Migration Monitoring Manual

Sara Pearce Menjerink, Geoff Holroyd and Jana Teefy

Last updated December 2024

Contact Information

Chair, Dr. Geoff Holroyd, email: chair@beaverhillbirds.com cell: 587-783-9188
Head Biologist, Jana Teefy, email: biologist@beaverhillbirds.com cell:780-721-1129

TABLE OF CONTENTS

INTRODUCTION

Study Objectives

The Beaverhill Bird Observatory Bird Observatory came into existence in 1984 after some informal bird banding (since early 1980s), and the formation of an organization to coordinate these activities. The goal of the migration monitoring program at the BBO is to provide consistent and comparable year to year information on songbird population sizes, body condition, survival, species composition, and migration timing. A daily migration "count" of individuals of each species in or passing through a specified area is conducted daily along with daily standard effort banding. A "migration count" includes any tally of birds on spring or fall passage, a definition that could include birds counted at stopover sites, flying past a fixed point, captured in nets or traps or seen on radar screens (Dunn 1992). For monitoring small land birds, particularly nocturnal migrants, this manual will be mainly concerned with birds observed or captured at the field station on the south-east shores of Beaverhill Lake, in the Beaverhill Lake Natural Area. This program is consistent with a wide network of such migration monitoring programs in Canada coordinated by the Canadian Wildlife Service, Canadian Migration Monitoring Network (CMMN) and Birds Canada.

Some objectives of the Observatory, other than migration monitoring and other research projects, is to maintain a consistently high level of staff and volunteer activity for research, provide valuable training and field experience for students, and establish on-site interpretation for Beaverhill Natural Area and Beaverhill Lake Heritage Rangeland. The natural area and rangeland are Crown Land managed by Alberta Public Lands and Alberta Parks.

This manual describes the standardized protocol to be used in the operations of the Beaverhill Bird Observatory (BBO) station in the Beaverhill Natural Area by its staff and volunteers. By reading and understanding the contents of this manual, all operators of the station (old and new) will perform tasks and collect data in a highly consistent manner, and can rely on fellow operators to do likewise. This in turn gives scientific credibility to the data collected by those working at the station.

Study Location

The land on which the BBO station is situated is within the 1 sq-mile of the Beaverhill Natural Area, located approximately 80 km south-southeast of Edmonton, Alberta. The habitat within the count area is made up of habitats found within the whole of the Natural Area: mixed poplar aspen woods, willow shrubbery, grasslands, marshes, sandy shores and open lake water as far from shore as the viewer can see (when the lake is present). The census route and 13 designated net-lanes are inside or on the perimeter of the count area.

The buildings are on 0.9 acres that is leased from Alberta Public Lands (Latitude 53.381, Longitude -112.527; website with directions www.beaverhillbirds.com). BBO secures annual permits from Alberta Environment and Parks, Alberta Fish and Wildlife, and Canadian Wildlife Service of Environment and Climate Change Canada. The regulations of the Natural Area do not permit other permanent structures to be built on the land, and alteration of the land must be kept to a minimum. The BBO has installed Alberta Parks signs to guide visitors through the area, to interpret natural features, and to encourage respect for the area to keep damage to the area to a minimum. Very few people have vehicle access through the Natural Area to the station, while most people walk to the station. Upkeep of net-lanes and trails is done with lawnmowers and small saws. Most of the general maintenance (up-keep and minor repairs) falls within the job description of the staff, and volunteers provide support for larger projects.

1.0 GENERAL OPERATIONS

Long-term population trends based on migration counts are only credible if based on count methods and effort levels that are consistent from day to day and year to year. The following operations protocol is central to the Trend Monitoring Program and must be followed by all staff and volunteers.

1.1 Personnel

A minimum of 2 are needed to conduct all standardized procedures on days with typical levels of bird activity (recognizing that there may be a few days each season when operations must be curtailed due to unusually high bird volume).

One Bander-in-Charge (BIC) must hold a banding permit (master or sub-permit). One experienced Field Assistant: able to identify > 90% of birds likely to occur in the Parkland region by sight and sound, such that he/she can conduct the Daily Census and Standard Observations, as well as assist with the mist-netting. One additional Field Assistant/Volunteer is ideal.

1.2 Seasonal Coverage Period

The Seasonal Coverage Period extends from May 1st to June 9th in the spring and from July 20th to October 20th in the fall. Daily coverage is interrupted only by conditions unsafe for operators and/or birds. Even partial coverage is better than none at all.

1.3 Daily Coverage Period

The Daily Coverage Period consists of 6 hours of fieldwork each morning starting one-half hour before sunrise. Field work components include the Daily Census, 6 hours of Mist Netting/Bird Banding and 6+ hours of Standard and Non-standard Observations.

All bird banding and visual bird counts that take place outside of the standard 6 hour Daily Coverage Period must be recorded on the Daily Estimated Totals Sheet as Other Observations.

1.4 Coverage Area

Counts must be taken by observers from within the Count Area boundary (Figure 1). All birds detected by sight or sound within the Count Area are counted, but those outside the boundary may only be counted when identified by sight.

If long-term habitat change eventually obscures the view of lakebed from the census route, the route should be extended far enough to afford a view. (Any such changes should be recorded in section 6 of the protocol, and Figure 1 should be revised.)

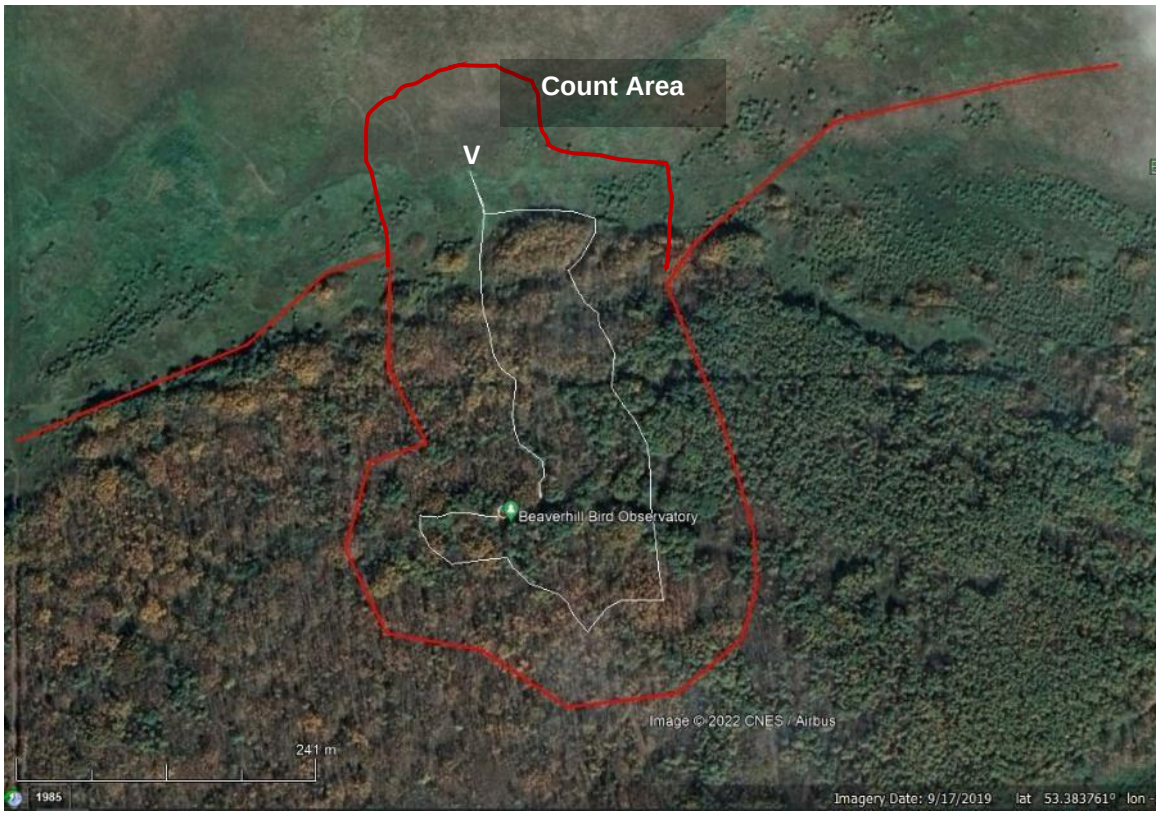


Figure 1. Count Area boundary (red loop) is 100m beyond the Census route (in white). V is the observation point for birds over the lake and lakebed to the east, north and west which requires a telescope. The red lines along the shore emphasize that unlimited distance sightings taken from point V should be included in the census count.

2.0 OBSERVATIONS

2.1 Daily Census

The Daily Census is the most important activity at the station and takes precedence over all other activities if personnel are lacking for complete coverage. Mist-nets must be closed or reduced in number if necessary to permit staff to conduct the census. The only exception is if there are large numbers of birds in nets, in which case staff will delay the Daily Census until nets are cleared and temporarily closed. Census should also be done when weather conditions prevent banding, to provide at least one standardized estimate of bird activity.

The census should begin one or two hours after sunrise, although weather conditions may force it to be delayed until later in the morning. It may be done by one or more observers and should take approximately 40 minutes. Observers will walk slowly along a standardized loop that leads them through forest, willow and lakeshore habitat. Five - ten minutes of the census will be spent overlooking and counting all birds seen flying, foraging or flocking over Beaverhill Lake.

When feasible, responsibility for conducting the Daily Census should be rotated among observers with the ability to identify 90% or more of all the birds that occur within the Parkland region. This will randomize the influence of the variable skill levels among observers, ensuring consistency of average skills across years. The aim is to count as many of the birds present as possible from the census route. Birds may be identified by sound alone from within the Count Area (100 m from

route), but birds further out can only be recorded if seen. For good estimation of large numbers (e.g. gull flocks), count birds in a section of the flock, then extrapolate by counting the number of similarly-sized sections. Seek agreement among observers. If you cannot identify a species, do not guess. However, do try to identify it as closely as possible (e.g. dowitcher spp., Empidonax spp., warbler spp.). Write a note in the comment section of the log sheet if you feel you missed a large proportion of the birds because of exceptional circumstances (e.g. if they were flying over too high to identify accurately). Do not estimate numbers of birds that you think may have been present, but were not actually seen or heard.

Description of the Daily Census route:

The census starts at the BBO Lab, heads north on Robin Route past the nets to the old shoreline where the purple martin boxes are located. Then east along the mowed trail along historical Short-eared Street, which then turns south along the mist net lanes leading to the junction of BBO Boulevard and Flicker Freeway. From there, continue traveling south on the foot trails past the Boreal Owl net lanes, and turn west when walking by the Saw-whet Owl net lanes. This connects to Warbler Way, at which point the loop travels north to just before Raven's Roost Bunkhouse, then a footpath west that loops north and then east back to the lab (See Figure 2).

How to do the census

- Stop frequently for 1-2 minutes to observe and record all birds.
- Spend 5-10 minutes out at the lakebed counting all the birds you see flying over the lake.
- Record birds on paper at regular intervals during the census rather than writing them down after the walk is completed.
- Conduct the census no matter how inclement the weather, with the exception of intense lightning storms (in this instance, conduct the census after the storm has passed and make a note in the Daily Log about the altered start and end time).
- Double check that the weather was recorded by the banders (see Weather Readings section).
- Do not 'pish' for birds or play bird songs or calls on your phone or other device.
- Do not leave the census route or walk off the path, although you may step off slightly to get a better view of a bird detected from the path.
- Use binoculars, and use a scope to view north over the lake from the purple martin houses.
- If flocks are too large to count individuals, estimate the flock size as best you can. Choose a single number (e.g., 600 instead of 500-700).
- Do not spend too much time trying to identify individual birds.
- Try not to vary the pace (rushing through on quiet mornings and going more slowly on busy mornings). Take the best count you can, recognizing that you are taking a standardized 'snapshot' of birds detected in 1-2 minutes rather than making an exact count of large flocks.

Table 1. GPS locations of intersections on the census route.

LANDMARKS	Latitude N	Longitude -W
BBO Lab	53.3806	112.5274
Old shoreline and purple martin boxes	53.3830	112.5280
The mist net lanes	53.3827	112.5262
Junction of BBO Boulevard and Flicker Freeway	53.3815	112.5255
Boreal Owl net lanes	53.3809	112.5253
Saw-whet Owl net lanes.	53.3789	112.5249
Raven's Roost Bunkhouse,	53.3803	112.5273
West loop	53.3804	112.5280

2.2 Other Observations

All birds detected from within the Count Area during the official Count Period additional to those captured or counted on Census are documented as 'Other'. It's a good idea to keep notes during the day so you don't forget.

2.3 Non-standard Observations

All birds documented by personnel when outside the Count Area are considered Non-standard Observations. These are not included in the official Daily Totals, but staff and volunteers are asked to record them in the Daily Log narrative. Ideally enter these observations directly into eBird under 'Beaverhill Natural Area' or 'Beaverhill Weir'

3.0 BANDING

3.1 Mist-netting

The mist-netting/bird banding operation commences 30 minutes before dawn and continues for 6 hours, weather permitting. 13 standard songbird nets are currently located as shown in Figure 2. Natural succession is advancing woodland into the lakebed, such that capture rates at permanent net sites are altered over time. To maintain capture rates at as standard a level as possible, nets may be moved periodically (on the order of decadal), with the aim of maintaining their relative position near the edge of the woodland. Plans for change (including new map and GPS points for proposed new locations) must be approved by CMMN Science Committee prior to implementation, and details should be provided in Section 6 of the updated protocol.

Figure 2. Beaverhill Bird Observatory's Migration Monitoring Nets upto including net 60. Nets 61 - 64 are for non-standard banding such as in the Young Ornithologist Workshop.

Procedure:

- Net should be checked every 30 minutes, and more frequently if weather is deteriorating or large numbers of birds are captured
- Nets can be checked in either direction
- With two or more observers the nets can be checked starting east and west and meet at the middle.
- If too many birds are caught for the personnel on site, consider closing one or more nets
- If the capture rate is high call our local banders: Geoff 587-783-9188, home 780-922-0178, Helen cell 780-717-7009 and home 780-662-4782, and Irene 780-242-6377 who live 20-30 minutes away
- The net lane where each bird is captured is recorded by attaching numbered clothes pins that are stored by each net. Return used clothes pins to the appropriate net lane when they are available at the banding bench.

The latitude and longitude coordinates are from the centre of each mist net. The angle of orientation gives the direction from one end of the net to the other, i.e. from one net pole to the next. Further notes about the standard positioning of each net are given in the 'Notes' column.

Non-standard mist netting and banding is allowed when public groups wish to see banding outside of the 6-hour monitoring period. Normally the net at the bird feeder is opened for such groups. During the Young Ornithologist Workshop and after the 6-hour period, nets in lanes 61, 62, 63 and 64 may be used (Figure 1). These records are reported as 'Other" on the daily form.

Table 2 – Beaverhill Bird Observatory mist nets: coordinates & orientation

Net I.D.	**Lat and Long coordinates**	**Angle of orientation**	**Notes**
Net 02	N53.38072, W112.52709	16˚	Continuous with Net 02X
Net 02X	N53.38080, W112.52703	16˚	Continuous with Net 02
Net 08	N53.38205, W112.52579	210˚	Free-standing
Net 09	N53.38213, W112.52596	300˚	Perpendicular to the end of Net 08, Continuous with Net 09X
Net 09X	N53.38218, W112.52605	300˚	Continuous with Net 09
Net 50	N53.38260, W112.52619	105˚	Free-standing
Net 51	N53.38236, W112.52636	240˚	Free-standing
Net 52	N53.38238, W112.52660	175˚	Free-standing
Net 53	N53.38224, W112.52700	250˚	Free-standing
Net 54	N53.38231, W112.52752	200˚	Free-standing
Net 55	N53.38211, W112.52749	195˚	Free-standing
Net 56	N53.38202, W112.52831	175˚	Free-standing
Net 57	N53.38186, W112.52910	270˚	Free-standing
Net 58	N53.382815, W112.526125	241˚	Free-standing

Net 59	N53.382240, W112.528220	18˚	Free-standing
Net 60	N53.382855, W112.525959	64˚	Perpendicular to the end of net 59, free-standing
Net 61	N53.382916, W112.525810	319˚	Perpendicular to the end of net 60, free-standing
Net 62	N53.382570, W112.524960	120˚	Free-standing
Net 63	N53.382660, W112.524480	116˚	Free-standing
Net 64	N53.382680, W112.524360	47˚	Perpendicular to the middle of net 63, free-standing

3.2 Banding

After extracting birds from nets, attach clothes pegs with corresponding net numbers to the bird bag loops. You can use one peg to flag multiple bird bags. Apply a second colored peg to any priority species, females with active brood patches, extremely young birds, and any difficult extractions and suspected injuries. To track net check time, hang time tags immediately to the left of bird bags on hooks from the corresponding net check. When banding, ensure to prioritize the oldest net checks and any birds with coloured priority pegs. Bird bags with a priority pin should be processed first

Species Identification – all birds must be identified to species *before* being banded and must be released unbanded if ID is not 100%. Take photos, measurements, and notes for unidentified, unbanded birds, if time permits.

Certain species are always released unbanded but should nonetheless be recorded as ‘captured’ in the Daily Log sheets. Example: Species to be released unbanded are Ruby-throated Hummingbirds (unless Geoff is present), and Northern Cardinals (which require special bands).

Biometrics – except as noted in Section 3.4, the following information must be recorded for all banded birds: band number, species, age and how aged, WRP age code, sex and how sexed, wing measure, tail measurement, flight feather wear, cloacal protuberance (CP), brood patch (BP), fat, body molt, weight, and extent of skull ossification (in the fall).

Ageing & Sexing – all captured birds must be aged and sexed when possible, using criterion accepted by the Bird Banding Office – Environment and Climate Change Canada, and following the methods outlined in Peter Pyle’s, Identification Guide to North American Birds. While staff must try to age and sex all individuals, it is important not to record an age/sex if the bander is not extremely confident (95% certain) of the bird’s status. Record age/sex as Unknown (Numerical Code 0) if there is any uncertainty.

WRP Aging Code – three alpha code used to age our birds (Appendix 1)

Wing Measurement – relaxed wing cord measured to the nearest millimeter using a wing ruler

Tail Measurement – tail length measured from the center rectricies to the nearest millimeter using a tail ruler

Flight Feather Wear – 0-5 numerical scoring system (Appendix 2.1)

Cloacal Protuberance – 0-3 numerical scoring system (Appendix 2.2)

Brood Patch – 0-5 numerical scoring system (Appendix 2.3)

Fat – 0-7 numerical scoring system (Appendix 2.4)

Body Molt – 0-4 numerical scoring system (Appendix 2.5)

Weight – mass to the nearest 0.1 gram.

Skull Ossification – 0-6 numerical scoring system (Appendix 2.6).

Band number – if a recorder is helping, the bander should read the last three digits aloud and the recorder should confirm aloud. The following additional information must also be recorded on the banding sheets: time trapped; the net number the bird was extracted from; the bander's initials, and the day, month and year the bird was captured (Appendix 3). Additional information can be written in the "Comments" column.

Time Trapped – Local time, to the nearest ten-minute interval. Use 24-hour clock.

Net Number – extractors must keep track of which net birds were caught in**.** Clothes-pins with the net-number on them are stored at each net, and one can be clipped to each bag as the birds are extracted. Once birds have been banded, pins can be returned to nets on the next net round.

Banders' Initials – three initials should be included for each banded bird and each bander's full name and three initials should be written at the top of each banding sheet.

3.3 Recaptures

Most recaptures are birds recently banded at the station that have remained in the area, although a few are recaptured from season-to-season and year-to-year. Foreign encounters – are birds caught at this site that were originally banded at another location. Band numbers should always be checked prior to release to ensure that foreign encounters are detected.

Data for recaptured birds are recorded on a separate Recapture Sheet (Appendix 4). All recaptures are processed the first time they are captured on a given day. If recaptured again the same day, enter the comment "SDR" (same day retrap) next to the data from the earlier recapture. and note the time and net number. READ THE BAND NUMBER FORWARDS AND AGAIN BACKWARDS TO THE SCRIBE OR HAVE THE SCRIBE READ IT BACKWARDS TO YOU.

A small group of local breeding birds have territories near the netting operation and maybe recaptured consistently in late-May and early June. Once these birds have become familiar to staff, bands should be read at the net and, if you are certain the bird is one of the regulars, it can be released immediately. Such recaptures should still be recorded on the Recapture Sheet, with the code 'RAN' (released at net) in the comment space.

3.4 Bird Handling

Handling Time – birds must not be held for more than **one hour** from the time they are extracted from nets. All measurements should be taken for birds that are banded but if necessary for the safety of the birds to begin omitting data (i.e., too many birds are backed up for banding). The required data fields are Band Number, Species, Date, Age, Sex, Location, Disposition, and Bird Status. Note that the required data fields must be filled in for every bird captured, even if the values are unknown! Never leave them blank. Record age and sex if immediately obvious, but wing measurement, tail measurement, flight feather wear, breeding characteristics (CP/BP), fat, body molt, weight, skull ossification and close examination required or sexing or aging may all be omitted. Of all the omitted data, wing measurement and weight are the data most used by other researchers, so give those measures priority if you can. Birds held more than one hour should be

released unbanded, after recording the species and number of individuals for recording in the Other Capture column on the Daily Log Sheet. The BIC must anticipate looming back-ups and take steps to close some or all of the mist nets and or call for help (see phone numbers above) (see Section 3.1), so that the capture rate declines to a rate that allows all measurements to be taken on every bird.

Injuries – Birds should be released immediately at the net in poor weather conditions or after a difficult extraction if they show signs of heat exhaustion, torpor, or undue stress (e.g., eyes closed, head waggling, feathers very fluffed). Place the bird back in a bag if it does not fly and take steps to assist in its recovery. On cold days, hang the bag containing the bird inside the warm banding lab building. On hot days, place the bird in its bag in a cool, shady spot. In either case, the bird should be kept in a quiet location. In the case of captured hummingbirds that are observed to be in distress, carefully administer sugar water via an eyedropper. Check the bird at least once every hour, being careful not to disturb it more than necessary, and if it is observed to have recovered (eyes are open, bird is active and moving well), release it. If the bird has not recovered well enough to fly after a few hours, place it slightly off the ground in a location some distance from the netting area. Do a visual check of the bird every hour until it recovers.

Any bird that is held for reasons of stress or injury must be recorded in the Casualty Log (Appendix 5), along with details of its condition, the steps taken for its recovery, and its condition upon release. This also applies to birds that are released at the net – for example, if a bird is badly tongued and is bleeding, the extractor may decide to release it rather than subjecting it to the additional stress of being banded. Such a bird should be counted as a Capture and the details of the case recorded in the Casualty Log; in addition, the BIC must be informed so that the situation may be discussed with other staff and volunteers, and any necessary steps to prevent or alleviate such injuries in the future can be carried out.

3.5 Closing Nets

Nets must be closed whenever conditions are such that undue stress to birds and injury are likely to result from leaving them open.

Too many birds --If a partial closure of the mist nets is needed, nets 57 and 56 should be closed first, followed by net 50 if necessary. These are the mist nets that are the most distant from the banding station, and closing them reduces the time needed to complete a net check. Alternatively, nets 58 – 61 can be closed first as they capture the most birds. If the banding station is still overwhelmed with birds, the remaining nets that are capturing the majority of the birds should be closed until all of the birds currently held at the banding station have been banded or released.

Rain – rain and other forms of precipitation have a very negative impact on birds caught in mist-nets and nets must never be opened during even light precipitation if there are many birds in the area. Furthermore, the BIC must always error on the side of caution if rain appears imminent i.e. closing nets in advance of rain, particularly on busy bird days. Check Environment Canada's website for radar images that show imminent rain or snow.

Wind – although the netting area is generally well protected from most winds except from north, some or all nets must be closed if the force of the wind is great enough to cause undue stress or injury to birds.

Temperature – extremes of heat and cold also have a dramatic and harmful impact on birds and so nets must not be opened if conditions are poor. Although the BIC must consider other factors such as wind strength on cold days, the number and level of experience of staff, the volume of bird activity, relative humidity, etc., caution must be taken whenever the temperature drops below 0°C or rises above 27°C.

Predation – BBO rarely has problems with predators at our nets. Occasionally, when a bird of prey discovers the netting area and is seen trying to predate a songbird, all nets in that area are close for 1 hour until the predator has left the area.

4.0 RECORD KEEPING

4.1 Daily Estimated Totals

The Daily Estimated Totals form (Appendix 6) summarizes all data collected at the migration station each day. It has data columns for total individuals captured (as tallied in Appendix 6), census totals, and other observations made during the dawn to dusk Count Period. The total of these counts is adjusted downward as needed to eliminate probable duplicates (e.g. a bird detected near nets that was likely to have been captured, or a bird seen by two observers that was probably the same individual).

The total number of individuals of each species documented within the Count Area during the six-hour Daily Coverage Period represents the Daily Estimated Total (DET) for that species. The DET is calculated by adding the results of the Daily Census**,** all birds captured during the Standard Count Period (newly banded, retraps, repeats, and captured but not banded), and Other Observations, adjusting as needed to eliminate duplicate counts. For example, if 6 American Robins are counted on the Daily Census, 3 are banded during netting observations, and 5 additional birds are recorded within the netting area during the Standard Observation period, the DET for American Robins would be 14.

If some individuals were likely double counted, the total should be adjusted accordingly. For example, if a Northern Waterthrush is seen and heard singing in the netting area during the Daily Coverage Period, and is likely the same bird that is captured and banded, it will be recorded as an Incidental Observation as well as a newly-banded bird, but will only be counted as one bird for the purposes of Daily Estimated Totals. DETs should be calculated with input from all personnel participating in the day's activities, so as to minimize duplication.

The DET includes all birds observed from within our study area. All other sightings should be reported to eBird as within the Natural Area or at the Weir.

4.2 Daily Log Sheet

The Daily Log Sheet is used to document and record all data collected at the migration station (Appendix 7). The columns 'Band,' 'Repeat,' 'Return,' and 'Other' are for summarizing the daily total captured. The 'Band' section records the numbers of birds newly banded that day. 'Repeat' is for birds that are retrapped within 90 days of original banding or last capture. 'Returns' are retrapped birds from the same station more than 90 days after last capture. 'Foreign recovery' refers to a bird that was banded elsewhere and retrapped at our location. 'Other' refers to birds captured but not banded.

The secondary table of the Daily Log Sheet keeps track of when each mist net was opened and closed, and how many birds were captured per net over the course of the morning. The Daily Log Sheet must be completed at the end of each day, including a narrative, staff work hours, number of visitors, volunteer's names, operations time line, number of nests found, other non-bird wildlife encountered, and plant records of note.

Details about how to fill out the specific data fields on the Daily Log Sheet are explained below:

4.3 Migration Monitoring Coverage Code

The Migration Monitoring Coverage Code (Table 2) indicates the level of coverage achieved at the station each day. Level 5 represents 100% coverage (i.e. two experienced birders/banders and one intern/scribe conducting the Daily Census, recording Standardized Observations for six hours and operating mist-nets for six hours) and present on site from predawn to sunset. The code should be entered in the appropriate box on page one of the Daily Log Sheet, based on the following criteria:

Table 2 – Migration Monitoring Coverage Codes

Code	Description
0	No coverage. Use of this code should occur only rarely.
1	Poor Coverage: only census
2	Fair Coverage: census or banding plus observations
3	Good Coverage: census plus banding (≥6 hours) plus observations
4	Excellent Coverage: same as (3), but observers active thru-out day
5	Above and Beyond Coverage: same as (4) but at least 2 observers active the entire day

4.4 Banders Hours

All staff that contribute observations to the DETs must be identified on the Daily Log Sheet along with their start and end time and total hours worked that day.

4.5 Weather Data

Weather readings are recorded at the start of banding day and every 2 hours including at the end of banding. The observations are entered in the appropriate field on page one of the Daily Log Sheet. Recording weather at other times of day is optional. The following information is recorded:

Table 3 – Weather Data

Data	Description
Time	24hr clock
Wind Direction	N, S, E, W, NE, ENE, etc.
Wind Strength	Beaufort Scale – see Appendix 8
Cloud Cover	Percentage to the nearest 5%
Temperature	In degrees Celsius
Precipitation	Light rain, sleet, snow, heavy thunderstorms, etc.

Temperature should be taken from the indoor/outdoor thermometer at the banding station. Wind Direction indicates the direction the wind is originating from rather than the direction it is blowing. Wind Strength is calculated using the marine-based Beaufort Scale (Appendix 7). Cloud Cover info above. Precipitation should be recorded in the appropriate field on the Daily Log Sheet.

4.6 Data Entry

In addition to the fieldwork, staff and long-term volunteers are responsible for entering data from the DETs and bird banding records onto computer. The station's DET data are entered into the Birds Canada DET software excel program and the DET totals entered into Beaverhill Bird Observatory's eBird. The banding records are entered directly into the digital data sheets at the time of banding and uploaded to the Bander Portal three times per year. Paper data sheets are available in the event of power outages. The BIC or other staff will familiarize long-term volunteers with the data entry process. A few hours at the computer each day is usually enough to keep on top of the work. Long-term volunteers are also asked to help with proofing the totals once they have been entered.

5.0 HABITAT MONITORING AND MANAGEMENT

5.1 Photographic records

A regular schedule of photographs of each net lane are very helpful for data users. Habitat change affects the species and numbers observed, and the habitat records allow researchers to quickly assess whether their use of the data is likely to be adversely affected by changes that have occurred. Photographs are to be taken annually of each net lane, 2 photographs looking down the net lane from either end, and 2 looking perpendicular into the surrounding habitat taken from the center of the net lane.

The following Table 4 gives the locations from which to take the photographs that are necessary for habitat assessment. Beginning at the latitude and longitude coordinates for each mist-net given in Table 1 (i.e. begin from the net pole closest to the path), face the direction with your back to the main trail, facing outwards, then aim the camera in the required direction to take the photograph. Because of the dense vegetation and narrow net lanes it is not always possible to get the entire mist-net in frame, but as much of the net as possible should be in the photograph. Take the 4 photos of each net lane, working in a clockwise directions. Sample photographs are available on the station laptop.

Table 4 – Location for habitat photographs of BBO Mist-nets

Net I.D.	**Distance***	**Direction to point camera for 1st photo**
Net 02	2.5 m from 'Net 02'	16^0
Net 02X	2.5 m from 'Net 02X'	16^0
Net 08	2.5 m from 'Net 08'	30^0
Net 09	2.5 m from 'Net 09'	300^0
Net 09X	2.5 m from 'Net 09X'	300^0
Net 50	2.5 m from 'Net 50'	150^0
Net 51	2.5 m from 'Net 51'	240^0
Net 52	2.5 m from 'Net 52'	175^0
Net 53	2.5 m from 'Net 53'	250^0
Net 54	2.5 m from 'Net 54'	20^0
Net 55	2.5 m from 'Net 55'	195^0
Net 56	2.5 m from 'Net 56'	175^0
Net 57	2.5 m from 'Net 57'	270^0
*Describes direction & distance from Latitude and Longitude coordinates for the mist-net (see Table 1)		

For the habitat assessment to be as detailed and accurate as possible, three other photographs should be taken in the netting area: one of the banding station and two more along the path leading to and from the nets. Photographs should also be taken along the path on the Daily Census route, at the following locations (Table 5).

Table 5 – Location for other habitat photographs

Location I.D.	***Lat and Long coordinates***	***Direction to point camera***
Banding station	*N53.380505 W112.527389*	*260º*
Net Area 01 (BBO Boulevard leaving the banding station)	*N53.380505 W112.527389*	*80º*

Net Area 02 (Warbler Way leading back to the banding station)	*N53.381438 W112.528780*	*180º*
Census 01 (Lakebed Lookout – looking West)	*N53.383017 W112.527795*	*245º*
Census 02 (Lakebed Lookout – looking North)	*N53.383017 W112.527795*	*0.0º*
Census 03 (Lakebed Lookout – Looking East)	*N53.383017 W112.527795*	*85º*
Census 04 (Male NSWO nets)	*N53.379928 W112.525449*	*350º*

When the image files are downloaded, rename them to define the location and date. The file name for each photo should follow this convention: '[DD] [MONTH] [YEAR] – [LOCATION ID]-[STATION NAME][photo #1-4], e.g., a photograph taken on October 16th, 2020 of Net 02 at BBO would be labelled '16 Oct 2020 – Net 02 – Beaverhill Bird Observatory-1'. The names for the locations photographed along the census route are provided in the table above.

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

5.2 Assessment of habitat structure

A formal habitat assessment following the MAPS protocol is be carried out once every 5 years beginning in 2022, and whenever there has been a significant change to the Count Area. Habitat assessments are to be carried out in June and July.

Habitat patches to be surveyed consist of areas of similar habitat that make up at least 2.5 acres within the Count Boundary**. T**he habitat patch definitions should be considered anew at each assessment. If more than one observer is available to carry out the habitat assessment, they should each complete a separate assessment and then collaborate on a consensus opinion that can be submitted to Birds Canada. On the map, designate the dominant habitat as A, the sub-dominant habitat as B, the first minor habitat as C (if applicable), and so on.
Once the habitats have been defined and delineated, complete a Habitat Structure Assessment (HSA) Form for each habitat type, available at https://www.birdpop.org/pages/mapsDataForms.php along with instructions.

The habitat assessment results are to be saved in a folder labelled 'Habitat assessment [YEAR] [BBO]'. Within that folder, save the habitat photographs (labelled according to the conventions above) and scanned copies of the Habitat Structure Assessment Forms (HSA). Each habitat will have its own HSA form: save each one as 'Habitat Structure Assessment form [YEAR] [HABITAT DESIGNATION] [BBO], e.g. for the dominant habitat in 2022, the file name will be 'Habitat Structure Assessment form 2022 A BBO'.

A copy of the habitat assessment folder is to be saved on BBO's Google Drive. Another copy will be submitted to Birds Canada along with year-end submission of bird data.

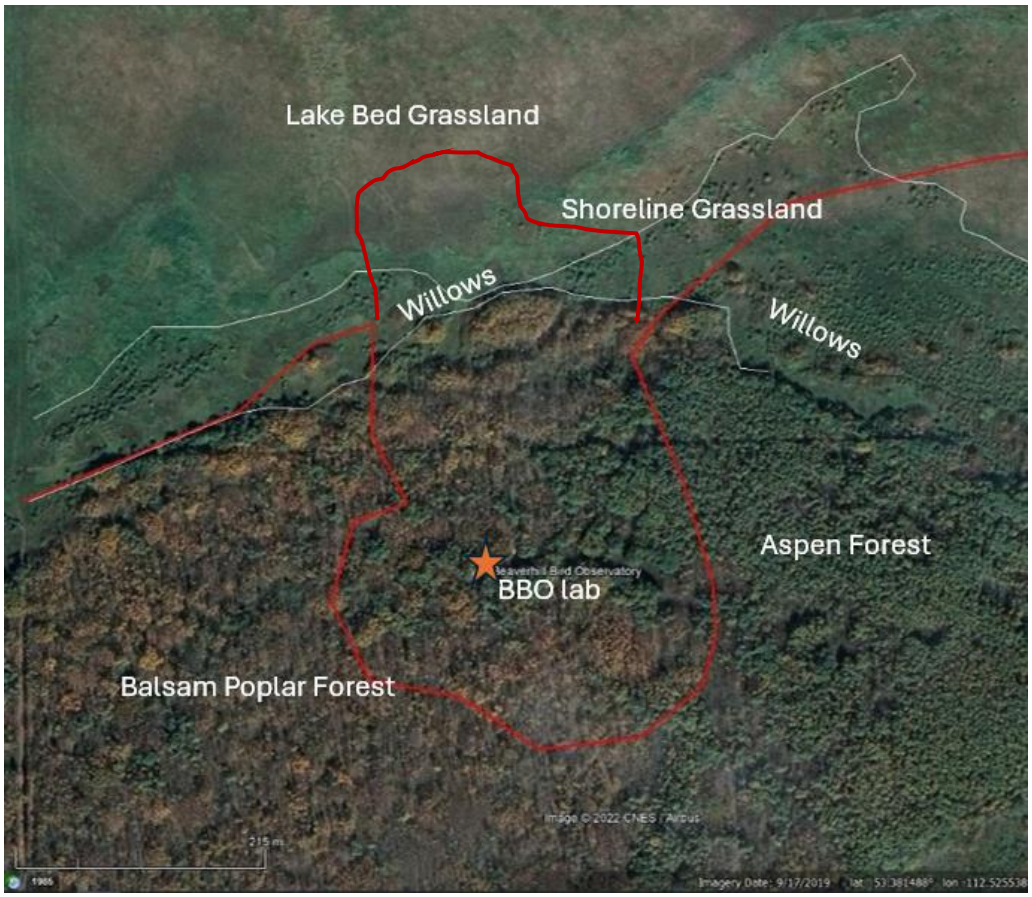


Figure 3. Habitat Patches across the Beaverhill Bird Observatory Count Area (red loop) as of 2023. White lines indicate habitat boundaries.

5.3 Habitat maintenance

Ongoing habitat maintenance should be carried out as needed in the net lanes during both the spring and fall migration monitoring seasons. Pruning saws and hand saws can be used to cut up trees and large branches that have fallen across the net lanes or foot paths as quickly as possible, rather than walk around obstructions.

Around the nets, vegetation should be trimmed back approximately three feet from the nets, to the height of the nets (just over 2.6 m). In strong winds, the nets should be able to billow straight out without catching on any twigs, branches, or leaves. Of course in very strong winds the nets will be closed: but remember, weather conditions can change unexpectedly, and rather than expecting that you will be able to anticipate and forestall any wind-related damage, it is better to take steps in advance to remove any potential sources of possible injury to mist-nets and birds.

6.0 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.

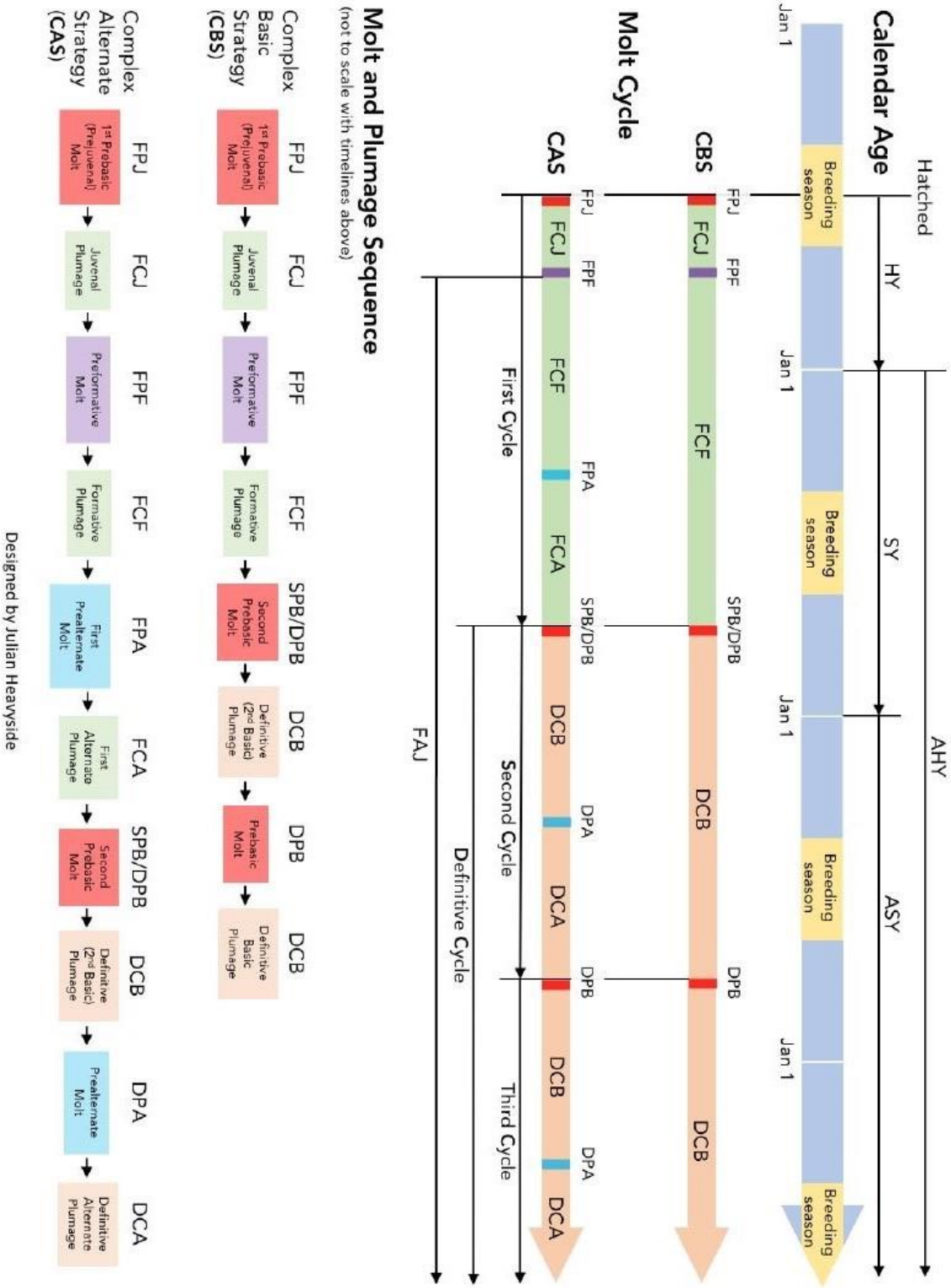
Instructions for record keeping

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 1 of this protocol. If changes have been made to the protocol other than adding to the table below, submit a copy of the entire revised protocol to Birds Canada along with year-end data submission; otherwise, send only a copy of the table.

Table 6 –Description of changes to the Beaverhill Bird Observatory's Migration Monitoring Program

Date	Description of change and justification (if applicable)
1984	Known-effort mist netting conducted annually, but net number and placement not well documented .
1992	Standardized protocol established, with 12-13 nets and fixed-route census.
2014	New net lanes established due to forest succession outgrowing our historical location. We operated 20 nets, with all captures included in Estimated Totals, but data from old and new nets can be separated.
2015	Retired old nets (03, 04, 11, 12, 40, 41, 43, 49), operating going forward nets; 2, 2X, 8, 9, 9X, 50, 51, 52, 53, 54, 55, 56, 57
Spring 2020	No coverage due to Covid-19 restrictions
Fall 2020	Daily census but no banding (Covid-19 restrictions)
Spring 2022	We established 4 new net lanes (58, 59, 60, 61) further into the willow habitat and operated them along with our historical 13 nets to enhance our capture data due to declining captures in the new growth aspen forest.
Spring 2025	All 17 net lanes will be used when weather conditions allow (north wind) and sufficient personnel are on site.

APPENDIX 1 – WOLFE-RYDER-PYLE AGING CODE CHEAT SHEETS



Molt and Plumage Sequence

(not to scale with timelines above)

Complex Basic Strategy (CBS)	FPJ	FCJ	FPF	FCF	SPB/DPB	DCB	DPB	DCB
	1st Prebasic (Prejuvenal) Molt	Juvenal Plumage	Preformative Molt	Formative Plumage	Second Prebasic Molt	Definitive (2nd Basic) Plumage	Prebasic Molt	Definitive Basic Plumage
Complex Alternate Strategy (CAS)	FPJ	FCJ	FPF	FCF	FPA	FCA	SPB/DPB	DCB	DPA	DCA
	1st Prebasic (Prejuvenal) Molt	Juvenal Plumage	Preformative Molt	Formative Plumage	First Prealternate Molt	First Alternate Plumage	Second Prebasic Molt	Definitive (2nd Basic) Plumage	Prealternate Molt	Definitive Alternate Plumage

Designed by Julian Heavyside

Table 1

W-R-P Code	Expanded W-R-P code	Calendar
FPJ	First Cycle Prejuvenal (undergoing 1st prebasic molt)	HY
FCJ	First Cycle Juvenal	HY
FPF	First Cycle Preformative (undergoing preformative molt)	HY
FCF	First Cycle Formative	HY/SY
FPA	First Cycle Prealternate (undergoing prealternate molt)	SY
FCA	First Cycle Alternate	SY
SPB	Second Cycle Prebasic (undergoing 2nd prebasic molt)	SY
DCB	Definitive Cycle Basic	SY/ASY
DPA	Definitive Cycle Prealternate (undergoing prealternate molt)	ASY
DCA	Definitive Cycle Alternate	ASY
FAJ	After First Cycle Juvenal (unknown nonjuvenal)	U/AHY
SMB	After Second Prebasic Molt	SY/ASY
UCU	Unknown Cycle Unknown Plumage	U/AHY
UCA	Unknown Cycle Alternate Plumage	U/AHY
UPU	Unknown Cycle Unknown Molt	U/AHY

These timelines and molt/plumage sequences apply to birds that follow either a complex basic strategy (CBS) or a complex alternate strategy (CAS) (see Howell *et al.* 2003 for descriptions of these molt strategies). It is assumed that birds attain definitive plumage in the second molt cycle. Timing of molt is indicated by a coloured vertical bar. Each molt cycle is initiated by a prebasic molt (red bar). The CAS builds on the CBS: In the first molt cycle (green), CAS birds undergo a prebasic (=prejuvenal) molt (red), a preformative molt (purple), *and* a prealternate molt (blue). In subsequent cycles (orange), CAS birds undergo only a prebasic and a prealternate molt.

See Table 1 for expanded codes (modified from Wolfe *et al.* 2010 and Johnson *et al.* 2011). Additional W-R-P three letter codes can be produced using Table 2.

Table 2

1. Determine the cycle	2. Determine the stage within the cycle (molting or not,)	3. Determine the molt or plumage type
First = F	Undergoing molt (Pre…) = P	Juvenal (J)
Second = S	Underwent molt (in Cycle) = C	Formative (F)
Third = T	After a given plumage (e.g. nonjuvenal plumage of unknown cycle) = A	Basic (B)
Fourth = 4		Alternate (A)
Definitive = D	After a given Molt = M	Unknown (U)
Unknown = U	Suspended = S	

e.g. A bird in its first cycle (F) molting (P) into its formative plumage (F) = FPF

References:

Howell, S.N.G., Corben, C, and Pyle, P. 2003. The first basic problem: A review of molt and plumage homologies. *Condor* 105(4):635-53

Johnson, E.I., Wolfe, J.D., Ryder, T.B., and Pyle, P. 2011. Modifications to a molt based ageing system proposed by Wolfe *et al.* (2010). *J. Field Ornithol.* 82(4):422-24

Wolfe, J.D., Ryder, T.B., and Pyle, P. 2010. Using molt to categorize the age of tropical birds: An integrative new system. *J. Field Ornithol.* 81(2):186-94

APPENDIX 2 – BIRD BANDING PARAMETER CODES

2.1 FLIGHT FEATHER WEAR

Code	Description
0	None; light feathers edges remain
1	Very slight edge wear; no fraying or nicks
2	Slight; definitely worn but very little fraying, very few nicks
3	Moderate; definite fraying and nicks; chips along vanes
4	Heavy; feathers worn and frayed, tips missing
5	Excessive; extreme wear, shafts exposed beyond vanes, tips broken off

2.2 CLOACAL PROTUBERANCE

Code	Description
0	Cloaca not enlarged
1	Small (conical; wide at base, narrow at tip)
2	Medium (cylindrical; as large at tip as at base)
3	Large (bulbous; larger at tip than at base)

2.3 BROOD PATCH

Code	Description
0	None present, breast feathered
1	Feathers dropped, skin smooth and dark red; some vascularization
2	Skin vascularized and wrinkled, fluid present
3	Vascularization extreme, skin wrinkled, much fluid
4	Wrinkled skin, thin and dry; vascularization and fluid mostly gone
5	Vascularization, fluid, and wrinkles gone; pinfeathers appearing

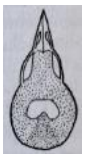
2.4 FAT

Code	Description
0	No fat anywhere
1	Furcular hollow less than 5% full
2	Furcular hollow 5-33% full
3	Furcular hollow about half full (34-66%)
4	Furcular hollow full, 67-100%, fat thick in wingpits and on abdomen
5	Fat bulging above furcular hollow, in wingpits, and on abdomen
6	Fat is bulging greatly above the furculum. Large amounts of fat are found under the wing and on the abdomen
7	Excessive fat is bulging from the furculum, under-wing and abdomen, so the entire ventral surface of the body is covered

2.5 BODY MOLT

Code	Description
0	None
1	Trace; a few feathers anywhere on the body
2	Light; approximately 1/3 of the birds body
3	Medium; approximately 2/3 of the body
4	Heavy; full body molt

2.6 CODE FOR SKULLING

Numeric Code	Stage of Pneumaticization		
0	None		
1	Trace (less than 5%)		
2	Less than 1/3 but greater than 5%		
3	Half (1/3 to 2/3)		
4	Greater than 2/3 but less than 95%		
5	Almost complete		
6	Complete		

BEAVERHILL BIRD OBSERVATORY - *BANDING DATA SHEET*

Licenced Banders (Include Initials):	Location:	Year: 202__
Assistants (Include Initials):	Band Size:	Page:
	Dates-From:	To:

Band Number		Species Code	Date		Time	Net	Age/	Sex/	WRP	Init'l	Wing	Tail	FF wr	CP/	Fat	Body	Wght	SK	Comments
Prefix	Suffix		MM	DD	24hr	Lane	how	How			lgth	lgth	wg/tl	BP		Moult	(g)		

Species and Number Banded:		

APPENDIX 3 – BANDING DATA SHEET

APPENDIX 4 - RECAPTURE DATA SHEET

BEAVERHILL BIRD OBSERVATORY - *BANDING DATA SHEET*

Licenced Banders (Include Initials):	Location: BBO Year: 201
Assistants (Include Initials):	Band Size: Page:
	Dates-From: To:

Band Number		Species Code	Date		Time 24hr	Net Lane	Age/ how	Sex/ How	Init'l	Wing lgth	Tail lgth	FF wt wg/tl	CP/ BP	Fat	Body Moult	Weight (g)	SK	Comments
Prefix	Suffix		MM	DD														

Species and Number Banded:

APPENDIX 5 – CASUALTY LOG

BBO Bird Casualty Log

Species	Date	Band No.	Description of Injury	Treatment	Outcome	Rehab Updates (if held or transported offsite)
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	
					Released ◯ Rehab ◯ Fatal ◯	

APPENDIX 6A – DAILY ESTIMATED TOTALS

(Front and Back View) data sheet used prior to 2021 and since 2025

BBO DAILY TOTALS (Migration Monitoring Program) Date _____

Census route run by from to (time) TOTAL

Full total tabulated by _____ at _____ (time) Number of banding hours _____

Species	Census	Band	Other	Total	Species	Census	Band	Other	Total
Common Loon					Peregrine Falcon				
Pied-billed Grebe					FALCON sp.				
Horned Grebe					Gray Partridge				
Red-necked Grebe					Ruffed Grouse				
Eared Grebe					Sharp-tailed Grouse				
Western Grebe					Yellow Rail				
GREBE sp.					Sora				
Am. White Pelican					American Coot				
Double-cr. Cormorant					Sandhill Crane				
American Bittern					Black-bellied Plover				
Great Blue Heron					Lesser Golden Plover				
Black-cr. Night Heron					Semipalmated Plover				
Tundra Swan					Killdeer				
SWAN sp.					PLOVER sp.				
Gr. White-fronted Goose					American Avocet				
Snow Goose					Greater Yellowlegs				
Canada Goose					Lesser Yellowlegs				
GOOSE sp.					YELLOWLEGS sp.				
Green-winged Teal					Solitary Sandpiper				
Mallard					Willet				
Northern Pintail					Spotted Sandpiper				
Blue-winged Teal					Whimbrel				
Cinnamon Teal					Hudsonian Godwit				
Northern Shovelor					Marbled Godwit				
Gadwall					Ruddy Turnstone				
American Wigeon					Sanderling				
Canvasback					Semipalm. Sandpiper				
Redhead					Least Sandpiper				
Ring-necked Duck					Wh.-rumped Sandpiper				
Greater Scaup					Baird's Sandpiper				
Lesser Scaup					Pectoral Sandpiper				
White-winged Scoter					Dunlin				
Common Goldeneye					Stilt Sandpiper				
Bufflehead					Buff-br. Sandpiper				
Hooded Merganser					PEEP sp.				
Common Merganser					Sh.-billed Dowitcher				
Red-br. Merganser					Long-billed Dowitcher				
Ruddy Duck					DOWITCHER sp.				
DUCK sp.					Wilson's Snipe				
Bald Eagle					Wilson's Phalarope				
EAGLE sp.					Red-necked Phalarope				
Northern Harrier					Franklin's Gull				
Sharp-shinned Hawk					Bonaparte's Gull				
Cooper's Hawk					Ring-billed Gull				
Northern Goshawk					California Gull				
ACCIPITER sp.					Herring Gull				
Swainson's Hawk					GULL sp.				
Red-tailed Hawk					Common Tern				
Rough-legged Hawk					TERN sp.				
HAWK sp.					Black Tern				
American Kestrel					Rock Dove				
Merlin					Mourning Dove				

Species	Censu	Band	Other	Total	Species	Census	Band	Other	Total
Great Horned Owl					Tennessee Warbler				
Snowy Owl					Orange-cr. Warbler				
Short-eared Owl					Yellow Warbler				
Northern Saw-whet Owl					Magnolia Warbler				
Long-eared Owl					Cape May Warbler				
Common Nighthawk					Myrtle Warbler				
Ruby-thr. Hummingbird					Bl.-thr. Green Warbler				
Yellow-bellied Sapsucker					Wstn. Palm Warbler				
Downy Woodpecker					Blackpoll Warbler				
Hairy Woodpecker					Black & White Warbler				
Northern Flicker					American Redstart				
WOODPECKER sp.					Ovenbird				
W. Wood-Peewee					Northern Waterthrush				
Trail's Flycatcher					Mourning Warbler				
Alder Flycatcher					Common Yellowthroat				
Least Flycatcher					Wilson's Warbler				
EMPIDONAX sp.					Canada Warbler				
Eastern Phoebe					WARBLER sp.				
Say's Phoebe					Western Tanager				
Eastern Kingbird					Rose-br. Grosbeak				
Horned Lark					Am. Tree Sparrow				
Purple Martin					Chipping Sparrow				
Tree Swallow					Clay-colored Sparrow				
Bank Swallow					Vesper Sparrow				
Cliff Swallow					Savannah Sparrow				
Barn Swallow					LeConte's Sparrow				
SWALLOW sp.					Sharp-tailed Sparrow				
Blue Jay					Song Sparrow				
Black-billed Magpie					Lincoln's Sparrow				
American Crow					Swamp Sparrow				
Common Raven					White-thr. Sparrow				
Bl.-capped Chickadee					White-cr. Sparrow				
Red-breasted Nuthatch					Harris' Sparrow				
White-breasted Nuthatch					SPARROW sp.				
Brown Creeper					Slate-coloured Junco				
House Wren					Lapland Longspur				
Sedge Wren					Snow Bunting				
Marsh Wren					Bobolink				
Golden-crowned Kinglet					Red-winged Blackbird				
Ruby-crowned Kinglet					Western Meadowlark				
Mountain Bluebird					Yell.-headed Blackbird				
Swainson's Thrush					Rusty Blackbird				
Hermit Thrush					Brewer's Blackbird				
American Robin					Common Grackle				
THRUSH sp.					Brown-headed Cowbird				
Gray Catbird					Baltimore Oriole				
Brown Thrasher					BLACKBIRD sp.				
American Pipit					Purple Finch				
Sprague's Pipit					Common Redpoll				
Cedar Waxwing					Pine Siskin				
Northern Shrike					American Goldfinch				
European Starling					Evening Grosbeak				
Blue-headed Vireo									
Warbling Vireo									
Philadelphia Vireo									
Red-eyed Vireo									
VIREO sp.									

APPENDIX 6B – DAILY ESTIMATED TOTALS (2022-24 only)

(Front and back view of data sheet used when tracking 'experimental net captures')

BBO DAILY TOTALS (Migration Monitoring Program) Date _____ # of Species _____

Census route run by _____ from _____ to _____ (time) Total _____

Species	Cens.	Band	Exp. Nets	Other	Total	Species	Cens.	Band	Exp. Nets	Other	Total
Pied-billed Grebe						Ruffed Grouse					
Horned Grebe						White-faced Ibis					
Red-necked Grebe						Virginia Rail					
Eared Grebe						Yellow Rail					
GREBE sp.						Sora					
Am. White Pelican						American Coot					
Double-cr. Cormorant						Sandhill Crane					
American Bittern						Black-bellied Plover					
Great Blue Heron						American Golden Plover					
Black-cr. Night Heron						Semipalmated Plover					
Trumpeter Swan						Killdeer					
Tundra Swan						PLOVER sp.					
SWAN sp.						Black-necked Stilt					
Gr. White-fronted Goose						American Avocet					
Snow Goose						Greater Yellowlegs					
Ross's Goose						Lesser Yellowlegs					
Canada Goose						YELLOWLEGS sp.					
Cackling Goose						Solitary Sandpiper					
GOOSE sp.						Willet					
Green-winged Teal						Spotted Sandpiper					
Mallard						Hudsonian Godwit					
Northern Pintail						Marbled Godwit					
Blue-winged Teal						Sanderling					
Cinnamon Teal						Semipalmated Sandpiper					
Northern Shoveler						Least Sandpiper					
Gadwall						White-rumped Sandpiper					
American Wigeon						Baird's Sandpiper					
Canvasback						Pectoral Sandpiper					
Redhead						Dunlin					
Ring-necked Duck						Stilt Sandpiper					
Greater Scaup						PEEP sp.					
Lesser Scaup						Sh.-billed Dowitcher					
Common Goldeneye						Long-billed Dowitcher					
Bufflehead						DOWITCHER sp.					
Hooded Merganser						Wilson's Snipe					
Ruddy Duck						Wilson's Phalarope					
DUCK sp.						Red-necked Phalarope					
Bald Eagle						SHOREBIRD sp.					
EAGLE sp.						Franklin's Gull					
Northern Harrier						Ring-billed Gull					
Sharp-shinned Hawk						California Gull					
Cooper's Hawk						Herring Gull					
American Goshawk						GULL sp.					
ACCIPITER sp.						Common Tern					
Swainson's Hawk						Forster's Tern					
Red-tailed Hawk						Black Tern					
Rough-legged Hawk						TERN sp.					
HAWK sp.						Rock Dove					
American Kestrel						Mourning Dove					
Merlin						Great Horned Owl					
Peregrine Falcon						Short-eared Owl					
FALCON sp.						Northern Saw-whet Owl					
Turkey Vulture						Long-eared Owl					

BBO DAILY TOTALS (Migration Monitoring Program) Date _____

Species	Cens.	Band	Exp. Nets	Other	Total	Species	Cens.	Band	Exp. Nets	Other	Total
Common Nighthawk						Magnolia Warbler					
Ruby-thrted. Hummingbird						Cape May Warbler					
Yellow-bellied Sapsucker						Myrtle Warbler					
Downy Woodpecker						Blk.-thrted. Green Warbler					
Hairy Woodpecker						Western Palm Warbler					
Northern Flicker						Blackpoll Warbler					
Pileated Woodpecker						Bay-breasted Warbler					
WOODPECKER sp.						Black & White Warbler					
Western Wood-Peewee						American Redstart					
Trail's Flycatcher						Ovenbird					
Alder Flycatcher						Northern Waterthrush					
Least Flycatcher						Mourning Warbler					
Yellow-bellied Flycatcher						Common Yellowthroat					
EMPIDONAX sp.						Wilson's Warbler					
Eastern Phoebe						Canada Warbler					
Eastern Kingbird						WARBLER sp.					
Purple Martin						Western Tanager					
Tree Swallow						Rose-breasted Grosbeak					
Bank Swallow						American Tree Sparrow					
Cliff Swallow						Chipping Sparrow					
Barn Swallow						Clay-colored Sparrow					
SWALLOW sp.						Vesper Sparrow					
Blue Jay						Savannah Sparrow					
Black-billed Magpie						LeConte's Sparrow					
American Crow						Nelson's Sparrow					
Common Raven						Song Sparrow					
Black-capped Chickadee						Lincoln's Sparrow					
Red-breasted Nuthatch						Swamp Sparrow					
White-breasted Nuthatch						White-throated Sparrow					
Brown Creeper						White-crowned Sparrow					
House Wren						SPARROW sp.					
Sedge Wren						Slate-colored Junco					
Marsh Wren						Lapland Longspur					
Golden-crowned Kinglet						Snow Bunting					
Ruby-crowned Kinglet						Bobolink					
Mountain Bluebird						Red-winged Blackbird					
Swainson's Thrush						Western Meadowlark					
Gray-cheeked Thrush						Yellow-headed Blackbird					
Hermit Thrush						Rusty Blackbird					
American Robin						Brewer's Blackbird					
THRUSH sp.						Common Grackle					
Gray Catbird						Brown-headed Cowbird					
American Pipit						Baltimore Oriole					
Sprague's Pipit						BLACKBIRD sp.					
Cedar Waxwing						Purple Finch					
Northern Shrike						Common Redpoll					
European Starling						Pine Siskin					
Blue-headed Vireo						American Goldfinch					
Warbling Vireo						Evening Grosbeak					
Philadelphia Vireo						**Additional Species:**					
Red-eyed Vireo											
VIREO sp.											
Tennessee Warbler											
Orange-crowned Warbler											
Yellow Warbler											

APPENDIX 7 – DAILY LOG SHEET
(Front and back view)

Beaverhill Bird Observatory - *Daily Log*

Location: *Year:* *Date:*

Banders	Intl's	Start	End	Hours

Weather						
Time*						
Wind Dir.						
Strength						
Cloud Type						
10ths Cover						
Temperature						
Precipitation						
Barometer						

Visitors:

Synopsis:

Census Start: Fin: Int'ls:

Migration Monitoring Coverage Code:

Operations Time Line:

0400 0800 1200 1600 2000 000

Narrative:

Signed:

Nests found:	Other (non-bird) wildlife:	Plant records:

*Environmental conditions to be taken ½ hour before sunrise and every two hours until banding complete

Beaverhill Bird Observatory - *Daily Banding Log*

Birds banded:	Caught:
Species banded:	Caught:

Net Information:

Net No.	Mesh & Dim.	Time up	Time down	Net-hours	Birds caught

Other traps used:	Species	No.c'ght
Trap #'s:		
# of hours:		
Number of trap hours:		

Nest-side banding:	Species	No.c'ght

Saw-whet Owls:	Species	No.c'ght
Nets set:		
# of hours:		
Total net hours:		

Casualties:

Casualties:

Species and band numbers of *return/recoveries:

* 90 days since last capture

Daily Banding Totals:

SPECIES	Birds band'd	No. of repeats	*Return/ Recov.	Other cap.	Total caught
Downy Woodpecker					
Alder Flycatcher					
Unid. Trail's Flycatcher					
Least Flycatcher					
Red-breasted Nuthatch					
Blk.-capped Chickadee					
House Wren					
Hermit Thrush					
Swainson's Thrush					
American Robin					
Cedar Waxwing					
Warbling Vireo					
Red-eyed Vireo					
Ruby-crowned Kinglet					
Golden-crowned Kinglet					
Tennessee Warbler					
Orange-cr. Warbler					
Yellow Warbler					
Magnolia Warbler					
Myrtle Warbler					
Blackpoll Warbler					
Northern Waterthrush					
Wilson's Warbler					
Blk. and White Warbler					
American Redstart					
Ovenbird					
Am. Tree Sparrow					
Chipping Sparrow					
Clay-Colored Sparrow					
Savannah Sparrow					
Song Sparrow					
Lincoln's Sparrow					
White-throated Sparrow					
White-crowned Sparrow					
Slate-colored Junco					
Brown-headed Cowbird					
Northern Oriole					
Pine Siskin					
American Goldfinch					
Other spp.					
TOTALS:					

APPENDIX 8 – BEAUFORT WIND SCALE

Beaufort Force	Windspeed (Km/hr)	Description	Conditions
0	< 2	Calm	Calm, smoke rises vertically
1	2 – 5	Light Air	Smoke drift indicates wind direction, still wind vanes
2	6 – 11	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	12 – 19	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	20 – 28	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
5	29 – 38	Fresh Breeze	Small trees in leaf begin to sway
6	39 – 49	Strong Breeze	Larger tree branches moving, whistling in wires
7	50 – 61	Near Gale	Whole trees moving, resistance felt walking against wind
8	62 – 74	Gale	Twig breaking off trees, generally impedes progress
9	75 – 88	Strong Gale	Slight structural damage occurs; chimney pots and slates blows off roofs
10	89 – 102	Storm	Seldom experienced on land, trees broken or uprooted, “considerable structural damage”
11	103 – 117	Violent Storm	
12	≥118	Hurricane	

APPENDIX 9 – SUNRISE/SUNSET TABLE

The chart below are the annual sunrise/sunset chart for MST and MDT for Tofield, Alberta that can be sourced online at: https://aa.usno.navy.mil/data/RS_OneYear . Staff should print off charts and keep them in a handy location in the Daily Log book or Bird Banding binder. Be sure to use the appropriate the sunrise times to allow for seasonal time changes i.e. Mountain standard time to daylight savings time.

Round off net opening times to the nearest fifteen-minute interval i.e. open nets at 6:30 a.m. (half-an-hour before sunrise) when sunrise is between 6:53 and 7:07 a.m.

Location: W112 30, N53 24

BEAVERHILL BIRD OBSERVATORY
Rise and Set for the Sun for 2022
MST Mountain Standard Time
Zone: 7h West of Greenwich

Astronomical Applications Dept.
U. S. Naval Observatory
Washington, DC 20392-5420

Day	Jan. Rise	Jan. Set	Feb. Rise	Feb. Set	Mar. Rise	Mar. Set	Apr. Rise	Apr. Set	May Rise	May Set	June Rise	June Set	July Rise	July Set	Aug. Rise	Aug. Set	Sept. Rise	Sept. Set	Oct. Rise	Oct. Set	Nov. Rise	Nov. Set	Dec. Rise	Dec. Set
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
01	0845	1622	0814	1713	0717	1808	0603	1906	0455	2000	0408	2048	0406	2101	0446	2025	0540	1919	0632	1806	0729	1657	0823	1615
02	0845	1623	0813	1715	0715	1810	0601	1907	0453	2002	0407	2050	0407	2101	0448	2023	0541	1917	0634	1804	0731	1655	0824	1614
03	0845	1624	0811	1717	0713	1812	0558	1909	0451	2004	0406	2051	0408	2100	0450	2022	0543	1914	0636	1801	0733	1653	0826	1614
04	0845	1626	0809	1719	0710	1814	0556	1911	0449	2005	0406	2052	0409	2100	0451	2020	0545	1912	0637	1759	0735	1651	0827	1613
05	0844	1627	0807	1721	0708	1816	0553	1913	0447	2007	0405	2053	0410	2059	0453	2018	0547	1909	0639	1757	0737	1650	0828	1613
06	0844	1628	0805	1723	0706	1818	0551	1915	0446	2009	0404	2054	0411	2059	0455	2016	0548	1907	0641	1754	0739	1648	0830	1612
07	0843	1630	0804	1725	0703	1820	0549	1917	0444	2011	0404	2055	0412	2058	0456	2014	0550	1905	0643	1752	0741	1646	0831	1612
08	0843	1631	0802	1727	0701	1822	0546	1918	0442	2012	0403	2056	0413	2057	0458	2012	0552	1902	0644	1750	0743	1644	0832	1612
09	0842	1633	0800	1729	0658	1823	0544	1920	0440	2014	0403	2056	0414	2056	0500	2010	0554	1900	0646	1747	0744	1643	0833	1611
10	0842	1634	0758	1731	0656	1825	0542	1922	0438	2016	0402	2057	0415	2055	0502	2008	0555	1857	0648	1745	0746	1641	0835	1611
11	0841	1636	0756	1733	0654	1827	0539	1924	0436	2017	0402	2058	0416	2055	0503	2006	0557	1855	0650	1742	0748	1639	0836	1611
12	0840	1637	0754	1735	0651	1829	0537	1926	0435	2019	0402	2059	0417	2054	0505	2004	0559	1853	0652	1740	0750	1638	0837	1611
13	0839	1639	0752	1737	0649	1831	0535	1927	0433	2021	0401	2059	0418	2053	0507	2002	0600	1850	0654	1738	0752	1636	0838	1611
14	0838	1640	0750	1739	0647	1833	0532	1929	0431	2022	0401	2100	0420	2051	0508	2000	0602	1848	0655	1736	0754	1635	0839	1611
15	0837	1642	0748	1741	0644	1835	0530	1931	0430	2024	0401	2100	0421	2050	0510	1958	0604	1845	0657	1733	0756	1633	0839	1611
16	0836	1644	0746	1743	0642	1836	0528	1933	0428	2026	0401	2101	0422	2049	0512	1955	0606	1843	0659	1731	0757	1632	0840	1611
17	0835	1646	0744	1745	0639	1838	0525	1935	0427	2027	0401	2101	0424	2048	0514	1953	0607	1840	0701	1729	0759	1630	0841	1611
18	0834	1647	0742	1747	0637	1840	0523	1937	0425	2029	0401	2102	0425	2047	0515	1951	0609	1838	0703	1727	0801	1629	0842	1612
19	0833	1649	0739	1749	0634	1842	0521	1938	0424	2030	0401	2102	0426	2045	0517	1949	0611	1835	0705	1724	0803	1627	0842	1612
20	0832	1651	0737	1751	0632	1844	0519	1940	0422	2032	0401	2102	0428	2044	0519	1947	0613	1833	0706	1722	0805	1626	0843	1612
21	0831	1653	0735	1753	0630	1846	0516	1942	0421	2034	0401	2102	0429	2043	0521	1944	0614	1831	0708	1720	0806	1625	0844	1613
22	0829	1654	0733	1755	0627	1847	0514	1944	0419	2035	0402	2102	0431	2041	0522	1942	0616	1828	0710	1718	0808	1624	0844	1613
23	0828	1656	0731	1757	0625	1849	0512	1946	0418	2037	0402	2103	0432	2040	0524	1940	0618	1826	0712	1716	0810	1623	0844	1614
24	0827	1658	0728	1759	0622	1851	0510	1947	0417	2038	0402	2103	0434	2038	0526	1938	0620	1823	0714	1713	0812	1621	0845	1615
25	0825	1700	0726	1801	0620	1853	0508	1949	0415	2039	0403	2103	0435	2037	0528	1935	0621	1821	0716	1711	0813	1620	0845	1615
26	0824	1702	0724	1803	0617	1855	0506	1951	0414	2041	0403	2102	0437	2035	0529	1933	0623	1818	0718	1709	0815	1619	0845	1616
27	0822	1704	0722	1804	0615	1857	0504	1953	0413	2042	0404	2102	0438	2034	0531	1931	0625	1816	0720	1707	0817	1618	0846	1617
28	0821	1706	0719	1806	0613	1858	0501	1955	0412	2043	0404	2102	0440	2032	0533	1928	0627	1813	0722	1705	0818	1617	0846	1618
29	0819	1708			0610	1900	0459	1956	0411	2045	0405	2102	0442	2030	0535	1926	0628	1811	0724	1703	0820	1617	0846	1619
30	0818	1710			0608	1902	0457	1958	0410	2046	0406	2102	0443	2029	0536	1924	0630	1809	0725	1701	0821	1616	0846	1620
31	0816	1712			0605	1904			0409	2047			0445	2027	0538	1921			0727	1659			0846	1621

Location: W112° 30', N53° 24'

BEAVERHILL BIRD OBSERVATORY
Rise and Set for the Sun for 2022
MDT **Mountain Daylight Time**
Zone: 6h West of Greenwich

Astronomical Applications Dept.
U. S. Naval Observatory
Washington, DC 20392-5420

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
Day	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
01	0945	1722	0914	1813	0817	1908	0703	2006	0555	2100	0508	2148	0506	2201	0546	2125	0640	2019	0732	1906	0829	1757	0923	1715
02	0945	1723	0913	1815	0815	1910	0701	2007	0553	2102	0507	2150	0507	2201	0548	2123	0641	2017	0734	1904	0831	1755	0924	1714
03	0945	1724	0911	1817	0813	1912	0658	2009	0551	2104	0506	2151	0508	2200	0550	2122	0643	2014	0736	1901	0833	1753	0926	1714
04	0945	1726	0909	1819	0810	1914	0656	2011	0549	2105	0506	2152	0509	2200	0551	2120	0645	2012	0737	1859	0835	1751	0927	1713
05	0944	1727	0907	1821	0808	1916	0653	2013	0547	2107	0505	2153	0510	2159	0553	2118	0647	2009	0739	1857	0837	1750	0928	1713
06	0944	1728	0905	1823	0806	1918	0651	2015	0546	2109	0504	2154	0511	2159	0555	2116	0648	2007	0741	1854	0839	1748	0930	1712
07	0943	1730	0904	1825	0803	1920	0649	2017	0544	2111	0504	2155	0512	2158	0556	2114	0650	2005	0743	1852	0841	1746	0931	1712
08	0943	1731	0902	1827	0801	1922	0646	2018	0542	2112	0503	2156	0513	2157	0558	2112	0652	2002	0744	1850	0843	1744	0932	1712
09	0942	1733	0900	1829	0758	1923	0644	2020	0540	2114	0503	2156	0514	2156	0600	2110	0654	2000	0746	1847	0844	1743	0933	1711
10	0942	1734	0858	1831	0756	1925	0642	2022	0538	2116	0502	2157	0515	2155	0602	2108	0655	1957	0748	1845	0846	1741	0935	1711
11	0941	1736	0856	1833	0754	1927	0639	2024	0536	2117	0502	2158	0516	2155	0603	2106	0657	1955	0750	1842	0848	1739	0936	1711
12	0940	1737	0854	1835	0751	1929	0637	2026	0535	2119	0502	2159	0517	2154	0605	2104	0659	1953	0752	1840	0850	1738	0937	1711
13	0939	1739	0852	1837	0749	1931	0635	2027	0533	2121	0501	2159	0518	2153	0607	2102	0700	1950	0754	1838	0852	1736	0938	1711
14	0938	1740	0850	1839	0747	1933	0632	2029	0531	2122	0501	2200	0520	2151	0608	2100	0702	1948	0755	1836	0854	1735	0939	1711
15	0937	1742	0848	1841	0744	1935	0630	2031	0530	2124	0501	2200	0521	2150	0610	2058	0704	1945	0757	1833	0856	1733	0939	1711
16	0936	1744	0846	1843	0742	1936	0628	2033	0528	2126	0501	2201	0522	2149	0612	2055	0706	1943	0759	1831	0857	1732	0940	1711
17	0935	1746	0844	1845	0739	1938	0625	2035	0527	2127	0501	2201	0524	2148	0614	2053	0707	1940	0801	1829	0859	1730	0941	1711
18	0934	1747	0842	1847	0737	1940	0623	2037	0525	2129	0501	2202	0525	2147	0615	2051	0709	1938	0803	1827	0901	1729	0942	1712
19	0933	1749	0839	1849	0734	1942	0621	2038	0524	2130	0501	2202	0526	2145	0617	2049	0711	1935	0805	1824	0903	1727	0942	1712
20	0932	1751	0837	1851	0732	1944	0619	2040	0522	2132	0501	2202	0528	2144	0619	2047	0713	1933	0806	1822	0905	1726	0943	1712
21	0931	1753	0835	1853	0730	1946	0616	2042	0521	2134	0501	2202	0529	2143	0621	2044	0714	1931	0808	1820	0906	1725	0944	1713
22	0929	1754	0833	1855	0727	1947	0614	2044	0519	2135	0502	2202	0531	2141	0622	2042	0716	1928	0810	1818	0908	1724	0944	1713
23	0928	1756	0831	1857	0725	1949	0612	2046	0518	2137	0502	2203	0532	2140	0624	2040	0718	1926	0812	1816	0910	1723	0944	1714
24	0927	1758	0828	1859	0722	1951	0610	2047	0517	2138	0502	2203	0534	2138	0626	2038	0720	1923	0814	1813	0912	1721	0945	1715
25	0925	1800	0826	1901	0720	1953	0608	2049	0515	2139	0503	2203	0535	2137	0628	2035	0721	1921	0816	1811	0913	1720	0945	1715
26	0924	1802	0824	1903	0717	1955	0606	2051	0514	2141	0503	2202	0537	2135	0629	2033	0723	1918	0818	1809	0915	1719	0945	1716
27	0922	1804	0822	1904	0715	1957	0604	2053	0513	2142	0504	2202	0538	2134	0631	2031	0725	1916	0820	1807	0917	1718	0946	1717
28	0921	1806	0819	1906	0713	1958	0601	2055	0512	2143	0504	2202	0540	2132	0633	2028	0727	1913	0822	1805	0918	1717	0946	1718
29	0919	1808			0710	2000	0559	2056	0511	2145	0505	2202	0542	2130	0635	2026	0728	1911	0824	1803	0920	1717	0946	1719
30	0918	1810			0708	2002	0557	2058	0510	2146	0506	2202	0543	2129	0636	2024	0730	1909	0825	1801	0921	1716	0946	1720
31	0916	1812			0705	2004			0509	2147			0545	2127	0638	2021			0827	1759			0946	1721

APPENDIX 10 – BANDER'S CODE OF ETHICS

1. More than anything else, banders are responsible for the safety and welfare of the birds they study. This means that stress and risks of injury or death need to be minimized. Some basic rules are as follows:
    - handle each bird carefully, gently, quietly, and with respect
    - capture and process only as many birds as you can safely handle
    - close traps or nets when there are known predators in the area
    - do not band in inclement weather
    - frequently assess the condition of traps and nets and repair them quickly
    - trainees must be properly trained and supervised
    - check nets every 20 to 30 minutes
    - check traps as often as is recommended for each trap type
    - properly close all traps and nets at the end of the banding day
    - do not leave traps or nets set and untended
    - use the correct band size and banding pliers for each bird
    - treat all bird injuries in the most humane way

2. Banders must continually assess their own work to ensure that it is beyond reproach.
    - reassess methods and your approach whenever an injury or mortality occurs
    - accept constructive criticism from other banders

3. Banders must offer honest and constructive assessment of others' work to help maintain the highest standards possible.
    - publish innovations in banding, capture and handling techniques
    - educate prospective banders and trainers
    - provide feedback of any instances of mistreatment of birds to the bander
    - if there is no improvement, then file a report with the Banding Office

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

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

APPENDIX 11 –HABITAT STRUCTURE ASSESSMENT FORM
(Using MAPS as our template)

Form H1: MAPS Habitat Structure Assessment (HSA) form

Location code: _ _ _ _ Station code: _ _ _ _ Date: (m/d/y) __/__/ **2021** Surveyed by: _____ Survey (circle one): single | consensus

Habitat dominance code (as shown on station map; circle one): A – dominant | B – sub-dominant | C – minor 1 | D – minor 2 | E – minor 3

Describe habitat type: _____

Successional stage of habitat type (circle one): L – late | M – mid | E – early National Vegetation Classification Standard Formation: _____

Percentage of station comprised of this habitat type (from station map): _____% National Vegetation Classification Standard Alliance: _____

Pattern code of this habitat type (1-12): _____ Average height of: Tree canopy _____m, Shrubs _____m, Herbaceous vegetation _____m

Vegetative Layers	Cover[1] <5, 10, 20,...see below...90, >95	Pattern 1-12	Number of Species	Vegetation types within each layer *Estimated percentages must add up to 100%* Conifer	Broad	Forbs & ferns	Grass-like	Main species *e.g. Vaccinium ovatum, Poa pretensis Quercus rubra, Q. alba, Pinus contorta*
Upperstory: >15m				%	%	%		
Midstory: 5 -15m				%	%	%		
Understory: 0.5 - 5m				%	%	%	%	
Ground cover*: <0.5m				**Woody**	**Nonvascular**	**Forbs & ferns**	**Grass-like**	
Live vegetation	%			%	%	%	%	
Dead vegetation	%		leaves	twigs	branches	old logs	recent treefall	
Total non-vegetative	%	**NA see text p.13**	rock	stones or gravel	dirt or sand	water	human-made	

Non-vegetative Features	Estimate %	Pattern 1-12	Circle one or more features of cover type					Comment
Running water	%		seep/trickle	very small brook	small stream	large stream	river	
			canal	(<0.5m)	(0.5-2.0m)	(2.0-5.0m)	(>5m)	
Standing water	%		pond/lake	for livestock	marsh/bog	seasonal	permanent	
			<50m² | >50m²	<50m² | >50m²	<50m² | >50m²	occasional	other	
Human-made Corridors	%		paved	gravel	dirt	mown	boardwalk	
			road	track	break	path	other	
Human-made Structure	%		building	fence	bridge	powerline	tower	
			culvert	dam	channel	wall	other	

General description of habitat type including habitat age:	Feature	Options
	Drainage:	well-drained | poorly-drained
	Slope:	flat | gentle | undulating | steep
	Geography:	bottomland | hillside | ridgetop | plain
	Ridges:	none | single | two | >2
Number of snags (>1m tall, >10cm diam.): 0 | <5 | 5-15 | >15	Aspect:	none | N | E | S | W | All
Management / Disturbance history: Year(s) occurred:	Logging:	clear-cut | selective | strip
Year(s) occurred:	Disturbance:	fire | wind | flood | drained | icestorm
Year(s) occurred:	Other:	write here

Percentage cover midpoints	**<5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**>95**
Percentage cover range	0----5%	5%--------15%	15%--------25%	25%--------35%	35%--------45%	45%--------55%	55%--------65%	65%--------75%	75%--------85%	85%--------95%	95%----100%

** Ground Cover (Live vegetation, Dead vegetation, and Total non-vegetative) must total 100%*