDIX 2. SICK AND INJURED BIRDS

"Orphaned" bird should be left alone unless faced with imminent destruction. Parents will care for their young on the ground, so unless you are sure a young bird is abandoned, its chances are better if you let it be. Fledglings may be carefully placed in a tree beyond the reach of predators. Contrary to folklore, the parents cannot detect human scent and will therefore not desert young that have been handled by humans.

When you come across a sick or injured bird, evaluate its condition and come to a prognosis. Is it likely to die or is it just stunned or suffering wing strain? Is a limb broken? There are no easy decisions especially if one has limited veterinary knowledge. Although a decision to euthanize a bird is always difficult, it is often the most humane thing to do, especially when dealing with hopelessly ill or mutilated birds. Bear in mind that most birds brought into rehabilitation centres will be euthanized anyway if there is no chance they can eventually be returned to the wild.

The best method of euthanizing smaller birds is to throw their backs against the hard ground or solid floor; if properly done death is instantaneous. **This unpleasant business should always be done away from public view. The corpse of euthanized birds or of any other casualties should never be left in public view but should be disposed of in the proper manner (see under Bird handling 8.2.2.)**

Some birds experience "wing strain" due to the netting operation. In this condition, one wing is slightly bruised or strained. The bird may or may not let it droop a bit. In any case, the bird will not fly more than a couple of feet, presumably because the wing is sensitive and the bird is favouring it. If a bird appears to be suffering wing strain or is stunned from a collision, keep it in a warm, dry, dark and quiet place for a few hours and periodically monitor its condition. Such birds often make amazing recoveries under these conditions. Nevertheless, if a station is experiencing any more than .05% incidence of wing strain, the station manager should investigate the cause; perhaps one of the banders may be too rough in his/her net extractions.

Injured or sick birds should never be banded, unless the injury is old and healed. Note any such injuries as Additional Information on the banding sheets

APPENDIX 3. BANDER TRAINING PROTOCOL

New volunteers, regardless of past experience, must be checked out and if necessary receive proper training. All of a novice's activities should be closely supervised by an experienced bander/trainer. They are not permitted to hold, band, or extract birds without first being acquainted with the station's training protocol. The following step-wise training procedure should be used as a guide only.

1. As a new volunteer you must first watch banders and learn to record information on banding sheets and other forms. You must learn the basics of how to properly set and close nets. You should thoroughly read the station's Operations Manual.
2. Continue to record and watch others. Practice opening and closing some practice bands, and practice reading them. If your eyesight or coordination is bad, perhaps you should consider acting primarily as a recorder as bird-banding requires good eyesight and hand/eye coordination. Assuming that you and your trainer feel comfortable, you should handle (not band) a few "large" birds (White-throated Sparrow or larger). You should master the all-important standard "banders grip" before attempting any banding.
3. Extract large birds from mist nets. Age, sex, measure and band large birds (band size 1B or larger).
4. Extract small birds from mist nets. Age, sex, measure and band small birds (band size 0-1). Throughout, remember that birds are fragile and that they should be handled with care and respect.
5. Within a month or two, you will have become a reasonably skilled bird bander. Meanwhile you should be supervised as your trainer becomes confident in your abilities. You should seek help from more experienced banders whenever you run into difficulty. Some people are natural-born bird-banders and others are much less skilled. If you happen to fall into the latter category, be patient; few people can learn the gentle art of bird-banding in a week. LMBO is more than happy to have your assistance whatever your skills or interests!

APPENDIX 4. SPECIES CODES, BAND SIZES AND NUMBER OF PRIMARIES

SPECIES CODES

Rules for forming unique species codes

1. One word names: use the first four letters.
Example: **Veery** = VEER
2. Two word names: use the first two letters of each word.
Example: **Least Flycatcher** = LEFL
3. Three word names, no hyphen or hyphen between the first and second words: use the first letter of the first two words and the first two of the third.
Example: **American Tree Sparrow** = ATSP
4. Three word names, hyphen between the second and third words: use the first two letters of the first word and the first letter of the last two words.
Example: **Western Wood-Pewee** = WEWP
5. Four word name: first letter of each word.
Example: **Black-and-white Warbler** = BAWW

Irregular species codes

Where two species would have the same code, both species codes are changed to new unique code names. Rules for forming irregular species codes are complex - it is easier to memorize these exceptions. *See Appendix 5.5b. Exceptions to Four Letter Codes* for a list of irregular species codes.

Codes for well-marked subspecies or groups of subspecies

In the cases of some well-marked subspecies or groups of subspecies the code to be used is derived from the common name of that subspecies/subspecies group. Thus if one is catching "Gambel's" White-crowned Sparrows this code (GWCS) is used instead of White-crowned, if Sparrow (WCSP). *See Appendix 5.5b, Exceptions to Four Letter Codes*, for a list of the species using subspecies/group codes.

Band Sizes. These are the recommended band sizes, the first size listed is the most commonly used. Note that some species require different sizes for each sex.

Number of primaries. In order to calculate the primary moult score it is necessary to know how many primaries each species has. As it is difficult to determine the location of the first or innermost primary (numbering begins at the primary next to the outermost secondary) it is easiest to score backwards from the outermost primary.

SPECIES	CODE	BAND	NO. OF PRIMARIES	PYLE
Sharp-shinned Hawk	SSHA	2-3(m); 3A-3B(f)		
Cooper's Hawk	COHA	4*(m); 5*-6*(f)		
Merlin	MERL	3A(m); 4*(f)		
Rock Dove	RODO	4	11, 11th spurious **	
Mourning Dove	MODO	3A-3B	11, 11th spurious **	47
Black-billed Cuckoo	BBCU	2	10 full	54
Long-eared Owl	LEOW	5*-6*		92
Northern Saw-whet Owl	NSWO	4*-3A		98
Common Nighthawk	CONI	2-1A	10 full	103
Common Poorwill	COPO	1A-2	10 full	109
Whip-poor-will	WPWI	1A-2	10 full	113
Chimney Swift	CHSW	1B	10 full	117
Ruby-throated Hummingbird	RTHU	X	10 full	136
Belted Kingfisher	BEKI	3B-3A	10 full	159
Red-headed Woodpecker	RHWO	2	10, 10th spurious **	168
Yellow-bellied Sapsucker	YBSA	1B-1A	10, 10th spurious **	177
Red-naped Sapsucker	RNSA	1A-1B	10, 10th spurious **	179
Downy Woodpecker	DOWO	1B	10, 10th spurious **	187
Hairy Woodpecker	HAWO	1A-2	10, 10th spurious **	189
Three-toed Woodpecker	TTWO	2	10, 10th spurious **	197
Black-backed Woodpecker	BBWO	2	10, 10th spurious **	199
Northern "Yellow-shafted" Flicker	YSFL	3	10, 10th spurious **	200
Northern "Red-shafted" Flicker	RSFL	3	10, 10th spurious **	200
Pileated Woodpecker	PIWO	4-3A	10, 10th spurious **	204
Olive-sided Flycatcher	OSFL	1-1B	10 full	213
Western Wood-Pewee	WEWP	0-1	10 full	215
Eastern Wood-Pewee	EAWP	0-0A	10 full	217
Yellow-bellied Flycatcher	YBFL	0-0A	10 full	220
Alder Flycatcher****	ALFL	0A	10 full	224
Willow Flycatcher****	WIFL	0A	10 full	224
Trail's Flycatcher	TRFL	0A	10 full	224
Least Flycatcher	LEFL	0-0A	10 full	228
Dusky Flycatcher	DUFL	0-0A	10 full	232
Eastern Phoebe	EAPH	0-1	10 full	240
Say's Phoebe	SAPH	1	10 full	241
Great Crested Flycatcher	GCFL	1A-1B	10 full	247
Western Kingbird	WEKI	1A	10 full	261
Eastern Kingbird	EAKI	1B	10 full	263
Northern Shrike	NSHR	2	10, 10th spurious **	271
Loggerhead Shrike	LOSH	1A	10, 10th spurious **	273
Blue-headed Vireo	BHVI	1	10, 10th spurious **	281

Irregular species codes and codes for subspecies groups are listed in boldface.

*These bands must be of the lock on type.

**Care must be taken not to score a fully grown but spurious outermost primary as a 2 or 3.

***Willow & Alder Flycatchers are banded as Trail's (TRFL) unless identity confirmed by song.

SPECIES	CODE	BAND	NO. OF PRIMARIES	PYLE
Yellow-throated Vireo	YTVI	1	10, 10th spurious **	282
Warbling Vireo	WAVI	0-1	10, 10th spurious **	285
Philadelphia Vireo	PHVI	0-0A	10 full	287
Red-eyed Vireo	REVI	1-0	10 full	288
Gray Jay	GRAJ	3-2	10, 10th spurious **	293
Blue Jay	BLJA	2-3	10, 10th spurious **	297
Black-billed Magpie	BBMA	3B-4-3	10, 10th spurious **	307
American Crow	AMCR	5	10, 10th spurious **	310
Common Raven	CORA	6-7A	10, 10th spurious **	314
Horned Lark	HOLA	1B	10, 10th spurious **	316
Purple Martin	PUMA	1A-2	9 visible	320
Tree Swallow	TRES	1C-1	9 visible	322
Violet-green Swallow	VGSW	1	9 visible	324
Northern Rough-winged Swallow	NRWS	0	9 visible	325
Bank Swallow	BANS	0	9 visible	327
Barn Swallow	BARS	0-1	9 visible	328
Cliff Swallow	CLSW	1	9 visible	330
Black-capped Chickadee	BCCH	0-1	10, 10th spurious **	334
Boreal Chickadee	BOCH	0-0A	10, 10th spurious **	340
Red-breasted Nuthatch	RBNU	0-1	10, 10th spurious **	351
White-breasted Nuthatch	WBNU	1B-1	10, 10th spurious **	352
Brown Creeper	BRCR	0A-0	9 full	356
Rock Wren	ROWR	1-0	10, 10th spurious **	359
House Wren	HOWR	0-0A	10, 10th spurious **	365
Winter Wren	WIWR	0A-0	10, 10th spurious **	366
Sedge Wren	SEWR	0A-0	10, 10th spurious **	368
Marsh Wren	MAWR	1	10, 10th spurious **	369
Golden-crowned Kinglet	GCKI	0A	10, 10th spurious **	374
Ruby-crowned Kinglet	RCKI	0A	10, 10th spurious **	375
Eastern Bluebird	EABL	1B-1	10, 10th spurious **	388
Mountain Bluebird	MOBL	1B-1A	10, 10th spurious **	390
Townsend's Solitaire	TOSO	1B	10, 10th spurious **	391
Veery	VEER	1B	10, 10th spurious **	392
Gray-cheeked Thrush	GCTH	1B	10, 10th spurious **	394
Swainson's Thrush	SWTH	1B	10, 10th spurious **	397
Hermit Thrush	HETH	1B-1	10, 10th spurious **	399
American Robin	AMRO	2	10, 10th spurious **	403
Varied Thrush	VATH	2	10, 10th spurious **	405
Gray Catbird	GRCA	1A	10, 10th spurious **	408
Northern Mockingbird	NOMO	2-1A	10, 10th spurious **	409
Sage Thrasher	SATH	1B-1A	10, 10th spurious **	410
Brown Thrasher	BRTH	2-3	10, 10th spurious **	411
European Starling	EUST	2-3	10, 10th vestigial ***	421

Irregular species codes and codes for subspecies groups are listed in boldface.

**Care must be taken not to score a fully grown but spurious outermost primary as a 2 or 3.

***Care must be taken not to score a fully grown but vestigial outermost primary as 1.

SPECIES	CODE	BAND	NO. OF PRIMARIES	PYLE
American Pipit	AMPI	1	10, 10th spurious **	431
Sprague's Pipit	SPPI	1	10, 10th spurious **	433
Bohemian Waxwing	BOWA	1A	9 full	435
Cedar Waxwing	CEDW	1B	9 full	437
Golden-winged Warbler	GWWA	0A-0	9 full	446
Tennessee Warbler	TEWA	0A-0	9 full	447
Orange-crowned Warbler	OCWA	0-0A	9 full	448
Nashville Warbler	NAWA	0A-0	9 full	450
Northern Parula	NOPA	0A-0	9 full	455
Yellow Warbler	YWAR	0-0A-1	9 full	459
Chestnut-sided Warbler	CSWA	0A-0	9 full	462
Magnolia Warbler	MAWA	0A-0	9 full	464
Cape May Warbler	CMWA	0-0A-1	9 full	466
Black-throated Blue Warbler	BTBW	0-0A	9 full	467
Yellow-rumped Warbler, "Myrtle"	MYWA	0-0A-1	9 full	469
Yellow-rumped Warbler, "Audubon's"	AUWA	0-0A-1	9 full	469
Townsend's Warbler	TOWA	0A-0	9 full	474
Black-throated Green Warbler	BTNW	0A-0	9 full	477
Blackburnian Warbler	BLBW	0-0A	9 full	480
Pine Warbler	PIWA	0-0A	9 full	484
Palm Warbler, Western	WPWA	0-0A	9 full	488
Bay-breasted Warbler	BBWA	0-0A-1	9 full	490
Blackpoll Warbler	BLPW	0-0A-1	9 full	491
Black-and-white Warbler	BAWW	0-0A-1	9 full	495
American Redstart	AMRE	0A-0	9 full	496
Ovenbird	OVEN	1-0	9 full	501
Northern Waterthrush	NOWA	0-1	9 full	502
Connecticut Warbler	CONW	1	9 full	505
Mourning Warbler	MOWA	0-1	9 full	506
MacGillivray's Warbler	MGWA	1-0	9 full	509
Common Yellowthroat	COYE	0-0A-1	9 full	510
Wilson's Warbler	WIWA	0A-0	9 full	515
Canada Warbler	CAWA	0-0A	9 full	517
Yellow-breasted Chat	YBCH	1B-1A	9 full	521
Scarlet Tanager	SCTA	1B	9 full	527
Western Tanager	WETA	1B	9 full	528
Eastern Towhee	EATO	2-1A	9 full	535
Spotted Towhee	SPTO	1A-2	9 full	536
American Tree Sparrow	ATSP	0-1	9 full	549
Chipping Sparrow	CHSP	0-0A	9 full	550
Clay-coloured Sparrow	CCSP	0	9 full	552
Brewer's Sparrow	BRSP	0-0A-1	9 full	554
Field Sparrow	FISP	0-1-0A	9 full	555

Irregular species codes and codes for subspecies groups are listed in boldface.

**Care must be taken not to score a fully grown but spurious outermost primary as a 2 or 3.

SPECIES	CODE	BAND	NO. OF PRIMARIES	PYLE
Vesper Sparrow	VESP	1B-1	9 full	558
Lark Sparrow	LASP	1B	9 full	559
Lark Bunting	LARB	1A	9 full	563
Savannah Sparrow	SAVS	1	9 full	565
Baird's Sparrow	BAIS	1	9 full	568
Grasshopper Sparrow	GRSP	1	9 full	569
Le Conte's Sparrow	LCSP	1	9 full	571
Nelson's Sharp-tailed Sparrow	NSTS	1-1B	9 full	574
Fox Sparrow	FOSP	1A-1B	9 full	577
Song Sparrow	SOSP	1B-1	9 full	579
Lincoln's Sparrow	LISP	0-1	9 full	584
Swamp Sparrow	SWSP	1	9 full	585
White-throated Sparrow	WTSP	1B	9 full	587
Harris' Sparrow	HASP	1A	9 full	588
White-crowned Sparrow	WCSP	1B	9 full	589
Gambel's White-crowned Sparrow	GWCS	1B	9 full	589
Golden-crowned Sparrow	GCSP	1B-1A	9 full	591
Dark-eyed Junco, "Slate-coloured"	SCJU	0-1	9 full	593
Oregon Junco	ORJU	0-1	9 full	593
McCown's Longspur	MCLO	1	9 full	597
Lapland Longspur	LALO	1B	9 full	598
Smith's Longspur	SMLO	1	9 full	600
Chestnut-collared Longspur	CCLO	1	9 full	601
Snow Bunting	SNBU	1A-1B	9 full	603
Northern Cardinal	NOCA	1A-2	9 full	607
Rose-breasted Grosbeak	RBGR	1A-2	9 full	609
Black-headed Grosbeak	BHGR	1A	9 full	612
Lazuli Bunting	LAZB	1	9 full	616
Indigo Bunting	INBU	1	9 full	618
Dickcissel	DICK	1B	9 full	623
Bobolink	BOBO	1A(m);1B(f)	9 full	625
Red-winged Blackbird	RWBL	2(m);1A(f)	9 full	626
Western Meadowlark	WEME	3(m);2-3(f)	9 full	634
Yellow-headed Blackbird	YHBL	2(m);1A(f)	9 full	636
Rusty Blackbird	RUBL	2	9 full	637
Brewer's Blackbird	BRBL	2	9 full	638
Common Grackle	COGR	3-3B	9 full	639
Brown-headed Cowbird	BHCO	1A(m);1B(f)	9 full	646
Orchard Oriole	OROR	1B	9 full	648
Bullock's Oriole	BUOR	1A	9 full	658
Baltimore Oriole	BAOR	1A	9 full	656
Gray-crowned Rosy-Finch	GCRF	1B	10, 10 th spurious **	662

Irregular species codes and codes for subspecies groups are listed in boldface.

**Care must be taken not to score a fully grown but spurious outermost primary as a 2 or 3.

SPECIES	CODE	BAND	NO. OF PRIMARIES	PYLE
Pine Grosbeak	PIGR	1A	10, 10 th spurious **	666
Purple Finch	PUFI	1-1B	10, 10 th spurious **	668
House Finch	HOFI	1B-1	10, 10 th spurious **	670
Red Crossbill	RECR	1B	10, 10 th spurious **	673
White-winged Crossbill	WWCR	1B	10, 10 th spurious **	675
Common Redpoll	CORE	0-0A	10, 10 th spurious **	677
Hoary Redpoll	HORE	0-0A	10, 10 th spurious **	679
Pine Siskin	PISI	0-0A	10, 10 th spurious **	680
American Goldfinch	AMGO	0-0A-1	10, 10 th spurious **	686
Evening Grosbeak	EVGR	1A-2	10, 10 th spurious **	688
House Sparrow	HOSP	1B	10, 10 th spurious **	690

****Care must be taken not to score a fully grown but spurious outermost primary as a 2 or 3.**

Appendix 5.2. Daily Log

Daily Log Last Mountain Bird Observatory Month ___ Day ___ Year ___

Personnel	Start	End	Hrs.	Activity
bic				

Weather	Start	Midpoint	Close
Temperature			
Wind direction			
Wind Speed			
Sky condition			
Synopsis			

Census

Start	End	Observer

Net	Open		Close		Hours	
	N	Other	N	Other	N	Other
1	0700		1300		6.0	
2	0700		1300		6.0	
3	0700		1300		6.0	
4	0700		1300		6.0	
5	0700		1300		6.0	
6	0700		1300		6.0	
7	0700		1300		6.0	
8	0700		1300		6.0	
9	0700		1300		6.0	
10	0700		1300		6.0	
11	0700		1300		6.0	
12	0700		1300		6.0	
13	0700		1300		6.0	
14	0700		1300		6.0	
15	0700		1300		6.0	
16	0700		1300		6.0	
Subtract net hours closed:						
# Nets closed	from		to		for a total of	
Total					78.0	

NARRATIVE

Bird Migration

Bird injuries or mortalities

Flora and non-avian fauna

Management of the Station

Appendix 5.3. Banding and Observations Form

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
	NEW	REC	CEN	I.O.	NSN	NSR	CAS		NEW	REC	CEN	I.O.	NSN	NSR	CAS		NEW	REC	CEN	I.O.	NSN	NSR	CAS
Snow Goose								Alder Flycatcher								Blackpoll Warbler							
Canada Goose								Least Flycatcher								Palm Warbler							
Tundra Swan								Eastern Phoebe								Yellow-rumped Warbler							
Gadwall								Western Kingbird								Black-thr. Green Warbler							
American Wigeon								Eastern Kingbird								Canada Warbler							
Mallard								Blue-headed Vireo								Wilson's Warbler							
Blue-winged Teal								Warbling Vireo								Spotted Towhee							
Northern Shoveler								Philadelphia Vireo								American Tree Sparrow							
White-winged Scoter								Red-eyed Vireo								Chipping Sparrow							
Hooded Merganser								Blue Jay								Clay-coloured Sparrow							
Common Loon								Black-billed Magpie								Vesper Sparrow							
Double-cr. Cormorant								American Crow								Lark Sparrow							
American White Pelican								Common Raven								Savannah Sparrow							
Great Blue Heron								Purple Martin								Le Conte's Sparrow							
Bald Eagle								Tree Swallow								Nelson's Sparrow							
Northern Harrier								Bank Swallow								Fox Sparrow							
Sharp-shinned Hawk								Cliff Swallow								Song Sparrow							
Cooper's Hawk								Barn Swallow								Lancotti's Sparrow							
Broad-winged Hawk								Black-capped Chickadee								Swamp Sparrow							
Red-tailed Hawk								Red-breasted Nuthatch								White-throated Sparrow							
Sora								White-breasted Nuthatch								Harris' Sparrow							
American Coot								Brown Creeper								White-crowned Sparrow							
Sandhill Crane								House Wren								Dark-eyed Junco							
Black-bellied Plover								Winter Wren								Rose-breasted Grosbeak							
Killdeer								Sedge Wren								Bobolink							
Spotted Sandpiper								Golden-crowned Kinglet								Red-winged Blackbird							
Solitary Sandpiper								Ruby-crowned Kinglet								Western Meadowlark							
Greater Yellowlegs								Gray-cheeked Thrush								Yellow-headed Blackbird							
Willet								Swainson's Thrush								Rusty Blackbird							
Lesser Yellowlegs								Hermit Thrush								Brewer's Blackbird							
Marbled Godwit								American Robin								Common Grackle							
Wilson's Snipe								Gray Catbird								Brown-headed Cowbird							
Wilson's Phalarope								Brown Thrasher								Orchard Oriole							
Franklin's Gull								American Pipit								Baltimore Oriole							
Ring-billed Gull								Cedar Waxwing								Purple Finch							
California Gull								Lapland Longspur								Pine Siskin							
Forster's Tern								Ovenbird								American Goldfinch							
Mourning Dove								Northern Waterthrush								House Sparrow							
Great Horned Owl								Black-and-white Warbler								<i>Empidonax</i>							
Long-eared Owl								Tennessee Warbler								Unid. thrush							
Northern Saw-whet Owl								Orange-cr. Warbler								Unid. warbler							
Common Nighthawk								Nashville Warbler								Unid. sparrow							
Scrub-thr. Hummingbird								Connecticut Warbler								Unid. blackbird							
Belted Kingfisher								Mourning Warbler								OTHER SPP.							
Western Wood-Pewee								Yellow Warbler								TOTAL BIRDS							
Yell-bellied Flycatcher								Chestnut-sided Warbler								TOTAL SPECIES							

APPENDIX 6. BEAUFORT SCALE and SKY CONDITION CODES

BEAUFORT SCALE

Force	Description	Wind Speed	Possible Effects
0	Calm	0 km/h	Chimney smoke rises straight up
1	Light air	3 km/h	Smoke drifts gently
2	Light breeze	9 km/h	Leaves rustle, wind felt on face
3	Gentle breeze	15 km/h	Leaves and twigs on trees move
4	Moderate wind	25 km/h	Dust and paper raised from ground
5	Fresh wind	35 km/h	Small trees start to sway
6	Strong wind	45 km/h	Large branches move
7	Near gale	56 km/h	Whole trees sway
8	Gale	68 km/h	Difficult to walk into wind
9	Severe gale	81 km/h	Branches and slates blown off
10	Storm	94 km/h	Houses damaged; trees uprooted
11	Severe storm	110 km/h	Serious damage to houses
12	Hurricane	118 km/h	Widespread damage

SKY CONDITION CODES

Code	Conditions	Code	Conditions
0	clear, few clouds	4	drizzle
1	partly cloudy	5	snow
2	cloudy, overcast	6	showers
3	fog or smoke		