Tommy Thompson Park Bird Research Station

Migration Monitoring Protocol

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Version 4.0

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1.0 INTRODUCTION

The Breeding Bird Survey (BBS) is the traditional method to monitor bird populations; however, this technique is restricted to breeding populations which are accessible by roadside data collection. By monitoring birds during migration, researchers can garner information on species which breed in remote northern areas that are not covered by the BBS. Migration monitoring in Canada began in 1960 at Long Point in Southern Ontario and has since spread across the country. The Canadian Migration Monitoring Network (CMMN), coordinated by Birds Canada, was established in 1998 to assess population trends of migratory landbirds.

Monitoring populations of migrant landbirds can yield long-term population trends, but the accuracy of these results depends on the integrity of the data collected. To avoid damaging inconsistencies within the data set, it is critical that Migration Monitoring stations follow standardized protocol. This manual provides guidelines and detailed procedures to ensure that methods are consistent, and data is useful for analysis. It is vital that all personnel adhere to the content of this manual.

In April 2003 Toronto and Region Conservation Authority (TRCA) established a pilot Migration Monitoring Program at Tommy Thompson Park (TTP), which includes a standard observation program and a standard capture program. The results of this pilot study (Derbyshire 2004) indicate that the site is appropriate for long term migration monitoring, research, and education. Tommy Thompson Park Bird Research Station (TTPBRS) joined the CMMN as a provisional member station in 2006 and was awarded full membership status in 2012. Count procedures have been standardized since 2016, though there were annual challenges from 2017-2022 that resulted in non-standard net placement and are documented in Appendix B.

1.1 Contact Information

Tommy Thompson Park Bird Research Station is an initiative of TRCA. All personnel affiliated with TTPBRS are TRCA staff or volunteers.

Table 1. Contact Information

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1.2 Date of Latest Revision

October 2024

A history of protocol revisions is outlined in Appendix A.

1.3 Migration Monitoring Program Objectives

There are three principal objectives of the Migration Monitoring Program at Tommy Thompson Park:

1. **Monitoring:** To provide quality data on landbird population trends and migratory behaviour for conservation and land use planning at the local, national, and international levels.
2. **Research:** To participate in collaborative research projects and share Migration Monitoring data with students and researchers.
3. **Education:** To create and sustain awareness of birds and bird conservation through public outreach. TTPRBS provides ornithological training for students and professionals.

Personnel observe and record all species, however landbirds are the priority of this project.

1.4 Migration Monitoring Priorities

Priority 1: Standard Observation Program – daily census as per the protocol in section 5.

Priority 2: Standard Capture Program – bird banding as per the protocol in section 6.

Priority 3: Non-standard Observations Program – daily observations.

Priority 4: Non-standard Capture Program – bird banding outside of standard hours and locations as per section 6.2.

1.5 Data Archive

Banding data and daily estimated totals were recorded on paper at TTPBRS from 2003 to 2023 and are stored at TRCA's Restoration Services Centre located at 9741 Canada Company Avenue, Vaughan, Ontario. Both datasets are digitized in Microsoft Excel and saved on TRCA servers. Starting in 2024, banding data is recorded directly into Microsoft Excel and saved on TRCA servers and the cloud, with backups performed daily. Banding data is uploaded and submitted to the Bander Portal at the end of each monitoring season. Daily estimated totals are submitted to Birds Canada (cjardine@birdscanada.org) at the end of each monitoring season.

2.0 STUDY SITE

2.1 Toronto and Region Conservation Authority

Toronto and Region Conservation Authority (TRCA) is the largest watershed-based conservation organization in Canada and is a global leader in habitat restoration with over 60 years of experience protecting, enhancing, restoring, and monitoring natural habitats, including those of Species at Risk. TRCA's Restoration and Resource Management group identifies, plans, implements, and assesses projects that restore and enhance habitat and ecosystem functions to benefit the native flora and fauna of the region, as well as the humans that live, work, and play in the area. TRCA uses a science-based approach to understand the history, hydrology, and local ecology to identify ecological needs, set restoration targets and apply sound methodology to successfully implement and monitor projects that restore ecological function to the landscape.

2.2 Tommy Thompson Park

Tommy Thompson Park (TTP) is located on the Leslie Street Spit on the central Toronto waterfront, which is situated on the northwestern shore of Lake Ontario (Figure 1). The Leslie Street Spit is a constructed landform that extends five kilometers in a southwestern direction into Lake Ontario. The Toronto Harbour Commissioners (now known as PortsToronto) began construction of a land base at the foot of Leslie Street in the late 1950s to expand port facilities in anticipation of increased shipping activity in the Great Lakes. From the late 1950s until 2015, a combination of lakefilling and dredging activities created its current configuration. Land use requirements changed in the 1970s and shifted to a public park, followed by a wilderness park in the 1980s. The entire Leslie Street Spit is approximately 500 hectares of land and water and TTP represents 62 hectares of land and 170 hectares of water of this total. TTP is owned by TRCA, and jointly managed with the City of Toronto.

Figure 1. Tommy Thompson Park Location

Through natural succession, as well as ongoing habitat creation, restoration, and enhancement efforts, most of the land area at TTP has been colonized by a variety of plant and animal communities. Overall, the park represents the largest area of natural habitat on the central Toronto waterfront. Tommy Thompson Park, as well as Leslie Street Spit and Base of the Spit are classified as Environmentally Significant Areas and the Spit was designated as an Important Bird Area (IBA #ON038) by Birdlife International in 2000; the IBA designation was upgraded to Key Biodiversity Area in 2022 (KBA #ON038). The geographical situation of the park and its natural features make it suitable for large numbers of colonial waterbirds and migrating landbirds, as well as overwintering waterfowl.

2.3 Tommy Thompson Park Bird Research Station

TTPBRS is located on Peninsula D, one of four peninsulas that branch off the main spine of the park (Figures 1 and 2). Peninsula D was created in 1973-74 through the hydraulic dredging of sand from the Outer Harbour. The habitat on this 10-hectare peninsula is dominated by Eastern cottonwood, shrub willow and European white birch communities with silver maple, Eastern white-cedar and alder interspersed in lower densities.

Ecological Land Classification mapping from 2017 characterizes the dominant communities on Peninsula D as Cottonwood-Birch-European Alder Coastal Deciduous Swamp; Cottonwood Woodland; and Willow-Dogwood Thicket Swamp, with smaller areas of Common reed Mineral Shallow Marsh, and Sand Barren.

Figure 2. Peninsula D 2017 Ecological Land Classification Map

2.4 Count Area

The count area refers to the area where data collection can occur. The boundaries are marked by natural and man-made features, as identified in Figure 3. The east boundary zig-zags; the south-western edge starts at the Embayment C shoreline 25 m east of the end of the dock wall, it then extends north to the Peninsula D Multi-use Trail and follows the trail east for 110 m, at this point it extends north to the Embayment D wetland shoreline (this is 10 m east of the Embayment D boat launch area). The boundary then extends northwest along the Embayment D shoreline to connect with the north boundary at the Embayment D fish and water level control structure.

Standard capture and observation take place within the count area. Any observations made when outside this area are treated as non-standard and are noted in the comments section of the daily log. All birds seen or heard from within the study area are counted, even if the birds themselves are outside of the boundaries.

Figure 3. TTPBRS Study Area Map

2.4.1 Net Lanes

There are 20 standard net lanes within the count area at TTPBRS, and two non-standard nets, including the canopy net (CN) as identified in Figure 3.

Table 2. Net Lane Coordinates

Net Number	End A		End B	
	Latitude	Longitude	Latitude	Longitude
1	43.63250167	-79.32992833	43.63258667	-79.32994833
2	43.63242333	-79.33004333	43.63240833	-79.32992333
3	43.632161	-79.330299	43.632118	-79.330225
4	43.63092474	-79.33185622	43.63088	-79.33175667

5	43.63117831	-79.33232891	43.6312489	-79.3322913
6	43.63125363	-79.33227232	43.63133255	-79.33229303
7	43.63069	-79.332345	43.63061522	-79.33229031
8	43.63075667	-79.33258333	43.630775	-79.33265
9	43.63061059	-79.33384732	43.63053167	-79.3338
10	43.630142	-79.334505	43.630116	-79.334482
11	43.629860	-79.335036	43.629886	-79.334947
12	43.63131667	-79.33330866	43.63124245	-79.33323657
13	43.6313	-79.33331866	43.63135249	-79.33320691
14	43.63131302	-79.33296751	43.63125167	-79.33289333
15	43.63169667	-79.331895	43.63161526	-79.33190695
A	43.62980146	-79.33408794	43.62985907	-79.33395568
B	43.62988599	-79.33420288	43.62980146	-79.33408794
E	43.63076474	-79.33324232	43.63066167	-79.33317833
F	43.63233073	-79.33056085	43.63235	-79.33071
J	43.63168095	-79.33232931	43.63178359	-79.33232667
CN	43.63176491	-79.3313787	43.63189	-79.331505
H	43.632238	-79.329844	43.632004	-79.329777

2.4.2 Net Blocks

The array of mist nets is divided into net blocks which are standard groupings primarily used for net checks and prioritizing area closures if there is a personnel shortage.

Table 3. Net Block Composition

Block	Nets
A	1, 2, 3, F
B	12, 13, 14, 15, J
C	4, 5, 6, 7, 8
D	E, 9
E	10, 11, B, A

2.4.3 Census Route

The census route is a line transect that bisects the count area in a roughly east-west direction (Figure 3). The route is divided into six sections, flanked by census stations which are marked with flagging tape and permanent markers. GPS coordinates for each census station are recorded in Table 4. The census route starts at Station C0 and progresses west sequentially to Station C6.

Table 4. Census Route Coordinates

Census Station	Latitude	Longitude
C0	43.632973	-79.329438
C1	43.632396	-79.331079
C2	43.631728	-79.332015
C3	43.631015	-79.333184
C4	43.630333	-79.334408
C5	43.630142	-79.334841
C6	43.629297	-79.336186

2.5 Permit Requirements

All banding permits, including the Station Permit, Master Permit and Sub-permits must be kept up-to-date and displayed in the station at all times.

3.0 PERSONNEL

At a minimum, the Migration Monitoring Program must be operated by one experienced bander plus two experienced extractors, one of whom can complete census. The Bander-in-Charge (Role 1) is responsible for all operations detailed in this document. However, all personnel are required to read and understand this protocol.

Listed below are the various roles at TTPBRS and the accompanying skill sets required to fulfill them. The role of Bander-in-Charge will be held on 100% of monitoring days by a single staff person, hired for this purpose.

Inevitably, situations will arise where the personnel requirement for complete coverage is not met on a given day. In these situations, the program will be scaled back to suit what the available personnel can accomplish appropriately. At bare minimum, a skilled observer is required to complete the observation program. Roles 1 and 2 are required for a complete observation and a reduced capture program. The roles are as follows:

Role 1. Bander-in-Charge

- Holds a current and valid Master Permit or Sub-permit to Capture and Band Migratory Birds with authorization to band passerines and other landbirds from Environment and Climate Change Canada
- Excellent visual and auditory bird identification skills
- Excellent extraction ability
- Excellent scribing ability
- Excellent processing, ageing and sexing abilities
- Ability to train personnel
- Ability to delegate responsibility and coordinate
- Ability to effectively interact with the public

- Ability to accurately produce and submit data to Birds Canada and ECCC
- Adherence to bird banding ethics
- Thorough understanding of Migration Monitoring protocol

Role 2. Migration Monitoring Assistant (Volunteer)

- Excellent scribing ability
- Good extraction ability
- Good ageing and sexing abilities
- Adherence to bird banding ethics
- Thorough understanding of Migration Monitoring protocol
- Excellent visual and auditory bird identification skills (optional if Role 3 has this qualification)

Role 3. Field Assistant (Volunteer)

- Excellent scribing abilities
- Good extraction abilities (or)
- Excellent visual and auditory bird identification abilities

3.1 Ornithological Training

Training in field ornithology methods is important to provide exposure and education to those interested in birds. These opportunities are valuable for student and professional biologists looking to enhance their field skills. Ornithological training is also significant for amateur birders and naturalists for its ability to draw people into avian conservation. Training is mutually beneficial, as trained volunteers are the backbone of TTPBRS.

The volunteer and training schedule is pre-arranged which ensures that coverage during the migration season is complete. **It is important to emphasize that not all applicants are suited to bander training. Vision, hearing, dexterity, hand-eye coordination, and fitness are important considerations for applicants**. Patience is mandatory in bander training, both for the trainer and trainee.

Trainees follow a set order of tasks, designed to ensure bird safety and to maximize station efficiency. New personnel with banding experience from elsewhere must also go through this process with the Bander-in-Charge. However, this can be done quickly if they demonstrate capabilities. Persons new to bird banding must be advised that progressing through levels 1 & 2 can be relatively quick, while levels 3 & 4 can take years depending on the amount of training hours invested. A training session once per week or every other week is not ideal, and these trainees should expect to progress very slowly. Two or more days per week for a season are appropriate for effective learning and retention of skills. The following is an outline of the typical training progression.

1. Introduction

a) Read operations manual and relevant materials.

b) Observe programs in action.

c) Become familiar with net locations.

d) Perform scribing duties.

e) Proof data.

f) Learn to identify common birds at TTP.

e) Participate in census and detected total calculations.

2. Bird Handling (supervised)

a) Release landbirds from palm.

b) Learn bander's grip.

c) Learn photographer's grip.

d) Learn to switch back-and-forth from bander's grip to photographer's grip.

e) Learn to safely rotate a bird's body while in bander's grip.

f) Learn to safely fan a bird's wing out while in bander's grip.

3. Extraction (supervised)

a) Observe extracting demonstrations by the trainer until familiar with the concept.

b) Learn to extract on easy to handle, straightforward captures. The trainer may take over at any time if the trainee is uncomfortable, if the extraction is taking longer than 6 minutes, if the bird becomes stressed, or if the trainer wishes to demonstrate a technique.

c) Complete extractions under the trainer's supervision.

d) Learn to extract more difficult birds like woodpeckers and grosbeaks.

e) Extract in the presence of other experienced extractors.

f) Extract independently.

4. Banding

a) Learn about ageing and sexing techniques.

b) Begin banding mid-sized landbirds (supervised).

c) Band all passerine and near-passerine species.

d) Learn how to safely remove bands.

e) Continue to learn about ageing and sexing

Not every volunteer will progress to the next stage of training. Volunteers must have good eyesight and be proficient in bird identification, as it is crucial that birds are identified correctly before being banded. Learning to age and sex birds is a time-consuming process, therefore the Bander-in-Charge can only train a limited number of volunteers to band each season. Volunteers will be given priority based on their current extraction and identification skills, the length of time they have been volunteering with TTPBRS, the number of days per week they are available to train, and their willingness to make a long-term commitment to the station. Furthermore, bander training is intended to produce safe and efficient banders and is not a means of gaining a banding license.

Training for census is offered to those who possess the identification skills necessary to complete those tasks. Other trainees may observe census but may not contribute observations. Talking is prohibited during census but volunteers may compare their results when the surveys are completed.

Trainees are advised that bird safety and data integrity precede training in terms of importance. There will be days that are too busy or short-staffed to allow for in-depth training.

4.0 GENERAL PROCEDURES FOR STANDARDIZED COVERAGE

4.1 Dates of Seasonal Coverage

Migration monitoring is conducted during spring and fall migration. Optimal spring coverage is from April 1 to June 9 (70 days). Fall coverage is from August 5 to November 12 (100 days). These target windows are necessary to maximize species coverage within the study area.

4.2 Hours of Daily Operation

The standard count period is a 7-hour period, beginning 30 minutes before dawn. All standard sampling takes place within the standard 7-hour count period. All observations or banding that take place outside of the count period are treated as non-standard.

4.2.1 Net Opening and Closing

Nets are opened 30 minutes before dawn on count days, and close 6 hours later. Timing varies through the season as sunrise time changes. Daily net open and close times are posted seasonally in the banding lab.

4.2.2 Census

Census starts at Station C0 (Figure 3), one-hour after sunrise and takes one-hour to complete, ending two-hours after sunrise. Daily census start times are posted seasonally in the banding lab and emailed to census volunteers.

5.0 OBSERVATION PROGRAM PROCEDURES

The observation program at TTPBRS consists of standard observations and non-standard observations.

5.1 Daily Census (Standard Observation)

The daily census is the most critical component of migration monitoring at TTPBRS (Priority 1). Census follows a set route at set times (Figure 3). **All birds seen and heard from the census path are counted.** The route is divided into six evenly distributed sections which standardizes the pace that census is conducted in to achieve a consistent sample of species composition and density. **Each section takes 10 minutes to complete, and the observer cannot proceed past a section marker until the 10 minutes have elapsed.** This means that an equal amount of time is spent on each section of the census route, independent of how busy each section is (eliminating a situation where on busy days, the census observer could spend 1/3rd of census time on 1/10th of the census route and then rush to complete the rest in time).

The first time a species is detected it is recorded with a four-letter alpha code. Subsequent individuals of that species are recorded with a running tally. This will limit the amount of time the observer's head is down when writing, maximizing observation time. The following colonial waterbird species are not tallied on census: Double-crested Cormorant, Black-crowned Night-Heron, Ring-billed Gull, Herring Gull, Common Tern, and Caspian Tern. However, indicate that these species were detected with a checkmark as they do count for the species total on census.

Straying more than 1.5 meters from the census path is not permitted. Observers may briefly step off the path to a maximum distance of 3 meters to confirm identification; however, any additional birds detected when off the census path are not countable.

Census Rules

- Census begins one hour after sunrise and runs for 60 minutes.
- Census is conducted by only one observer at a time (others may join but cannot contribute observations).
- Census duty must be rotated on a daily or weekly basis to limit observer bias.
- Census observer must record start and finish time as well as weather information.
- Census observer must stick to the designated census route.
- Census observer must use binoculars but may not use spotting scopes.
- Census observer must adhere to pace markers.
- Census observer may not use "pishing" or any other means of attracting birds.
- Census observer must focus on landbirds; brief scans of waterbirds are permitted.
- Census observer cannot interrupt the census to socialize (e.g. turn cell phones off).
- Census observer must enter census results in the daily log.

5.1.1 Double Counting Individuals

Census observers must be cognizant of "double-counting" the same individual bird(s). This is especially important for birds seen flying beyond sight in the census path direction (east-west). Only ignore birds you feel strongly that you already counted. If there is doubt, count it again. Census observers should also look for characteristics that can easily separate individuals. Age, sex, condition, behaviour, and whether they are banded are helpful clues. The following four scenarios are common double-counting situations.

Scenario 1 – Unusual species

An Olive-sided Flycatcher is detected actively sallying for insects in a slow eastern direction at the beginning of the census. A second Olive-sided is briefly sighted 10 minutes later and then flies east.

- *Treat as two different birds.*

Scenario 2 – Unusual species

An Olive-sided Flycatcher is sighted near net #15 flying past you in a western direction. 20 minutes later one is detected in a cottonwood at the tip (western limit).

- *Given the low density of the species and its flight path, treat as same bird.*

Scenario 3 – Common species

A group of 11 Blue Jays is seen flying east overhead and later a second group of 11 is seen flying 10 minutes later in a western direction.

- *Treat as same birds.*

Scenario 4 – Common species

A group of 10 Blue Jays are flying west out of your sight. 30 minutes later, another 10 are seen flying in the same direction.

- *Treat as different birds.*

5.1.2 Cancelling Census

There are circumstances that justify the cancellation of census. These include lightning storms, precipitation that substantially reduces visibility, very high winds, and emergencies. The Bander-in-Charge will make decisions on factors that may preclude the completion of census. Otherwise, the census should be done every day during the migratory window. It takes precedence over all other monitoring activities.

If a circumstance prevents census from happening at the scheduled time, but the condition improves, census should be completed later in the day. Census time is marked in the daily log, and if census is completed within the standard count period the records are considered standard and included in the DET.

5.2 Other Observations

Casual observations are made **during the standard count period** and **within the count area** but not during the census. For example, casual observations are most often recorded between net rounds. Staff and volunteers should carry a notebook for these records and pay attention to double counting.

Observations taken by observers **outside of the count area,** or from inside the count area but **outside of the standard coverage period,** are non-standard observations, and should be recorded as notes in the log.

There will be significant day-to-day variation in observer skill, area covered, and time spent on casual observations, but the casual observations add to the overall migration picture and are important for recording birds that are missed by census and banding. They may be used to calculating trends in numbers of certain species that are poorly sampled by banding and census, including numbers of colonial waterbirds that are excluded from census records. These observations are therefore an important part of the data set and should be recorded as carefully as time allows.

6.0 CAPTURE PROGRAM PROCEDURES

The standard capture program consists of the use of 20 mist nets that are set for the standard count period of 6 hours. Capturing migrants is significant to this project for its ability to sample in an unbiased manner. Mist nets are an excellent counting tool, particularly for cryptic species not easily detected by observers. Banding also provides valuable data on stopover rates, ecology, morphometric (measurements), and demographic information.

6.1 Banding Ethics

At TTPBRS, bird safety supersedes all aspects of this protocol. A “good” day is measured by this principle. The Bander-in-Charge is ultimately responsible for ensuring a safe operation; however, all personnel are required to familiarize themselves with the protocol and the North American Bander’s Study Guide prior to participation.

Personnel are advised that birds in the hand are resilient but sensitive, and simply want to be released. It is the bander’s responsibility to be aware of the sentient qualities of the birds they are handling and to let that guide their judgment. As one develops their banding and extracting abilities, there may be a tendency to become overconfident and lose focus on the underlying principles of safe handling. All banders must be conscious of these principles since errors can occur at all levels of experience.

The following are some guidelines on bird safety:

- Stressed birds are released at the net without being processed.
- Potential predators are reported to the Bander-in-Charge.
- Any injuries must be reported to the Bander-in-Charge.
- Bird safety precedes personal goals with respect to bander training.
- Attempting to maximize capture for personal satisfaction is intolerable.
- Treat birds with respect. Socializing while bird handling is unacceptable.
- Birds are treated equally, without respect to rarity.

Bander's Code of Ethics (North American Banding Council 2021)

1. Ensure the respect, safety, and welfare of birds and their populations, people, and the environment.
   - Handle each bird carefully, gently, quietly, and in minimum time; capture and process only as many birds as you can safely handle given your ability and the environmental conditions
   - Follow safety procedures as outlined in NABC materials and constantly innovate ways to conduct operations more safely
   - Follow the NABC Code of Conduct to help guide professional behavior

2. Design or use appropriate studies, methods, and analyses to advance a valid scientific purpose.
   - Collect accurate data and submit to an appropriate data repository
   - Collaborate to maximize data collection
   - Promote and contribute to projects using standardized protocols when appropriate

3. Be accountable and strive for high standards.
   - Engage in self-assessment and invite assessments from others to ensure that your work is beyond reproach
   - Share knowledge and offer honest and constructive feedback to others to improve skills and banding practices

4. Obtain all necessary permits and permissions; understand and adhere to the conditions, responsibilities, and limitations thereof.

6.2 Standard vs Non-standard Banding

Standard banding includes birds captured in the standard mist net array, during the official count period. Only birds captured that meet these criteria are entered into the standard components of the daily log. At TTPBRS the focus is on standard banding.

Non-standard banding refers to banding which does not meet the criteria of standard banding. Instances include:

- Birds captured outside the daily count period or count area.
- Birds that were intentionally flushed into mist nets.
- This includes luring birds into nets with playback, bait, or trying to push a bird into the net with human presence. *Note that these practices are unacceptable at TTPBRS and must not be used under any circumstances.*
- Birds captured by hand or other trapping method besides the standard mist nets.
- Birds captured in mist nets located in non-standard locations. However, under exceptional circumstances such as flooding, mist nets may be minimally repositioned to allow continued access. Any such changes should be fully documented (distance moved, how long net stayed in the new position) in Appendix B.

These capture records are indicated on the banding data forms by writing NSB or NSR (non-standard recapture) in the comments section. There are columns for NSB and NSR in the non-standard sections of the daily log.

6.3 Equipment

Equipment used in banding includes a digital scale, bander pliers, wing rulers, magnifying glass, task lighting, etc. and must always be kept in good working order. Problems with equipment must be reported immediately to the Bander-in-Charge.

6.3.1 Mist Nests

The standard capture setup is an array of 20 Ecotone mist nets. Numerical net lane nets measure 9 m x 2.5 m, alphabetical net lane nets measure 12 m x 2.5 m. The mesh diameter is 30 mm, which is designed to capture small landbirds. To maintain long-term consistency, the net manufacturer, length, and mesh diameter must be identical. Nets are held in place by the Advanced Pole System that includes a 48” base pole with corkscrew auger and 3x48” extension poles for a maximum net height of 14-14.5’ (for 30/40’ nets) and the base plus 4x48” extension poles for a maximum net height of 18-18.5’ (for 60’ nets). Net positions are marked in the off-season to ensure that nets are placed in the same position each year, and GPS locations are noted in Table 2.

Nets are fragile and periodically develop holes from wear and tear. Holes can reduce capture rate and can cause birds to become more tangled. To ensure bird safety and consistent capture rates, nets should be assessed and repaired on a regular basis. Net repair kits should always be in supply and the Bander-in-Charge should train all personnel on net repair. Repairs should be made outside of standard banding hours.

6.3.2 Bird Bags

Bird bags should be made of thin, soft cotton. They should measure 15-20 cm or larger, depending on the size of the bird. Bags need to be large enough that the bander can easily reach in to extract a bird. The whole body and the tail of the bird must be able to fit easily into the bag, without the tail being bent. Conversely, tiny birds should not be placed in large bags, as they can fly around inside the bag and expend energy.

Extractors should always carry an assortment of bags. Draw strings should be kept long enough that extractors can fit the loop around their wrists, but not so long that the bags dangle too low. Seams of the bags should be finished without loose threads that could get tangled with a bird’s feet. If a bag has loose threads on the inside, it may be turned inside-out and used. Bags should not be made of camouflaged materials in case a bag is accidentally dropped and blends in with the vegetation.

Bird bags must be washed after each use, that is, after the bags have been turned inside-out and used once on each side. Before washing, bags should be shaken out to remove debris. Only shake bags outdoors and be careful not to inhale airborne particles. Wash bags on a delicate cycle with hot water, gentle unscented detergent, and a small amount of bleach. Before use, make sure that any bags with loose strings are turned inside out.

6.4 Net Lane Maintenance

Net lane maintenance should occur during pre-season setup, and as required throughout the season, outside of standard banding hours. Vegetation should be trimmed to maintain a maximum net lane width of 1.5 metres, and vegetation below the net should be cut close to the ground to prevent interference with birds captured in the lowest net panel. Net lanes should be raked to remove anything that may cause tripping and/or tangling with the net.

When clearing net lanes of vegetation, personnel should only remove what is necessary to extract comfortably and prevent vegetation becoming tangled in the net. Clearing unnecessary vegetation will reduce net success.

The presence of a European red ant colony under the net is cause for concern. Keep the bottom trammel high enough from the ground that a heavy bird will not touch any vegetation or the ground. Ants can quickly crawl from a blade of grass onto a bird, causing significant harm. Measures should be taken to remove ant colonies and/or reduce them from crawling into nets by painting net poles with Tanglefoot, a non-toxic substance that traps ants.

6.5 Net Setup and Storage

Each net is held in place using two sets of the Advanced Pole System. The 48" base pole has a corkscrew auger at the base that should be twisted 1-1.5 feet into the ground – the base should be installed on a slight angle away from the net to balance the pull exerted by the net on the poles. Three 48" extension poles are added onto the base for the 30/40' nets; four 48" extension poles are used for the 60' nets. Ensure the connector pegs are pointed **toward** the net so they don't interfere with the net loops. Net poles are properly placed when there is enough tension to keep the trammels from sagging or sliding down the poles.

When storing nets, the Bander-in-Charge should inspect each net and take note of any damage that requires repair. The bag for each mist net is marked with a corresponding location when stored so that nets can be returned to their original location.

6.6 Net Opening and Closing

Weather permitting, nets are opened 30 minutes before sunrise and are operated for six hours. It is imperative that everyone pay attention to net operation times. Nets are checked and closed in the same order that they were opened to ensure that six hours are completed for each net. If nets are closed in the reverse order to opening, there can be more than 20 minutes difference in coverage between nets.

The net poles are marked with positions for the bottom panels of each net (standard is at about knee height [positioned so that birds captured in the bottom shelf do not touch the ground], raised to 4' when mink are active). The four remaining loops of the net should be evenly distributed. Nets can be raised with a net stick and lowered by pulling on the ropes attached to the loops. The top trammel will only reach the top of the pole when the bottom panel is in the 'high' position. **Never pull a net down with a shelf string, as this will tear the net.**

To ensure there's a visual reminder of which nets are open at any time, each net has a 'net tag' (a laminated card with the net number attached to a carabiner) that is kept in the station. When the net is opened, the net tag is attached to the loop of the lowest trammel. When the net is closed, the net tag is removed and returned to the

lab. Furthermore, there is a net open/close checklist (Appendix C) located inside the lab door. This checklist is updated each time a net status changes and includes a column to record the time of early closures.

The Bander-in-Charge is responsible for ensuring that all nets have been properly shut down. This is especially important with new personnel who may be unfamiliar with the net array. Experienced staff or volunteers should accompany new personnel until they have memorized net locations. At the end of each day, one or two volunteers will be assigned to back-check all the nets to make sure they are closed properly, and at the lab all net tags are inventoried and the net checklist is reviewed to confirm all nets have been accounted for.

Personnel must wear clothing that will not catch on the delicate nets as this can cause major tears (no zippers, buttons, keys etc.). When in the netting area, personnel should be as quiet as possible. Talking is allowed, however voices should be kept to a moderate level. **Do not spend any unnecessary time near the net as this affects bird capture**.

The Bander-in-Charge will offer instruction on net furling and net tying procedures. The furl into top panel/half hitch tie method is used. Once the nets are closed at the end of the day, the loops at either side of the net are locked so that the nets cannot be opened by a curious passerby. Alternatively, the nets may be taken down entirely at the end of the day and stored in the station to avoid vandalism and theft.

6.7 Net Checking

Nets are checked every 30 minutes under optimal operating conditions. Nets are checked more frequently on days of marginal weather, high capture volume, or when there's risk of predators.

When performing a net check, personnel must clearly communicate and coordinate where they are going to ensure that all the nets are covered. While conducting net checks, the 2-way radios should be used to keep the team updated on progress. To minimize time that people are on the radio, extractors should report back once they are done checking their net block.

Sometimes the beginning of a radio transmission is cut off, so it is preferable to save the number of birds for the latter part of the sentence. An example would be "Nets 4-8 are clear, 4 birds." If a net has lots of birds, it should be communicated immediately so that others who are free can assist with extraction. This is especially important if it is one of the first nets to be checked – subsequent nets could also be filled with birds.

It is important to move from net to net quickly, so personnel must avoid taking "birding breaks" while on a net check. Remember that the next net could contain a tangled, stressed, or injured bird, or a high number of birds. This kind of situation can easily take personnel into the next net run. Time is of the essence.

6.8 Extraction

Independent bird extraction is performed only by those authorized by the Bander-in-Charge – all others must be supervised. Extraction by inexperienced persons is dangerous, both for the people and the birds. Those wishing to be trained in bird extraction should approach the Bander-in-Charge for training procedures.

All extractors must carefully note the net location for each bird extracted. This can be done by using numbered clothes pegs found at each net.

6.8.1 Methods of Extraction

The primary methods of extraction used at TTPBRS are the feet first method and the body-grasp method. There are many tips and techniques that are not found in the study guide, which can only be learned through one-on-one training. It is important for the Bander-in-Charge to personally oversee the training of all personnel and continue to assess the skills of all extractors. This includes new personnel who have previous extraction experience; not all training is equal, and extractors can sometimes pick up bad habits along the way. All extractors must be open to review and constructive feedback, as it is essential for bird safety.

6.8.2 Rules for Extractors

- Carry a radio or stay near someone who has one.
- Carry a list of band numbers of same day captures.
- Carry an extraction tool for precise manipulation of net strands.
- Lower the net first; never hold upper panels down with elbows.
- Radio for assistance if an extraction takes longer than 6 minutes.
    - If during an extraction you feel the situation is worsening, contact the Bander-in-Charge for assistance. Do not wait until it is too late.
- Never cut a net without permission from the Bander-in-Charge.
- Extract birds on the bottom panels first.
- Birds are taken out in the following order:
    (1) raptor
    (2) presence of stress/injury
    (3) large landbird
    (4) sensitive species (hummingbirds, kinglets) and
    (5) all others.
- Do not double-check a net unless there is suspicion of danger to birds in net.
- If you see a predator in the study area, report it **immediately** to the Bander-in-Charge.
- Raise nets that were lowered for extraction – don't forget!
- Do not cause unnecessary stress to birds by talking loudly during extraction.
- Always focus on the extraction.
- Do not place more than one bird in a bird bag.
- Note the net location for each bird captured.
- Do not place bagged birds on the ground or on branches. These can blend with the vegetation and be forgotten.
- Avoid clothing with buttons, zippers or anything that can become tangled in a net.

6.9 Processing

Processing is the banding and data collection of each captured bird. Captured birds are brought back to the station after a net check. There are two sets of hooks beside the banding table which correspond to each net and bags are hung accordingly. Noise should be minimized in the banding station so as not to distract the bander or

scribe, and more importantly to minimize stress to the birds being processed. Processing procedures are critical as information recorded needs to be as accurate as possible.

6.9.1 Personnel

Processing is only carried out by the Bander-in-Charge, a Migration Monitoring Assistant, or by trainees under supervision.

6.9.2 Order of Processing

Processing must follow the order of the net check. This order is important for limiting the amount of time a captured bird is held. Any stress-prone birds such as kinglets should be processed first, regardless of net check order. Birds with a brood patch also take priority. If during processing an inordinate number of individuals are visibly stressed, stop banding, release all waiting birds, and record as captured-unbanded.

6.9.3 Species Identification

A bird must be correctly identified *before* it is banded. If a bird cannot be identified, it must be released unbanded.

6.9.4 Morphological Assessment

Following species identification and banding, the morphological parameters are assessed using standard protocol from the Bird Banding Office and Pyle.

- Fat – rating scale 0-6, 0 being empty and 6 bulging.
- Wing Length – mm
- Skull – rating scale 0-6; *optional*.
- Age – numeric code
- Sex – M, F, U
- Weight – g

6.9.5 Holding Time

Birds should not be held longer than 60 minutes from the time they are extracted from the net. If the bander has such a high number of birds waiting to be banded that they cannot process them quickly enough, birds which have been held for 60 minutes should be released unbanded, keeping note of the species and recording as capture-unbanded. As there are two sets of hooks for bird bags, if a second net check is completed before all birds from the first net check are processed, they are kept separate and birds from the first net check can be released if they approach the 60-minute hold mark.

6.9.6 Data Priority if Busy

When the bander is busy, and needs to catch-up on a backlog of birds to avoid having to close net blocks, they can skip data collection in the following order:

1) fat scoring first
2) followed by sexing and aging (or simply classifying as hatch-year/after hatch-year); and
3) wing length and weight last.

If, after reducing data collection, there are still more birds than the bander can safely process, simply band and release, recording only the species as to track individuals. As a final resort, release birds unbanded, but record the number of each species. To avoid this scenario, the Bander-in-Charge should anticipate the build-up of a back-log and close nets temporarily as needed to allow for catch-up (see section 6.11.4).

6.9.7 Recaptures

Recaptures are previously banded birds which are captured again. Recaptures are processed the same way as newly banded birds, with the information recorded on separate Recapture data sheets. The bander must clearly read the band number out loud and have the scribe read the number back to ensure that it is recorded correctly.

Birds are not to be processed twice in one day, as we do not want to put birds under additional stress. All extractors carry a list of the first band numbers of the day and check recaptures at the net. Same-day recaptures are released on the spot, away from the net.

6.9.8 Captured-unbanded

Captured-unbanded is the term for a captured bird that is released without being banded. Birds are sometimes released unbanded due to stress, casualty, and escape, but more often from excessive capture volume. The extractor or bander must have touched the bird to count as captured-unbanded. A bird that escapes prior to handling at the net should be recorded as a casual observation. Personnel are required to keep track of captured-unbanded birds in their field notebooks. Captured-unbanded is a standard data column in the daily log.

Note: if a bird needs to be released at the net and is already banded, write down the band number in your notebook before letting it go.

6.9.9 Releasing Birds

Birds are normally let go out of the release chute, which is a hole built into the wall directly in front of the bander. If a bird is not ready to fly, it typically stays at the end of the chute. Personnel can retrieve the bird from the chute outside of the lab and allow it to recover. In this situation the bird is replaced into a bird bag and checked every 5-10 minutes until it is ready to fly. If a bird is taken outside to be released, the bander should let the bird go low to the ground in case it is not ready to fly. With the bird in bander's grip, the bird is set upon the palm of the other hand, which the bird uses as its "launching pad." Personnel should make sure to close the station doors prior to release so the bird does not fly inside.

6.10 Scribing Procedures

Scribing is the act of recording information that the bander calls out when processing a captured bird. **Scribing is a critical task of bird banding as data integrity depends on accurate record keeping.** By having someone else record data, the bander's hands are free to process birds unhindered. A scribe also allows the bander to focus

on ageing and sexing rather than writing. Ultimately, scribing results in faster processing times, ensuring that birds are released quickly.

Scribing is one of the first tasks undertaken by new volunteers, as it is easy to learn and can be done by anyone, regardless of ornithological training. It is also a good way to learn and observe the banding process. All volunteers, however, scribe as the need arises. Therefore, it is important that both new and existing volunteers stay familiar with scribing protocol. These guidelines have been written to ensure that all volunteers understand the scribing protocol and maintain consistency. An example of the banding form is in Appendix D.

General guidelines for scribes:

- Confirm the band number with the bander before proceeding.
- Always ask the bander if unsure of what to enter into a field.
- Inform the bander if you cannot maintain pace.
- Remain focused on the bander at all times.
- The last row of a given band size is highlighted at the end of each day to visually separate dates.
- The banding log is organized by band size. When starting a new band string, have the bander read the full band number of the first band. Find that number in the band inventory sheet and cross out the string using ~~strikethough~~ formatting. Drag down the full band string in the appropriate sheet, and have the bander read out the last two digits of every subsequent band until the string is exhausted.

The columns on the data sheets should be filled out from left to right as follows:

1. **Band Number –** This will have been pre-populated by the scribe upon starting a new string. Have the bander read the last two digits of the band *before* opening it, and only let them proceed if it matches the next band in sequence. Notify the bander immediately if the number is out of order.
2. **Species –** Each species has a 4-letter alpha code. If you are unsure of the code, ask the bander or consult the reference sheet.
3. **Species Name –** Full name corresponding to the 4-letter alpha code. This is auto-populated by the worksheet. Verify that it shows the expected species before proceeding. If it is not the expected species, verify the alpha code with the bander.
4. **Bird Status –** This will usually be 300 and is also auto-populated as such, which stands for a “normal wild bird Federal numbered band only.” The alternate status is 500, which is used for “sick, exhausted, injured, crippled, or physical deformity federal numbered band only.”
5. **Disposition –** Refers to band condition. This will usually be 1, meaning a newly banded bird, and is auto-populated as such. Other options are 4 for a lost band or 8 for a destroyed band.
6. **Date –** The spreadsheet will auto-populate the banding date when a species code is entered.
7. **Age –** Age codes are provided in the Lookups section of the data entry spreadsheet.
8. **How aged –** The method used to determine the bird’s age. Codes are also provided in the Lookups section.
9. **Sex –** The sex of the bird as determined by the bander, either M, F or U.
10. **How sexed –** The method used to determine sex. May be left blank if the sex is unknown (U).

11. **Bander ID –** The bander's personal initials, typically three characters.
12. **Capture time –** The time corresponding to the net check the bird was captured in. A colon (:) is not required.
13. **Wing –** Relaxed wing chord of the bird, measured in millimeters.
14. **Fat –** Visible subcutaneous fat load, scored from 0 to 7 (refer to reference sheets).
15. **Skull –** Score representing extent of skull ossification. May be left blank if skulling was not performed, but must be filled out if the bird was aged by skull.
16. **Body Molt –** Whether or not any pin feathers are present in body plumage (not wings).
17. **WRP –** Wolfe-Ryder-Pyle age code. Three or four characters, optional.
18. **Weight –** Mass of the bird in grams. Measured just before release.
19. **Weight time –** Time of weighing, auto-populated when weight is entered.
20. **Net –** The numeric designator of the mist net/trap the bird was captured in.
21. **Remarks –** Anything of importance should be written in this section, such as physical abnormalities, details about molt limits, unusual behavior, etc. Comments are required for a status code of 500.

Table 5. Ageing and Sexing Codes

Age		How Aged		Sex		How Sexed	
0	unknown	AM	auxiliary marker	U	unknown	BO	behavioral observation
1	after hatch-year	BO	behavioural observation	M	male	BP	brood patch
2	hatch year	BP	brood patch	F	female	CC	combination of characteristics/measurements
4	local	BU	bursa of fabricius			CL	cloaca
5	2nd year	CA	calendar			DN	DNA/chromosome analysis
6	after 2nd year	CC	combination of characteristics/measurements			EG	egg in oviduct
7	3rd year	CL	cloaca			EY	eye color
8	after 3rd year	EG	egg in oviduct			FS	feather shape (primaries or tail)
		EY	eye colour			IC	inconclusive, conflicting
		FB	fault bar			LL	laparotomy/laparoscopy
		FF	flight feathers (regimes), condition or colour			MB	mouth/bill
		IC	inconclusive, conflicting			NA	not attempted
		LP	molt limit present			OT	other
		MB	mouth/bill			PL	body plumage
		MR	active molting regimes			RC	sexed upon recapture
		NA	not attempted			TL	tail length
		NF	nestling recently fledged, incapable of powered flight			WL	wing length
		NL	no molt limit				
		NN	nestling in nest (altricials), downy young (precocials)				
		OT	other				
		PC	primary covert wear/shape				
		PL	body plumage				
		RC	recapture				
		SK	skull				
		TL	tail length				
		TS	tail shape/wear				

6.11 Rules for Reducing Banding Effort

There are many situations that can arise during banding which result in reduced netting coverage. Depending on the circumstances, either all nets will be closed (complete closure) or only some nets (partial closure).

6.11.1 Complete Closure

All nets are closed when:

- There is moderate to heavy or prolonged light precipitation.
- Temperatures exceed 30˚C or drop below 0˚C.
- There is high wind (force 5+ on Beaufort scale).
- There has been a casualty that the Bander-in-Charge feels merits net closure (e.g. active predation).
- Weather is marginal but expected to quickly worsen.
- In case of emergency.

The procedure for completely shutting down the banding operation is simply to gather all available personnel and close as quickly and efficiently as possible. In situations of an immediate downpour, personnel should check all nets quickly before closing on the way back. Although this counteracts net opening order, it minimizes the risk to birds.

6.11.2 Partial Closure

The number of nets is reduced when:

- A predator is discovered in the area.
- Sufficient personnel are unavailable.
- There is excessive capture volume.
- Weather is marginal but not expected to worsen.
- A net or nets are damaged.

When only some nets need to be closed, a net block or blocks are closed in a sequence based on distance from banding lab. Block E (furthest) is closed first followed by D, C, B, and A. **Nets are closed as a block** unless just a single net from a block needs to be closed in which case the rest of the nets in the same block can remain open (this exception is applicable in the event of net damage or wind). This procedure eliminates bias towards favored nets and maximizes efficiency by shortening the net round on days when time is critical.

6.11.3 Reducing Number of Nets due to Weather

When weather is marginally inclement nets should be evaluated on an individual basis. If the temperature is hovering around 30° for instance, nets in the shade may be fine whereas those in the sun will need to be closed. If the temperature is 0° even moderate wind is enough to warrant net closure. The Bander-in-Charge is ultimately responsible for decisions on net reduction, but all personnel must carefully assess the conditions at each net and report any concerns to the Bander-in-Charge.

6.11.4 Reducing Number of Nets due to Excessive Capture

The experience of the Bander-in-Charge is important for the evaluation of what can and cannot be safely accomplished by available personnel. Net blocks are to be reduced if birds are waiting longer than 30 minutes in

the net and/or 40 minutes in the lab. The total time of capture (time spent in net, bag and in-hand) should never exceed 60 minutes.

If all birds cannot be processed with all the information, then net groups should be reduced. However, if the Bander-in-Charge deems that they can catch up with a backlog of birds within one net round by dropping fat scoring and micro-ageing and sexing, then they should do so (see section 6.9.6). Close Block E first and Block A last as necessary.

6.11.5 Reducing Number of Nets due to Predators

There are occasionally predators present which will take a bird from a net if the opportunity presents itself. Predators include raccoons, mink, and hawks. If a predator is seen anywhere near a net, first try to scare it away by chasing and shouting. Radio the Bander-in-Charge immediately for instruction on which nets to shut. If you cannot get through on the radio, always err on the side of caution and shut the nets that may be at risk.

Mink

American Mink is a common species at Tommy Thompson Park and individuals are regularly observed in the habitats surrounding the TTPBRS study area. All personnel should be on constant alert for mink within the study area as they are smart mammals that quickly learn mist net locations if they find a bird in a net. New net poles were implemented in 2023 to allow for raising of net height, bringing the bottom shelf high enough off the ground that mink cannot reach it.

Mink observed in net lane, but no birds in net

- Radio Bander-in-Charge.
- Increase net height so the bottom trammel is at least 4’ above the ground.
- Leave the net open for another 30 minutes but increase net check frequency to 15-minute intervals.

Mink observed in net lane, birds in net (no injuries or mortality)

- Radio Bander-in-Charge.
- Extract birds from net.
- Close net for 2-3 days.

Mink observed in net lane, birds in net (injuries or mortality occurred)

- Radio Bander-in-Charge.
- Extract birds from net in the following order:
    - Injured birds
    - Uninjured birds
    - Mortalities
- Close nets for 2-3 days and Bander-in-Charge to discuss longer-term strategy with Project Manager.
- Assess injuries and treat as per section 6.12.

If mammal predation becomes consistent, the Bander-in-Charge should contact the Project Manager to determine options to manage the situation.

6.12 Injured Birds

Injuries are rare, but they can happen. If an extractor discovers that a bird is injured, they must immediately tell the Bander-in-Charge. When taken back to the banding station, the bird should be set aside and promptly evaluated by the Bander-in-Charge. All injuries and casualties are recorded in the casualty log. Record species, band number (if applicable), date, nature of injury/mortality, cause, and course of action taken if any.

6.12.1 Treatment of Minor Injuries

Some injuries can be dealt with on site. A bird "first aid" kit is kept on hand for these occasions. Minor cuts can be treated with alcohol wipes and antiseptic cream. Styptic powder is used to stop wounds from bleeding. Latex gloves should be worn when treating open wounds. Additional information on how to treat minor injuries can be found in the Bander's Study Guide (NABC, 2001). If there is a minor injury on the right leg, the left leg should be banded instead. If an injured bird is banded, the Bird Status code is 500.

6.12.2 Major Injuries

For serious injuries like broken legs or wings, birds should be taken to the Toronto Wildlife Centre (416) 631-0662 after they have confirmed they will accept the bird. An injured bird should be held quietly in either a bird bag or in a well-ventilated shoe box lined with material until it can be released or transported.

A seriously injured bird should not be banded, as its chances of survival are lowered, and the data is therefore skewed. Exceptions can be made for birds with pre-existing injuries that have clearly not affected their survival. For example, birds have been captured with only one leg or a missing eye, the wound having healed over.

In the event of a critical injury where rehabilitation is not feasible, quick and humane euthanasia techniques should be utilized by the Bander-in-Charge. If the bird was already banded, the band should be removed and the Bird Status code on the banding sheet changed to 500 and the Disposition code changed to 4: Band Destroyed. The bird should be disposed in a sanitary manner, or if it is an uncommon or rare species should be offered to the Royal Ontario Museum as detailed in section 6.12.3.

All injuries must be followed by a thoughtful and thorough assessment of the events and circumstances that contributed to the injury. It won't always be possible to figure out how an injury came about, but every effort must be made to increase our understanding of how and why these accidents occur and how to avoid recurrence.

6.12.3 Casualties

Very rarely birds may die from stress, injuries, or natural causes. Dead birds should be processed as though they were being banded to collect as much information as possible. This information should be recorded in the casualty log. If the bird dies after it is banded, the band should be removed and the Bird Status code on the banding sheet should be changed to 500 and the disposition code should be changed to 4: Band Destroyed. Once processing is finished, the bird should be disposed in a sanitary manner. Uncommon or rare specimens should

be put in a plastic bag and the Migration Monitoring Coordinator should offer the specimen to the Royal Ontario Museum, to be made into a study skin or skeleton. If accepted, the bird should be labeled with all the collection details, most importantly the location and date. All casualties must be reported on an annual basis to the Banding Office.

7.0 DATA COMPILATION AND MANAGEMENT

7.1 Standard Totals

Standard Totals (ST) are the figures used for analysis of population trends. The ST is the estimated number of each species actually detected with standard operations on a given day. It is calculated as the sum birds detected during census, standard captures, and other observations (see section 5.2), after reduction as needed to remove probable duplications among the count methods. The Standard Totals provide a better indicator of species richness compared to each count method on its own.

Because the simple sum of the totals of all surveys may result in multiple counting of some individuals, interpretation is needed to arrive at the best estimate separate individuals detected. The ST can never be higher than the sum of the 3 component figures. For example, if there were 2 Magnolia Warblers banded, 3 censused and 4 casual observations, then the ST must be equal to or less than 9 (2+3+4=9). There is often an overlap between surveys, however, meaning that the same bird might be counted more than once. Estimating how many separate individuals of each species were detected is done through group discussion upon the completion of the count period.

For example, discussion of the Magnolia Warbler counts above might reveal that one of the birds on census was close to nets and likely to have been banded soon after, while 1 of the 4 casual observations was made close to the census route when census was being conducted. The ST would therefore be adjusted downward by 2, from 9 to 7. Adjustments should be conservative, however, and only made when duplication was highly likely. When large numbers are present, for example if small flocks were repeatedly observed throughout the day, consider whether the flocks were behaving as if on stopover (same flock observed over and over) or were moving through (and therefore likely to have been separate observations). Personnel present for many days can easily detect whether overall daily numbers have markedly jumped or dropped, and small adjustments to STs will not be large enough to obscure such changes.

The process of identifying duplicates is subjective but is better than including birds known to have been double counted. The Bander-in-Charge is responsible for the appropriate completion of detected totals; however, the ST conductor role should rotate as much as possible to eliminate potential bias towards a single person's rationale. The following points should be considered when making observations and identifying probable duplicates:

- Location/direction of movement
- Sex of bird
- Bands present
- Age of the bird
- Behaviour

- Unusual condition/characteristic (e.g. crossed mandibles, missing flight feathers, etc.)

7.2 Non-standard Totals

The Non-Standard Total (NST) is the combined tally of the ST and additional, non-standard captures and observations (such as birds counted outside the daily coverage period or from outside the boundaries of the count area). The NST is not used for trend analysis but can be used for reports. The ST conductor calculates the NST after the ST is completed and in the same manner as calculating the NST (i.e., ensuring that additions to NST observations do not duplicate what is already in STs).

7.3 Daily Log

The daily log summarizes the activities for the migration monitoring day. An example daily log is shown in Appendix E. As of spring 2024, the daily log has been converted from paper to digital format. The daily log includes the species total forms and a summary form, which includes the following information:

- Date
- Season banding total (running total)
- Season species total (running total)
- Coverage code
- Number of visitors
- Log compiler/ST conductor (initials)
- Personnel initials
- Comments (narrative/synopsis)
- Weather for count period start, census and count period end
- Standard and non-standard net hours, detailing which nets were open for which hours
- Census observer, and start and finish times

7.3.1 Weather

Weather is recorded in the daily log three times daily: at opening, census and closing. The following information is recorded:

- Wind direction and strength using Beaufort Wind Scale (Table 6)
- Temperature in degrees Celsius
- Precipitation (0=none, 1=drizzle, 2=showers, 3=rain, 4=light snow, 5=snowfall)
- Cloud cover in tenths (1 = 10%)
- Visibility (P=poor, A=average, G=good)

Table 6. Beaufort Wind Scale

Scale	km/h	Wind Speed Indicators
0	<1	Smoke rises vertically

1	1-5	Wind direction shown by smoke drift
2	6-11	Wind felt on face; leaves rustle
3	12-19	Leaves and twigs in constant motion
4	20-28	Wind raises dust; small branches moving
5	29-38	Small trees in leaf begin to sway
6	39-49	Large branches in motion
7	50-61	Whole trees in motion

7.3.2 Coverage Codes

A coverage code (Table 7) is assigned on each monitoring day based on the degree to which all standard surveys were completed. The coverage code is entered into a designated box on the daily log summary form.

Table 7. Coverage Codes

Coverage Code	Criteria
0	No standard sampling
1	No Census but some casual observations or banding
2	Census only
3	Census plus some standard banding (<40 net hours)
4	Census plus some standard banding (<80 net hours)
5	Census plus some standard banding (<120 net hours)
6	Census, complete standard banding (120 net hours)

7.3.3 Net Hours

All net opening and closing is recorded throughout the day on the dry erase board. Net hours are recorded in the daily log at the end of the day. Every hour that a net is open equals one hour, therefore 20 nets X 6 hours = 120 hours. Early closures should be explained in the notes section.

7.4 Data Management

Data management refers to the proofing and digital entry of data. The daily log is entered directly into the TTPBRS Microsoft Excel Daily Log workbook, with a new sheet for each day. Once proofed, the daily sheet is locked to prevent data modifications. At the end of the season, data from the TTPBRS Microsoft Excel workbook is transferred into Bird Canada's CMMN Daily Estimated Totals (DET) and Effort program and then proofed. The banding and recapture data are recorded directly into Microsoft Excel and proofed by the Bander-in-Charge and

volunteers daily. At the end of the season, the banding and recapture data are transferred from the data entry Microsoft Excel workbooks to the Banding Portal data upload template, and uploaded to the Banding Portal. When setting up the CMMN DET program, the CMMN fields must match the TTPBRS data field as provided in Table 8.

Table 8. Daily Estimated Totals Codes

Order	CMMN field	TTPBRS Daily Log	Definition
1	OBS01	Band	Number of birds banded (standard)
2	OBS02	Rec	Number of birds recaptured (standard)
3	OBS03	Cap	Number of birds captured unbanded (standard)
4	OBS04	Cens.	Census
5	OBS05	ST	Standard total (=DET)
6	OBS06	NSB	Number of birds banded (non-standard)
7	OBS07	NSR	Number of birds recaptured (non-standard)
8	OBS08	NSC	Number of birds captured unbanded (non-standard)
9	OBS09	Obs	Casual observations
10	OBS10	NST	Non-standard total

Digital data is saved in multiple locations daily: on TRCA servers, on the cloud, and on the C: drive of the station laptop. During the field season, previous daily versions of the digital banding data Excel file are saved for a week; so, there are always seven versions of the file should the current day's version be corrupt. Hard copy data are archived at TRCA's Restoration Services Office, 9741 Canada Company Avenue, Woodbridge, Ontario.

8.0 HABITAT MONITORING AND MANAGEMENT

8.1 Habitat Monitoring

Habitat monitoring is a requirement for the CMMN Trend Monitoring Program and must follow the standard protocol developed by CMMN in 2019. Habitat monitoring provides site condition information, allowing researchers to evaluate how data were collected and what factors influence the kinds and numbers of birds observed. As well, quantitative assessment of vegetation structure is a valuable research product in itself for studies of bird-habitat associations.

Prior to 2022, habitat monitoring was completed at TTPBRS in 2008 (Jack 2008) and 2015, following the draft protocol from Long Point Bird Observatory (Allair and McCracken 2001) which was based on James and Shugart (1970).

8.1.1 Photographic Record

Standardized photos of trap sites, and of the site more generally, convey a non-quantitative but very informative quick impression of site conditions and whether they have changed over time. The photographic record complements the habitat assessment as it documents changes at each specific net location where changes can directly impact banding totals. Photographs must be taken in the last week of September-first week of October, every 3 years, starting in 2022. If there is a significant change in site conditions within the 3-year period, the photographic record should be updated sooner.

Photos are to be taken following a standard protocol to ensure consistency between photographic periods. Two photos are taken of each net lane, from each end. Photos should be taken from behind the net poles, and directed straight down the lane, toward the opposite net pole. A copy of the previous photo record should be referenced while taking new photographs to help match the same angle and frame. The photographer must ensure photos are good quality (i.e. not blurry) while on-site.

Photo requirements:

- All net lanes: standard and non-standard
- All census stations
- General site context photos

All photographs must follow this standard naming convention: YYYY-MM-DD_TTPBRS_LocationEnd (e.g. 2022-06-09_TTPBRS_Net1A.jpg). See Table 2 for net locations and net end references. Photos must be saved in the TTPBRS > CMMN > Habitat Monitoring > YEAR folder on the TRCA server. Photos must also be submitted to Birds Canada (cjardine@birdscanada.org) with the habitat assessment results and the Daily Estimated Totals and Effort data.

8.1.2 Habitat Assessment

The quantitative habitat assessment describes the horizontal and vertical habitat compositions within the TTPBRS study area. The habitat assessment will be completed following the standard protocol developed by CMMN in 2022 (Appendix F). Figure 2 shows the primary habitat types at TTPBRS, three of which qualify for monitoring: Cottonwood woodland, willow-dogwood thicket, and cottonwood-birch-alder coastal deciduous swamp.

Habitat assessments must be completed in the last week of September to the first week of October, every 3 years, starting in 2022. Data is to be digitized and saved in the TTPBRS > CMMN > Habitat Monitoring > YEAR folder on the TRCA server. Habitat assessment results must also be submitted to Birds Canada (cjardine@birdscanada.org) with the photographic record and Daily Estimated Totals and Effort data.

8.2 Habitat Maintenance

Vegetation communities are continually maturing at Tommy Thompson Park and are subjected to natural impacts including beaver activity and occasional flooding.

8.2.1 Annual Maintenance

Annual vegetation trimming is required within the net lanes to maintain access and net clearance. Vegetation is trimmed in late-July or early-August, ahead of fall migration monitoring. Foliage is cut back horizontally to maintain a 1.5 m wide net lane, and vegetation is removed from the ground to prevent tripping hazards. Minor vegetation trimming may also occur along trails to maintain clear access to net lanes, and along the census route off official park trails.

8.2.2 Habitat Management

Beaver Management

Tommy Thompson Park supports a healthy population of American Beaver, that impacts the survival of mature native trees. Beavers actively remove native trees and shrubs, particularly in fall to prepare winter food caches. TRCA conducts passive beaver management at TTP, by wrapping protective fence around the base of mature native trees. TRCA wraps trees on an as-needed basis based on beaver activity – not all trees within the study area are wrapped and are sometimes targeted by beaver.

Invasive and non-native species

Tommy Thompson Park is a constructed landform and highly susceptible to non-native and invasive plants. TRCA monitors non-native and invasive plant communities at the park and conducts management based on threats to biodiversity and funding availability. Invasive and/or non-native species are managed with the goal of restoring a native vegetation community. These management actions could be undertaken within the TTPBRS study area; they will seek to maintain the existing vegetation structure (e.g. plant shrubs, not trees, when non-native shrubs are removed; plant grasses, not shrubs or trees, when non-native grasses are removed).

9.0 PUBLIC OUTREACH

Tommy Thompson Park is visited by thousands of people each year. Volunteers and staff should greet each visitor as they approach the banding station. This is important for providing both cautionary and educational information. Visitors are welcome in the banding area; however, they should be informed of the sensitivity of the operations. Politely explain the project objectives and ask visitors to speak quietly in the banding lab.

When appropriate, show birds and provide information on the species, the capture and banding process, and the purpose of migration monitoring. Never hold a demonstration bird longer than a few minutes and avoid touching of birds by visitors. Visitors should be invited into the lab to show them the banding process as this provides an interesting perspective. Photos are allowed, but without the use of flash.

People often come to the lab without any previous knowledge of bird banding, and understandably have many questions. The Bander-in-Charge will be the primary person to answer these questions unless they are away from the lab on a net run or banding a large volume of birds. All personnel should be comfortable answering questions, but it is a good idea for a particular person to act as the point person for greeting and interpretation. In all instances, be polite and avoid confrontation.

Not everyone believes in the merit of bird banding, and some people can be outspoken. It is important to be polite and respect each person's point of view. Explain that bird safety is top priority and only thoroughly trained personnel are allowed to handle birds. The process may seem invasive, but it is in the best interest of the birds we monitor. If we felt that our operation posed a threat to birds, we would not be involved. People are often pleased to know that we recapture birds year after year once they are banded, evidence that the practice of bird banding is harmless if done responsibly.

Here are some common arguments and situations that could arise, and the appropriate responses:

1. ***"Banding is useless and harmful because of the low incidence of recovery."***
   Banding is no longer about recoveries - it is used to determine population trends, ecology, behaviour, demographics etc. Banding is the only tool that provides conservation organizations with a micro-perspective.
2. ***Visitors may indicate their dogmatic right to go and do as they please, despite our request to avoid disturbing net lanes.***
   Indicate that the park was opened for both research and public use and that we are not telling anyone what to do but rather asking for co-operation.
3. ***A visitor is hostile or verbally abusive.***
   Direct them to the Bander-in-Charge and leave the situation.
4. ***Some visitors may not be after information and merely want to harass or complain.***
   Do not feel you need to engage the person beyond what is necessary. It is better to walk away and return to your work rather than plead with such a person. Provide them with appropriate channels for complaints.

It is common to think of visitors as a distraction from operations but remember that education can be rewarding for both teacher and student, and ultimately for the birds. For the station and the program to be successful it must have public support.

9.1 Organized Events

Education for larger groups is geared towards schools, clubs, and organizations. A structured approach is required because there are more people involved. Organized events are pre-arranged and scheduled primarily for May and September when bird numbers and temperatures are most suitable. Staffing must be increased for these events, as some attention will be drawn away from the monitoring programs. A minimum of four, preferably five, skilled people must be available for one of these events (Bander-in-Charge, Migration Monitoring Assistant, and two or more Volunteer Field Assistants).

The education structure for these groups is designed to minimize detraction from the monitoring program. Environmental educators will be present to handle most of the interpretation. The Bander-in-Charge will be in and out of the banding lab but will likely spend less time at the nets than usual, so good communication is critical. The Bander-in-Charge will perform all banding demonstrations for groups.

On days with unusually high bird volume, the normal operating procedures apply as nets blocks are closed according to safe processing limits. An organized event will run as normal, except for reduced interpretation on the part of the Bander-in-Charge, an abbreviated banding demonstration and the cancellation of the net

visitation. It is important that the amount of time a bird is held not be increased substantially for the demonstrations. Birds will be selected for demonstration according to perceived health and total length of time from capture to banding to demonstration. Some guidelines for organized events are as follows:

- The Bander-in-Charge will decide if weather should force cancellations.
- Before the banding demonstration, the Bander-in-Charge or Migration Monitoring Assistant gives a brief introductory talk about mist netting and banding and the objectives of migration monitoring.
- The Bander-in-Charge gives a banding demonstration while a volunteer provides interpretation. Questions should be saved for the end of the demonstration.
- Groups will be shown a mist net only after a check by personnel. Personnel must confirm that there are not more than three birds in the net and that the birds do not appear stressed.
- If groups visit a mist net, they will be asked not to touch the net and to stay at a distance from captured birds or the person extracting.
- Groups are asked not to talk while watching a banding or extracting demonstration.

10.0 FINAL THOUGHTS

Procedures and guidelines detailed in this protocol are set, and any adjustments should be approved by the CMMN Science Committee and phased in over the course of two years. Personnel are required to understand this document prior to any training procedures and should stay familiar with this protocol throughout tenure. Finally, the Migration Monitoring Protocol is also a guide for data analysts, so treat procedures and guidelines accordingly.

11.0 ACKNOWLEDGEMENTS

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APPENDIX A: RECORD OF CHANGES OR MAJOR INTERRUPTIONS IN STANDARDIZED DATA COLLECTION

Important interruptions to operations should be recorded here, such as flooding or lack of personnel that reduced effort for periods of a week or more. Also to be recorded are any permanent changes to data collection methods. Although operational changes are sometimes necessary (as when a netting location is destroyed), changes in data collection are not to be made unless absolutely necessary, and must first be discussed with CMMN advisors.

Instructions for record keeping

If any standardized operational change or interruption occurs, enter details into the table below, underneath any previous entries. Refer to parts of the text that were changed (e.g. section number, altered locations on a map, new GPS points). Revise the 'latest version' date on page 6 of this protocol. If changes have been made to the protocol other than adding to the table below, submit a copy of the entire revised protocol to Birds Canada along with year-end data submission; otherwise, send only a copy of the table.

Date	Description of change and justification (if applicable)
2004-2012	Rapid vegetative succession doubtless affected numbers and types of landbirds counted.
Fall 2008	No Bander-in-Charge – no standard capture, but census completed.
2009	Tracking of Known Stopover or Resident discontinued. 2003-2008 KSR recorded on TTPBRS Daily Log in the KS field and in the CMMN Estimated Totals column PKS.
2012	Point counts discontinued, past records were included in the ST.
Feb 2016	Added 5 new mist nets to protocol (12 m vs. 9 m of existing nets). Following habitat maturation, these new areas supported substantial bird passage that was being missed in the original net layout. This marks start of standardized coverage for population trends based on ST. Coverage codes updated to reflect increased net hours. Data analysts should be aware that the coverage codes before/after 2016 have different thresholds.
2017-2022	Some standard nets relocated to non-standard locations, intermittently, due to environmental factors including flooding and predation. See Appendix B for details.
Fall 2017	Mink predation issues resulted in early shutdown of the CMMN program on October 6. Census continued intermittently until November 12.
Apr 2019	Switched to Ecotone mist nets (previously used Avinet). Same size and length; no change to standardized protocol.
Spring 2020	No migration monitoring due to COVID-19.
Fall 2020	Migration monitoring on reduced capacity due to COVID-19. No weekend banding during this period to reduce staff and volunteer exposure to park visitors. Limited personnel – 1 staff, 4 consistent volunteers. Intermittent census despite banding. Did not operate net block E. Mink predation issues resulted in early shutdown of the CMMN program on October 5. Daily census continued intermittently after October 5.
Spring 2021	Migration monitoring on reduced capacity due to COVID-19. No weekend banding during this period to reduce staff and volunteer exposure to park visitors. Limited personnel – 1 staff, 4 consistent volunteers. No weekend or weather day census in April due to COVID restrictions. Did not operate net block E.

Fall 2021	Migration monitoring on reduced capacity due to COVID-19 – no weekend banding and limited personnel during August. Returned to weekend banding and increased volunteer base after Labour day. Intermittent census on weather days. Did not operate net block E.
Spring 2022	Closed net block E in mid-May when DCCO roosted in large numbers in the area (nets were covered in guano). DCCO effectively deterred. Issues with mink: moved nets 4, 7, 8, E to non-standard locations (Appendix B); delayed net opening times.
Fall 2022	Significant challenges with mink predation. Operated a limited number of nets in September and October; delayed net opening time; raised net height. Intermittent census on weather days. Did not operate net block E.
Apr 2023	Changed net poles from 2.5-centimeter electrical conduit and rebar at both ends to the Advanced Pole System that includes a 48” base pole with corkscrew auger and 3x48” extension poles to increase maximum net height to 14-14.5’ (for 30/40’ nets) and the base plus 4x48” extension poles to increase maximum net height to 18-18.5’ (for 60’ nets). This is in response to consistent increased mink activity in the study area since 2017. The taller net poles provide the option to raise the net height to prevent mink from reaching the bottom net panels. No change to standard protocol.

APPENDIX B: NET LANE RECORD

Nets 1-15 have been in standard locations since the station started in 2003.

Letter net details:

- The original letter nets (A, B, C and E) were added in 2012 – non-standard.
- F and J were added in 2014 – non-standard.
- C was permanently removed in 2014 due to regular public use of the net lane and vandalism. It appears again in 2017 when we first experienced flooding and moved net J to this location.
- A, B, E, F, J are standard from 2016.

Other nets, all non-standard, as recorded in the banding data (*non-passerines not part of CMMN project, but detailed here for consistency)*:

- Passerines
    - H – added in 2017
        - 2 H records from 2012, appear to be for HN
    - CN - Canopy Net - was added in 2017
    - GT - Ground Trap – baited
    - NB - Nest Box
    - G, G1, G2 – 2012 only
        - These were testing a new location. Setup in the honeysuckle area.
- Shorebirds
    - BN - Beach Net is used for shorebirds – non-standard, audio; and decoys (2015-2019)
        - SH - same as BN
        - SN – same as BN
        - SP – same as BN
        - ST – same as BN
        - MN – 2015, we think this is the same as BN
- Raptors
    - BC - Bal-Chatri, for raptors
    - NH - Hawk Net – location varies
        - 2012-2015 banding data records are on Peninsula D. Not used on Peninsula D after 2015.
        - 2018 and 2019 banding records are in the Toplands i.e. Raptor Station
    - RS - Raptor Station – on the Toplands
        - R - Raptor Station – on the Toplands, one record in 2018
    - ON - Owl Net – pre-2020, audio
        - ON1 - Owl Net 1 – same as ON, same location as H for passerines
        - ON2 - Owl Net 2 – *second owl net used in 2020*
- DT - Duck Trap
- GR - Gull Ring – baited
    - NR – Noose Ring – baited, same as GR
- OT – Other, not captured in mist net
- XX – other capture method

Details for 2017-2022

- **Standard** nets in non-standard locations, intermittently, due to environmental factors including flooding and predation.
- **Spring 2017**
    - Was the first 'record high' Lake Ontario flood event. Most net lanes had to be moved to avoid water. There was poor record keeping of specific dates the nets were repositioned, and repositioned nets were not properly recorded on the daily logs as NSB.
    - Not moved during the flood (i.e. standard, but not necessarily opened): A, B, 10, 11, F, 8
        - Raised, but stayed in the same position.
    - Repositioned during the flood: J (to old C, but was only temporary); E, 1, 2, 3, 4, 5, 6, 7, 9, 12, 13, 14, 15
    - Effort and DET data for the whole season recorded as:
        - Standard for nets A, B, 10, 11, F, and 8
        - Non-standard for all other nets
- **Fall 2017**
    - Flood waters receded through August and September, some nets moved back to standard locations, but no record of dates they were moved or which ones.
    - Issue with mink predation. Banding operation shutdown for the season October 6, shifted to raptor project in the Toplands.
- **Spring 2018**
    - All nets in standard locations, except for net 3 which remained in non-standard location from 2017.
- **Fall 2018**
    - All nets in standard locations, except for net 3 which remained in non-standard location from 2017.
- **Spring 2019**
    - Was the second 'record high' Lake Ontario flood event, exceeding water levels recorded in 2017. As in 2017, net lanes were moved to avoid water and/or closed. There was poor record keeping of specific dates the nets were repositioned, and repositioned nets were not properly recorded on the daily logs as NSB.
    - Nets A, B, 10, 11, F and 8 stayed in standard locations.
    - Effort and DET data for the whole season recorded as:
        - Standard for nets A, B, 10, 11, F, and 8
        - Non-standard for all other nets
- **Fall 2019**
    - Flood waters receded through August and September, most nets moved back to standard locations, but no record of dates they were moved.
    - Effort and DET data for the whole season recorded as:
        - Standard for nets A, B, 10, 11, F, and 8
        - Non-standard for all other nets
    - Nets 3 and 9 remained in non-standard locations.
- **Spring 2020**
    - No monitoring due to COVID-19 lockdown.
- **Fall 2020**
    - Operated on a reduced capacity – with 4 consistent volunteers, and Bander-in-Charge; weekdays only to reduce interactions with park visitors.
    - Did not operate nets A, B, 10, 11

  - Nets 3 and 9 in non-standard locations
  - Issue with mink predation. Banding operation shutdown for the season October 5, shifted to Project Owlnet.
- **Spring 2021**
  - Operated on a reduced capacity – with 4 consistent volunteers, and Bander-in-Charge; weekdays only to reduce interactions with park visitors.
  - Did not operate nets A, B, 10, 11
  - Nets 3 and 9 in non-standard location
- **Fall 2021**
  - Operated on a reduced capacity until Labour Day – with 4 consistent volunteers, and Bander-in-Charge weekdays only to reduce interactions with park visitors.
  - After Labour Day returned to 7 days/week with additional volunteers (but fewer than pre-pandemic)
  - Did not operate nets A, B, 10, 11
  - Net 3 and 9 in non-standard locations
- **Spring 2022**
  - Operated normally, 7 days/week, with unrestricted volunteers (but fewer than pre-pandemic)
  - All **standard** nets confirmed in standard location at start of the season except for net 9.
  - Issues with mink.
    - Moved problem nets to non-standard locations 4-M, 7, 8, E
    - Delayed net opening time
  - Meticulously recorded NSB in log
  - Reopened 10, 11, A and B, but had to close in mid-May when cormorants started roosting in large numbers above these nets. Cormorants were effectively deterred, but the nets required cleaning and were not re-opened this season.
- **Fall 2022**
  - Start of season, all nets in standard locations, except for net 9. A, B, 10 and 11 were not put back this season – due to limited personnel and experience.
  - Mink issues started in mid-August and nets were repositioned
    - 1, 12, 13, 9 were moved to non-standard locations. 12 and 13 were in new locations (in line with/immediately south of standard 14); only operated for a couple days.
    - Most nets closed.
    - Added rebar to increase net height at standard locations in late September. Nets open were in standard locations. Only opened nets we had capacity for with volunteers, and that had been raised.

Non-Standard Net Locations

Net Number	End A		End B	
	Latitude	Longitude	Latitude	Longitude
1	43.632635	79.329706	43.632623	-79.329558
2	43.632447	-79.329571	43.632484	-79.329685
3	43.632501	-79.33014	43.632424	-79.330056
4	43.630943	-79.331873	43.630992	-79.331897

4-M	43.63142	-79.331263	43.631481	-79.331275
7	43.631321	-79.33229	43.631412	-79.332373
8	43.631048	-79.333293	43.631119	-79.333306
12	43.631177	-79.332628	43.63125	-79.33263
13	43.631598	-79.332754	43.63155	-79.332658
14	43.631493	-79.332539	43.631423	-79.33247
E	43.631007	-79.333117	43.631031	-79.333191

APPENDIX C: NET CHECKLIST

TTPBRS Net Status

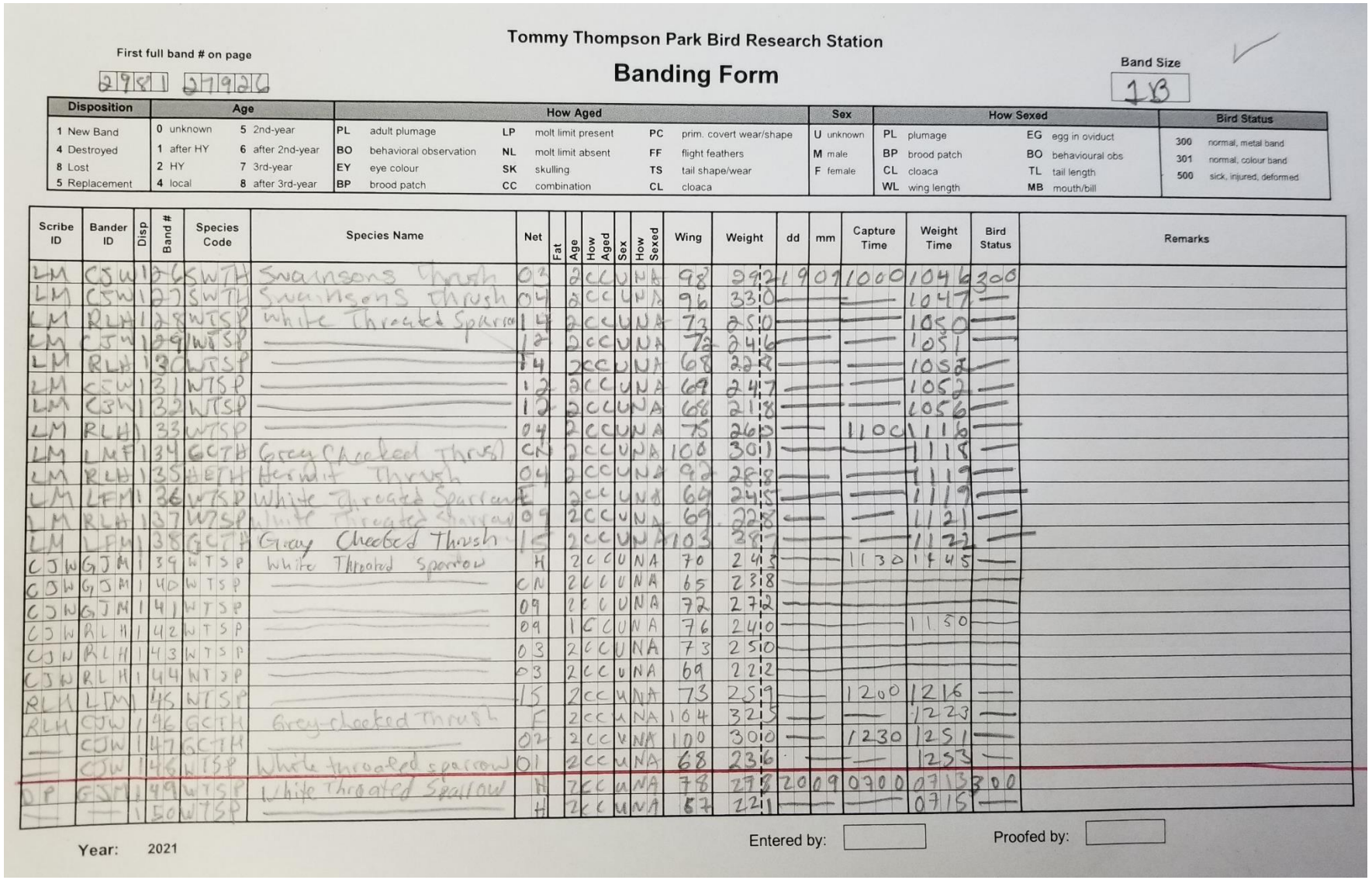
All nets **MUST** be verified closed before leaving. Record early closure times immediately upon returning to the lab.

Mist Net	Open	Closed	Close Time
1	☐	☐	_____
2	☐	☐	_____
3	☐	☐	_____
F	☐	☐	_____
4	☐	☐	_____
5	☐	☐	_____
6	☐	☐	_____
7	☐	☐	_____
8	☐	☐	_____
E	☐	☐	_____
9	☐	☐	_____
10	☐	☐	_____
11	☐	☐	_____
A	☐	☐	_____
B	☐	☐	_____
12	☐	☐	_____
13	☐	☐	_____
14	☐	☐	_____
15	☐	☐	_____
J	☐	☐	_____

Indicate closed nets with a check mark (✓). Indicate verified closed nets by crossing the check mark to create an X.

APPENDIX D: EXAMPLE OF BANDING AND RECAPTURES DATA RECORD SHEETS

Previously used paper data record sheets:



Tommy Thompson Park Bird Research Station

Banding Form

First full band # on page: 29811 29926

Band Size: 1B

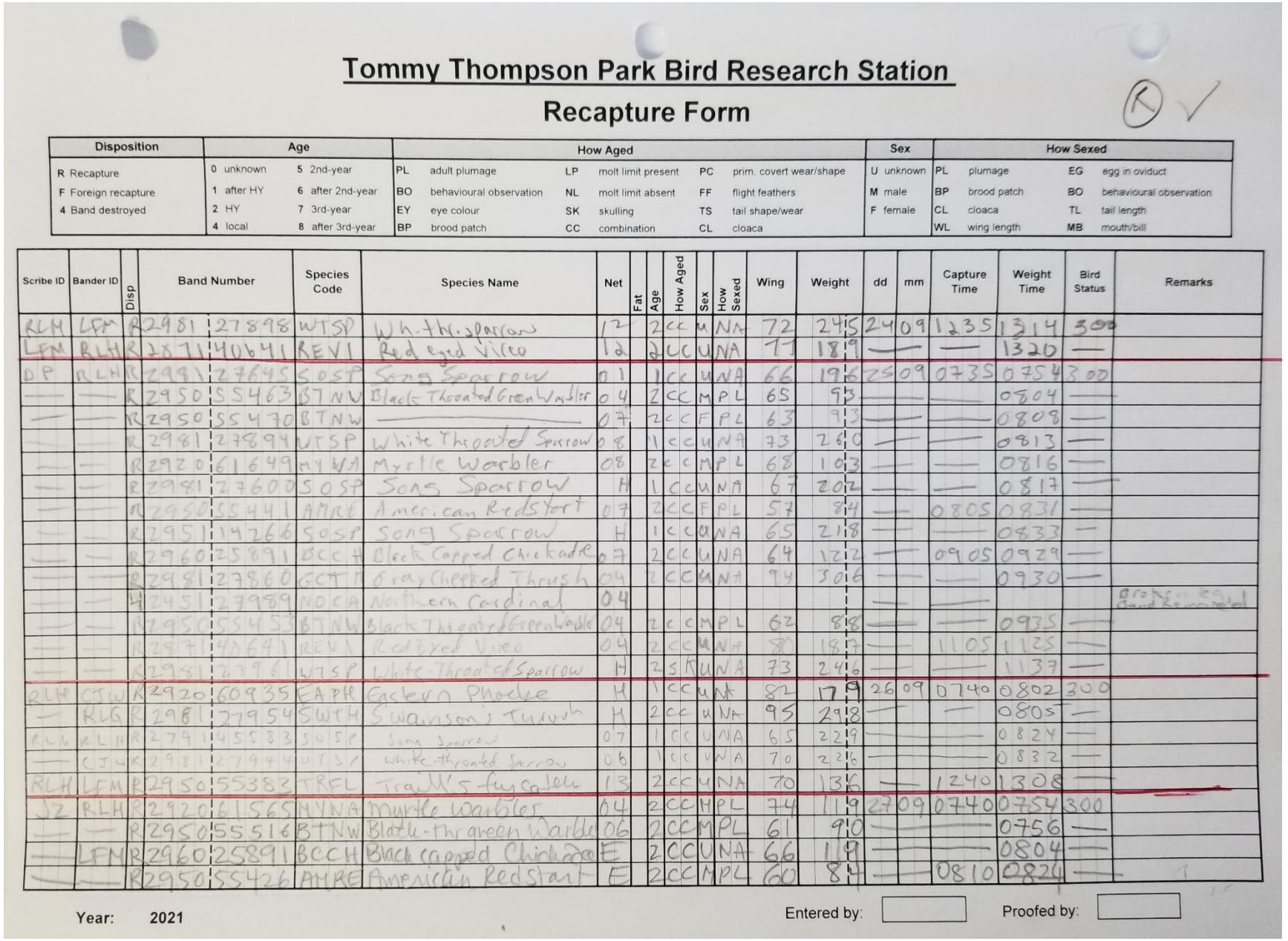
Disposition	Age	How Aged	Sex	How Sexed	Bird Status
1 New Band	0 unknown 5 2nd-year	PL adult plumage; LP molt limit present; PC prim. covert wear/shape	U unknown	PL plumage; EG egg in oviduct	300 normal, metal band
4 Destroyed	1 after HY 6 after 2nd-year	BO behavioral observation; NL molt limit absent; FF flight feathers	M male	BP brood patch; BO behavioural obs	301 normal, colour band
8 Lost	2 HY 7 3rd-year	EY eye colour; SK skulling; TS tail shape/wear	F female	CL cloaca; TL tail length	500 sick, injured, deformed
5 Replacement	4 local 8 after 3rd-year	BP brood patch; CC combination; CL cloaca		WL wing length; MB mouth/bill	

Scribe ID	Bander ID	Disp	Band #	Species Code	Species Name	Net	Fat	Age	How Aged	Sex	How Sexed	Wing	Weight	dd	mm	Capture Time	Weight Time	Bird Status	Remarks
LM	CJW	1	26	SWTH	Swainsons Thrush	03		2	C	U	NA	98	29.2	19	09	1000	1046	300	
LM	CJW	1	27	SWTH	Swainsons thrush	04		2	C	U	NA	96	33.0				1047		
LM	RLH	1	28	WTSP	White Throated Sparrow	14		2	C	U	NA	73	25.0				1050		
LM	CJW	1	29	WTSP		12		2	C	U	NA	72	24.6				1051		
LM	RLH	1	30	WTSP		14		2	C	U	NA	68	22.2				1052		
LM	CJW	1	31	WTSP		12		2	C	U	NA	69	24.7				1052		
LM	CJW	1	32	WTSP		12		2	C	U	NA	68	21.8				1056		
LM	RLH	1	33	WTSP		04		2	C	U	NA	75	26.0			1100	1116		
LM	LMF	1	34	GCTH	Grey Cheeked Thrush	CR		2	C	U	NA	100	30.1				1115		
LM	RLH	1	35	HETH	Hermit Thrush	04		2	C	U	NA	92	28.9				1119		
LM	LFM	1	36	WTSP	White Throated Sparrow	E		2	C	U	NA	69	24.5				1119		
LM	RLH	1	37	WTSP	White Throated Sparrow	09		2	C	U	NA	69	22.8				1121		
LM	LFM	1	38	GCTH	Grey Cheeked Thrush	15		2	C	U	NA	103	28.7				1122		
CJW	GJM	1	39	WTSP	White Throated Sparrow	H		2	C	U	NA	70	24.3			1130	1145		
CJW	GJM	1	40	WTSP		CN		2	C	U	NA	65	23.8						
CJW	GJM	1	41	WTSP		09		2	C	U	NA	72	27.2						
CJW	RLH	1	42	WTSP		09		1	C	U	NA	76	24.0				1150		
CJW	RLH	1	43	WTSP		03		2	C	U	NA	73	25.0						
CJW	RLH	1	44	WTSP		03		2	C	U	NA	69	22.2						
RLH	LFM	1	45	WTSP		15		2	C	U	NA	73	25.9			1200	1216		
RLH	CJW	1	46	GCTH	Grey-cheeked Thrush	F		2	C	U	NA	104	32.5				1223		
	CJW	1	47	GCTH		02		2	C	U	NA	100	30.0			1230	1251		
	CJW	1	48	WTSP	White throated sparrow	01		2	C	U	NA	68	23.6				1253		
DP	GJM	1	49	WTSP	White Throated Sparrow	H		2	C	U	NA	78	27.5	20	09	0900	0715	300	
		1	50	WTSP		H		2	C	U	NA	67	22.1				0715		

Year: 2021

Entered by:

Proofed by:



Tommy Thompson Park Bird Research Station

Recapture Form

Disposition	Age	How Aged	Sex	How Sexed
R Recapture	0 unknown 5 2nd-year	PL adult plumage LP molt limit present PC prim. covert wear/shape	U unknown	PL plumage EG egg in oviduct
F Foreign recapture	1 after HY 6 after 2nd-year	BO behavioural observation NL molt limit absent FF flight feathers	M male	BP brood patch BO behavioural observation
4 Band destroyed	2 HY 7 3rd-year	EY eye colour SK skulling TS tail shape/wear	F female	CL cloaca TL tail length
	4 local 8 after 3rd-year	BP brood patch CC combination CL cloaca		WL wing length MB mouth/bill

Scribe ID	Bander ID	Disp	Band Number	Species Code	Species Name	Net	Fat	Age	How Aged	Sex	How Sexed	Wing	Weight	dd	mm	Capture Time	Weight Time	Bird Status	Remarks
RLH	LFM	R	2981 27898	WTSP	Wh.-thr.sparrow	12		2	CC	U	NA	72	24.5	24	09	1235	1314	300	
LFM	RLH	R	2871 40641	REVI	Red eyed Vireo	12		2	UC	U	NA	77	18.9	—	—	—	1320	—	
DP	RLH	R	2991 27645	SOSP	Song Sparrow	01		1	CC	U	NA	66	19.6	25	09	0735	0754	300	
—	—	R	2950 55463	BTNW	Black Throated Green Warbler	04		2	CC	M	PL	65	9.3	—	—	—	0804	—	
—	—	R	2950 55470	BTNW	—	07		2	CC	F	PL	63	9.3	—	—	—	0808	—	
—	—	R	2981 27894	WTSP	White Throated Sparrow	08		1	CC	U	NA	73	26.0	—	—	—	0813	—	
—	—	R	2920 61649	MYWA	Myrtle Warbler	08		2	CC	M	PL	68	10.3	—	—	—	0816	—	
—	—	R	2981 27600	SOSP	Song Sparrow	H		1	CC	U	NA	67	20.2	—	—	—	0817	—	
—	—	R	2950 55441	AMRE	American Redstart	07		2	CC	F	PL	57	8.4	—	—	0805	0831	—	
—	—	R	2951 14266	SOSP	Song Sparrow	H		1	CC	U	NA	65	21.8	—	—	—	0833	—	
—	—	R	2960 25891	BCCH	Black Capped Chickadee	07		2	CC	U	NA	64	12.2	—	—	0905	0929	—	
—	—	R	2981 27860	GCTH	Gray Cheeked Thrush	04		2	CC	U	NA	94	30.6	—	—	—	0930	—	
—	—	4	2451 27989	NOCA	Northern Cardinal	04								—	—				Broken leg Band Removed
—	—	R	2950 55453	BTNW	Black Throated Green Warbler	04		2	CC	M	PL	62	8.8	—	—	—	0935	—	
—	—	R	2871 40641	REVI	Red Eyed Vireo	04		2	CC	U	NA	80	18.7	—	—	1105	1125	—	
—	—	R	2981 27996	WTSP	White-Throated Sparrow	H		2	SK	U	NA	73	24.6	—	—	—	1139	—	
RLH	CJW	R	2920 60935	EAPH	Eastern Phoebe	H		1	CC	U	NA	82	17.9	26	09	0740	0802	300	
—	RLG	R	2981 27954	SWTH	Swainson's Thrush	H		2	CC	U	NA	95	29.8	—	—	—	0805	—	
RLH	RLH	R	2791 45583	SOSP	Song Sparrow	07		1	CC	U	NA	65	22.9	—	—	—	0824	—	
—	CJW	R	2981 27944	WTSP	White-throated Sparrow	06		1	CC	U	NA	70	22.6	—	—	—	0832	—	
RLH	LFM	R	2950 55382	TREL	Traill's flycatcher	13		2	CC	U	NA	70	13.6	—	—	1240	1308	—	
JZ	RLH	R	2920 61565	MYWA	Myrtle Warblers	04		2	CC	M	PL	74	11.9	27	09	0740	0754	300	
—	—	R	2950 55516	BTNW	Black-thr green Warbler	06		2	CC	M	PL	61	9.0	—	—	—	0756	—	
—	LFM	R	2960 25891	BCCH	Black capped Chickadee	E		2	CC	U	NA	66	11.9	—	—	—	0804	—	
—	—	R	2950 55426	AMRE	American Redstart	E		2	CC	M	PL	60	8.4	—	—	0810	0824	—	

Year: 2021

Entered by: _____ Proofed by: _____

Current Microsoft Excel Data Entry Spreadsheets:

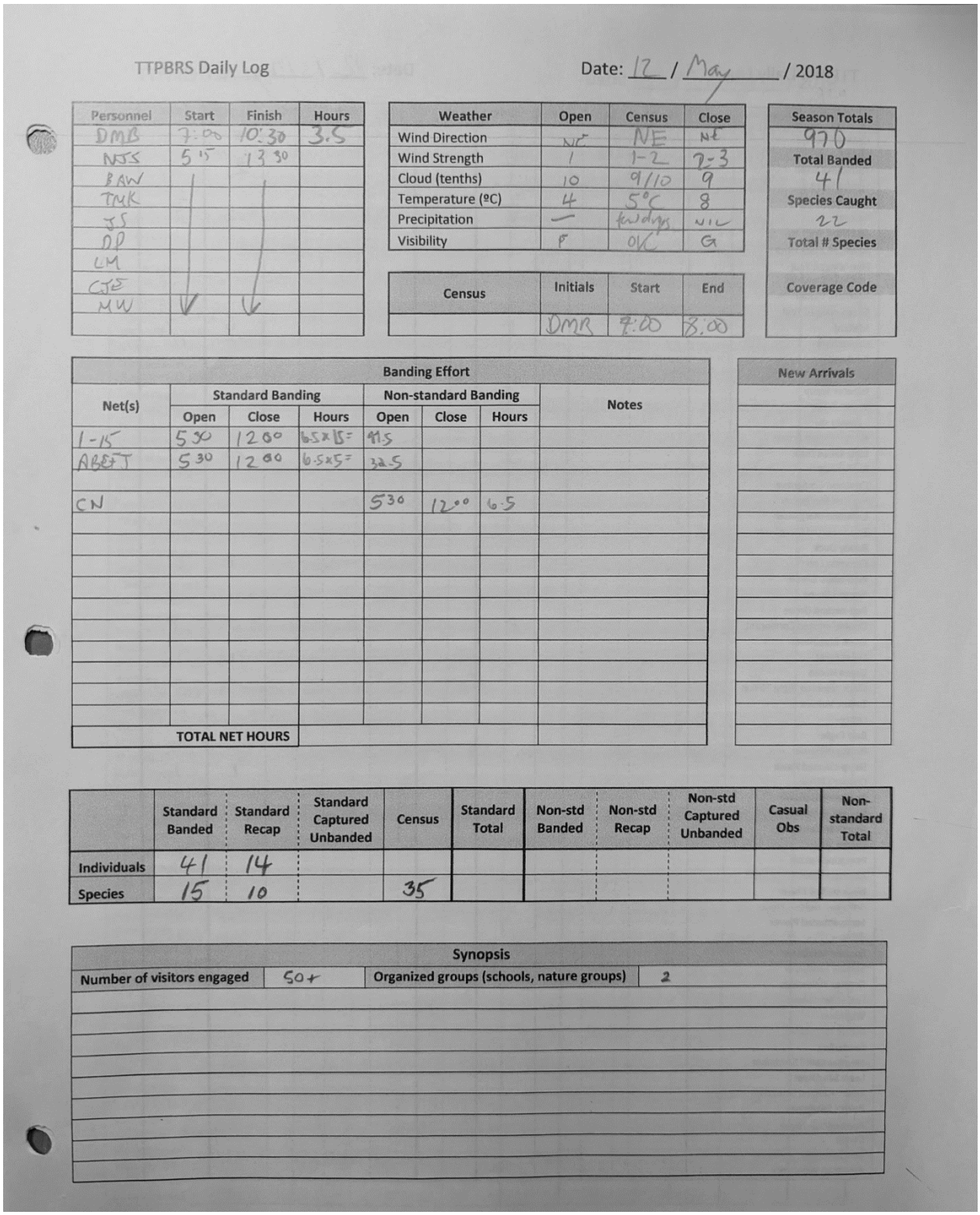
Banding Data

Band	Species	Species Name	Status	Disp	Day	Month	Age	How Ag	Sex	How Se	Bander ID	Capture Ti	Wing	Fat	Skull	Body Molt	WRP	Weight	Weight Time	Net	Remarks	Feather Sample	MinMass	MaxMass	MinWing	MaxWing
267090125	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	TS	M	PL	SKA	830	57	2				6	08:54:40	F			5.3	7.3	49	62
267090126	GCKI	Golden-crowned Kinglet	300	1	01	04	ASY	TS	M	PL	SKA	900	59	4				6.8	09:44:00	8			5.3	7.3	49	62
267090127	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	TS	M	PL	SKA	900	60	3				6.6	09:45:46	8			5.3	7.3	49	62
267090128	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	TS	M	PL	SKA	900	59	2				6.5	09:45:00	1			5.3	7.3	49	62
267090129	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	CC	M	PL	JSC	930	59	3				6.5	10:10:16	6			5.3	7.3	49	62
267090130	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	CC	M	PL	JSC	930	58	3				6.3	10:13:38	J			5.3	7.3	49	62
267090131	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	CC	M	PL	JSC	930	57	4				6.1	10:17:10	J			5.3	7.3	49	62
267090132	GCKI	Golden-crowned Kinglet	300	1	01	04	SY	CC	M	PL	JSC	1000	57	4				6.8	10:28:28	J			5.3	7.3	49	62
267090133	GCKI	Golden-crowned Kinglet	300	1	01	04	ASY	TS	M	PL	JSC	1000	59	4				6.6	10:33:48	J			5.3	7.3	49	62
267090134	GCKI	Golden-crowned Kinglet	300	1	01	04	ASY	TS	M	PL	SKA	1000	59	4				7.2	10:34:01	J			5.3	7.3	49	62
267090135	GCKI	Golden-crowned Kinglet	300	1	01	04	ASY	TS	M	PL	MGJ	1000	57	2				6.4	10:58:47	J			5.3	7.3	49	62
267090136	GCKI	Golden-crowned Kinglet	300	1	06	04	AHY	IC	M	PL	SKA	645	57	3				6.3	07:28:21	5			5.3	7.3	49	62
267090137	GCKI	Golden-crowned Kinglet	300	1	06	04	ASY	TS	M	PL	SKA	645	59	3				6.8	07:33:15	5			5.3	7.3	49	62
267090138	GCKI	Golden-crowned Kinglet	300	1	06	04	SY	TS	M	PL	SKA	715	60	2				5.7	08:09:31	6			5.3	7.3	49	62
267090139	GCKI	Golden-crowned Kinglet	300	1	06	04	AHY	TS	M	PL	SKA	715	57	2				5.9	08:12:10	6			5.3	7.3	49	62
267090140	GCKI	Golden-crowned Kinglet	300	1	06	04	ASY	TS	M	PL	SKA	715	57	4				5.7	08:13:57	6			5.3	7.3	49	62
267090141	GCKI	Golden-crowned Kinglet	300	1	06	04	ASY	TS	M	PL	ACL	745	57	3				5.9	09:01:56	6			5.3	7.3	49	62
267090142	WIWR	Winter Wren	300	1	06	04	SY	PL	U		ACL	815	46	4				9.8	09:13:54	3			7.2	10.4	43	52
267090143	GCKI	Golden-crowned Kinglet	300	1	06	04	SY	TS	M	PL	JSC	845	58	2				6.8	09:24:21	6			5.3	7.3	49	62

Recapture Data

DupeChec	Band	Species	Species Name	Status	Disp	Day	Month	Age	How A	Sex	How Se	Bander ID	Capture Ti	Wing	Fat	Skull	Body Molt	WRP	Weight	Weight Time	Net	Remarks	Feather Sa	Species	Age	Sex	Day	Month
	298070594	BCCH	Black-capped Chickadee	300	1	01	04	SY	TS	U		JSC	700	63	1				11.2	07:41:00	F			Band # no	Band # no	Band # no	Band # no	Band # not
	141217491	AMRO	American Robin	300	1	01	04	ASY	PL	M	CL	SKA	730	126	0				80.3	08:12:42	14			Band # no	Band # no	Band # no	Band # no	Band # not
	296074922	BCCH	Black-capped Chickadee	300	1	01	04	AHY	IC	U		SKA		64	0				10.5	08:56:57	8			Band # no	Band # no	Band # no	Band # no	Band # not
	307100411	NOCA	Northern Cardinal	300	1	01	04	AHY	PL	M	PL	JSC	830	96	1				41	09:07:36	4			Band # no	Band # no	Band # no	Band # no	Band # not
	298070387	BCCH	Black-capped Chickadee	300	1	01	04	SY	TS	U		SKA	900	64	0				10.5	09:56:46	2			Band # no	Band # no	Band # no	Band # no	Band # not
	307100420	NOCA	Northern Cardinal	300	1	06	04	AHY	PL	F	PL	SKA	645	88	0				41.9	07:39:39	5			NOCA	AHY	F	1	4
	298070777	BCCH	Black-capped Chickadee	300	1	06	04	SY	TS	U		SKA	715	64	0				10.5	08:02:02	3			BCCH	SY	U	1	4
	298070594	BCCH	Black-capped Chickadee	300	1	06	04	AHY	IC	U		SKA	715	62	0				11	08:05:17	3			Band # no	Band # no	Band # no	Band # no	Band # not
	144200418	RWBL	Red-winged Blackbird	300	1	06	04	ASY	PL	M	PL	SKA	715	122	0				66	08:18:27	3			Band # no	Band # no	Band # no	Band # no	Band # not
	304146387	SOSP	Song Sparrow	300	1	06	04	AHY	PL	U		ACL	715	65	2				22.8	08:45:24	4			SOSP	AHY	U	1	4
	298070286	BCCH	Black-capped Chickadee	300	1	06	04	SY	PL	U		GCT	1115	62	1				9.8	11:47:01	3			Band # no	Band # no	Band # no	Band # no	Band # not
	298167514	SOSP	Song Sparrow	300	1	07	04	AHY	PL	U		SKA	645	66	1				20.4	07:13:27	3	R3 PULLED	Y	Band # no	Band # no	Band # no	Band # no	Band # not
	307100420	NOCA	Northern Cardinal	300	1	07	04	AHY	PL	F	PL	TWL	715	89	1				41.1	08:09:04	14			NOCA	AHY	F	1	4
	304119742	SOSP	Song Sparrow	300	1	07	04	AHY	PL	U	BO	FHN	715	71	0				21	08:16:22	J			Band # no	Band # no	Band # no	Band # no	Band # not
	267090133	GCKI	Golden-crowned Kinglet	300	1	07	04	ASY	PL	M	PL	CWS	745	57	4				7	08:45:26	1			GCKI	ASY	M	1	4
	304146387	SOSP	Song Sparrow	300	1	07	04	AHY	PL	U		TWL	745	65	1				21.9	08:48:47	4			SOSP	AHY	U	1	4
	304146396	SOSP	Song Sparrow	300	1	07	04	AHY	PL	U		TWL	815	65	0				19.9	09:01:08	6			SOSP	AHY	U	6	4

APPENDIX E: EXAMPLE OF DAILY LOG



TTPBRS Daily Log

Date: 12 / May / 2018

Personnel	Start	Finish	Hours
DMB	7:00	10:30	3.5
NJS	5:15	13:30	
BAW			
TMK			
JS			
DP			
LM			
CJE			
MW			

Weather	Open	Census	Close
Wind Direction	NE	NE	NE
Wind Strength	1	1-2	2-3
Cloud (tenths)	10	9/10	9
Temperature (ºC)	4	5°C	8
Precipitation	—	few drips	NIL
Visibility	F	OK	G

Census	Initials	Start	End
	DMB	7:00	13:00

Season Totals
970
Total Banded
41
Species Caught
22
Total # Species
Coverage Code

Banding Effort							
Net(s)	Standard Banding			Non-standard Banding			Notes
	Open	Close	Hours	Open	Close	Hours	
1-15	5:30	12:00	6.5x15=	97.5			
ABEFJ	5:30	12:00	6.5x5=	32.5			
CN				5:30	12:00	6.5	
TOTAL NET HOURS							

New Arrivals

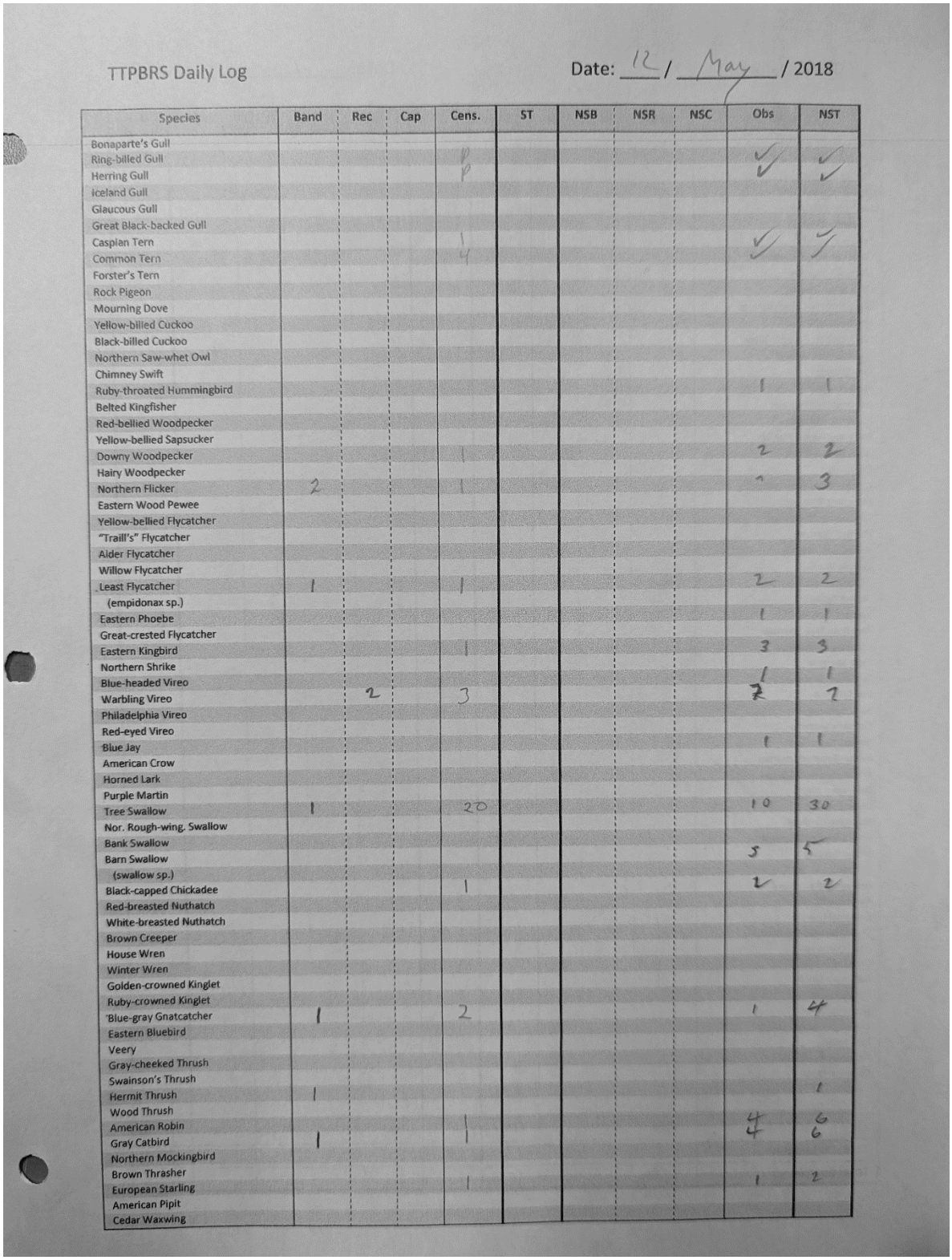
	Standard Banded	Standard Recap	Standard Captured Unbanded	Census	Standard Total	Non-std Banded	Non-std Recap	Non-std Captured Unbanded	Casual Obs	Non-standard Total
Individuals	41	14								
Species	15	10		35						

Synopsis			
Number of visitors engaged	50+	Organized groups (schools, nature groups)	2

TTPBRS Daily Log

Date: 12 / May / 2018

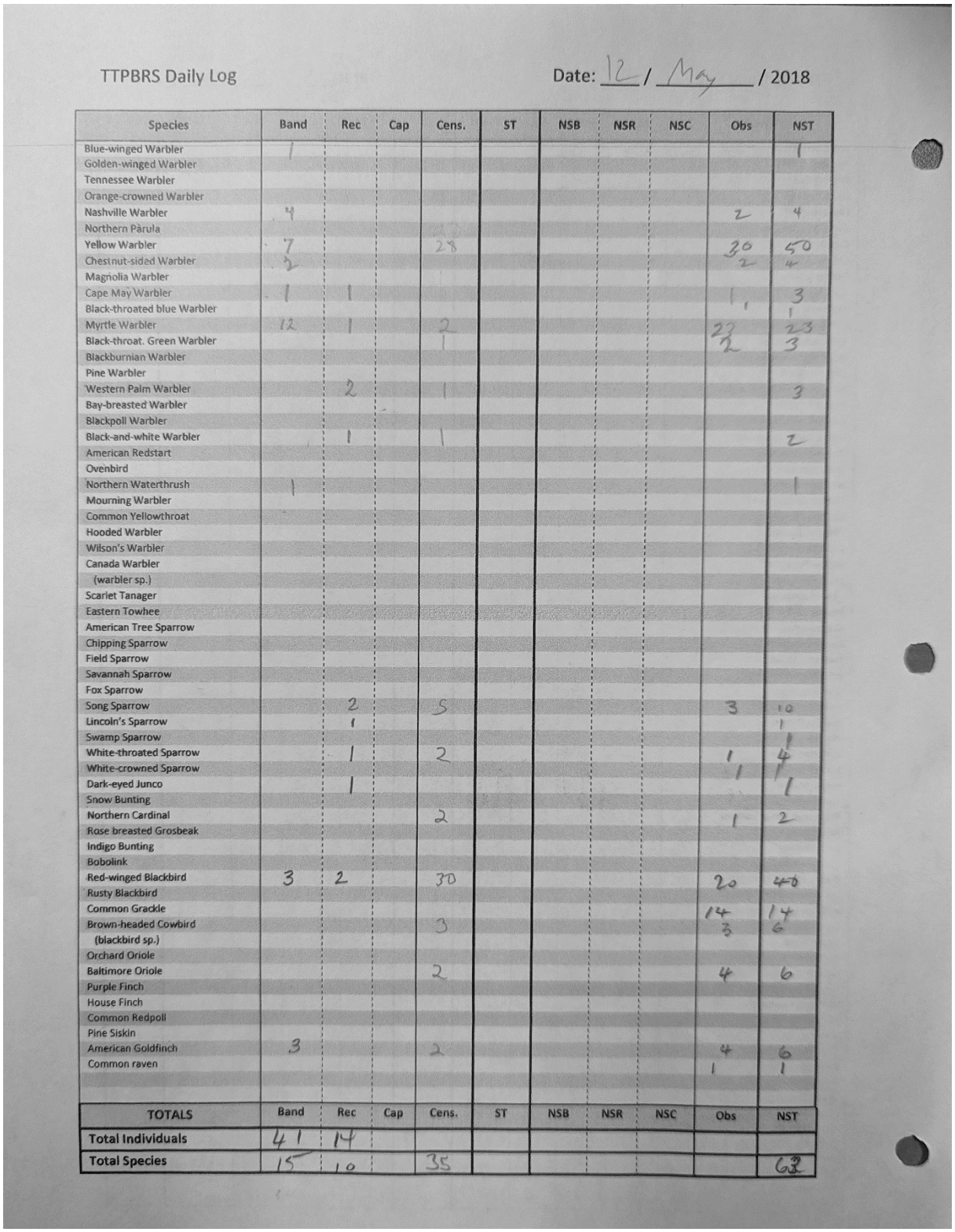
Species	Band	Rec	Cap	Cens.	ST	NSB	NSR	NSC	Obs	NST
Canada Goose				5					12	20
Mute Swan				2						2
Trumpeter Swan									5	5
Tundra Swan										
Wood Duck				2						2
Gadwall				3					2	5
American Wigeon										
American Black Duck										
Blue-winged Teal										
Northern Shoveler										
Northern Pintail										
Green-winged Teal										
Mallard				1					6	7
Canvasback									11	11
Redhead										
Ring-necked Duck										
Greater Scaup										
Lesser Scaup										
(scaup sp)										
White-winged Scoter										
Long-tailed Duck				1						1
Bufflehead				3					26	29
Common Goldeneye										
Hooded Merganser										
Common Merganser										
Red-breasted Merganser										
Ruddy Duck										
Common Loon									2	2
Pied-billed Grebe										
Horned Grebe										
Red-necked Grebe										
Double-crested Cormorant				P					✓	✓
Great Blue Heron										
Great Egret									1	1
Green Heron										
Black-crowned Night-Heron									✓	✓
Turkey Vulture										
Osprey										
Bald Eagle										
Northern Harrier										
Sharp-shinned Hawk										
Cooper's Hawk									1	1
Northern Goshawk										
Red-tailed Hawk										
American Kestrel										
Merlin										
Peregrine Falcon										
American Coot										
Black-bellied Plover										
American Golden Plover										
Semipalmated Plover										
Killdeer									1	1
Spotted Sandpiper										
Solitary Sandpiper										
Greater Yellowlegs										
Lesser Yellowlegs										
Whimbrel										
Ruddy Turnstone										
Sanderling										
Semipalmated Sandpiper										
Least Sandpiper										
White-rumped Sandpiper										
Baird's Sandpiper										
Pectoral Sandpiper										
Dunlin										
Stilt Sandpiper										
American Woodcock										



TTPBRS Daily Log

Date: 12 / May / 2018

Species	Band	Rec	Cap	Cens.	ST	NSB	NSR	NSC	Obs	NST
Bonaparte's Gull										
Ring-billed Gull				P					✓	✓
Herring Gull				P					✓	✓
Iceland Gull										
Glaucous Gull										
Great Black-backed Gull										
Caspian Tern				1					✓	✓
Common Tern				4						
Forster's Tern										
Rock Pigeon										
Mourning Dove										
Yellow-billed Cuckoo										
Black-billed Cuckoo										
Northern Saw-whet Owl										
Chimney Swift										
Ruby-throated Hummingbird									1	1
Belted Kingfisher										
Red-bellied Woodpecker										
Yellow-bellied Sapsucker										
Downy Woodpecker				1					2	2
Hairy Woodpecker										
Northern Flicker	2			1					3	3
Eastern Wood Pewee										
Yellow-bellied Flycatcher										
"Traill's" Flycatcher										
Alder Flycatcher										
Willow Flycatcher										
Least Flycatcher	1			1					2	2
(empidonax sp.)									1	1
Eastern Phoebe										
Great-crested Flycatcher										
Eastern Kingbird				1					3	3
Northern Shrike									1	1
Blue-headed Vireo										
Warbling Vireo		2		3					7	7
Philadelphia Vireo										
Red-eyed Vireo										
Blue Jay									1	1
American Crow										
Horned Lark										
Purple Martin										
Tree Swallow	1			20					10	30
Nor. Rough-wing. Swallow										
Bank Swallow										
Barn Swallow									5	5
(swallow sp.)										
Black-capped Chickadee				1					2	2
Red-breasted Nuthatch										
White-breasted Nuthatch										
Brown Creeper										
House Wren										
Winter Wren										
Golden-crowned Kinglet										
Ruby-crowned Kinglet										
Blue-gray Gnatcatcher	1			2					1	4
Eastern Bluebird										
Veery										
Gray-cheeked Thrush										
Swainson's Thrush										
Hermit Thrush	1									1
Wood Thrush										
American Robin				1					4	6
Gray Catbird	1			1					4	6
Northern Mockingbird										
Brown Thrasher										
European Starling				1					1	2
American Pipit										
Cedar Waxwing										



TTPBRS Daily Log

Date: 12 / May / 2018

Species	Band	Rec	Cap	Cens.	ST	NSB	NSR	NSC	Obs	NST
Blue-winged Warbler	1									1
Golden-winged Warbler										
Tennessee Warbler										
Orange-crowned Warbler										
Nashville Warbler	4								2	4
Northern Parula										
Yellow Warbler	7			28					30	50
Chestnut-sided Warbler	2								2	4
Magnolia Warbler										
Cape May Warbler	1	1							1 1	3
Black-throated blue Warbler										1
Myrtle Warbler	12	1		2					23	23
Black-throat. Green Warbler				1					2	3
Blackburnian Warbler										
Pine Warbler										
Western Palm Warbler		2		1						3
Bay-breasted Warbler										
Blackpoll Warbler										
Black-and-white Warbler		1		1						2
American Redstart										
Ovenbird										
Northern Waterthrush	1									1
Mourning Warbler										
Common Yellowthroat										
Hooded Warbler										
Wilson's Warbler										
Canada Warbler										
(warbler sp.)										
Scarlet Tanager										
Eastern Towhee										
American Tree Sparrow										
Chipping Sparrow										
Field Sparrow										
Savannah Sparrow										
Fox Sparrow										
Song Sparrow		2		5					3	10
Lincoln's Sparrow		1								1
Swamp Sparrow										1
White-throated Sparrow		1		2					1	4
White-crowned Sparrow									1	1
Dark-eyed Junco		1								1
Snow Bunting										
Northern Cardinal				2					1	2
Rose breasted Grosbeak										
Indigo Bunting										
Bobolink										
Red-winged Blackbird	3	2		30					20	40
Rusty Blackbird										
Common Grackle									14	14
Brown-headed Cowbird				3					3	6
(blackbird sp.)										
Orchard Oriole										
Baltimore Oriole				2					4	6
Purple Finch										
House Finch										
Common Redpoll										
Pine Siskin										
American Goldfinch	3			2					4	6
Common raven									1	1

TOTALS	Band	Rec	Cap	Cens.	ST	NSB	NSR	NSC	Obs	NST
Total Individuals	41	14								
Total Species	15	10		35						63

APPENDIX F: CMMN ASSESSMENT OF HABITAT STRUCTURE PROTOCOL

This is a first pass at simplified instructions for assessment. Thank you for helping us test them!

Instructions for CMMN assessment of habitat structure – test version

Members of the Canadian Migration Monitoring Network (CMMN) participating in the Trend Monitoring Program have been required since 2018 to regularly track habitat structure at monitoring sites. The recommended assessment method, described in detail here, is based on a version developed by MAPS program (Monitoring Avian Productivity and Survival) that is specifically aimed at monitoring major changes in the vegetation resulting from natural successional change, new management practices (logging, grazing, development), or the occurrence of major catastrophes such as fire or flood.

Numerous studies have shown that vertical and horizontal habitat structure is an important factor for predicting diversity and abundance of breeding, dispersing and migrating birds alike. Specific plant communities may typically be selected for breeding, but during migration, niches are broadened and habitat structure (field vs. forest, tall vs. short trees) plays a much greater role.

It is important to monitor the habitat structure at CMMN sites because many are located in areas subject to long-term vegetative succession. Change in habitat structure can alter both the types and numbers of birds captured in mist-nets, and the proportion of birds present in a Count Area that can be detected visually. Both these effects could result in apparent trends in abundance that are unrelated to changes in the number of birds actually using the site.

CMMN Habitat Structure Assessment (hereafter HSA) should be repeated every 3-5 years, depending on rapidity of change, with a new assessment done whenever there have been a significant events such as fire or severe wind damage. It is best to assess habitat at the same time each year, preferably in the summer when migration monitoring will not be disrupted and vegetation is at a stage experienced by migrants both in spring and fall. Assessment results are archived at Birds Canada as part of the metadata for each station, allowing researchers to evaluate possible effects on long-term trends in bird counts.

Step 1. Prepare Base Map

A map for your site (example in Figure 1), has been sent to you as a separate file. The map is based on satellite views of the station, with boundaries, nets and/or other landmarks to help with orientation in the field.

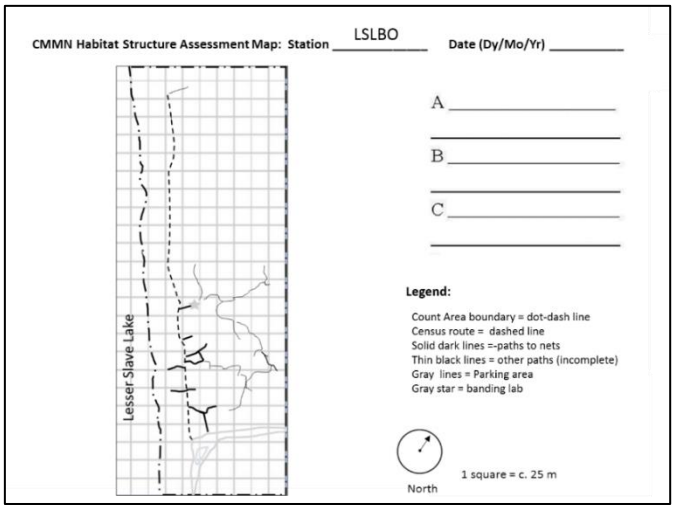


Figure 1. Sample HSA base map. showing main features of landscape and observatory operations.

Step 2: Define and map the habitats within the Count Area

Although satellite map views can be helpful in initial definition of habitat zones, they are not always up to date or available for the correct season, and the apparent habitat structure they show is often unreliable. G**round-truthing is essential**. **Before going any further, read through ALL remaining instructions**, because some of the information is relevant to deciding what should be considered a separate zone.

For each assessment, take a copy of the base map into the field and following the instructions below, draw in the current location of habitat zone boundaries as best you can. **Do not simply repeat** the zone boundaries used in the previous assessment. The main point of the assessment, after all, is to document any change that may have occurred in the size and configuration of structural zones since the previous assessment. Some of the zones defined in the previous assessment might even need to be eliminated or newly characterized (e.g., changed from shrub to young deciduous woodland), or a new zone might be added. On the map, label the habitat zones in sequence of coverage within the Count Area ('A' is largest, 'B' second largest, etc.)

Tips:

- Define and separate habitat zones primarily by simple successional stage: e.g. short herbaceous, shrub, woodland. It is justifiable to split categories, for example dividing coniferous and broadleaf woodland if they occupy substantially separate portions of the Count Area. Most CMMN stations will have only one or two habitat types.
- Where habitat is a mosaic of types (e.g. young woodland with small openings), without any one type clearly dominating a particular part of the Count Area, the entire area can be considered as a single habitat zone for assessment. (See Appendix 1 for guidance.)
- Unvegetated areas (water bodies, rocky outcrops) should not be considered as separate zones, regardless of size. Non-vegetated areas within the Count Area should be considered part of the nearest habitat zone (and should remain linked to that area in future assessments).

- Non-contiguous areas of the same type (e.g. deciduous woods separated by a large field) should be considered parts of a single zone.
- To decide whether a small area (e.g., < 0.5 ha) of distinct habitat is large enough to be treated as a separate category, consider its effect on bird observations. For example, Thunder Cape Bird Observatory has a small area of mown grass (0.1 ha) and a slightly-larger area of short shrub (both strictly managed to maintain their character). A 6-hour daily watch takes place from a platform in the open area, and allowing growth of the vegetation would markedly affect daily bird counts. Those small areas should therefore be considered as separate habitat zones for structural assessment.
- If you want advice on defining habitat zones at your site, consult with CMMN Science Committee (cmmn-rcsm@birdscanada.org)

Step 3. Assess habitat structure within each habitat zone

Print a Habitat Assessment Form (provided as a separate file) for each one of the habitat zones you defined on the station map.

Complete the lines above the tables:

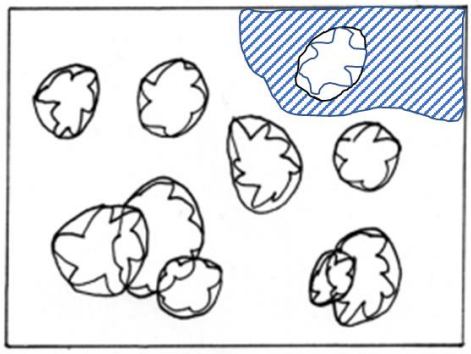
- Fill in date of assessment, and names of surveyors. It is recommended that at least 2 people survey together, because individuals can vary in judging boundaries and consultation will help moderate extremes.
- Circle the code and dominance label for the habitat zone being assessed.
- Describe the main habitat type: (trees, shrub, short herbaceous)
- Indicate the successional stage for the zone listed above. This indicates likelihood of change in that habitat in the near future *if left alone*: early-successional habitats change rapidly, mid-successional habitats change rather slowly, and late-successional habitats change very slowly. Examples: mown grass = Early (would grow if uncut), but native short-grass prairie = Late. Shrubs starting to take over a field = Early, but shrubs in regularly-flooded areas that limit growth could be Late.
- Percent of Count Area occupied by this zone: Use the base map (Step 1) to determine the proportion of grid squares within the Count Area that are occupied by this zone. The percentages across all zones should add up to 100%.
- Estimate the average height of trees, shrubs and herbaceous vegetation within thos zone. To estimate height of tree canopy it may help to find a tree that appears to be the average height, then visualize where its tip would land if the tree fell over, and measure the distance along the ground to that point.
- Distribution pattern (from Appendix 1) of the vegetation type in this zone **across the entire Count Area.** For example, a zone defined as woodland might be split into several clumps embedded in a zone defined as field; but the field itself may also contain scattered trees, such that one of the clumped patterns (7-10) would best describe the dispersion of trees across the entire Count Area.

Provide further detail on conditions within this habitat zone by filling in the tables**.** Every box asking for a percentage should be filled, with zeros entered where appropriate.

Vegetative Layers:

- Using Appendix 1, assign a pattern to each layer (Upperstory through Human-made Structure).

- Using the Percentage Cover Midpoints shown at the bottom of the form, record Percentage Cover of Upperstory, Midstory, and Understory. For example, 10-20% cover should be reported as 15%. The sum of cover percentages for these three layers may be less than 100%, depending on the proportion of the zone with open ground, ponds, buildings, etc.
    - To determine cover, imagine looking down from above and tracing the outer limit of every tree (or shrub, forb, etc.) in the layer you are analyzing, as illustrated by the solid circles surrounding tree crowns in the diagram at right. The Percent Cover is the proportion of the Habitat Zone that lies underneath those circled spots. Start with Upperstory first. When doing Midstory, *exclude all portions of the zone already included in Upperstory*. For example, the shaded area in the diagram excludes the area under the tree embedded within it. Follow the same procedure for Understory.



    - For each of the levels, estimate the percentage of vegetation in that layer made up of the listed vegetation categories (conifers, shrubs, etc.), remembering that vines and mosses may live in tree canopy as well as lower down. List the Main Species in each layer with the most precise names you can (latin or complete common name) instead of general names such as pine or fern.
- For Ground Cover, record actual percentage (vs. range midpoint) that each feature occupies **across the entire zone -- not** just areas in lacking any overstory. Thus, the 3 categories of Ground Cover must add up to 100%. (Ground cover includes all the non-vegetative features in the next table on this form.)

Non-vegetative features

- Flooded areas should be included in standing water as *marsh/bog*, and labeled either *seasonal* or *occasional* depending upon the regularity and duration of the flooding. Clarify as needed in comments (e.g. if there are multiple waterbodies of different status).

Step 4. Submit and archive

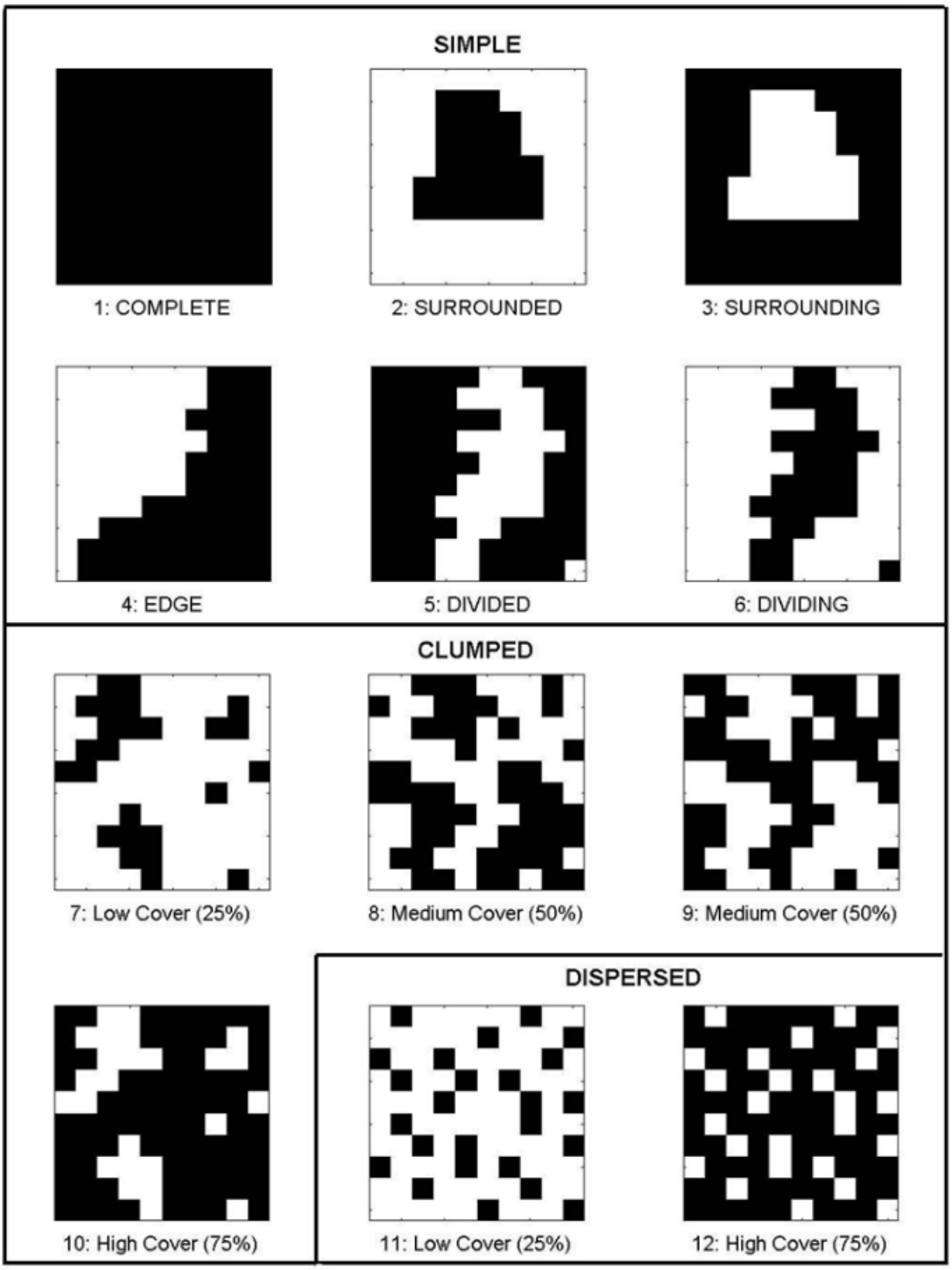
Make sure the map and data forms are complete (dated, all % boxes with a number, etc.)

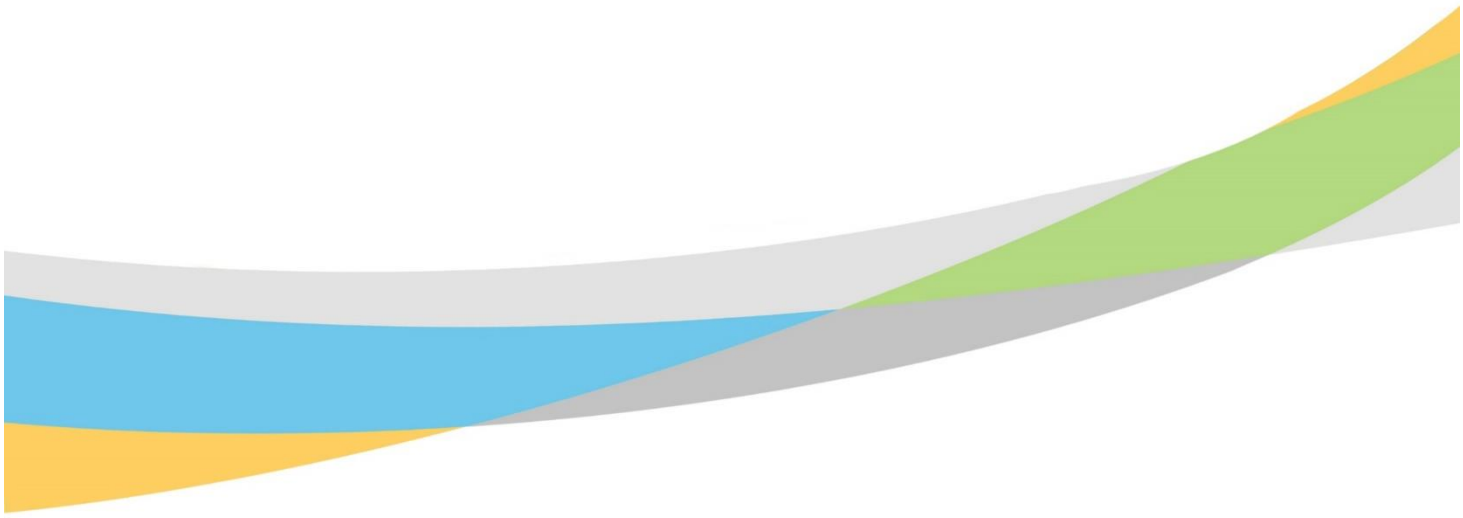
Scan or photograph the map and the data forms to create electronic copies. Use the file-naming convention in your site protocol, or this one:

- If all pieces are in a single file (e.g. a pdf), name it 'Habitat assessment_[STATION NAME]_[YEAR]'
- If pieces are separate, name a folder as above, and place the separate files within it, each one named as follows:
    - HSA Map: HSA-Map_[STATION NAME}_{YEAR]
    - HSA data forms: HSA-[ZONE ID]_[STATION NAME]_[YEAR]
- Archive one copy onsite, and submit another to CMMN along with annual data submission.

Appendix 1. Habitat pattern categories, with description and examples that correspond to the graphical examples in the figure below. Black areas in the figure represent the habitat, vegetative layer, or non-vegetative feature being described; white areas represent open space or a different habitat.

	Code	Description	Examples
1	Simple-Complete	Total cover of a single habitat type (or vegetative layer).	Prairie grassland, dense forest or any extensive habitat type.
2	Simple - Surrounded	A large patch of a single habitat type surrounded by another habitat type.	A meadow in a forest or a willow thicket within a meadow.
3	Simple - Surrounding	A habitat type surrounding a patch of another type.	The forest around a meadow or the meadow around a thicket.
4	Simple - Edge	A habitat type with an edge that crosses the station.	The edge of a large forest where it meets grassland.
5	Simple - Divided	Large patch of habitat divided by another habitat type - extensive edge.	Woodland, forest or meadow either side of a riparian corridor.
6	Simple - Dividing	Narrow habitat patch with extensive edge dividing another habitat type.	Riparian corridors, or bare ridgelines dividing forest habitat.
7	Clumped – Low Cover	Varying sized habitat clumps spread through the landscape.	Clumps of shrubs invading a grassland prairie.
8	Clumped – Medium Cover	A few large clumps of habitat type within the landscape.	Shrubby thickets in a divided watercourse.
9	Clumped – Medium Cover	Narrow patches of intricately connected habitat with extensive edge.	Divided watercourse and associated wet meadows.
10	Clumped – High Cover	Patches of non-habitat are spread throughout the landscape.	Nearly closed-canopy forest with clumped areas of selective logging.
11	Clumped – Low Cover	Small isolated patches of habitat dotting the landscape.	Shrubs in a grassland or saplings in forest gaps caused by treefall.
12	Clumped – High Cover	Almost homogenous patch but with well spaced small holes in it.	Mature forest with small clearings caused by treefall.


SIMPLE
1: COMPLETE
2: SURROUNDED
3: SURROUNDING
4: EDGE
5: DIVIDED
6: DIVIDING
CLUMPED
7: Low Cover (25%)
8: Medium Cover (50%)
9: Medium Cover (50%)
DISPERSED
10: High Cover (75%)
11: Low Cover (25%)
12: High Cover (75%)



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