Lesser Slave Lake Bird Observatory
Standard Operating Protocol

Revised: March 2021

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PREFACE

This manual outlines the activities of the core monitoring programs of the Lesser Slave Lake Bird Observatory (LSLBO) in the Lesser Slave Lake Provincial Park, Alberta and provides standard protocol for field operations. While this manual contains the most pertinent information relating to specific protocols of the LSLBO, it should be read in conjunction with the other manuals and handbooks prepared by several organisations and agencies, including: the Canadian Migration Monitoring Network, the Institute for Bird Populations, the North American Banding Council, Birds Canada, and others (Appendix A).

This manual provides the third update to the LSLBO's original operating manual prepared by Jason Duxbury in 1995 (LSLBO 1995), which was based in part on *A Manual for Monitoring Bird Migration* (McCracken et al. 1993). Revisions by Jul Wojnowski in 2003 (LSLBO 2003) and Nicole Krikun in 2013 (LSLBO 2013) are included. Although most material is taken directly from the above manuals, further editing and additional resources were added by Robyn N. Perkins in 2021. Few changes were made to migration monitoring and MAPS operations, but certain operating procedures required modifications to accommodate new facilities, new technology, and recommendations from the Canadian Migration Monitoring Network. Operating protocols for an additional core program, fall owl migration monitoring, have been included. For a log of protocol changes and interruptions to standard coverage, see Section 8.

The ultimate goal of this manual is to provide all necessary information for any reader – once familiar with all information contained herein and other relevant manuals – to operate the station and to collect data in a highly consistent manner. This in turn gives scientific credibility to the data collected by those working at the station. This manual is intended as a 'living document' which will need periodic updating. The LSLBO welcomes any suggestions or comments for improvements.

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SECTION 1: INTRODUCTION

Informal migration monitoring and bird banding was conducted by the Beaverhill Bird Observatory on the shores of the Lesser Slave Lake in 1992-93. In 1994, the Lesser Slave Lake Bird Observatory (LSLBO) was formalized and has operated every year since. Dedicated to bird conservation through research and education, the LSLBO's core programs focus on monitoring migrating and breeding bird populations in the Lesser Slave Lake Provincial Park (Figure 1), approximately 300 km north by northwest of Edmonton, Alberta. The LSLBO aims to maintain a consistently high level of accuracy in data collection. This manual describes the standardized protocols to be used for migration monitoring, Northern Saw-whet Owl banding and Monitoring Avian Productivity and Survivorship (MAPS) by staff and volunteers.

1.1 Monitoring Goals of the LSLBO

The goals of the LSLBO are to provide comparable year-to-year data on bird population trends, survival rates, species composition and migration timing for use in various conservation initiatives. This is accomplished through the LSLBO's three core programs:

Largely standardized in 1995 (but see Section 8), the first core program is migration monitoring, which is conducted in the spring (mid-April to June 10) and fall (July 12 to September 30). We are a member of the Canadian Migration Monitoring Network - Réseau canadien de surveillance des migrations (CMMN-RCSM), participating in the trend monitoring program. Established in 1998, the CMMN is a unique network including Birds Canada, the Canadian Wildlife Service and approximately 25 member stations working collaboratively to monitor avian migration across Canada.

The newest core program is Northern Saw-whet Owl migration monitoring by means of target banding September 1 through October 31. Operated since 2004, this banding program is one of many conducted within North America to understand these owl's movements and population trends and to infer habitat quality and population trends of their prey species.

The final core program is Monitoring Avian Productivity and Survivorship (MAPS), which is conducted during the summer (June 10 to August 8) to monitor breeding bird populations. MAPS is a continent-wide program coordinated by the Institute for Bird Populations. The LSLBO currently operates four MAPS stations and has contributed to MAPS since 1994.

The LSLBO has and will continue to assist in as many collaborative research projects as possible, including studies of moult, parasites, isotopes and breeding bird atlases. The LSLBO also conducts independent research projects, such as the Canada Warbler project. Through education partnerships, the LSLBO provides positive experiences for visitors while maintaining high standards for bird safety and data collection to promote bird conservation.

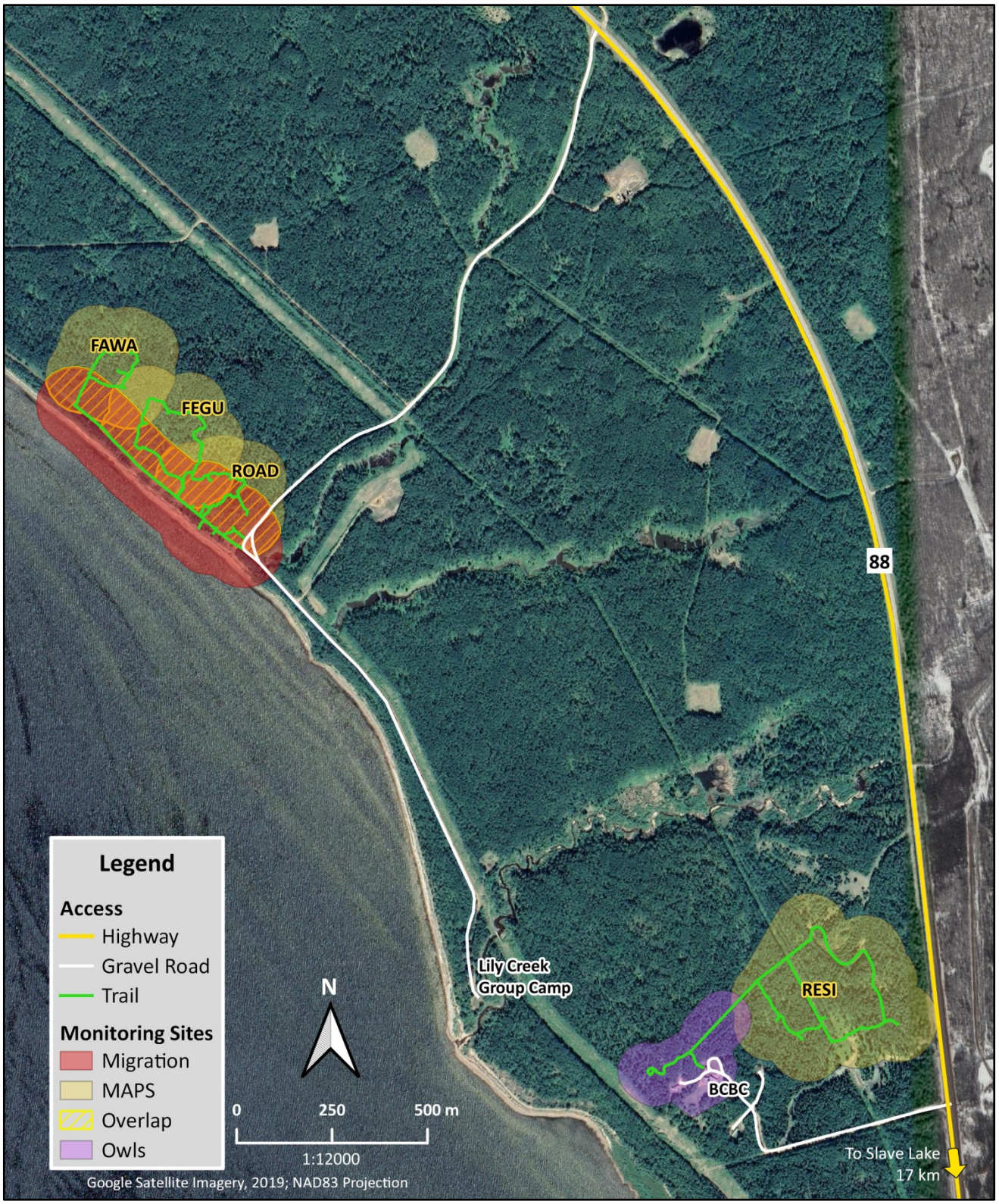

Figure 1. Overview of core study site locations within the Lesser Slave Lake Provincial Park relative to the Boreal Centre for Bird Conservation (BCBC) and the Lily Creek Group Camp.

SECTION 2: STAFF, VOLUNTEERS AND PERMITS

2.1 Staffing Requirements

The LSLBO migration monitoring site is relatively small, but can experience sudden high volumes of bird migration; therefore, two people during peak migration is the minimum for ensuring full, standardized coverage, one of them being a licensed bander. Outside of peak periods, the migration station can generally be managed by one licensed bander. The MAPS sites FAWA, FEGU and ROAD can be operated by one licensed bander, but two personnel are required to operate RESI. The owl banding program requires only one qualified staff member. Currently, the LSLBO hires three seasonal staff to oversee field operations. A 'Bander-in-Charge' (BIC), is hired for a minimum of nine months to hire additional field staff, obtain valid permits, oversee station operations, compile, verify and report data, and write reports. An Assistant Bander is hired for approximately five months. Both the BIC and the Assistant Bander are highly experienced and possess valid banding permits. Lastly, a Field Assistant with exceptional identification skills that may or may not have banding experience is hired for a minimum of four months. Having three staff members ensures that quality data can be collected in a safe manner that conforms to labour standards across core programs. The participation by volunteers, ranging from beginners to highly experienced, is an important aspect to the operation of the LSLBO and is strongly encouraged. The training of volunteers and paid assistants is the responsibility of the BIC. In the absence of the BIC, the Assistant Bander will assume the role of BIC.

2.2 Safety Protocol

All personnel should be aware of potential hazards and how to manage them by reviewing the relevant Hazard Assessment sheets (LSLBO 2019) and safety protocols (LSLBO n.d.). All staff members are required to have valid first-aid certification and a first-aid kit is required to be on-site at all times.

The primary way to ensure a safe day is for everyone to stay in contact. All staff must carry a cell phone and the BIC must have up-to-date contact information. Every spring an up-to-date contact list should be printed and posted in the lab.

The largest hazards are environmental. Minor injuries can result from slips or falls on any of the walking trails. Avoid running at the lab and wear good quality boots to minimize the risk. The sun is often overlooked as a potential hazard, but during the second half of the daily monitoring period it can become hot and heat stroke or sunburn are possible. Stay hydrated, wear a hat and apply sunscreen.

Other hazards include wildlife. The banding lab is frequented by many large animals including deer, moose, bear, coyote and wolf. Wildlife is not likely to cause any harm except breaking nets, but always be aware that wild animals can be unpredictable and even deer can be dangerous if they feel threatened. Staff are required to carry bear spray at all times and have air horns on-site in the case of threatening wildlife. Insects can also be a concern. The LSLBO does not condone the use of insect repellent for anyone who is handling birds. Operators should cover up to minimize insect bites, including wearing gloves and bug hats/jackets.

2.3 Required Permits

Several permits are required for core monitoring activities. The Bander-in-Charge (BIC) is responsible for obtaining and renewing these permits. **Scientific Permits to Capture and Band Migratory Birds** are issued to qualified operators by Environment Canada's Bird Banding Office (BBO). The BIC acts as the contact for the master banding permit, which must be renewed every three years. When banding, at least one person on-site must possess a Scientific Permit to Capture and Band Migratory Birds, whether a master permit, an LSLBO sub-permit, or a sub-permit from another master permit holder (within Alberta is the BBO's preference). All permits must be kept on-site when operations are occurring.

The following authorizations are required for the migration monitoring station:

- Band at CMMN Station (Canadian Migration Monitoring Network)
- Band incidentally captured migratory birds listed under Schedule 1 of the Species at Risk act as Threatened or Endangered, pursuant to Section 74 of the Species at Risk Act
- Band passerines and other landbirds
- Use mist-nets

In addition to the above, MAPS operators should have the "Band at MAPS Station (Monitoring Avian Productivity and Survivorship)" authorization.

Additional authorizations for owl banding are:

- Band raptors *OR* Band raptors NSWO only (if in possession of a valid Provincial…)
- Use audio lures

Wildlife Research Permits must be obtained from the Alberta Government (currently Alberta Environment and Parks Policy and Planning Division Fish and Wildlife Policy Branch). Since the LSLBO operates within a Provincial Park, it also requires a **Research and Collection Permit** issued by the Alberta Government (currently the Tourism, Parks and Recreation Parks Division). These permits must be renewed annually.

Any additional research activities will require additional permits specific to the project or study. Contact the Bird Banding Office for any required authorizations of federal permits and both of the above Albertan branches for provincial permit requirements.

2.4 Permit Reporting and Renewals

The Bird Banding Office will send out a Year End Report to the master permit holder contact. This report contains a review of the band inventory, a list of current projects and verification of the current sub-permittees and authorizations. The Year End Report must be completed by the BIC before March 1.

Similarly, both the Wildlife Research Permit and the Research and Collection Permit reporting forms are due before March 1. Reporting for both permits can be completed simultaneously by the BIC online through the Alberta Government's Online Permitting and Clearance (OPAC) system. The report includes brief justification of monitoring projects, capture totals and reporting of fatalities and injuries that occurred as a direct result of mist-netting.

SECTION 3: MIST-NETTING AND BIRD BANDING

Bird banding is an important tool for monitoring across core programs. It is the method that requires the most training and experience. Every effort must be made to ensure risks to bird health and safety are minimized. All staff and volunteers must receive proper training in bird handling and banding techniques and are required to be familiar with and follow the Bander's Code of Ethics (Appendix B) regardless of which core program they are assisting with. It is at the discretion of the BIC to determine when trainees are able to handle, extract or bands birds without supervision.

All participants at any banding station must be especially concerned with maintaining good public relations for banding. Some members of the public might understandably regard a captured bird with a certain amount of concern. For more information on public relations during banding operations as it pertains to each core program, see *Tours and Visitation* sections (4.8, 5.7 and 6.7).

The following applies to all banding and mist-netting activities at the LSLBO unless otherwise stated. For more information on using mist-nets and banding birds, see *The North American Bander's Study Guide* (NABC 2001).

3.1 Use and Care of Mist-nets

Capturing birds for banding at the LSLBO is done through mist-netting. Being non-selective, mist-nets produce a more accurate and reliable sample of bird populations and diversity than other traps.

Different mesh sizes are used for different target groups of birds; the smaller the bird, the smaller the recommended mesh size. Mesh size is measured as the length between diagonally opposite corners of a mesh square when the net is pulled taut. The LSLBO uses 30 mm mesh for small passerines and 60 mm for Northern Saw-whet Owl banding.

There are several manufacturers of nets of all sizes and specifications. The LSLBO currently uses Avinet nets made in the USA. The 12 m by 2.6 m, four-panel nets are made of 2-ply, 70 dernier nylon thread. Sources of nets and other banding equipment are listed in Appendix C.

3.1.1 Setting the Nets

Although it can be done alone, the initial set up of nets is easiest with two people. First, ensure the netlane is unobstructed and clear of major debris for its entire length. The vegetation may be overgrown and require trimming, especially when setting up for MAPS and fall migration monitoring. Place the loops (in correct order) of one end of the net on to a net pole and slide the pole over the rebar stake at one end of the netlane. Next, walk along the netlane, keeping tension on the net as it is fed out so it does not touch the ground and stays clear of vegetation. Slide the remaining loops onto the other pole. When the net is pulled taut, the pole can be placed on the rebar. The net should be checked that the loops are in the proper order and the net is not twisted. Both net poles can then be guyed to either stakes in the ground or trees such that the poles stand perfectly vertical and the net does not get stretched out unevenly. For migration the guy lines are tied to the tops of the poles. For MAPS the guy line is tied to the centre of the pole with three net loops above and two below the knot. Periodically, the net may need adjusting to ensure it does not sag. This is easily done by moving the toggle on the elastic loops. Migration nets are left in place throughout the season. When not in use, they are furled and tied closed with three cloth ties using a simple slip knot.

To open the nets, undo any ties and place them under an elastic near the base of the poles. Push the loops apart on the pole to spread the net. Long sticks painted yellow found at the ends of each net are used as to help raise and lower the panels to the proper height. The shelf strings should be spaced evenly apart and allow about 7 to 10 cm of 'bag'. Too much bag may result in birds becoming overly entangled as well as a reduced capture rate by decreasing the height of the net; too little bag will result in fewer captures as birds will be more apt to bounce out.

Ensure that the bottom panel is no lower than 30 cm from the ground at any point (roughly knee height) so that birds caught in the bottom panel do not touch the ground, where they can get overly tangled, injured, wet, or fall victim to depredation. Test this distance by dropping a couple of bird bags into the lowest panel mid-way along the length of the net. The height of the bottom panel should be adjusted according to the evenness of the netlane. Netlanes with a large dip in them, such as nets 6 and 11 in the migration monitoring site, can have the bottom loops set lower on the poles.

Make sure that everyone at the station is aware whenever you open or close a net, otherwise a set net can get forgotten because one person mistakenly assumes that everyone is aware of that net's status. Make sure to record the times the nets were set and taken down in the daily log.

3.1.2 Use of Nets

Do not open nets if it is raining, very cold (below 0 °C or when your hands are too cold to extract and band) or exceedingly windy or gusty. Do not use nets on cool (below 4 °C) windy days. If the nets are open and it starts to rain lightly or there is a heavy mist, they can remain opened, but should be checked more frequently. If the rain persists and the nets begin to show sign of being wet, they should be closed. Do not use the nets if the temperature rises above 27 °C on calm days, especially nets that are exposed to the sun. One must also be aware of predators around nets (e.g. Sharp-shinned Hawk, black bears, weasels and red squirrels). Nets should not be set or must be checked more frequently until the problem predator has left the area.

Nets can safely be used in moderate winds. On windy days, though, nets should be set with more bag and checked more frequently. When the wind is parallel to the net, close the windward (upwind) end of the net slightly to give it more bag since the wind blows it away from that end; also, make sure the leeward (downwind) end is open as wide possible. Use a bird bag to test the net bag at both ends. Netting in low winds is rarely hazardous to birds. It is, however, more apt to reduce the number of birds captured, especially if the wind is perpendicular to the net, simply due to the fact that the net may be more visible and birds may bounce out more easily.

3.1.3 Checking the nets

Once set, nets must be checked regularly. The LSLBO typically checks nets every 30 minutes. When the weather is hot, cold, damp, windy, or when there are predators around, nets are checked more frequently, ideally every 15 minutes. Net check frequency can also be increased when there are visitors around. This will reassure members of the public that bird safety is a priority and will allow staff to keep an eye on visitors and avoid intentional or unintentional harm to nets and birds. When checking the nets, it is important to walk the entire length of the net. It is easy to overlook a bird at the far end of the netlane, especially if the net is shaded or partially obscured.

Although rare, if you are catching more birds than you can process between checks, quickly collapse some or all of the nets and speed up the banding process by limiting measurements taken. In this event, the non-standard aerials (11X/12X) should be closed before the standard nets at the migration station. The entirety of a MAPS station may need to be closed and resumed the next day. In exceptional cases, it may be necessary to simply extract birds from the net and release many of them right away, unbanded. Record the species, date, time of capture and netlane of released birds. The Bander-in-Charge must make sound judgments. Do not try to set records; the health and welfare of the birds is always of greater concern. Do not allow birds to remain in nets any longer than absolutely necessary, certainly no more than 30 - 40 minutes.

3.1.4 Removal of Birds from Nets

Removing birds from the net takes a lot of training, experience and patience. It must be learned under the supervision of an experienced person, ideally the station Bander-in-Charge. Removing a bird from a net is a one-person job – two people trying to work together is seldom successful. Banders should remember this and keep their hands off the bird and net unless specifically called upon by the person removing the bird. When multiple extractors are removing birds from the same net, always ask permission/warn the other extractors if you need to raise or lower parts of the net.

Please refer to section 9.2 of the *North American Banders' Study Guide* (NABC 2001) for more detailed instruction and hints on bird extraction.

Once birds are removed from mist-nets, they are placed in soft, cloth bags which are tied closed with the drawstring to be carried to the banding lab. Only one bird is ever to be placed in a bag at a time. Place the drawstring loop around your wrist and make sure you do not swing your arms when walking (never run). Once in bags, birds should remain on your wrists until you are at the banding site. In the lab beside the banding table is a peg board that is numbered with all the net numbers. Captured birds should be hung from the appropriate peg showing which net they were caught in. Pegs are also available at MAPS banding sites where operators can use numbered clothes pins to indicate what net each bird was extracted from.

During migration monitoring, coloured clothes pegs are found at each net that are numbered with the net number. On busy days when many birds are being caught in multiple nets, clothes pegs can be clipped to the bird bag drawstring to help remember which net the bird came from. There are yellow and white pegs. The white pegs are used to notify the bander that the bird needs immediate attention and should be processed first, including species at risk (i.e. Canada Warblers), injured or stressed birds, 'broody' females or fledglings. Birds that are injured, stressed or females with developed eggs in their oviduct should be released at the net and recorded as unbanded including the species, nature of injury, date, time, and netlane in the daily records. Yellow pegs are used for healthy, normal birds. For MAPS and owl banding, pegs can be brought into the field on the straps of the bags used for holding bird bags.

Bags are only used once before being laundered as a means of preventing the spread of disease and parasites. Take care to ensure bags are completely dry after washing to make them an inhospitable environment for parasites. Laundry facilities are available at the staff residence. Inspect cloth bags every time they are laundered to make sure there are no large holes. Repair any holes or broken drawstrings on the bags regularly and keep the drawstrings knot-free. To avoid tangles in loose threads, bags are best used inside-out (seams on the outside).

3.1.5 Closing the Nets

Always close, furl, and tie all nets at the end of each day's banding. During every net check and before closing the nets, remove any insects, leaves, twigs, etc. If you do not, they become entangled, and the net is much harder to open or it may tear. To close the net for the day, lower the top panel and pull the bottom four loops together on the pole to about waist height. Next, furl all the lower panels into the pocket of the top panel. Then, close the top panel and give the net a couple of final quick furls. Tie the nets closed with three cloth ties using a slipknot. If left untied, the loops can separate and the net can come open.

Keep an eye on weather conditions as inclement weather can arrive quickly. Nets can be left open with more frequent checks if a light, brief rain is falling. However, nets should be closed quickly if it starts to rain hard or if a storm seems imminent (wet birds can die of exposure). After making sure the net is empty, quickly collapse the loops and give the net one or two loose furls before going to the next net. If weather improves opening will be easy. If poor weather precludes netting for the remainder of the day, then the nets should be properly furled and tied.

In the rare event that the station is to be left unmanned for more than a few days, take the nets down completely. Allow nets to dry if wet or damp or they may rot. A plastic grocery bag works well for storing nets. Feed one of the bag handles through the net loops from below and feed your hand through the bag loop so that the handle rests on your wrist and the net loops are hanging from the bag handle below your wrist. Next, lift the pole off the rebar stake and set it aside. As you walk towards the other end of the net, use your empty hand to feed the loose net into the bag. When you reach the other end of the netlane, feed the other bag handle through the net loops from the bottom and tie the bag handles.

3.1.6 Maintenance of the Nets

Daily maintenance includes checking that guy lines are tight, the net is taut and clear of debris. Guy lines should be flagged so that people do not trip over them or their stakes. When setting up the nets each day, check to make sure the netting is not caught on the tethering knots of the top panel. Otherwise the netting will get progressively more knotted reducing the size of the top panel. Keep netlanes trimmed of weeds, branches, etc. which can catch on the net.

Make any possible repairs on nets as soon as possible (e.g. broken loops, shelf strings, holes and tears), before the damage gets worse. Holes can be repaired with a needle and thread. Do not use nets that are rotten and tear easily, or that have too many irreparable holes. Portions of many such nets should be salvaged (e.g. loops and shelf strings can be saved for future repairs). Damaged and irreparable netting should be burned so it cannot become a hazard to wildlife.

3.2 Bird Banding

Procedures for capturing and processing birds are described in great detail in several manuals that can be found in the operations binder and will not be elaborated on here except where LSLBO procedures differ. These materials are required reading for all new staff and long-term volunteers, especially those with little or no previous experience (Appendix A).

All birds captured fall into three categories: new bandings, recaptures and unbanded.

3.2.1 New Bandings

Any bird captured which does not have a band and is not exempt from banding according to the LSLBO's banding permit should be banded using data collection methods and sheets specific to each monitoring program.

3.2.2 Recaptured Birds

Recaptured birds fall into three categories: repeats, returns and foreign recoveries. A 'repeat' is a recapture of a bird that was banded at the same station less than 90 days prior. A 'return' is a recapture at the same station more than 90 days after original banding. A 'foreign recovery' refers to a bird that was banded elsewhere and recovered at the LSLBO.

Always process recaptures and double-check the band number against that written. Foreign recoveries are extremely rare, and you cannot afford to miss them. Also, the rate of repeats and returns is used to determine breeding status, turnover rates and stop-over times of birds at the station. For many analyses, recapture data can be more valuable than data collected on a bird captured only once and never recorded again.

When you process a recaptured bird, first check the banding records and the recapture sheets to see if the bird has already been handled that day; if it has, release it and record the capture time and net in the comment section of the first daily record for that bird. If it is new for the day, all data must be collected for that recapture. Each bird should be aged and sexed on the basis of what you observe. Repeating someone else's errors does not do anybody any good.

3.2.3 Unbanded Birds

Birds may go unbanded for several reasons: birds can escape at the net, in the lab before being banded, or be purposefully released due to injury or a high volume of birds captured. Unbanded birds can also include species exempt from the LSLBO's banding permit - upland gamebirds and hummingbirds for instance. Escapes are defined as birds that have escaped from the net with human assistance either through direct contact or indirectly through contact with the net in proximity to the bird. Birds that have extracted themselves from the net without any human interference are not considered captures.

A separate recapture sheet (clearly labelled "unbanded") can be used for recording unbanded birds; as much information as possible should be included. Recording data for unbanded birds is useful for determining capture rates as accurately as possible.

3.2.4 Foreign Recoveries by the Public

Members of the public sometimes bring in dead birds or report them to banding stations. Get all pertinent details of these recoveries: species, age, sex, band number (if banded), when and where the bird was found, how it died, and the name and contact of the person who reported it. Whenever possible, double-check the band number. Report all information for band recoveries online on Report a Band. If the body was brought in and is in good condition, it may be placed with a record of the above details in a plastic bag into the BCBC's freezer for donation to the Royal Alberta Museum's collections.

3.2.5 Data Collected from Captured Birds

There are several levels of priority for collecting data from captured birds (Table 1). All captured birds, even those left unbanded, require the collection of data in level 1, while all processed birds require the data in level 2. Measurements in levels 3 and 4 are to be collected whenever possible, but may be omitted if captures are unusually high. Additional measurements that may be required for MAPS fall into level 3. For more details on measurements and scoring systems, see the *Identification Guide to North American Birds* (Pyle 1997) for aging and sexing and *MAPS Manual: 2020 Protocol* (DeSante et al. 2020) for all other measurements except muscle and primary moult scores, which are described in Appendix D.

Table 1. Priority for data collection of birds captured in mist-nets (see Section 4.5.3).

1. All captured birds:	**2. All processed birds:**	**3. When time permits (in order of priority):**
Banded, recaptured or left unbanded	*Banded or recaptured*	*Banded or recaptured, especially unusual species*
a. Date (dd/mm/yy) b. Species (4-letter) c. Time of capture (24h) d. Netlane number	a. Full band number b. Age / how aged c. Sex / how sexed d. Initials of bander processing the bird	a. Wing chord (unflattened, mm) b. Additional information used for species, age or sex determination c. Flight feather moult score d. Weight (nearest 0.1 g) e. Fat score f. Cloacal protuberance score g. Brood patch score h. Body moult score i. Flight feather wear score j. Muscle score k. Skull ossification score (fall)
4. For unusual species, plumages, diseases, deformities, or other notable features: take photos with a note of who took the photo on what device (recorded in "comments" column).		

3.2.6 Releasing Birds

All birds should be released immediately after they are processed. The release method is to gently slide the bird out of the weighing tube onto the platform located directly outside the release hatch. Although most birds take off immediately, the platform gives the bird a place to sit and get its bearings if it has become disorientated during the process. Try to place the bird far enough out on the platform and block the window to prevent the bird from attempting to fly back through the window and into the lab. If banding outdoors, slide the bird out of the weighing tube onto your hand or another stable surface.

Some birds should be returned to the site where they were captured instead of being released at the banding site; these include:

1. Females with a heavy brood patch or egg in her oviduct
2. Dependent juveniles (indicated by a growing tail)
3. Adults and dependant young birds captured together suspected of being a family group

In exceptional circumstances, birds waiting to be banded in the lab should be released (unbanded) if they have been kept longer than an hour. Record the number and species of birds released along with the check time and net lane.

3.2.7 Injured Birds

Although uncommon, bird injuries do occur and anyone working at the station must know how to correctly handle the situation. Injuries can vary in severity from torn out pin feathers to broken legs or worse. These injuries can be a result of the bird being attacked by a predator, hitting the net with enough force to strike the ground, pulling a wing or leg muscle while struggling, or many other circumstances. Injuries can occur due to improper extraction techniques, but this is inexcusable and all persons should receive proper training. Birds can also become stressed at any point during the process; stress is just as dangerous to the bird's well-being as an injury. Signs that a bird is overly stressed include: nodding its heads back, closing its eyes, puffing up all its feathers, panting or shaking.

If you approach a bird in the net that you see is injured or overly stressed you should extract it as carefully as possible to avoid further injury. If the injury is minor and the bird does not appear to be overly stressed it can be brought to the lab for processing; ensure that the bag it is in is marked for immediate attention with a white clothes peg. If the bird has a major injury, such as a broken leg, it should be released immediately. The LSLBO is not equipped to care for injured birds correctly and attempting to vet the bird can result in greater harm. Birds are extremely resilient and many birds can survive if left to nature. If the injured bird is unable to fly, walk it away from the netlanes and deposit it in a sheltered location either on a branch if it can perch or on the ground if it cannot. Record as much pertinent information as you can gather, without causing more stress, about the bird in the unbanded datasheet. Also record the injury in the casualties section of the daily logs sheets including the species, date, time and suspected cause.

If you encounter a bird in the net that is dead, whether due to depredation or stress, you should extract it and collect the body for donation to the Royal Alberta Museum. If too damaged, deposit the body in the forest away from the net. Record any dead birds in the casualties section of the daily log sheets, including the species, date, time and suspected cause. Consider closing the net or reducing time between net checks to 15 minutes.

After any injury or fatality, re-evaluate the event and determine if something could have been done better to prevent it from happening. If the injury was a result of the bird striking the ground or an object near the net, adjust the net so that it is at the proper height and ensure that the lane is clear of debris so it will not happen again. If the injury was a result of depredation, assess if the predator is still in the area and close the net if you believe the predator may strike again. If the bird was suffering from extreme stress ensure that it is not because the nets are not being checked well enough, also be sure that weather conditions are favourable for mist-netting. Although it is impossible to prevent all injuries, it is the responsibility of all personnel at the lab to do everything in their power to prevent harm coming to birds captured at the LSLBO.

SECTION 4: MIGRATION MONITORING

4.1 Study Area

The migration monitoring station is roughly 2 km north-west of the Boreal Centre for Bird Conservation (Figure 1). The habitat within the study area is primarily poplar-spruce mixed woods, willow and alder shrubbery, limited grassy areas, cobble lake shores that may have limited sand and open lake water as far from shore as the viewer can see (Figure 2). The Count Area for the migration monitoring program does not have specific outer boundaries, but is defined as the area that can be surveyed by observers moving along the netlanes and their trails, the census route, the lakeshore and the parking lot. Any birds seen or heard by observers who are within the count area during the count period may be included, regardless of whether the birds themselves are within the count area, including all birds on or over the lake seen by the naked or aided eye.

4.1.1 Maintenance of the Study Area

Upkeep of netlanes and trails is done primarily with hedge clippers, a handsaw, and a gas trimmer. Maintenance activities attempting to keep the habitat at a steady state are not permitted within the Park. It is the responsibility of the people visiting the Lesser Slave Lake Provincial Park to know and respect Alberta Parks regulations. Keeping the area clean of garbage is not only crucial to keep it as natural as possible, but also to prevent attracting unwanted and dangerous wildlife (especially bears).

4.2 Data Collection Periods

The migration monitoring program collects data during both spring and fall migration. Spring migration monitoring occurs from mid-April (weather dependent) to June 10 and fall migration monitoring runs July 12 to September 30 although some years may have different start or end dates. The daily data collection period begins half an hour before sunrise (defined as morning civil twilight end) and ends no earlier than five hours later on poor weather days and seven hours later on fair weather days. For example schedules of daily activities, see Appendix E.

4.3 The Techniques Used in Migration Monitoring

The Daily Total (DT) is an estimate of the total number of individuals from each species detected during the daily monitoring period and is derived from the totals of four monitoring techniques: census, visual migration watches, captures and incidental observations. By compiling observations from multiple techniques and excluding duplicates between counting methods, the DT provides a better estimate of counts for more species than any count method taken individually. Details on the collection of DT component data appear in the following sections, while instructions for calculating the DT are at the end of Section 4.4.

During the migration monitoring season, work directed towards producing DTs takes precedence over other station activities, including maintenance and visitor education. A census, a number of visual migration watches, and banding are usually done daily, but if time or resources are limited, the census and visual migration watches take priority, followed by mist-netting. Even during poor-weather days, fair coverage is entirely possible and expected. There has been some remarkably heavy migration activity on days of very foul weather when the mist-nets could not be opened.

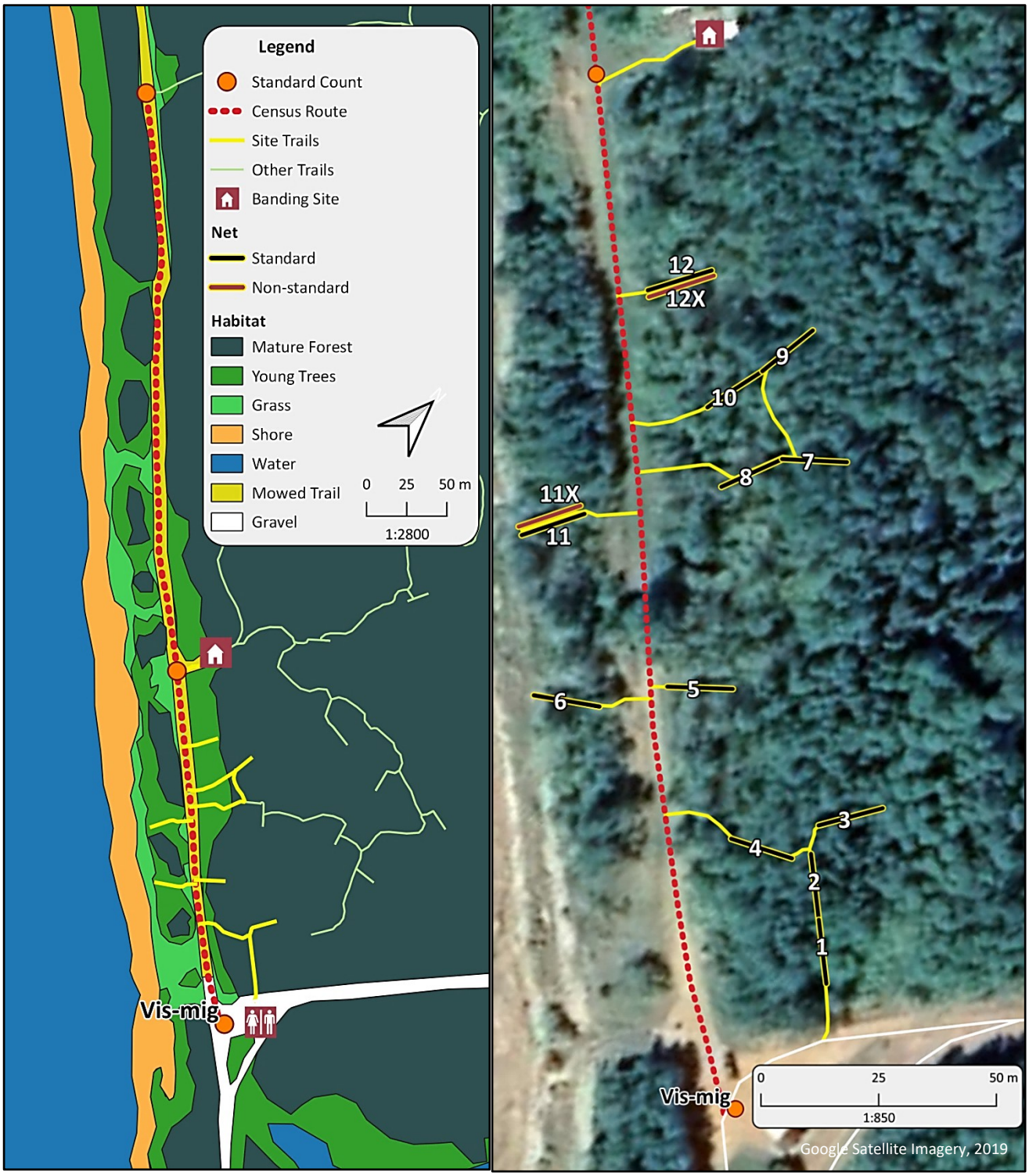

Figure 2. Map of migration monitoring station including locations of census route, standard count locations, netlanes, trails and banding site with inset of net locations. All netlanes are unique to the migration monitoring program. See section 4.1 for boundaries of the count area.

4.3.1 Census

A daily census is conducted during the first two hours after sunrise, unless there is inclement weather. In this case, the census start can be delayed until three hours after sunrise. In the event that only one person is operating the station, the census should be started as soon as possible after net opening to ensure it is completed before the nets become busy. Alternatively, with one operator the nets can be collapsed to run census at the normal time as necessary. The census should be completed in 30 minutes give or take 10 minutes. The census route is about 700 m along the Trans Canada Trail, from the entrance to the FAWA MAPS site to the parking lot (Figure 2).

All birds seen or heard along the census route are to be recorded, except those captured in the nets. Observers are required to use binoculars, but using a spotting scope is prohibited. Birds observed during the census are to be recorded on the left hand side of the back of the vis-mig datasheet. The start and end times of the census as well as the initials of the observer(s) are to be recorded in the top left hand corner. Census data should represent the total number of birds seen or heard from the census route, however, personnel should not use the 30 minutes trying to chase down every last bird. If you cannot identify a species, do not guess, but try to identify it as closely as possible (e.g. *Empidonax* spp., warbler spp.). "Pishing" or "squeeking" to lure a shy bird out from under cover for identification purposes is acceptable; however, this should not be done habitually or near the nets. Write a note in the narrative section of the log sheet if you feel you missed a large proportion of the birds because of exceptional circumstances (e.g. flying overs were too high to identify accurately).

The census should either start or end by conducting one of the visible migration watches (vis-mig; section 4.3.2). Start and end points are dependent on the season. In spring, the census route is to be walked to the southeast, starting near FAWA and ending with a vis-mig in the parking lot. During the fall it is run to the northwest, starting in the parking lot with a vis-mig and ending near FAWA. Five minutes are to be spent recording birds at each of three spots, namely the start and end points (one of which includes a vis-mig), and at the picnic table set along the trail in front of the banding lab. The distance between these points should be walked at a slow, steady pace with occasional brief stops to look and listen for birds. Birds observed visibly migrating in the vis-mig that happens during census should be included in the census list, but underlined so they can be added to the appropriate column of the vis-mig datasheet after the census has been completed. When compiling Daily Totals, subtract these migrating birds since they have been counted simultaneously for both census and visible migration watches.

Qualified personnel should take turns completing the census. The census can be done by more than one person if it does not negatively impact station operations. At least one person on the census should have an observer code of 1 (section 4.4.1). Combined efforts of experienced birders and those being trained for census are necessary until trainees are competent and confident enough to complete the census on their own (as judged by the BIC).

4.3.2 Visible Migration Watches

Anytime during the day there can be a constant flow of small songbirds, the occasional raptor, waterfowl or shorebirds flying through the area. It is important to record all birds in the area, not just those caught in the nets or detected during the census. Since visible migration occurs over many hours, it is impossible to count all the birds migrating in a standardized way. Therefore, monitoring overhead migration must be done in short time periods that are as standardized as possible. A five minute visible migration watch (vis-mig) is to be conducted once during each hour block of the daily monitoring period. Vis-migs are done in the parking lot (Figure 2) where the sky is not obscured by the forest canopy. The

watch can be done anytime during each hour block, but are ideally done close to an hour apart. If conditions do not permit equal spacing, then consecutive vis-migs should be at least 30 minutes apart. If two or more people are present, one person can begin opening the nets while the other conducts the first vis-mig. If only one person is staffing the station, the first vis-mig should be done before net opening. If weather does not allow for net opening, the vis-mig can be started upon arrival at the site. A minimum of six hourly vis-migs should be conducted daily, but preferred coverage is eight hourly vis-migs (early in each of the seven hours of the count period and another at the end of daily coverage).

Only birds deemed to be visibly migrating are to be recorded. Visibly migrating birds are those that are flying through the area without stopping (or only pausing briefly) and not significantly changing course. Birds seen during the watch which are not deemed to be visibly migrating are not included, but can be recorded as incidental observations. Judgment is required to avoid double or multiple counts of flocks or individuals milling around the area. Generally, only birds migrating in the 'normal' direction (i.e. north in spring and south in fall) should be counted on vis-migs. Occasionally, birds may undergo a 'reverse' migration, where the majority of flight is going against the expected direction. This can occur if skies are severely overcast and birds become disoriented or are avoiding an incoming front bringing inclement weather. These birds should be recorded, but with their totals circled to be added to incidental totals in the daily logs (not vis-mig totals) and included in a separate column of the vis-mig excel spreadsheet.

The observer should always be one of the most highly skilled birders present at the station. Qualified observers should take turns conducting vis-migs throughout the day, but one observer can be designated as the official observer and recorder each day.

Observers are required to use binoculars during vis-migs, but using a spotting scope is prohibited. If you cannot identify a species, do not guess, but try to identify the bird as closely as possible (e.g. yellowlegs spp., warbler spp.). A Visible Migration Datasheet (Table 2, Appendix G) should be present with the counter during the vis-mig to allow for quick recording of both visibly migrating and incidentally observed birds during the count period. Fill in the time at which each count is started along the top. Write the initial(s) of the observer(s) conducting the watch below the time. List any species observed by its four-letter code in the column on the left. Fill out the number of birds for each species observed in the appropriate count period. Total the number of birds in each row. At the end of the day, the total for each species is tallied and entered into the "Total" column. Make sure the vis-mig datasheet is dated.

Table 2. Example selection a of visible migration watch datasheet from late August. Numbers include birds recorded during the vis-mig segment of the census (count #3 below; see section 4.3.1). Circled value indicates reverse migration that is added to incidental totals, not vis-mig totals.

Time	605	707	807	909	1007	1101	1200	1306	
Initial	RGK	RNP	RGK	RNP	RGK	RNP	RGK	RNP	
Species	1	2	3	4	5	6	7	8	Total
MYWA		2,2,1,3,1,2 11	48	14,3,5,15, 10,10,5,3,3 11,3 82	5,2,3,4,3, 3 20	4,2,16,2,2, 1 27	2,2 4	1,4,1,3 9	201
UNWA		2,1 3	9	1,3,2,3,1,1, 2 13	2,1 3	2 2	(3)	2,2 4	34

Hints for quickly estimating the number of birds in large flocks on a vis-mig (or other observation):

1. Count birds in a section of the flock, then extrapolate by counting the number of similarly-sized sections. Seek agreement among observers.
2. Counts should be conservative, but do not be afraid of arriving at high numbers. It is just as bad to grossly underestimate as to grossly overestimate.
3. While it is important that counts be firmly based upon observations (do not include extrapolations of birds that 'were likely going by' but no one was observing), do not argue over whether there were 200 geese or 210. It is more important that the counts are not out by an order of magnitude.
4. Estimation is allowable solely to pick a number for a large group that could not be counted accurately.

4.3.3 Captures

The use of mist-nets and banding to record bird activity requires skill and practice. All participants should be familiar with the required reading materials pertaining to mist-netting and banding (Section 3, Appendix A). One experienced person (generally the most experienced staff member on-site) shall be designated as the Bander-in-Charge (BIC) at all times. The BIC is responsible for ensuring that mist-netting and banding is conducted safely and in accordance with this protocol.

The LSLBO operates 12 consecutively labeled nets at standardized locations (Figure 2, Appendix F) during migration monitoring. Nets are four panel, 12 m by 2.6 m with 30 mm mesh size for small passerines. The 12 standard net locations were chosen because of the following characteristics:

1. Optimal locations (in terms of capture rate) with some variety of habitats and orientation to provide shelter from windy conditions.
2. Accessible to the banding lab and can be monitored in a single five minute walk, not including time taken to remove birds from the nets.

In 2010, the LSLBO added two aerial nets set parallel to and above the standard nets 11 and 12. The purpose of these nets is to evaluate the potential effects that changes in vegetation are having on the capture rates and diversity of birds captured at the LSLBO. The style and size of the aerial nets is identical to the standard nets. When set, the bottom of the aerial net should be slightly above the top of the adjacent standard net. The aerial nets should be operated daily unless weather conditions prevent it or if only one qualified bander is present at the observatory during the peak of migration.

Banding occurs daily throughout the migration monitoring period when it is safe to do so (section 3.1.2). The standard banding period extends for seven hours, with net open starting half an hour before sunrise and net close starting six and a half hours after sunrise. Ideally, all nets should be opened during the seven hour period. However, at times this may not be possible. Opening and closing of nets is at the discretion of the BIC. Such discretion will be exercised with regard to on-site personnel, weather conditions and/or excessive numbers of birds. During the peak of migration in spring (last half of May) and fall (last week of July to first half of August), caution should be exercised when first opening nets. If there is a high capture event and some nets need to be collapsed, nets 11X and 12X should be shut first. These nets are frequently the most productive, but the best trend analyses will be based on standardized captures only (nets 1-12). In the exceptional case that capture volumes are still too high, the busiest standard nets should be closed (generally, but not always nets 6 and 11).

If only one person is present and there is a lot of bird activity in the area, nets should be collapsed during the census (if it was not completed earlier in the day). However, if activity is low, nets need not be closed during the census provided it can be completed in about a half hour. If more than one staff person is present, the census should not affect banding operations unless it is extremely busy.

Birds banded outside of the standard banding period must not be included in the Daily Totals. The use of additional nets during the standard banding period is not permissible except in extraordinary circumstances (such as setting a temporary trap to catch a rare bird), and should only take place if the additional nets will not capture birds that might otherwise be captured by the standard nets or aerials, and the location data and hours of operation of additional nets are recorded in the 'Non-standard Nets' section of the daily logs. The use of extra nets must not impede or take precedence over any standard or aerial nets. Birds captured in additional nets during the count period are to be recorded as non-standard captures in the daily log, as are the net opening and closing times.

The use of bird attractants such as water drips is prohibited; as is the practice of baiting the areas around the mist-nets with food. Birds should not be purposefully flushed, 'pushed' or scared into any of the standard nets.

4.3.4 Incidental Observations

Incidental observations include all other birds seen in the count area incidental to banding and other standardized counts during the daily monitoring period. They can include birds seen on net rounds not captured in the nets, birds seen during vis-migs which were not deemed to be visibly migrating, and casual observations in the area throughout the period. Observers can use binoculars and spotting scopes. Indicate if a spotting scope was used in the daily logs since this can increase waterfowl counts. Do not rely on mental notes for these observations. Record any bird seen or heard as soon as possible on the right hand side of the back of the Visible Migration Watch datasheet. Observers will confer regularly with other each other and at the end of the daily period to avoid recording individual birds multiple times.

Only incidental observations made within the count area and standard monitoring period will be included in the daily log sheets. Other notable sightings in surrounding areas or outside of the standard monitoring period can be mentioned in the narrative section of the daily log.

4.4 Completing the Daily Log

Monitoring data must be reported carefully in the daily log sheets by field personnel each day. If left until later, or for others to do from field notes, records could be missed, forgotten or entered incorrectly. All data recorded must be as complete, accurate and legible as possible, using a dark lead pencil or black ink.

The log sheets are mostly self-explanatory and consist of six pages (Appendix G). Pages 1 and 2 of the daily log describe effort, weather and other notes. Pages 3 to 6 consist of the bird observation and capture data. Explanations of each field with examples are shown below. All pages of the log sheet must be individually dated.

4.4.1 Page 1 and 2

Observers and Banders: Record full names of personnel contributing to the Daily Totals. Each observer will be assigned an observer code by the BIC according to their identification skills as follows:

1 - able to identify > 75 % of birds routinely encountered in the area
2 - able to identify 50 – 75 % of birds routinely encountered in the area
3 - able to identify < 50 % of the birds routinely encountered in the area

Each observer contributing to the DTs should record their start and end times of observation and the total number of hours spent in the count area recording birds during the count period. Time spent off-site or in the banding lab should not be included. "Total observer hours" is the sum of the "hours" column. If the spotting scope was used during the count period, circle "Y", if not, circle "N".

Visitors: Record the number of visitors to the station. If possible, provide names of persons or organizations, a rough description of the demographics (e.g. child, adult, senior, place of residence, etc.) and separate drop-ins from scheduled tours.

Weather: Once in every two-hour period, record the time at which the following records are made (preferably at first light, mid-morning, noon, and subsequent times after). List wind direction and wind speed (Beaufort scale, Table 3), precipitation descriptions, sky (cloud cover in tenths), temperature (Celsius), relative humidity and barometric pressure. At the end of the count period, record a weather synopsis including unusual phenomena.

Table 3. Beaufort scale of wind strength.

Beaufort	km/h	Description
0	< 2	Calm, leaves still
1	2-5	Light air movement
2	6-11	Wind felt on face, leaves rustle
3	12-20	Leaves and twigs in constant motion
4	21-30	Raises dust and loose paper, small branches move
5	31-40	Small trees in leaf begin to sway

Netting effort: The time of net opening(s) and closing(s) is recorded for each net. Total net-hours are calculated at the end of the day. If non-standard nets are of different sizes than standard nets, their dimensions must also be recorded.

Census: Record the start and end times, duration and observer initials of the census.

Visible Migration Watches: Record the start time and observer initials for each hourly block.

Coverage Codes: The codes assigned are based only on coverage in the standard count period:

1. **Standard mist-netting:** Divide the total number of standard net-hours by 84 (maximum standard net-hours) for a value between 0 and 1, recording to three decimals.
2. **Vis-Mig:** Divide the number of vis-migs conducted by 10 to get a code between 0 and 1.
3. **Census:** If a census was conducted, the code is "1", if not, the code is "0".
4. **Overall:** An overall code is assigned based on the quality of coverage (Table 4). All the minimum criteria must be met. Observers should strive for the highest code possible with the available staff, resources and weather conditions.

Table 4. Criteria for overall coverage codes; field hours are mandatory, other methods as described.

Code	Description	Minimum Criteria
0	None	No coverage
1	Casual	1 field-hour by a class 2 or better observer and **any one** of the following: census; **or** 4 visible-migration watches; **or** netting coverage code >0.1
2	Poor	2 field-hours accumulated by **1 or more** class 2 or better observer; **and either** 4 visible-migration watches; **or** 0.25 netting coverage code and a census
3	Fair	4 field-hours accumulated by **1 or more** class 2 or better **and any two** of the following; 6 visible-migration watches; census; **or** netting coverage code 0.5
4	Good	6 field-hours accumulated by **1 or more** class 1 observer; 7 visible-migration watches; census and 0.5 netting coverage code
5	Excellent	At least 10 field-hours accumulated by **3 or more** class 1; 8 visible migration watches; census; and netting coverage code 0.9

Migration Monitoring Daily Summary: The number of birds and species are recorded in the relevant columns. Incidental observations and unbanded birds are included in the Daily Total, but not summarized here.

Narrative: Record station activities including a general description of bird activity at the station and surrounding areas during that particular day. Include interesting observations of birds, other animals, plant-life, strange weather occurrences, and lake ice conditions. If other projects were carried out, then list those as well as their success. Keep a record of what maintenance work was done by whom. Also note any rare species caught or seen. Do not use species codes; they may change in the future. Long informative narratives are much more valuable than short ones.

Other Wildlife: Record other animal sightings and behaviour.

Nests Found: Record the species, current state of use, number of eggs and the location of nest.

Plant Records: Record botanical observations.

Casualties: Record any bird injuries or fatalities that were a direct result of banding operations. Note the species, time of capture, netlane, as well as the cause of injury/mortality if known (e.g. depredation) and any steps taken to treat an injury or if the body of a deceased bird was collected for donation.

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Lesser Slave Lake Bird Observatory - Daily Log Date 27 / Aug / 2018 (Day / Month / Year)

Observers and Banders	Code	Start	End	Hours
BIC Nicole Krikun	1	605	1315	6
Robyn Perkins	1	605	1315	6
Michelle MacMillan	3	630	1315	4·5
Total observer hours				16·5
Spotting scope used				Y / (N)

Weather	4:00-6:00	6:00-8:00	8:00-10:00	10:00-12:00	12:00-14:00
Time		630	840	1015	1215
Wind Dir.		-	NW	NW	NW
Strength(Bf)		0	1	1-2	2
Precip.		-	-	-	-
10th cover		9	10	10	7
Temp (°C)		7	8	9	12
R. H. (%)					
Bar. (mb)					

Visitors:
BOT: 2 adults
12 kids

Weather synopsis:
Cool and calm becoming warm and breezy

Netting Effort

Standard Nets						Non-Standard Nets						
Net #	Time up	Time down	Time up	Time down	Hours	Net #	Time up	Time down	Time up	Time down	Hours	Mesh & size
1	605	1305			7	11X	605	1205			6	
2	‖	‖			‖	12X	605	1305			7	
3	‖	‖			‖							
4	‖	‖			‖							
5	‖	‖			‖							
6	‖	1205			6							
7	‖	1305			7							
8	‖	‖			‖							
9	‖	‖			‖							
10	‖	‖			‖	Total non-standard net-hours					13	
11	‖	1205			6							
12	‖	1305			7							
	Total standard net-hours				82							

Census			
Start	End	Min.	Initials
807	837	30	RNP

Visible Migration Watches										
Period	4:00-5:00	5:00 -6:00	6:00 - 7:00	7:00 - 8:00	8:00 - 9:00	9:00 -10:00	10:00 - 11:00	11:00-12:00	12:00-13:00	13:00 -14:00
Time			605	708	807	909	1007	1108	1207	1306
Initial			RNP	NDK	RNP	NDK	RNP	NDK	RNP	NDK

Migration Monitoring Daily Summary						
Totals	Banded	Retrap.	Captured	Census	Vis mig	DET
# Birds	63	6	69			
# Sp.	17	3	17	20	4	64

Coverage Codes	
Std. mist-netting	0·976
Vis. Mig.	0·8
Census	1
Overall	4

Lesser Slave Lake Bird Observatory - Daily Log Date 27 / Aug / 2018

Narrative:

This morning was cool with wet nets for open· The rest of the morning remained cool and the wind picked up mid-morning, closing the shoreline nets· The first gray-cheecked thrush was banded and a white-crowned sparrow was spotted near the lab again· After a burst of reverse migrating warblers (most myrtle) in the early morning, bird activity became low overall· A white-throated sparrow fledgling was banded on closing round· Despite overall low bird activity, banding was good with 63 birds - 22 of which were Swainson's thrush·

Signed: Robyn

Other wildlife:
2 white-tailed deer - one doe, one buck

Plants:

Nests found:

Casualties/Injuries:
OVEN in net 3 @ 805, cut on back of neck actively bleeding, cause unknown, released at net

Figure 3. Example page 1 (left) and 2 (right) of daily log datasheets summarizing monitoring efforts and events.

4.4.2 Pages 3 to 6

The remainder of the daily log is a list of commonly observed species and columns of monitoring activities. Take care to enter values into the correct rows and columns as shown in the following example (Table 5) and described as follows.

Table 5. Selection from late August as an example for completing pages 3 to 6 of the daily log. Note: both Song Sparrows were counted incidentally and on census, all Lincoln's Sparrows were deemed to be unique individuals (5+3=8). Four White-throated Sparrows overlapped across count methods (12+8+15-4=31). Three unidentified sparrows overlapped in the vis-mig during census (4-3+9=13).

	Captures						Census		Vis	Incidental		Daily	
Species	Band	Rec	NS Band	NS Rec	Tot Cap	PKS	Tot	PKS	Tot	Obs Tot	PKS	DT	PKS
Sparrow, Song							2	2		2	2	2	2
Lincoln's	4	1			5	1				3	1	8	2
White-throated	10	1	1		12	1	8	4		15	6	31	7
Unid. sparrow							4		3	9		13	

Probable or Known Stop-overs (PKS)

Ideally, only newly arrived migrants in the daily count should be used for determining population changes. For data analysis, stopover individuals and residents are not a relevant part of the daily count and should be removed from the data. However, the study site has several species breeding locally which are also target species for monitoring. There are also occasions when genuine migrants have resided in the area for several days, generally due to inclement weather. These birds are considered probable or known stop-overs (PKS). In an effort to 'clean' capture, census, incidental observation and Daily Total data to reflect new migrants only, several PKS columns have been provided in the daily log.

Birds that meet the following criteria should be entered into the appropriate PKS column. It is quite possible that a single bird can be counted in each PKS column. For example, a locally banded Black-capped Chickadee could be recaptured, seen on census and seen on net rounds a few days later. This bird would be recorded as PKS in each appropriate column, but the overall PKS will be one chickadee and not three. PKS birds are included in the total for the associated categories, including the Daily Total. Table 5 provides additional examples of PKS birds and how they may impact DT calculations.

PKS Criteria:

1. Individuals recognized by plumage, behavioural characteristics, injury or rarity as having been present on a previous day.
2. Birds recaptured from previous days banding. This should be extended to estimate numbers in stopover flocks even when only part of the flock was trapped previously.
3. Birds that were not trapped, but are seen daily and are almost certainly breeding nearby (e.g. Song Sparrow, American Redstart, Common Raven, Black-capped Chickadee).

Captures

At the end of the day, captures for each species are tallied in the first six columns with the following exceptions: unbanded birds are to be included in the incidental counts and only the first instance of recapture for same-day recaptures is to be included.

1. **Band:** new bands within the standard period caught in standard nets (1 through 12).
2. **Rec:** birds which are already banded and recaptured in standard nets.
3. **NS Band:** birds captured in non-standard nets, including all birds captured in aerials (11X/12X).
4. **NS Rec:** birds recaptured in a non-standard net, including aerial nets.
5. **Tot Cap:** total number of new bands and recaptures from **all** nets for each species (add columns 1 through 4).
6. **PKS:** probable or known stop-overs. These birds are believed to be breeding locally or staying in the area for more than one day. Any 'repeats' (birds originally banded within same season) will be considered as stop-overs and entered into the PKS column (see above).

Census

After census is completed or at the end of the day, the species can be tallied and entered into the "Census Tot." column, including birds counted on the vis-mig that occurred during the census period. Probable or known stop-overs recorded on census are entered in the associated PKS column.

Visible Migration Watches

At the end of the day, the total for each species observed during the vis-migs is tallied and entered into the "Vis. Tot." column of the daily log, including the census overlap, but excluding reverse migrants. Since birds counted using this method are clearly migrating, there is no associated PKS column.

Incidental Observations

The incidental total for each observed species is entered in "Obs. Tot" regardless of known double counting between observation methods (i.e. the calling loon on the lake heard before census was recorded as an incidental observation even if the census taker has recorded the same bird). This is done so that analyses of component data are independent. Unbanded birds and reverse migrants are included in this total. Probable or known stop-overs detected as incidental observations are entered in the associated PKS column.

Daily Totals

The Daily Total (DT) is an estimate of the total number of individuals from each species detected during the daily monitoring period from all counting methods and includes PKS birds. The DT should be compiled after all other record-keeping for the day has been completed, and should be done with all personnel who contributed observation records present. This is to ensure that all birds observed are accounted for and none are recorded multiple times. If someone must leave before all others, a preliminary consensus of what has been seen to that point should be determined. The DTs should be done every day to prevent confusion between what birds were seen on what days.

The total number of birds observed through captures, visual migration watches, census, and incidentals ("Tot. Cap.", "Vis. Tot.", "Census Tot." and "Obs. Tot.", columns in the log respectively) are largely independent, since they are arrived at independently. However, there may be some overlap. For example, a bird heard singing before census would be recorded as an incidental observation. This same bird may be encountered during the census. The bird should be entered in both columns since they

relate to results from two separate activities. However, if the totals for incidental observations and census were simply added together, the DT would be falsely inflated. Conservative judgment must be used to record individuals that were counted using two or more methods so that they are represented as one individual in the DT. As a consequence, numbers in the “DT” column are never more than the sum of the DT components, but they can be less than this sum as is the case for all species except Lincoln’s Sparrow in the example provided (Table 5).

Helpful tips on how to arrive at Daily Totals:

1. Complete entry of the component data first (captures, census, vis-migs and incidentals).
2. Run down the list of species asking if anyone has any other observations to add.
3. If birds were steadily passing through the area in one direction and none were seen moving in the opposite direction, it can be confidently assumed that they were always different birds.
4. If one Swainson's Thrush was seen on the census and two were seen together later on in the same area, there might be reason to assume that one of the two birds was the same individual seen singly on census. In that case the DT should be two (not three).
5. If two female Black-throated Green Warblers were seen and then someone saw a male, then record a DT of 3.
6. In general, get a feel for who saw what, when, where and the circumstances.
7. Remember to subtract the overlap between census and the vis-mig performed during census.

4.5 Completing Banding and Recapture Datasheets

4.5.1 Banding Datasheets

Each sheet should only be used for one band size and the sheets for the different band sizes should be divided for easier record keeping. To speed data entry, ditto marks (**“**) on the banding sheets are acceptable when the same information is repeated on successive data lines for the following columns: species code, date, time, age/how, sex/how and bander initials. Band numbers should never repeat and netlane number and other measurements must be written out so they are not misinterpreted as “11”. Leave a field blank if the data was not taken.

Begin each datasheet by completing the fields at the top of the sheet, especially “First band”. After the complete band number for the first band has been recorded, successive bands can be referred to simply by their last two digits. There are 25 lines of data on a banding sheet so strings of 100 bands will take four complete pages (records 1 - 25, 26 - 50, 51 - 75 and 76 - 100). If a partial string of bands is to be used (e.g. because it was started in the previous season), then record the first band number on the appropriate line on the banding sheet, so that the page will end with the band number ending with 25, 50, 75 or 100. Record lost or destroyed bands as "Band Lost" or "Band Destroyed" on the appropriate line for that band. If lost or destroyed, the next data line must be filled out completely (e.g. re-enter the data as if you were starting a new sheet), with no ditto marks to avoid confusion during data entry and proofing. At the bottom of each page is space for species totals to provide a brief verification of recorded data and to explain changes in species codes overtime. Complete the “last band” field by recording the full band number before putting it on the bird. This will give clues in the case of misread band numbers.

4.5.2 Recapture Datasheets

Recapture datasheets are very similar to banding datasheets and only the differences will be explained here. Full band numbers must be written out for every recapture and never copied with ditto marks. Fields for band size, first band, last band and species totals are removed. There is no need to split recaptures by band size or to start recording anywhere on the datasheet except at the top.

4.5.3 Capture Data Categories

The following supporting information is required on all migration monitoring banding and recapture datasheets, except those fields omitted for recaptures:

- **Licensed banders (initials):** List the names of active banders with valid banding permits. Also list the bander's preferred three-letter initials. Banders should keep the same initials on all subsequent visits.
- **Assistants (initials):** List the names of those helping and/or learning bird banding and their preferred three-letter initials.
- **Scribes:** List volunteers recording banding and recapture data, but not banding themselves.
- **Location:** These sheets can be used in other locations, therefore provide the current location.
- **Band size:** Give the size of the band used on all of the birds on that page.
- **First band:** Give the complete band number of the first band to appear on the sheet.
- **Year:** The current year.
- **Page:** Fill in the sequential page number for each band size or page of recaptures.
- **Last band:** Give the complete band number of the last band to appear on the sheet.
- **Totaled:** Initials of the qualified bander who totaled the number of birds of each species.
- **Entered:** Initials of the qualified bander who entered the data into Bandit.
- **Proofed:** Initials of the qualified bander who proofed the entered data against the originals.

Required Information

There is a minimum of information to be collected for each bird captured at the LSLBO. Even on busy days when there is a back-log of birds, this information must be filled out.

- **Band number:** The complete band number is required for all recaptures. New bands need only the last two band numbers recorded (the full band number is listed at the top).
- **Species code:** Give the current four-letter species code for the bird being banded.
- **Date:** The date of the capture (Month/Day).
- **Time (24-hour):** Exact time of the start of the net-check during which the bird was extracted, not the time when it was banded or weighed.
- **Netlane ("NL"):** Record the number of the netlane where the bird was caught.
- **Age/how aged:** Give the age and the code describing justifications of the age assignment. **Sex/how sexed:** Give the sex and the code describing justifications of the sex assignment.
- **Initials ("In'l"):** Record the initials of the bander who processed the bird.

Desired Information

All data listed below should be collected if possible, but some measurements may be omitted if there is a backlog of birds that must be cleared. Wing length, primary moult, weight (but not time of weighing) and additional measurements for age or sex determination are higher priority than other data.

- **Wing length (mm):** Measure the wing chord of an unflattened wing from wrist to longest primary on folded wing held in a natural position (Pyle 1997).
- **Wing wear:** Amount of wear on the outer four primaries of the wings (DeSante et al. 2020).
- **Muscle ("Mu"):** Score for the breast muscle development (Appendix D).
- **Cloacal protuberance ("CP"):** Size of the cloacal protuberance (DeSante et al. 2020).
- **Brood Patch ("BP"):** Development of the brood patch (DeSante et al. 2020).
- **Fat:** Amount of fat on the bird (DeSante et al. 2020).
- **Skull pneumatization ("SK"):** Amount of pneumatization of the skull (Pyle 1997).
- **Weight (g):** Weight of the bird to the nearest tenth of a gram.
- **Body moult ("BM"):** Extensiveness of the moult (DeSante et al. 2020).
- **Primary moult ("PM"):** Moult score of the primary flight feathers according to the system described by Ginn and Melville (1983; Appendix D) beginning at the outermost primary (p10) and moving inward to end on the innermost secondary (s6).
- **Other measurements ("Other Measur."):** Any extra measurements, including tail length bill length, tarsus length, wing formula, etc.
- **Comments:** Discrepancies between banding manuals, descriptions of abnormalities, suspected age, injuries or parasites of a particular bird.

4.6 Migration Monitoring Station Start-up and Shutdown

When setting up the station each season, be sure to place nets of the same type and length at the locations specified in Appendix F.

4.6.1 Spring

Start-up: Supplies are stored in the lab, basement lockers or the "Researcher" office in the Boreal Centre for Bird Conservation (BCBC).

1. The deep-cycle batteries are in the storage room of the banding lab. The cells should be topped up with distilled water to just above the plastic plates. Flip the switch on the yellow box on the wall to power the building. Check the solar panels are unobstructed.
2. Poles are stored in the entrance area of the banding lab, with guy ropes attached.
3. Spare guy ropes and numbered clothes pegs are in the storage room of the banding lab.
4. Yellow sticks for opening the nets are behind the lab's main entrance door.
5. Nets are stored in the lockers in the BCBC. Refer to the section on mist-net use and care for instructions on setting up the nets (Section 3.1).
6. All datasheets are found in Appendix G and digital copies can be found on the LSLBO computer. Photocopies can be made at the office. Always use the most current forms available.
7. Banding supplies including bands, pliers, wing rulers, scales, bird bags, books and manuals, binoculars, scopes, and stationary supplies are stored in the lab or the BCBC.

Shutdown: At the end of the spring migration monitoring season, nets should be placed in bags with the net number written on a ribbon attached to a loop at the end of the net. They should be mended before

being taken down for the summer or between MAPS periods. The nets can be kept in the locked cabinet in the storage room. Bands and banding equipment can be stored in the cabinet as well. Net poles can remain on the rebar, but guy ropes should be tied up, away from rodents.

4.6.2 Fall

Start-up: Maintenance should be performed on overgrown vegetation in the trails and netlanes. Nets should be put back up in their corresponding netlanes and banding equipment reorganized.

Shutdown: Put equipment back where you found it for spring start-up in the banding lab, lockers or offices.

1. Nets must be taken down and stored dry and labelled. Nets are stored for the winter in a box with a few mothballs.
2. An inventory of bands must be made so an order can be placed to the Bird Banding Office for new bands for the following year.
3. All bird bags should be laundered, dried, repaired and stored in bins.
4. Expensive or difficult to replace equipment should be brought to the BCBC and locked in the appropriate lockers.
5. Net poles are labeled, tied together by their guy ropes, which do not need to be removed from the tops of the poles, but may need to be tightened. Poles are stored in the entrance area of the banding lab.
6. Gas powered tools (weed eater) should be drained of gasoline.
7. The switch on the yellow box in the lab's storage room should be flipped to turn off power to the lab and the batteries should be topped up with distilled water to just above the plates.
8. The banding lab should be cleaned, swept and mopped.
9. The white board should be erased, cleaned and placed in the storage room.
10. All windows and doors need to be closed and locked.

4.7 Habitat Monitoring

When the site was originally established the habitat-type was young riparian mixed-wood with adjacent mature mixed-wood behind it. Since the study site is within a protected area, the habitat has not been managed and has consequentially matured substantially, potentially affecting capture rates.

In the summer of 2011 the first comprehensive vegetation surveys were conducted at all of the standard netlane locations. The 2011 survey became the benchmark for habitat assessment at the LSLBO to analyse the impacts of habitat succession on capture rates at the observatory (Linfoot 2011). Vegetation assessments and standardized photographs are expected to be taken every five years during: 2017, 2022, 2027, 2032 etc. unless the schedule has been otherwise modified or significant habitat changes occur that merit immediate documentation.

4.7.1 Vegetation Assessments

Measurements around the netlanes adhere to the *Measuring Vegetation* sections of the *BBird Field Protocol* by Martin et al. (1997). Starting in 2022, additional monitoring will be performed along the census trail using methods described in the *MAPS Habitat Structure Assessment Protocol* (Nott et al. 2003) to monitor site-wide conditions. Habitat assessments should be done during the summer between the end of spring migration and the beginning of fall migration. This time period is ideal since the vegetation is at its fullest and the netlanes are empty. The centre of each vegetation survey corresponds to the centre of the netlane as marked by a metal peg permanently buried in the ground (Figure 4). All equipment can be found in the BIC's office.

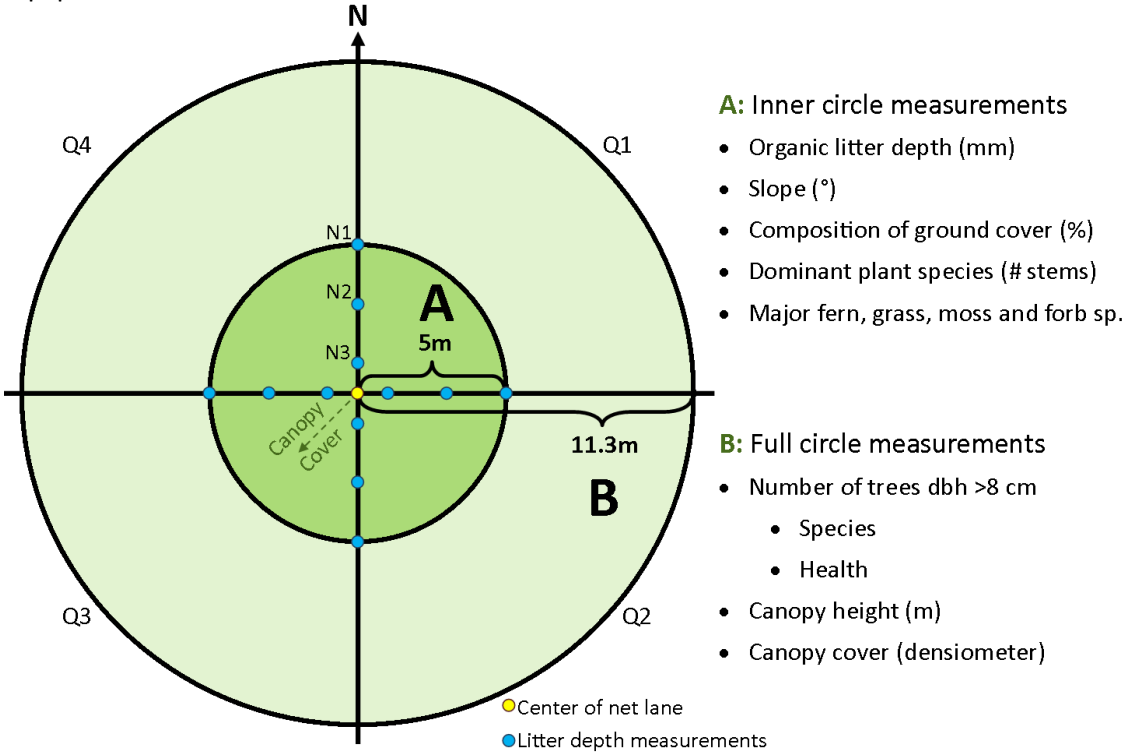

Figure 4. Summary of the sample area for vegetation measurements around netlanes.

Although surveys are not required for nets 11X and 12X since they overlap with nets 11 and 12 (which are surveyed), if additional non-standard nets or traps are created (cannot capture birds that would otherwise be captured by standard nets), a habitat assessment must be performed for those traps during the year that they are first operated. Surveys are completed again for additional traps on the normal schedule.

If a large-scale disturbance 'resets' the habitat to a much earlier successional stage, habitat assessments should be performed more frequently since the rate of habitat change will be rapid after a severe disturbance. Once the habitat has again reached a more mature stage that is experiencing very gradual change, assessments may be performed on a five year schedule.

In the event that LSLBO staff are not capable of the plant identification required for these surveys, they can approach several local organizations for training or collaboration, including the Lesser Slave Forest Education Society, Alberta Parks, local forest industry personnel or volunteers known to have strong plant identification skills.

4.7.2 Standardized Photography

Habitat assessments should be supplemented by photographs in the summer (June to early July) of each netlane to provide a visual summary of the habitat at full growth representing conditions experienced by most birds for late spring migration, breeding, and most of fall migration. Preliminary analysis of the impacts of habitat succession on capture rates suggest that birds are moving through the area differently when the trees are bare than when they are fully leafed-out. Therefore, photographs should also be taken during either the spring (late April to mid-May) or the fall (late September through October) of the same year to show the habitat without leaves, similar to that experienced by migrating birds in the early spring and late fall.

Starting in 2022, photographs must be taken using the following standardized methods for easy comparisons between years. Prepare the netlane by putting net poles on the rebar if the nets are not already set-up. Vertically place the marked measuring sticks found underneath the banding lab five meters from the camera for each direction (north, east, south and west from center). Photos should be taken with the same field of view as the previous years' photographs. To accomplish this, place the camera on the spotting scope's tripod at full height (approximately 1.5 m) on the center of the netlane as marked by the permanent metal peg. Use a compass to take photos facing north, east, south and west. Check vegetation features are clearly visible and adjust the camera's settings if necessary to provide more clarity. Additional photos should be taken using the same methods at the picnic table near the banding lab and in the parking lot from the coordinates in Appendix F.

4.7.3 Computerization of Habitat Monitoring Data

For habitat assessment data, create a new excel file using the previous year's formatting in the "Netlane Vegetation" folder that can be found using the following file path:
Documents > Data > Migration Monitoring > Habitat Monitoring > Netlane Vegetation
Update the year of the "Vegetation 20XX" filename and enter the data.

For photographs, create a new folder labeled with the current year in the "Netlanes" folder:
Documents > Data > Migration Monitoring > Habitat Monitoring > Habitat pictures > Netlanes
Add all photos with the following naming conventions, where photos taken in the summer begin with "S" and those in the late fall or early spring begin with "F"; "X" is the net number; direction is indicated by a "N" for north, etc.; and end with the date that the photo was taken:

S/F Net **X N/E/S/W – DD MMM YYYY**

For example, F Net 8 E – 01 Nov 2011 was taken when the trees were bare in net 8 facing east on November 1, 2011. If additional photos were taken, add "A" to the end of the standard photo's file name and "B", "C", etc. to the end of the additional photos.

4.8 Tours and Visitation

In 2006 the Boreal Centre for Bird Conservation (BCBC) was built as a partnership between the LSLBO and Alberta Parks. The BCBC is within the Lesser Slave Lake Provincial Park and is an education and research centre. It offers interpretive displays as well as environmental education and outreach programs designed to nurture stewards of the boreal forest. Since the establishment of the BCBC, tours, visitations and educational programs at the LSLBO have increased. This increase in visitors to the observatory means that a new protocol has been implemented to ensure that the public has a rewarding experience without disrupting monitoring activities or compromising the well-being of the birds being banded.

The LSLBO has always encouraged an 'open-door' policy. Educating the public and fostering a desire to learn about and to conserve birds is so important to the LSLBO that it is part of our mission statement, "dedicated to bird conservation through research and education". With that in mind though, it is important that boundaries and guidelines be set for how to properly manage visitors and give banding demonstrations.

4.8.1 Managing Visitors

Random drop-in visitors during the summer are common and the LSLBO staff will give as much time as they are able to explaining the research we do and demonstrating banding. However, if it is busy with heavy migration or high captures, the monitoring activities of the station always take precedence over visitors. Gently explain your priorities and describe the etiquette for visitors during these situations and they will generally be content with minimal conversation. Between net checks, suggest they explore the areas north of the lab or the shoreline away from the nets.

For scheduled tours, programs or events at the LSLBO, a Parks or Boreal Centre interpreter must be present. The interpreter is able to answer questions and to explain what is being done for the public without it disrupting monitoring activities. During any tours, the interpreters are not to bring the public into any of the netlanes unless invited by the person doing the extracting. No bird should be placed back into the net once it has been extracted for the purpose of showing the extraction process. Visitors are not to 'hover' around the netlanes unless explicitly allowed by LSLBO staff. Since many of our netlanes are visible from the main path, curious visitors can reduce capture rates as birds avoid the area and can stress out birds in the net, causing escapes or even injury. Interpreters are to always set up the demonstration net near the lab building when guiding tours or scheduled drop-ins to allow visitors to see nets in a controlled environment, keeping birds safe. Staff at the BCBC are encouraged to call ahead when possible for drop-in visitors and to enquire about the status of the nets and banding operations to manage visitor expectations. It is entirely possible the nets may not be open.

There is no reason why visitors cannot be shown birds in nets and traps that are properly set, operated and tended, or be allowed to watch a competent and experienced bander remove and band the birds. However, visitors should not be brought into netlanes. Trainees should not operate in the public eye until they have developed the necessary skills and are comfortable with an audience.

4.8.2 Banding Demonstrations

The LSLBO gives many banding demonstrations to visitors, whether they are drop-in or part of a scheduled tour. Demonstrations typically include discussions of what banding is, why we band birds and interesting facts or conservation concerns about the species being banded. In the occurrence of a busy day with a high volume of captured birds, processing the birds in an efficient and timely manner takes precedence. Detailed demonstrations will not be done whether they are for drop-ins or scheduled tours, although visitors are allowed to silently watch banders work at a normal speed and at the bander's discretion. Interpreters may be repurposed as scribes.

While in the banding lab, visitors are required to stay relatively quiet and the invitation or removal of visitors from the lab is at the full discretion of the bander. How many people, and how close to the bander they are allowed to stand is also at the discretion of the bander. Visitors are not allowed to pet or handle the birds in any way. Similarly, visitors are not to touch any banding or other research equipment. Photography of the birds is allowed, but avoid putting cameras too close to the bird, surrounding it with multiple cameras, or blinding it with a high-powered flash.

Regular banding should take little more than a minute for an experienced bander. For the sake of giving a demonstration and explaining the banding process, banding will take longer, but the bird should not be on display for more than five minutes. If there are multiple birds to be banded, the demonstration should be split up between the different birds so that each bird is on display for a shorter amount of time. Remember, you can still explain about the banding process, the research, and answer questions after the bird has been released.

Certain birds are not well suited for demonstrations and should not be used, including:

1. Species that can become stressed easily such as, but not limited to, Eastern Phoebes, Kinglets, and Cape May Warblers.
2. Threatened species such as Canada Warblers.
3. Females with large brood patches.
4. Any bird captured during late spring or early fall that is likely feeding young.
5. Fledglings.
6. Any bird that is already stressed or injured in any way.

If there is programming occurring in the parking lot and a bird has been captured that is suitable for demonstration, the banders should alert the interpreter on their way back to the banding lab. Time should be given for the group to arrive at the lab, but no bird should be held in waiting for longer than five minutes before being processed. No bird, rare or otherwise, should be held for visitors coming from the BCBC or the campground.

SECTION 5: NORTHERN SAW-WHET OWL MIGRATION MONITORING

Northern Saw-whet Owls (*Aegolius acadicus*) are the target species of this monitoring project because they are small and easy to handle, are attracted by audio lures and their migratory behaviour allows for the capture of adequate sample sizes. Since the LSLBO is one of the few owl banding stations located within the boreal forest portion of the Saw-whet Owl's range, data collected are valuable, despite relatively low capture rates.

After the first Northern Saw-whet Owl was banded by the LSLBO at the MAPS site FEGU in 1997 and a nest was found in 2000, this species was confirmed to breed locally. The first attempt at owl migration monitoring occurred in 2000 in late September. The results were encouraging and suggested that an extensive monitoring project was feasible. Unfortunately, further work on an owl monitoring project was not pursued until 2004 when voluntary efforts laid the framework for this protocol. In 2013, efforts for owl banding were formalized and improved as the program shifted from voluntary to a core monitoring program.

Nightly banding and observations are used during the fall to determine population demographics, biometrics and long-term population trends. Northern Saw-whet Owls may be negatively affected by human induced changes to the environment; they are a secondary cavity nester and require mature forests for breeding. They also need a healthy prey base consisting of small rodents and songbirds. Some of these rodent populations have cyclical patterns, which are mirrored by fluctuating owl populations. Long-term monitoring is critical to interpret these fluctuations as temporary natural responses to prey cycles or as permanent population declines caused by habitat loss or degradation.

5.1 Owl Study Area

Owl banding is performed out of the offices in the Boreal Centre for Bird Conservation. When operations began in 2004, nets were placed close to staff accommodations (Figure 5, nets 1A to 4A). However, due the conversion of the original netlanes into a septic field, frequent noise interferences from the lake and staff housing and noise disturbances to staff living in the accommodations, the nets had to be moved in 2013. The standard nets are now located in a straight line along the trail to the MAPS site RESI beginning approximately 70 m from the junction to the Songbird Trail (nets 1 to 4). The habitat surrounding the nets is mature conifer-dominated mixedwood. Since 2016, additional non-standard nets (5 and 6) have been set-up approximately 20 m east of the south-east section of the Songbird Trail for a trial Boreal Owl monitoring program with a Boreal Owl audio lure projecting only 100 m.

5.2 Owl Data Collection Period

Northern Saw-whet Owl banding occurs from September 1 until October 31, depending on weather and staffing conditions. Monitoring is performed on fair weather nights. The standard operating period begins one hour after sunset and ends four hours later.

If the nets cannot be safely opened, operators do not have to attempt owl monitoring. Conversely, if banding is busy and coverage has been low, monitoring may continue after the standard operating period at the bander's discretion. Care must be taken to mark all observations and bands during this extra period as non-standard. Operations cannot begin earlier than one hour after sunset as this may influence capture rates in the standard period.

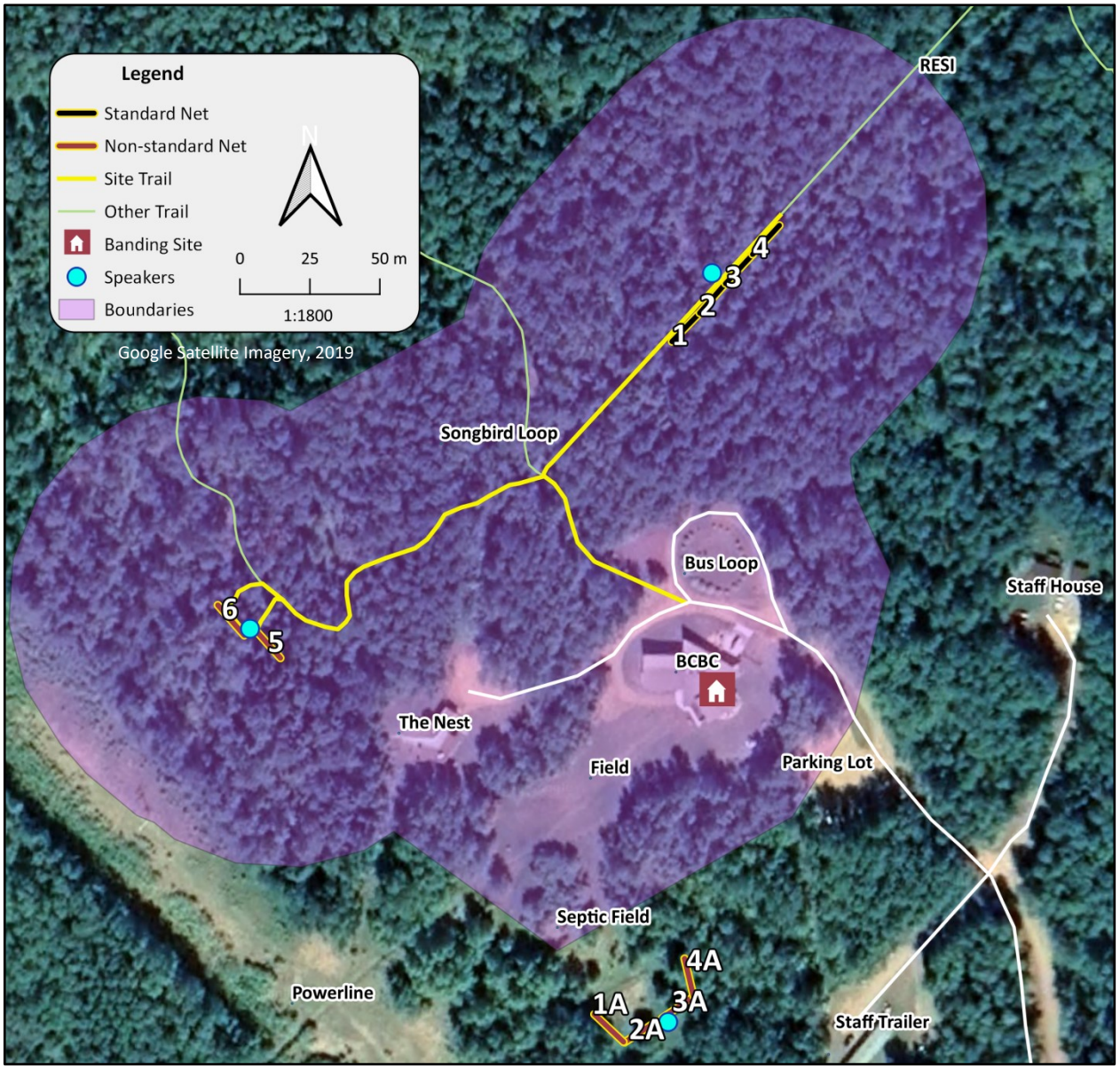

Figure 5. Map of the owl migration monitoring station, including station boundaries, active and historical netlanes, trails, roads, banding site, and names of reference locations to be used when making nightly observations.

5.3 The Techniques used in Owl Migration Monitoring

5.3.1 Mist-netting

Please consult the *Mist-netting and Bird Banding* section of this manual for more information (Section 3). Four standard nets will be set an hour after sunset (12 m x 2.6 m with 60 mm mesh), unless there is rain, heavy snowfall or if the temperature falls below -15 °C. Banding should not occur if the wind speed is above three on the Beaufort Scale (Table 3) since strong winds 'blow out' the nets and reduce the broadcast range of the audio lure. Nets are to be checked every 30 minutes.

To attract the owls to the nets, a CD player is placed near the centre of the nets. Under calm conditions, the call should be clearly audible 200 m away from the speaker and faintly audible 300 m away (for example, near the staff trailer). After finding the volume required to achieve this broadcast range, the volume setting is fixed at the same level with the speaker in the same orientation on all following visits. The CD player should be raised from the ground approximately 50 cm to protect it from the elements and from being trampled. An umbrella or plastic bag may be placed above the CD player if light precipitation is expected. All power sources should be recharged at the end of every night and spares should be available. A standard call sequence with the Saw-whet male breeding call has been made and can be found in the silver CD player and on the computer. The lure CD is played continuously for the entire four hours. If a different call sequence is to be tested, it must be done outside of the standard banding period or at a separate non-standard net array far enough away to not interfere with standard captures.

5.3.2 Banding

The techniques used in the processing of owls is basically the same as that done in migration monitoring, although not all of the same data are required. Owls can be processed in the "researcher" office or in the lab in the basement of the BCBC. Rooms upstairs cannot be used due to the large, open concept ceiling. All owls must be aged and sexed. Age is determined by moult patterns of the primary and secondary flight feathers (Pyle 1997). Owls express multiple generations of flight feathers as they age, so moult patterns of the primary and secondary flight feathers are recorded on the moult page (Section 5.4.3). If an owl is hatch year (HY), a moult card is not required. Sex is determined by Brinker's (2000) wing length to weight ratio (Appendix D). Other data collected includes crop and comments of interest.

5.3.3 Release

The preferred method of release is to place the owl on a branch near the trunk of a spruce tree. This will provide the owl time for its eyes to readjust in safety. If multiple owls were captured, they should be placed in different trees. Trees should be used at random so banders are not developing a pattern that discerning Barred Owls could potentially decipher.

5.3.4 Observations

Observations of owls and other wildlife seen or heard will be recorded throughout the duration of the banding period. This information includes the species, time of the observation, type of observation (distress call, breeding call, seen, etc.) and the approximate distance and direction from the nets or the BCBC. All observations will be recorded in the "Observations" section of the data sheets. Observations are incidental and most observations will be made on net checks.

5.4 Owl Datasheets

5.4.1 Completing the Nightly Log

Full datasheets for the nightly log are found in Appendix G.

Date: Date that banding began.

Observers: Names of staff and volunteers performing owl banding. Visitors to owl banding can be written in the blank space along the right-hand side of the table.

Start/End time: Time in 24-hour format that the nets were opened/closed.

Net hours: Record the number of standard net-hours across nets (maximum 16). Non-standard net-hours, if accumulated, are written in brackets after the standard hours.

Moon phase: Circle the phase that the moon is in, even if it is not visible.

Snow depth: During the first weather check, sink a tail ruler into an average section of snow and record the snow depth (mm).

Weather: Weather data is first taken before the nets are opened and then again every hour.

- **Time:** The time during which the weather data was taken.
- **Temperature:** The temperature in Celsius.
- **Cloud:** Cloud cover in tenths.
- **Wind speed:** Breeze and gust speeds using the Beaufort scale (Table 3).
- **Wind direction:** General direction the wind is coming from.
- **Precipitation:** Type and relative intensity of precipitation.
- **Moon visible:** If the moon is visible, circle “Y”, if not, circle “N”.

Banding: Summarize the captures for the banding period in the appropriate columns. Record non-standard captures in brackets.

Comments/observations: Use this space to record additional comments on the weather, injuries or fatalities, detailed observations of owls and other wildlife, interferences with the audio lure, reasons for standard net-hour reductions, sources of non-standard hours, or any other events of note.

5.4.2 Completing Banding and Recapture Datasheets

Datasheets for new bands and recaptures are the same as those used for migration monitoring (Appendix G). All required information described in sections 1 and 2 of Table 1 must be collected. For owl banding, wing length and weight are additional required measurements on all owls. Be careful when recording the date as it often changes during the banding period each night.

Desired Information

Not all data in the columns to the right of the bander's initials are required. The following is desired, but may be omitted on extremely busy nights.

- **Crop:** Record if the crop is full, partially full, or empty in the "Fat" column.
  - **1:** Crop is empty.
  - **2:** Crop is not empty, but less than ½ full.
  - **3:** Crop is roughly ½ full.
  - **4:** Crop is over ½ full, but not exceptionally bulging.
  - **5:** Crop is bulging.
- **Body moult ("BM"):** Record the extensiveness of the moult (if any).
- **Primary moult ("PM"):** If recorded separately on the moult sheet, note the corresponding moult sheet page and row numbers.
- **Comments:** Write comments on discrepancies between banding manuals or descriptions of abnormalities, suspected age, injuries or parasites of a particular bird.

5.4.3 Completing Moult Datasheets

For all owls older than hatch year, a moult card must be completed (Table 6). Record the band number. If the moult pattern is the same on both wings, record "L/R" in the "Wing" column. If it is not, record the left wing ("L") and right wing ("R") separately using two rows. On feathers that are in pin, describe the feather development using codes one through four in the system described by Ginn and Melville (1983; Appendix D). For feathers of the same age, the first and last feathers in the track must be coded. Feathers in the middle can have a straight line drawn through them. Be careful to distinguish codes for stage "1" growth (will be very rare) from codes for intermediate ages by always including the horizontal lines for "I". On feathers that are not in pin, record the suspect age of each feather:

- **Juvenile (J):** A feather with strong evidence of being a juvenile feather.
- **Old (O):** A feather that appears to be the oldest. This category can also be used for feathers that are suspected to be juvenile, but the evidence is weak and uncertainty is high.
- **Intermediate (I):** A feather that appears to be neither the oldest, nor the newest.
- **New (N):** A feather that appears to be very fresh with good condition; rich browns and glows bright pink under the UV lamp (Ginn and Melville code "5" equivalent).

Table 6. Example moult cards for a second year with asymmetrical moult and an actively moulting owl.

		Wing	Primaries										Secondaries											
Row	Band	(L/R)	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0924-51854	L	N	—	—	—	—	—	N	J	—	—	—	—	—	J	N	—	—	—	—	N			
2	"	R	N	—	—	—	—	N	J	—	—	—	—	—	—	J	N	—	—	—	—	N			
3	0924-51882	L/R	3	4	N	N	O	O	I	—	—	I	N	N	I	—	—	—	—	I	N	N			

5.5 Owl Station Start-up and Shutdown

Start-up: Maintenance should be performed on overgrown vegetation in the trails and netlanes.

1. Yellow sticks, rebar and poles corresponding to each net are stored in the shed near the staff trailer, with guy ropes attached.
2. Nets labeled for each netlane are stored in the lockers in the BCBC. Refer to the section on mist-net use and care for instructions on setting up the nets (Section 3.1.2).
3. Banding supplies including pliers, bands, wing rulers, the scale, the UV lamp, CD players, call sequence CDs, reference sheets, spare guy ropes and numbered clothes pegs are stored in the lockers in the BCBC.
4. All datasheets are found in the researcher office filing cabinet or in Appendix G. Digital copies can also be found on the LSLBO computer. Photocopies of the datasheets can be made at the office. Always use the most current forms available.
5. The large, white bird bags should be separated from the songbird bags at the migration lab.

Shutdown: Put equipment back where you found it in the storage shed, lockers or offices.

1. Nets must be taken down and stored dry and labelled. Nets are stored in a box with mothballs.
2. All bird bags should be laundered, dried, repaired and stored in bins.

5.6 Owl Habitat Monitoring

Starting in 2022, measurements of the vegetation around the owl banding netlanes are to adhere to the BBird Field Protocol (Martin et al. 1997) using the same methods as the migration monitoring habitat assessments (Section 4.7). Habitat assessments should be completed every five years during the summer alongside surveys in the migration monitoring and MAPS sites. Since there are high degrees of overlap between the standard owl nets, only nets 1 and 4 are assessed in detail. Standardized photography should be taken for every net using methods explained in the migration monitoring section during the early fall (early September) and again after all of the leaves have dropped (the end of October).

5.7 Owl Tours and Visitation

Owls are an incredible medium to teach the public due to their natural charisma. Every effort should be made to encouraging visitor and volunteer participation. However, since operations are based out of a government building (the BCBC), additional staff are required to manage visitors during owl banding activities and this often limits the educational potential for this program. Visitors cannot be left in the BCBC unattended, nor can they come on net checks. As a result, drop-in visitation is not permitted.

Most years, a handful of local organizations and school groups observe owl banding. The classes observe a banding demonstration when possible, are given a slide-show presentation on owls of northern Alberta, and participate in other activities such as owl pellet dissections. Banding demonstrations should take the same precautions as those outlined for songbirds (Section 4.8). Although demonstrations can take somewhat longer than for songbirds, extra care should be taken to release the owl somewhere not only safe from predators, but from visitors as well.

SECTION 6: MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS)

This manual only summarizes the MAPS project and how it applies to the LSLBO. For specific details on MAPS procedures, techniques, and datasheets please see DeSante et al. (2020). MAPS is a continent-wide cooperative project coordinated by the Institute for Bird Populations. It allows bird banding site operators to contribute to an ongoing study of breeding bird population trends. The program requires standardized mist-netting and observational data collected during the breeding season.

6.1 MAPS Study Areas

The LSLBO operates four MAPS stations, all within the Lesser Slave Lake Provincial Park (Figure 1). Since the stations are located within a park, they should remain unchanged over the years, allowing for highly standardized methodologies and thus consistent data. The stations are: ROAD (the site nearest the access road), FAWA (stands for Far AWAy; named because it was originally the farthest away from other study sites), FEGU (FErn GUlley; named for a stretch of tall Ostrich Ferns near an intermittent stream) and RESI (located close to the staff RESIdence). The access to ROAD (Figure 6) and FEGU (Figure 7) can be found behind the migration monitoring banding lab just past the Stevenson screen/instrument shelter. The entrance to FAWA (Figure 8) is approximately 700 m north from the parking lot along the Trans Canada Trail. RESI (Figure 9) is located near the Boreal Centre for Bird Conservation and can be accessed following a trail that branches off to the north from the Songbird Loop. Although the areas for observational data collection overlap between MAPS and migration monitoring, netlanes are unique to each site.

6.2 MAPS Data Collection Periods

ROAD, FEGU and FAWA were all first established in 1994, while RESI was established in 2000. FEGU was closed in 2000, but reactivated in 2003. All sites have been run every year since. The MAPS program operates from approximately June 11 to August 8 (Table 7). Six hours of constant-effort mist-netting begins at approximate local sunrise time. The program should be run for at least six consecutive ten-day periods during the breeding season. The nets at each site must be operated for one day during each ten-day period, leaving at least six days between visits for each site. Since the fifth and sixth periods overlap with the start of fall migration monitoring, it is important that enough manpower is present during this period to maintain the operation of both projects simultaneously.

Table 7. Standard date ranges, start and end times for MAPS periods monitored at the LSLBO.

Period	Dates	Standard Start	Standard End
5	June 11 - 19	5:00	11:00
6	June 20 - 29	5:00	11:00
7	June 30 - July 9	5:10	11:10
8	July 10 - 19	5:20	11:20
9	July 20 - 29	5:30	11:30
10	July 30 - August 9	5:50	11:50

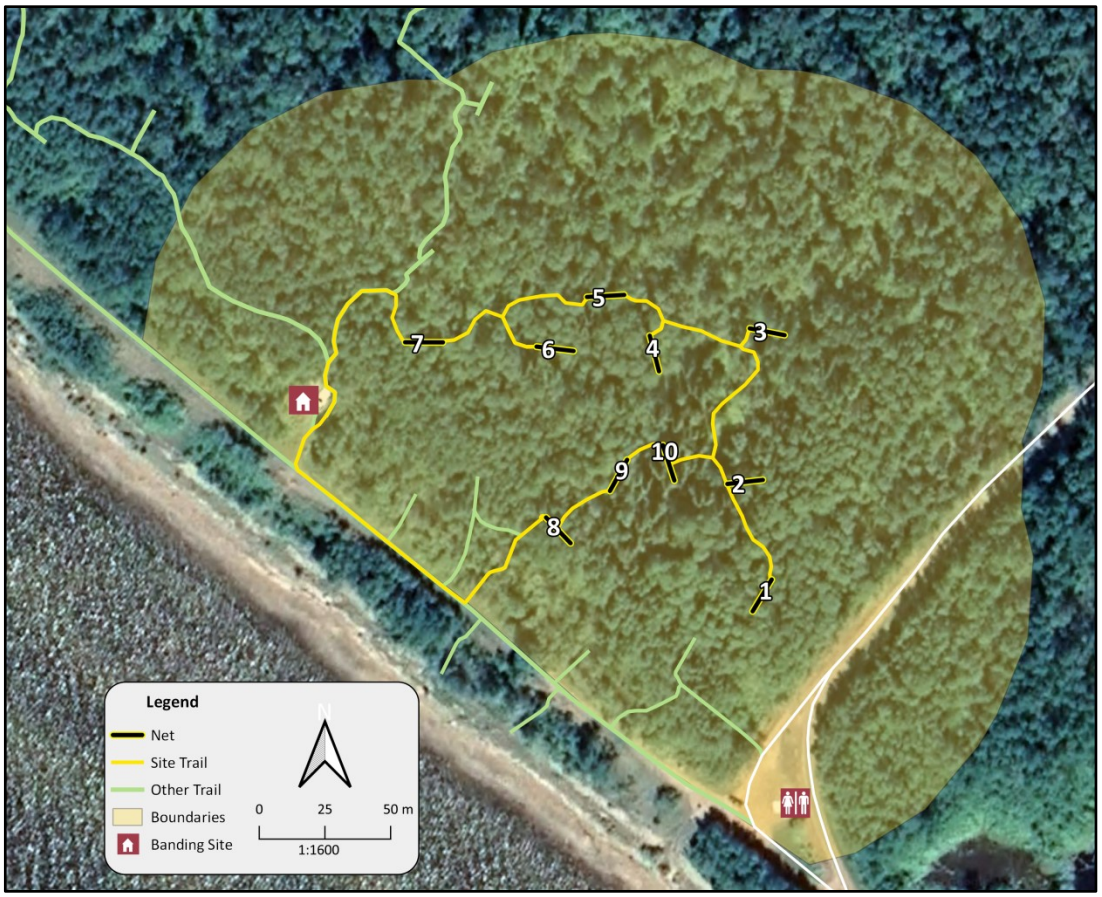

Figure 6. Location of nets, banding site, trails and boundaries for **ROAD** MAPS site.

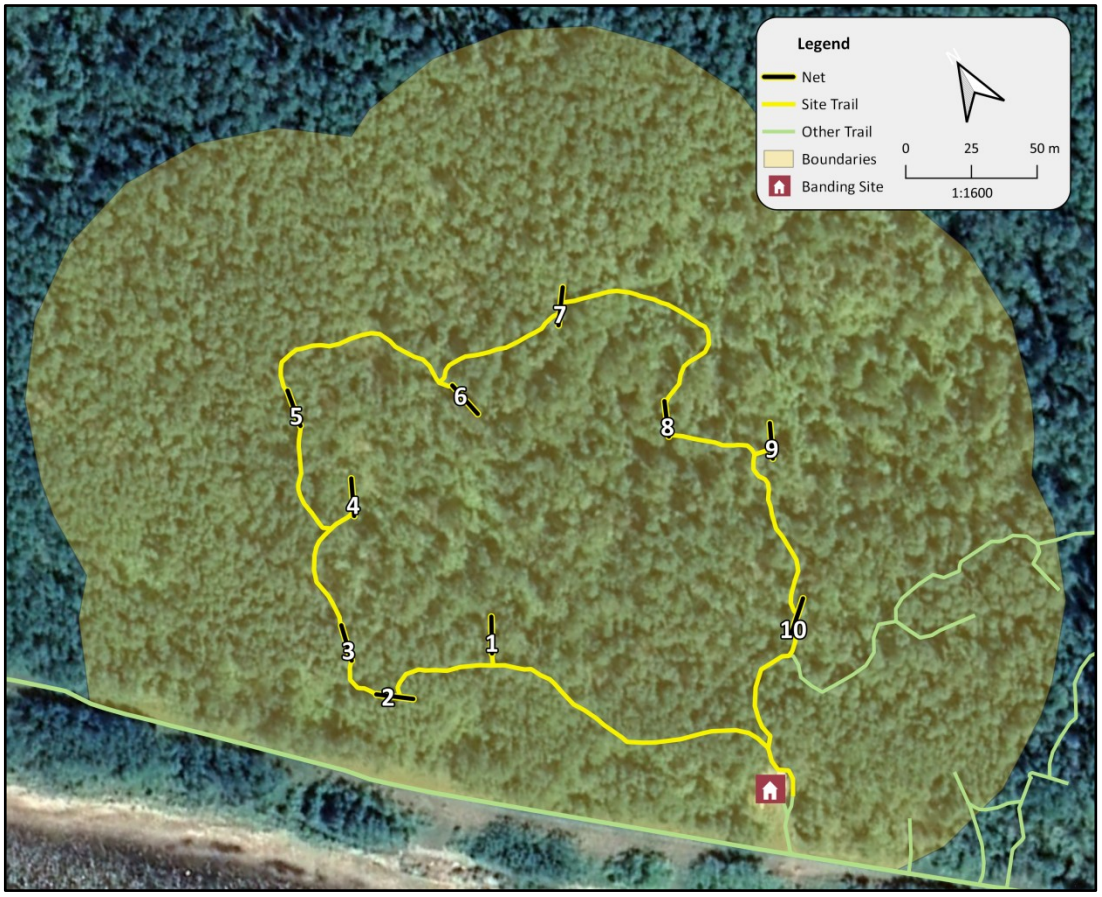

Figure 7. Location of nets, banding site, trails and boundaries for **FEGU** MAPS site.

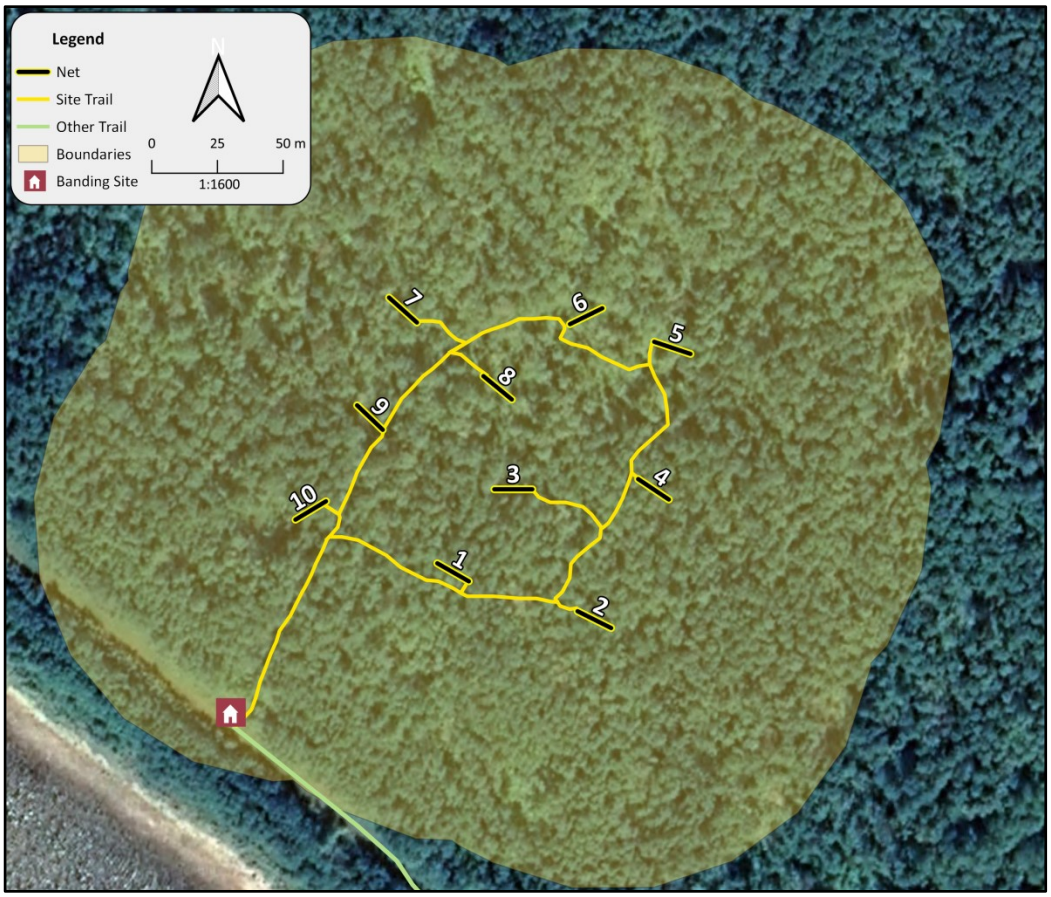

Figure 8. Location of nets, banding site, trails and boundaries for **FAWA** MAPS site.

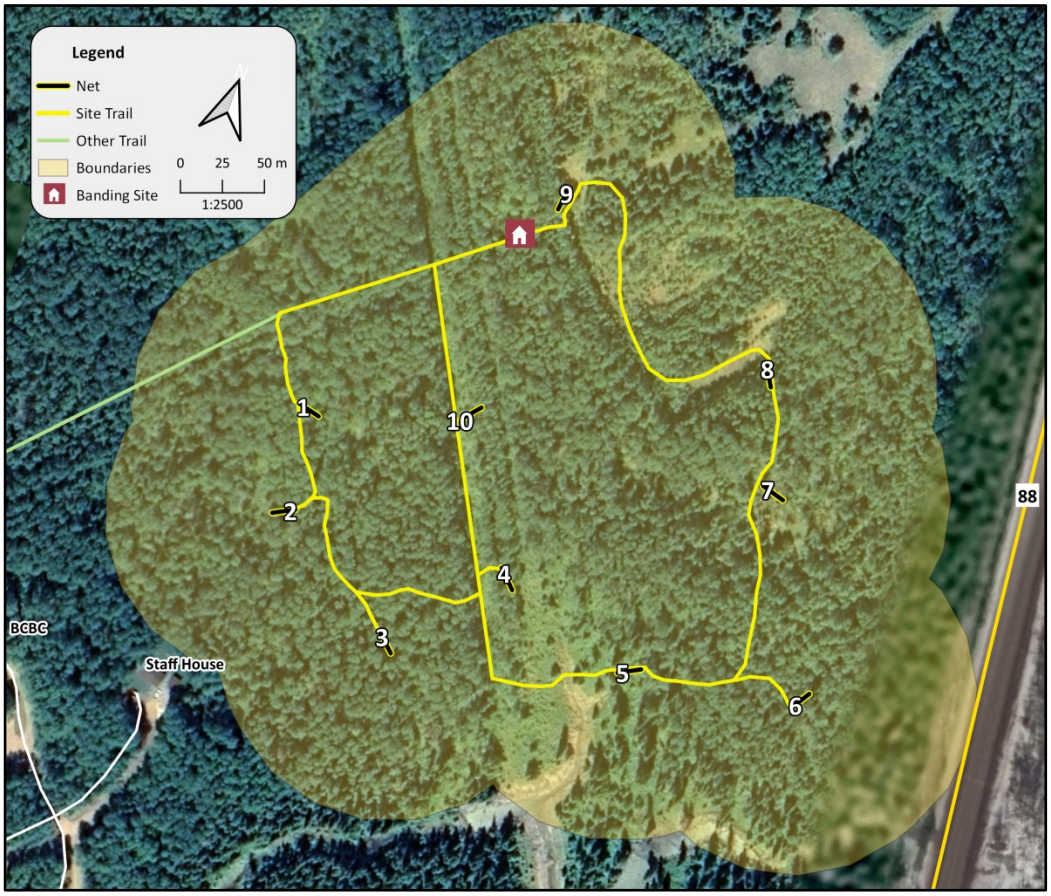

Figure 9. Location of nets, banding site, trails and boundaries for **RESI** MAPS site.

6.3 The Techniques used in MAPS

A thorough MAPS protocol has been developed by the Institute for Bird Populations (DeSante et al. 2020) and will not be elaborated on here. All LSLBO personnel involved in the operation of the MAPS program are required to be thoroughly familiar with this protocol. Periodically, the manual is updated and the station copy should be replaced with the most recent version available. There are three major data collection components to MAPS: standardized mist-netting, determination of breeding status and habitat analysis.

6.3.1 Banding

Please consult section 3 of this manual for more information. Each of the LSLBO MAPS sites contains ten nets located in areas of high bird-capture potential. The nets are placed far enough away from each other that they will catch as many different birds as possible, but close enough together that they can all be visited within 10 minutes, not including extraction time. RESI is an exception; it is substantially larger and must be operated by two people.

The techniques used in the processing of birds is basically the same as that done in migration monitoring, although not all of the same data are required for the MAPS program (see DeSante et al. 2020). Unless operating the ROAD or FEGU stations, where birds can be processed in the migration banding lab, birds can be processed at nearby picnic tables. Because banding is occurring at the peak of the breeding season, it is critical that birds be processed and released as quickly as possible. This is particularly true for adult females with heavy brood patches and fledglings that have recently left the nest. Fledglings should be returned and released near the site of capture.

6.3.2 Breeding Status

Breeding status is to be determined for each species recorded at a station based on banding information and observations. When conducting a MAPS visit, record all species encountered and note any evidence of breeding activity, ranging from territorial behaviour (singing) to finding a nest. It is important for operators to spend time tracking individuals in order to collect the highest level of breeding evidence, especially when banding is slow. A notebook should remain in the MAPS banding kit to record observations.

6.4 MAPS Datasheets

Prior to the start of the MAPS season, MAPS organizers send out *pdf* files of banding and breeding status datasheets for each station monitored by the operator. Manuals and other datasheets are also available online. Contact MAPS organizers if there is any problem with the download. Print 15 or so copies of the MAPS banding sheet and about 6-7 copies of the recaptures sheet. Blank datasheets from previous years should not be used to avoid confusion.

6.5 MAPS Station Start-up and Shutdown

Start-up
At the start of the MAPS season, all trails and netlanes must be cleared of encroaching vegetation. Storage of most MAPS equipment and spare materials is the same as for migration monitoring. MAPS banding equipment (bands, pliers, Pyle, etc.) is kept separate from migration banding tools in a black kit labeled "MAPS Kit" that can be found at the BCBC.

Between-period shutdown
Since a minimum of six days will lapse before a MAPS site is visited again, MAPS mist-nets must be taken down at the end of each day of operation. Make sure nets are dry and clear of debris. Net poles should be placed on the ground with the guy ropes tied up, away from small mammals.

Last-period shutdown
MAPS net poles and guy ropes can be left on-site at the end of the season. Poles can be tied to trees near the netlanes with the guy rope or placed on the ground. If left standing on the rebar, poles are likely to get bent out of shape by falling trees or itchy moose over the winter. It is important that the rope be kept off the ground to minimize exposure to the elements and small mammals, which may chew it up. Mist-nets and other equipment are to be stored in a similar fashion to migration monitoring equipment (Section 4.6).

6.6 MAPS Habitat Monitoring

Part of the MAPS program consists of doing a vegetation survey using methods described in the *MAPS Habitat Structure Assessment Protocol* (Nott et al. 2003). These habitat surveys have changed somewhat over the years so it is best to consult the current MAPS protocol for survey instructions. As of 2002, vegetation surveys (Habitat Structure Assessments) need to be conducted every five years. Each year, operators should go out to the MAPS sites with the most recent vegetation data and compare to be sure no significant changes have occurred that would warrant an early assessment. MAPS organizers should be informed of any major habitat changes as soon as possible.

Habitat Structure Assessments are expected to be completed during: 2017, 2022, 2027, 2032 etc. unless the schedule has been otherwise modified.

6.7 MAPS Tours and Visitation

Since MAPS sites are less accessible to visitors and operate on an uncertain schedule, visitation is not generally allowed to MAPS operations. If the operator is banding at ROAD or FEGU out of the migration banding lab and a visitor drops-in, they may be given banding demonstrations following the protocol outlined in Section 4.8 at the bander's discretion. Visitors are not to be brought on MAPS net checks.

SECTION 7: DATA MANAGEMENT

7.1 Computerization of LSLBO Data

Analysis of any LSLBO data requires that it be computerized. All data recorded in the daily logs are to be entered by staff or trained volunteers on a daily or near daily basis to prevent a back-log using the following software: banding and recapture data for all monitoring programs are entered in Bandit (USGS Bird Banding Lab). Daily Totals (DTs) are entered in the DET excel spreadsheet (CMMN). All other migration monitoring data, including net-hours, census times, vis-migs (normal and reverse migrants by count time and species), weather, observer codes, observer hours, coverage codes, injuries, and visitors are entered in individual Microsoft excel spreadsheets. For effort data in the spring and fall, data can be combined in the same excel files for each year. Narratives are transcribed into a Microsoft word document.

Similar to migration monitoring, owl banding effort data is entered into an excel spreadsheet. MAPS data are entered in MAPSPROG (IBP). All data on the LSLBO laptop should be backed-up regularly onto the external hard-drive and the Google Drive. Files can be copied from the previous year, but be sure to update the year in the file-name and keep consistent labeling between documents. When data has been finalized, all effort, DT data and habitat assessments are to be formatted and entered into the LSLBO Microsoft access file.

Ensuring quality of data is a high priority at the LSLBO and all data needs to be thoroughly checked/proofed. Prior to data entry, banding sheets must be verified and initialled by a qualified bander (usually the BIC). After entry, banding data should be printed and proofed against the original banding sheets. Mistakes should be highlighted and corrected on the computer after all the proofing is done. Schedule a fair amount of time for proofing; it will take about 5-6 hours to proof 2,000 records. Proofing of the DTs and all other data does not require a printout, but can be done by comparing originals to data on screen. After corrections are made, banding, recapture, DT and effort data for all monitoring programs should be crosschecked.

7.2 Data Submission

The Bander-in-Charge is responsible for validating and submitting all data electronically.

Banding and recapture data from Bandit must be submitted to the Bird Banding Office no later than December 31. See the Bandit Manual for instructions.

Spring and Fall DET files need to be submitted to the CMMN by December 31.

MAPS data are submitted to the Institute for Bird Populations no later than November 15. See the MAPSPROG User's Guide and Manual for instructions.

SECTION 8: RECORD OF CHANGES OR INTERRUPTIONS IN STANDARDIZED DATA COLLECTION

Although operations are as standardized as possible, some protocol changes have been necessary. Interruptions to operations lasting a week or more are noted as well as any permanent changes to data collection methods. Additional changes in data collection are not to be made unless absolutely necessary, and must first be discussed with CMMN advisors. 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 the year-end data submission; otherwise, send only a copy of the table.

Date	***Description of change and justification (if applicable)***
1995-2004	Non-standard nets were used infrequently for which there is no record of location or hours of operation; minimum of 16 days in 1999 (133 birds banded), 21 days in 2000 (132 birds) and 3 days in 2001 (27 birds). Species composition suggests the nets were on the shoreline.
1995, Spring	Census route, count period and netlanes standardized.
1998, Fall	Fall migration monitoring period to begin July 12 instead of early August.
1999, Fall	Visible migration counts reduced from 10 min each to 5 min each.
2000, Spring	Standard monitoring period increased from 6 hours to 7 hours.
2000, MAPS	FEGU discontinued and RESI created to sample more diverse habitat.
2002, Fall	Primary feather moult now recorded on all moulting birds on a scale from 0 to 5 beginning at P1 moving outwards and included on banding data sheets. Prior, a different scale was used.
2003, MAPS	FEGU operation renewed.
2005, Fall	Flight feather moult records to include secondaries, now begin at P10 moving inward.
2008, Spring	Personnel required to arrive at designated starting time, regardless of weather. Prior, some rainy days were skipped or began late despite possibility of good migration. Data analysts can consult daily records to determine daily hours of operation.
2009, Spring	In past years, time lost from standard coverage due to temporary net closures was to be made up through extended coverage beyond normal closing time. From this year on, no make-up time allowed. Analysts may obtain daily log sheets if needed to determine specific net hours.
2010, Fall	Began operation of two aerial nets to potentially account for altered capture rates due to habitat succession; included as non-standard captures and net-hours in daily logs.
2010, Fall	Priority for closing nets if too many captures changed to the non-standard aerial nets. Previously other net groupings were closed. Daily records can be consulted for details on what was closed and when.
2011	Began using BBird Protocols to document habitat succession in surrounding netlanes.
2011, Spring	Forest fires caused evacuations May 15, stopping the spring monitoring season.
2013	Northern Saw-whet Owl banding program added to standardized operations and nets relocated. Prior, effort and speaker projection may be inconsistent.
2019, Fall	Large (273,045 hectares) forest fire to the north creates an additional funnel, potentially increasing fall capture rates.
2020, Spring	Reverse migrants are to be recorded in vis-mig columns (circled), but included only in incidental totals. Prior, reverse migrants were included in incidental totals only.
2020, Spring	Began to record whether spotting scope was used for incidental observations as this affects the number of waterfowl observed.

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Pyle P. 1997. Identification Guide to North American Birds: Part I. Bolinas, CA: Slate Creek Press.

APPENDIX A: REQUIRED READING FOR STAFF AND LONG-TERM VOLUNTEERS

For all on-site activities:

1. Lesser Slave Lake Bird Observatory Safety Handbook
2. Lesser Slave Lake Bird Observatory Employee Handbook
3. All relevant *Hazard Assessment* tables

For all banding programs:

1. Lesser Slave Lake Bird Observatory Standard Operating Protocol, 2021 Revision
2. The North American Bander's Study Guide
3. Pyle 1997, Introduction
4. MAPS Manual: 2020 Protocol, Measurement sections

For MAPS:

1. All of the above
2. MAPS Manual: 2020 Protocol (entirety)

For habitat monitoring:

1. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HSA) Protocol
2. Measuring Vegetation; pages 34 to 45 in BBird (Breeding Biology Research and Monitoring Database) Field Protocol

For data entry:

1. Lesser Slave Lake Bird Observatory Standard Data Processing Guide: Entering, proofing, finalizing and submitting core program data

APPENDIX B: THE BANDER'S CODE OF ETHICS

1. 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 and 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 species
- treat all bird injuries in the most humane way

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

- reassess methods and your approach whenever a mortality occurs
- accept constructive criticism from other banders

3. 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

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

5. Banders must obtain permission to band on private property.

APPENDIX C: SOURCES OF BANDING EQUIPMENT

Currently, the LSLBO obtains its banding equipment from several suppliers; most, if not all, have online ordering capabilities. Web sites are located in the "Banding" folder under favourites on the LSLBO office computer. Web addresses are not listed here as they are subject to change periodically but can be found quickly enough by searching on the internet.

Wing rulers, banding pliers, mist-nets, net repair kits, leg gauges, weighing scales, optical visors, calipers, coloured leg bands and other equipment can be obtained from Avinet Inc.

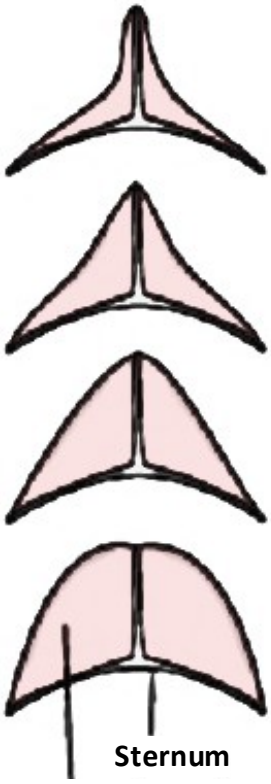
Circlip or "reverse grip" pliers can be obtained from BTO (British Trust for Ornithology). The LSLBO currently uses Avinet nets made in the USA. The 12 m by 2.6 m, four-panel nets are made of 2-ply, 70 dernier nylon thread. The BTO also provides excellent specialty nets such as 60 mm nets for owl banding.

USFWS bands must be obtained through the Bird Banding Office of Environment Canada. Bands can be ordered by email or on the Bander Portal by authorized personnel. It is a good idea to put an order in the fall for the following year as some band sizes, especially smaller ones can be on back-order for long periods.

Mist-net poles (electrical conduit) can be purchased at Home Depot or any electrical supplies store.

APPENDIX D: BANDING REFERENCE SHEETS

Methods and illustrations for measuring wing length, skull pneumaticization, cloacal protuberances and brood patches, and additional measurements such as tail length, bill length/depth/width, and tarsus length can be found in the *Identification Guide to North American Birds* (Pyle 1997), pages 2 to 25. Descriptions of numerical codes used for measuring skull pneumatization, cloacal protuberances, brood patches, fat, body moult, and flight feather wear are described in the *MAPS Manual* (DeSante et al. 2020), pages 51 to 62. Below are illustrations and brief descriptions used for measurements that are not described in the above manuals.



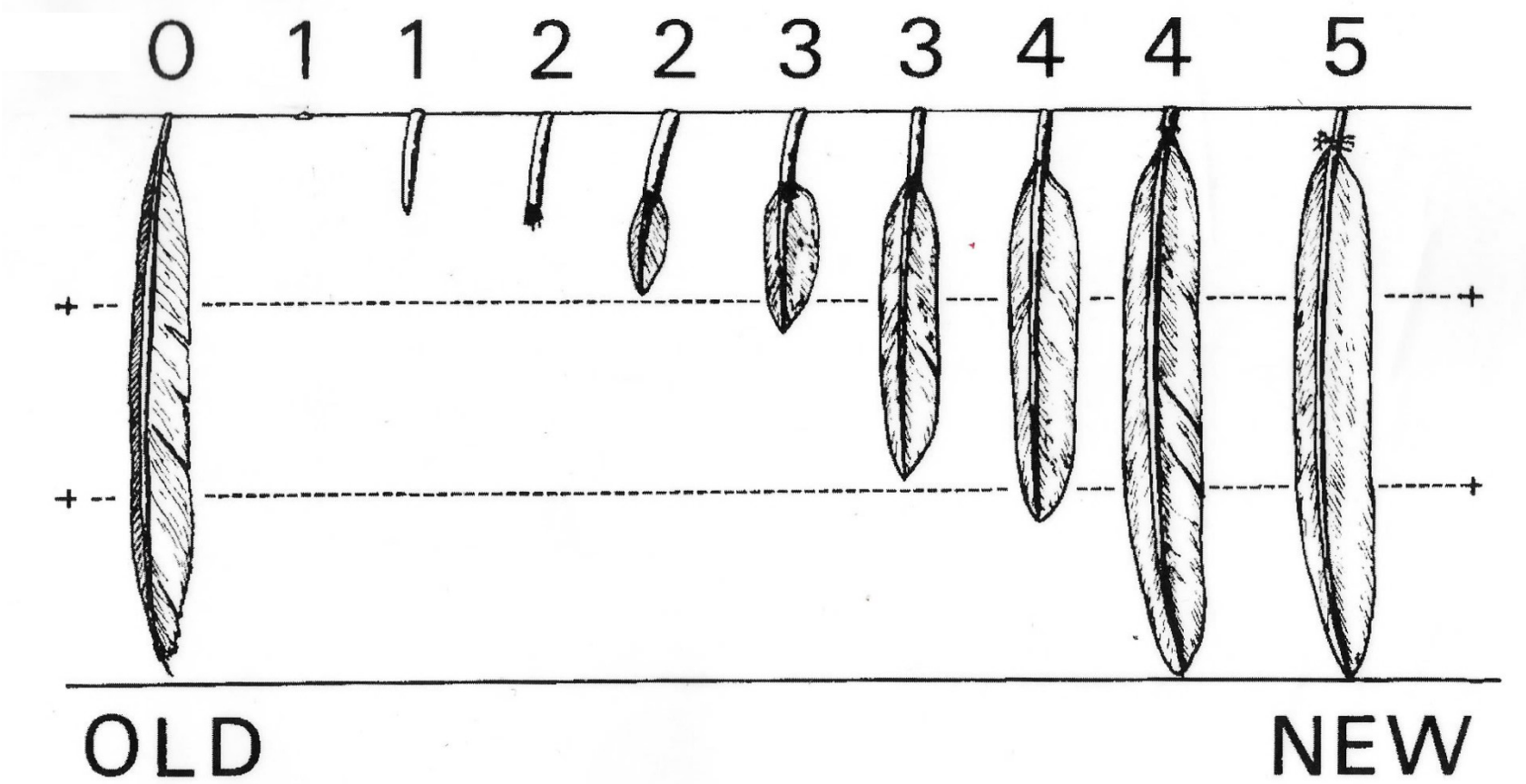
0 Strongly emaciated
Sternum sharp, muscle indented

1 Emaciated
Sternum clearly visible, but not sharp; muscle neither indented nor bulging

2 Moderate condition
Sternum noticeable, muscle slightly bulging

3 Good condition
Sternum difficult to see because of the (fully developed) clearly bulging muscles

Classification of pectoral muscle development, adapted from Van Franeker (1983).



The feather scoring system. The dashed horizontal lines represent one third and two thirds growth. The numerical scoring system is:

0 Old feather remaining.
1 Old feather missing or new feather completely in pin.
2 New feather just *emerging from the sheath up to one third grown.*
3 New feather between one and two thirds grown.
4 New feather more than two thirds grown and with remains of waxy sheath at its base.
5 New feather fully developed with no trace of waxy sheath remaining at base.

Scoring system for flight feather moult development, adapted from Ginn and Melville (1983).

Wing length to weight ratio for sexing Northern Saw-whet Owls (Brinker 2000).

Boundaries for assignment of sex in Northern Saw-whet Owls*

> 95% probability of correct sex for any individual.

Wing Chord	Mass (grams)			
	Male	Unknown		Female
120	≤88	≥89	≤92	≥93
121	≤87	≥88	≤92	≥93
122	≤87	≥88	≤92	≥93
123	≤86	≥87	≤91	≥92
124	≤85	≥86	≤91	≥92
125	≤85	≥86	≤90	≥91
126	≤84	≥85	≤90	≥91
127	≤84	≥85	≤90	≥91
128	≤83	≥84	≤89	≥90
129	≤82	≥83	≤89	≥90
130	≤82	≥83	≤89	≥90
131	≤81	≥82	≤88	≥89
132	≤80	≥81	≤88	≥89
133	≤80	≥81	≤88	≥89
134	≤79	≥80	≤87	≥88
135	≤78	≥79	≤87	≥88
136			≤87	≥88
137			≤87	≥88
138			≤86	≥87
139			≤86	≥87
140			≤86	≥87
141			≤85	≥86

*When using these criteria to sex owls as part of banding schedule preparation you must include the following remark for each owl. **Sex determined using the wing-mass DF available from Project Owlnet**.

APPENDIX E: SAMPLE MIGRATION MONITORING DAILY SCHEDULE

Experienced operators can comfortably schedule daily activities so all components of migration monitoring receive good coverage. However, the inexperienced operator can easily find him/herself falling behind, especially in the early parts of the day. The following schedules are a rough guideline to provide new personnel with a reference point on how and when the day's activities should be carried out. The following examples assume that sunrise is 6:00 (nets open at 5:30) and the weather is fine for operating mist-nets.

Two or more operators:

05:30
Arrive at the station. One person can run the first vis-mig while the other starts opening the nets. When the vis-mig is complete, begin 'leap-frogging' to finish opening nets. Although both operators should monitor bird activity during open, the person who performed the vis-mig should be especially aware since they will likely be running census. This helps prevent double-counting between counts in the DTs.

05:45
Once the nets are opened, the first weather data of the day can be collected while the other operator can unlock the lab and begin the day's paperwork.

06:00
Nets have been open for a half hour so do the first net check. Both operators can check together.

06:30
One operator conducts the second vis-mig while the other begins a net check. If the nets are empty, the check may be completed before the vis-mig is finished. The person checking the nets should meet the other operator in the parking lot to indicate that all nets have been checked. Otherwise the person who conducted the vis-mig may check the nets again and increase disturbance in the netlanes, which may reduce captures.

07:00 - 08:00
Conduct census sometime within this hour. In the spring, time it so that the census ends on the third vis-mig, in the fall start the census on the third vis-mig. One operator can complete census and the vis-mig while the other checks nets and collects weather data.

08:00 - 12:00
Continue to work together to check the nets and band the birds. If both operators are highly skilled, one person can band while the other watches for bird activity and keeps an eye on the nets so that observers are aware of other wildlife in the area and can better prepare themselves for net checks that may have weasels, deer or bears.

12:30
Nets have been open for the standard 7 hours and they should now be closed in the same order they were opened (starting on net 1). Again, one operator can perform the final vis-mig, while the other begins closing nets.

13:00 - 14:00
Upon returning to the lab any captures should be processed. Since two operators contributed to counts, the paperwork must be completed together to minimize double-counting and include birds that may have missed getting recorded. As you leave, it is a good idea to double check that all the nets are closed and tied. Most nets can be seen from the main trail but a small detour has to be made to check net 3.

One operator:

Operations can be completed by a single operator outside of peak migration windows. If only one experienced operator is available during peak migration (example, during MAPS overlap), then volunteers that can extract and/or scribe should be contacted. Generally volunteers lack the skills required to band or perform observational data collection and the BIC should plan station activities accordingly.

05:25
Plan to arrive at the station at least 5 minutes prior to net opening time (½ hour before sunrise). This will provide the opportunity to conduct the first visible migration count prior to net opening. Dawn vis-migs are generally very quiet, but if birds are already on the move it is a good indication that it might be a busy day and provide insight into the number of nets that can be safely operated.

05:30
After the first vis-mig, nets can be opened starting from net 1. If it is in the peak of the migration season, keep the aerials closed. Otherwise, all nets should be opened. Opening the nets should take about 20 minutes.

05:50
Once the nets are opened, the first weather data of the day can be collected. In the lab, the datasheets should be readied and dated, the first vis-mig should be recorded on the vis-mig datasheet and any incidental observations should be written down. The banding binder and the banding equipment should be properly laid out in preparation for banding.

06:00
The first nets have been open for a half hour so it is time to do the first net check. The first round is generally not busy and normally takes 5-10 minutes.
- If it is during the peak of spring migration, this is a good time to start the census after a net check immediately after open so that it ends on the second vis-mig while bird activity in the nets is still low. After census, check the nets immediately upon arrival back at the lab.

06:25
Conduct the second vis-mig before checking the nets again.
- If it is during the peak of fall migration, this is a good time to start the census after a net check so that it starts on the second vis-mig while bird activity in the nets is still low. After census, check the nets immediately upon arrival back at the lab.

07:00 - 08:00
The second weather recording should be done. If not already completed (outside of peak migration), census should be conducted sometime within this hour, after ensuring the nets are empty as the operator will be away from the nets for up to 30 minutes. If it has become unexpectedly busy in the nets, clear and collapse the busiest nets before going on census. In the spring, time it so that the census ends on the third vis-mig, in the fall start the census on the third vis-mig. Advance consideration must be given to the timing of the census so that the vis-mig falls in the appropriate hourly block and is not missed.

08:00 - 12:00
Birding, net checks and banding will take up much of the time during this period but there are still some activities to be done which, although brief, can detract attention away from the banding. Continue to run hourly vis-migs so that they are completed before the scheduled net checks. If you wait until after a

net check to run a vis-mig, the time between vis-migs can become unnecessarily short due to time spent in the netlanes. Do not forget weather still needs to be recorded twice more (around 9:00 and 11:00, on odd numbered vis-migs).

12:00 - 12:30
The day is winding down and the operator should be preparing for closing up. It is a good idea to check the nets about fifteen to twenty minutes before scheduled closure just to be sure there are not many birds to prolong the actual closing of nets. Birds caught on this penultimate round should be processed prior to closing nets but if many birds were caught they may have to be left in the lab until returning from closing nets.

12:30
Assuming no interruptions in the netting due to rain or other reasons, nets have been open for the standard 7 hours and they should now be checked and closed in the same order they were opened (starting on net 1). Closing nets should not take much more time than opening the nets, but it is not unusual to catch a few birds on this closing round so it will probably take a half hour to close and tie all the nets.

13:00 - 14:00
Upon returning to the lab any captured birds should be processed. As you leave, it is a good idea to double check that all the nets are closed and tied. Most nets can be seen from the main trail, but a small detour has to be made to check net 3. You are now free to leave the station and all that remains is the daily paperwork, which must be completed before you begin operations tomorrow.

APPENDIX F: GPS LOCATIONS

Standard locations for mist-net poles by netlane, banding sites, standardized counts (migration monitoring) and audio lure speakers (owl banding) in decimal degrees, WGS84 projection. Errors range ± 3 to 6 m.

MIGRATION MONITORING STATION		
Netlane	**Latitude**	**Longitude**
1a	55.4256665	-114.8241280
1b	55.4255874	-114.8239629
2a	55.4257479	-114.8242986
2b	55.4256666	-114.8241285
3a	55.4257976	-114.8243456
3b	55.4259052	-114.8242284
4a	55.4256647	-114.8245287
4b	55.4257168	-114.8243351
5a	55.4257933	-114.8250344
5b	55.4258754	-114.8248693
6a	55.4256069	-114.8253408
6b	55.4256768	-114.8251547
7a	55.4262599	-114.8252773
7b	55.4263402	-114.8251118
8a	55.4261419	-114.8253619
8b	55.4262599	-114.8252766
9a	55.4263564	-114.8255278
9b	55.4264790	-114.8254980
10a	55.4262344	-114.8255786
10b	55.4263561	-114.8255276
11a	55.4258138	-114.8257389
11b	55.4259254	-114.8256346
12a	55.4263196	-114.8259936
12b	55.4264306	-114.8258832
11Xa	55.4258217	-114.8257661
11Xb	55.4259315	-114.8256632
12Xa	55.4263115	-114.8259759
12Xb	55.4264261	-114.8258661
Banding Location (Same as FEGU/ROAD)		
Banding lab	55.426772	-114.826442
Standard Count Locations		
Vis-mig/ Census start	55.4252942	-114.8238973
Census midpoint	55.4265532	-114.8266166
Census end	55.4287934	-114.8307313

OWL BANDING STATION		
Netlane	**Latitude**	**Longitude**
1a	55.4135082	-114.8053515
1b	55.4135965	-114.8051911
2a	55.4135969	-114.8051903
2b	55.4136876	-114.8050419
3a	55.4136887	-114.8050392
3b	55.4137795	-114.8048810
4a	55.4137799	-114.8048810
4b	55.4138702	-114.8047252
5a	55.4126288	-114.8077589
5b	55.4125317	-114.8076163
6a	55.4126083	-114.8078160
6b	55.4127079	-114.8079598
1Aa	55.4113563	-114.8059095
1Ab	55.4112645	-114.8057494
2Aa	55.4113280	-114.8055558
2Ab	55.4112632	-114.8057434
3Aa	55.4113368	-114.8055277
3Ab	55.4114033	-114.8053456
4Aa	55.4114027	-114.8053462
4Ab	55.4115260	-114.8053905
Banding Location		
BCBC	55.412336	-114.805178
Speaker Locations		
NSWO	55.4137239	-114.8051134
BOOW	55.4126289	-114.8077825
Old NSWO	55.4113239	-114.8054945

Standard locations for mist-net poles and MAPS banding sites. WGS84, errors ± 3 to 6 m.

FAWA		
Netlane	**Latitude**	**Longitude**
1a	55.4292706	-114.8292988
1b	55.4293355	-114.8294849
2a	55.4291567	-114.8286506
2b	55.4290957	-114.8284519
3a	55.4295823	-114.8291280
3b	55.4295782	-114.8288998
4a	55.4296019	-114.8282616
4b	55.4295287	-114.8280811
5a	55.4300693	-114.8281393
5b	55.4300241	-114.8279237
6a	55.4301388	-114.8286423
6b	55.4301894	-114.8284451
7a	55.4302488	-114.8297252
7b	55.4301606	-114.8295622
8a	55.4299703	-114.8291726
8b	55.4298875	-114.8290062
9a	55.4298839	-114.8299372
9b	55.4297977	-114.8297878
10a	55.4294997	-114.8303293
10b	55.4295593	-114.8301425
Banding Location		
Table	55.428844	-114.830766

RESI		
Netlane	**Latitude**	**Longitude**
1a	55.4143362	-114.8028038
1b	55.4143025	-114.8025896
2a	55.4137904	-114.8025253
2b	55.4137355	-114.8027216
3a	55.4133139	-114.8014166
3b	55.4132201	-114.8012519
4a	55.4138391	-114.8005116
4b	55.4137432	-114.8003531
5a	55.4134996	-114.7991706
5b	55.4135559	-114.7989704
6a	55.4136152	-114.7975119
6b	55.4137123	-114.7973977
7a	55.4146906	-114.7984181
7b	55.4146514	-114.7982001
8a	55.4153211	-114.7987519
8b	55.4152043	-114.7986402
9a	55.4158756	-114.8010262
9b	55.4157525	-114.8010602
10a	55.4145278	-114.8013076
10b	55.4146185	-114.8011626
Banding Location		
Table	55.415548	-114.801252

FEGU		
Netlane	**Latitude**	**Longitude**
1a	55.4276634	-114.8274847
1b	55.4277710	-114.8273720
2a	55.4277528	-114.8282055
2b	55.4276731	-114.8280310
3a	55.4278953	-114.8282243
3b	55.4280163	-114.8281660
4a	55.4283108	-114.8277542
4b	55.4284245	-114.8276508
5a	55.4286688	-114.8277438
5b	55.4287946	-114.8276982
6a	55.4285127	-114.8268398
6b	55.4283842	-114.8267996
7a	55.4284963	-114.8261065
7b	55.4285985	-114.8259650
8a	55.4279746	-114.8258946
8b	55.4280849	-114.8258055
9a	55.4277232	-114.8254330
9b	55.4278314	-114.8253364
10a	55.4271849	-114.8258856
10b	55.4272627	-114.8257212

ROAD		
Netlane	**Latitude**	**Longitude**
1a	55.4261021	-114.8237497
1b	55.4259956	-114.8238701
2a	55.4264337	-114.8239977
2b	55.4264436	-114.8237842
3a	55.4269629	-114.8238341
3b	55.4269362	-114.8236264
4a	55.4269486	-114.8244366
4b	55.4268259	-114.8243874
5a	55.4270876	-114.8248067
5b	55.4270908	-114.8245825
6a	55.4269233	-114.8251188
6b	55.4269044	-114.8248973
7a	55.4269523	-114.8259078
7b	55.4269479	-114.8256808
8a	55.4263384	-114.8250939
8b	55.4262479	-114.8249515
9a	55.4265268	-114.8245960
9b	55.4264224	-114.8247048
10a	55.4265729	-114.8243782
10b	55.4264512	-114.8243161

APPENDIX G: BLANK LSLBO DATASHEETS

The follow pages are the datasheets used during migration monitoring and fall owl banding operations.

Migration Monitoring:

1. Daily log sheets (next 8 pages)
2. Banding datasheet
3. Recapture/unbanded datasheet

Fall Owl Banding:

1. Daily log sheets

Owl banding uses the same banding and recapture datasheets as migration monitoring.

The Institute for Bird Populations emails *pdf* files of datasheets required for the operation of **MAPS** stations before the start of each season. These sheets include banding/recapture/unbanded datasheets, breeding status sheets, and effort logs. Contact MAPS organizers if there are any problems with the download or datasheets have not been received.

Lesser Slave Lake Bird Observatory - Daily Log

Date ____/_____/____
(Day / Month / Year)

Observers and Banders	Code	Start	End	Hours
BIC				
Total observer hours				
Spotting scope used				Y / N

Weather	4:00-6:00	6:00-8:00	8:00-10:00	10:00-12:00	12:00-14:00
Time					
Wind Dir.					
Strength(Bf)					
Precip.					
10th cover					
Temp (°C)					
R. H. (%)					
Bar. (mb)					

Visitors:

Weather synopsis:

Netting Effort

Standard Nets					
Net #	Time up	Time down	Time Up	Time down	Hours
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
	Total standard net-hours				

Non-Standard Nets						
Net #	Time up	Time down	Time up	Time down	Hours	Mesh & size
11X						
12X						
Total non-standard net-hours						

Census			
Start	End	Min.	Initials

Visible Migration Watches										
Period	4:00-5:00	5:00 -6:00	6:00 - 7:00	7:00 - 8:00	8:00 - 9:00	9:00 -10:00	10:00 - 11:00	11:00-12:00	12:00-13:00	13:00 -14:00
Time										
Initial										

Migration Monitoring Daily Summary						
Totals	Banded	Retrap.	Captured	Census	Vis mig	DT
# Birds						
# Sp.						

Coverage Codes	
Std. mist-netting	
Vis. Mig.	
Census	
Overall	

Lesser Slave Lake Bird Observatory - Daily Log Date ____/_____/____

Narrative:

Signed:_____

Other wildlife:

Plants:

Nests found:

Casualties/Injuries:

Lesser Slave Lake Bird Observatory - Daily Log Date ____/____/____

	Captures						Census		Vis	Incidental		Daily	
Species	**Band**	**Rec**	**NS Band**	**NS Rec**	**Tot Cap**	**PKS**	**Tot**	**PKS**	**Tot**	**Obs Tot**	**PKS**	**DT**	**PKS**
Goose, Greater White-fronted													
Canada													
Lesser Snow													
Unid. goose													
Swan, Trumpeter													
Tundra													
Unid. swan													
Mallard													
Gadwall													
Northern Pintail													
American Wigeon													
Blue-winged Teal													
Northern Shoveler													
Green-winged Teal													
Canvasback													
Redhead													
Ring-necked Duck													
Scaup, Greater													
Lesser													
Unid. scaup													
Long-tailed Duck													
Scoter, Surf													
White-winged													
Common Goldeneye													
Bufflehead													
Merganser, Common													
Red-breasted													
Unid. Merganser													
Unid. Duck													
Ruffed Grouse													
Common Loon													
Grebe, Red-necked													
Western													
Unid. grebe													
Double-crested Cormorant													
American White Pelican													
Great Blue Heron													
Northern Harrier													
Osprey													
Sharp-shinned Hawk													
Northern Goshawk													
Unid. accipiter													
Hawk, Broad-winged													
Red-tailed													
Rough-legged													
Unid. Buteo													
Bald Eagle													
Sandhill Crane													
Killdeer													

Lesser Slave Lake Bird Observatory - Daily Log Date ____/____/____

	Captures						Census		Vis	Incidental		Daily	
Species	Band	Rec	NS Band	NS Rec	Tot Cap	PKS	Tot	PKS	Tot	Obs Tot	PKS	DT	PKS
Yellowlegs, Greater													
Lesser													
Unid. yellowlegs													
Sandpiper, Solitary													
Spotted													
Semipalmated													
Dowitcher, Long-billed													
Short-billed													
Unid. dowitcher													
Wilson's Snipe													
Unid. shorebird													
Gull, Bonaparte's													
Franklin's													
Mew													
Ring-billed													
California													
Herring													
Unid. Gull													
Tern, Common													
Forster's													
Unid. Tern													
Owl, Great Horned													
Barred													
Northern Saw-whet													
Common Nighthawk													
Ruby-throated Hummingbird													
Belted Kingfisher													
Yellow-bellied Sapsucker													
Woodpecker, Downy													
Hairy													
“Yellow-shafted” Flicker													
Woodpecker, Pileated													
Unid. woodpecker													
Peregrine Falcon													
American Kestrel													
Merlin													
Unid. Falcon													
Olive-sided Flycatcher													
Western Wood-Pewee													
Flycatcher, Yellow-bellied													
Alder													
Least													
Unid. empidonax													
Phoebe, Eastern													
Say's													
Eastern Kingbird													
Unid. flycatcher													
Vireo, Blue-headed													

Lesser Slave Lake Bird Observatory - Daily Log Date ____/____/____

	Captures						Census		Vis	Incidental		Daily	
Species	**Band**	**Rec**	**NS Band**	**NS Rec**	**Tot Cap**	**PKS**	**Tot**	**PKS**	**Tot**	**Obs Tot**	**PKS**	**DT**	**PKS**
Warbling													
Vireo, Philadelphia													
Red-eyed													
Unid. Vireo													
Jay, Blue													
Gray													
Black-billed Magpie													
Common Raven													
American Crow													
Horned Lark													
Swallow, Tree													
Bank													
Cliff													
Barn													
Unid. swallow													
Chickadee, Black-capped													
Boreal													
Nuthatch, Red-breasted													
White-breasted													
Brown Creeper													
Wren, House													
Winter													
Kinglet, Golden-crowned													
Ruby-crowned													
Thrush, Hermit													
Gray-cheeked													
Swainson's													
American Robin													
Unid. thrush													
European Starling													
American Pipit													
Cedar Waxwing													
Lapland Longspur													
Ovenbird													
Northern Waterthrush													
Warbler, Black-and-white													
Orange-crowned													
Tennessee													
Connecticut													
Mourning													
Common Yellowthroat													
American Redstart													
Warbler, Cape May													
Magnolia													
Yellow													
Blackpoll													
Bay-breasted													
“Western” Palm													
“Myrtle”													

Lesser Slave Lake Bird Observatory - Daily Log Date ____/____/____

	Captures						Census		Vis	Incidental		Daily	
Species	**Band**	**Rec**	**NS Band**	**NS Rec**	**Tot Cap**	**PKS**	**Tot**	**PKS**	**Tot**	**Obs Tot**	**PKS**	**DT**	**PKS**
Warbler, Black-throated Green													
Wilson's													
Canada													
Unid. warbler													
Sparrow, American Tree													
Clay-colored													
Chipping													
Savannah													
Vesper													
Le Conte's													
Fox													
Song													
Lincoln's													
Swamp													
“Slate-colored” Junco													
“Gambell's” White-crowned Sp.													
Sparrow, White-throated													
Unid. sparrow													
Western Tanager													
Rose-breasted Grosbeak													
Blackbird, Brewer's													
Rusty													
Common Grackle													
Blackbird, Red-winged													
Yellow-headed													
Brown-headed Cowbird													
Unid. blackbird													
Baltimore Oriole													
Evening Grosbeak													
Purple Finch													
White-winged Crossbill													
Common Redpoll													
Pine Siskin													
American Goldfinch													
Unid. finch													
Unid. passerine													
Total # individuals													
Total # species													

Lesser Slave Lake Bird Observatory - Daily Log Date ____/_____/____

Visible Migration Datasheet

Time									
Initial									
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**

Census (Underline migrants recorded during the vis-mig)

Incidental

Licensed banders (initials):	**Location:**	**Year:**
Assistants (initials):	**Band size:**	**Page:**
Scribes:	**First band:**	

Band	Species	Date	Time					Wing										Other	
No.	Code	m/d	24hr	NL	Age/how	Sex/how	In'l	Length	Wear	Mu	CP	BP	Fat	SK	Weight	BM	PM	Measur.	Comments (con't. on back)
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Last band: ____________

Species	No.	Species	No.

Totaled:
Entered:
Proofed:

Licensed banders (initials):	**Location:**	**Year:**
Assistants (initials):	**RECAPTURES**	**Page:**
Scribes:		

	Species	Date	Time					Wing										Other	
Band No.	Code	m/d	24hr	NL	Age/how	Sex/how	In'l	Length	Wear	Mu	CP	BP	Fat	SK	Weight	BM	PM	Measur.	Comments (con't on back)
															.				
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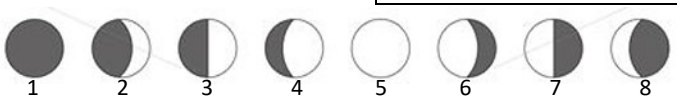
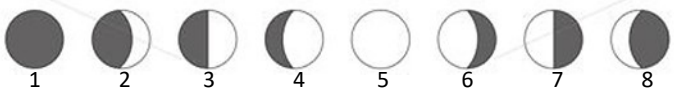
Entered: Proofed:

LSLBO Northern Saw-whet Owl/Boreal Owl Fall Migration Monitoring

Date		**Observers**			
Start time		Moon Phase: (circle)		Snow depth	
End time					
Net hours					
		1 2 3 4 5 6 7 8			
Time					
Temp.					
Cloud					
Wind spd.					
Wind dir.					
Precip.					
Moon visible	Y / N	Y / N	Y / N	Y / N	Y / N
Banding	NSWO	BOOW	Other	Recaptures	Total

Comments/Observations:

Date		**Observers**			
Start time		Moon Phase: (circle)		Snow depth	
End time					
Net hours					
		1 2 3 4 5 6 7 8			
Time					
Temp.					
Cloud					
Wind spd.					
Wind dir.					
Precip.					
Moon visible	Y / N	Y / N	Y / N	Y / N	Y / N
Banding	NSWO	BOOW	Other	Recaptures	Total

Comments/Observations: