Joint Oil Sands Monitoring: Environment Canada Cause and Effects Monitoring for Landbirds

Standard Operating Procedure (SOP) # 6: Conducting Territory Mapping

This Standard Operating Procedure gives step-by-step instructions for surveying birds using territory mapping methods. The project description, objectives, and sampling design are described in the document Local Project 2014 Workplan: Species-Level Responses of Landbirds to SAGD Features at the Local Scale.

Territory mapping techniques will be employed to (1) determine the density of territorial males/breeding pairs relative to a gradient of SAGD disturbance, (2) define and map the home range and territory of each territorial male/breeding pair, and (3) determine the spatial placement (space use) of the home range and territory relative to SAGD disturbance features.

Territory mapping will be conducted using a variety of techniques including (1) spot mapping; (2) supplemental burst sampling; (3) supplemental consecutive flush; and (4) call playback/response elicitation. Spot mapping will be the primary technique to estimate species density and delineate home range and territory boundaries. Each pair of observers will monitor approximately 6 study sites for the entire breeding season. We will conduct 8-10 rounds of spot mapping within each study site from late May to early July to map the home range and territory boundaries of males exhibiting territorial or breeding behaviours (boundary disputes with neighbouring males, courtship vocalizations and displays, copulation events, nest building, incubation and brooding behaviour) throughout the breeding season (Bibby et al. 2000). Each day one observer will traverse a study site along alternating 50 m grid lines mapping the location and behaviour of individual birds and mammalian predators (squirrels, chipmunks, weasels, other mammals) observed and heard within 50 m. Evaluation of the size, shape, and placement of individual territories in conjunction with habitat data provides information on the differences between areas of use and non-use (Bibby et al. 2000; Manly et al. 2002). The detailed spatial use information provided by spot mapping and other territory mapping techniques will enable determination of use, selection, and avoidance to natural habitat and disturbed habitat created by SAGD exploration. Furthermore, combining the utilization distribution derived from spot mapping with behavioural observation data (See SOP 7-Resource Selection) will provide an understanding of behavioural mechanisms behind shifts in abundance, distribution, spacing, and habitat use within the home range or territory.

The spot mapping protocol selected for this project attempts to balance the acquisition of utilization distribution data with practical, logistical, and operational constraints. The spot mapping protocol below follows recommendations by Bibby et al. (2000) and

Kernohan et al. (2001). Detailed elements of the protocol, with the rationale for each element are described below (Table A).

Table A. Key elements and rationale of the spot-mapping protocol used for JOSM Cause and Effects Monitoring for Landbirds.

Element	**Strategy**	**Rationale**
Observation Time of Day	Surveys will be completed during the breeding season (pre-fledging) between sunrise and 5 hours after (~04:30 to 09:30). Start location and direction of transect route should be varied with each visit.	Visits should occur during hours of peak activity, when species exhibit increased territorial behaviours that enhance detection probability and increase evidence for territory boundary delineation. Surveys should end before young fledge to prevent confusion between breeding and non-breeding individuals. Time from sunrise to mid-morning is the period with most uniform activity for songbirds (Bibby et al. 2000; Ralph et al. 1995). Variation in transect route start location and direction will provide even coverage of the survey area and prevent temporal biases in detection probability (Bibby et al. 2000; Marchant 1983).
Observation Method	Linear Transect surveys	Line-transect methods generate less bias in distance measurements than in point-transect estimates (Buckland 2006).
Observation Speed	~1km per hour walking speed	Completion of route should be at a slow pace in order to identify and locate any birds detected. A speed of ~1km per hour is recommended for forested

		habitats as a reasonable speed to identify and record birds present. Observer speed should be standardized to avoid creating bias in comparisons between sites. (Bibby et al. 2000).
Distance Estimation	Exact distance estimation will be used. Locations will be plotted on study site maps of very high resolution (50 cm) colour satellite imagery georeferenced to 50 m grids in the field. Perpendicular distance from each observation point to the survey transect line will be calculated using GIS.	Exact distance estimation is recommended for more reliable analysis and modeling of the detection function (Bibby et al. 2000).
Map Scale	Map scale should be 1:2500	A map scale of 1 cm to every 25 m is a standard scale that will enable the position of birds to be drawn accurately (Bibby et al. 2000; Marchant 1983)
Bird Attributes	Identify birds to species and record if the detection is visual, auditory, or both. Record flyovers and flythroughs separately. Record sex, age, activity/behaviour data.	Recording visual versus auditory detections will allow exploration of bias. Flyovers and flythroughs may not be breeding in the spot mapping grid, but could be used to record the presence of all species. Recording behaviour data is important to providing information to support interpretation of observation clusters and for delineation of territory boundaries (Bibby et al. 2000).
Rotating Observer	Rotate observers between study sites.	Trained observers will conduct spot mapping individually in order to maximize the number of

		study sites surveyed. Rotating the observer will prevent detection bias between study sites (Bibby et al. 2000).
Distance Between Linear Transects	Linear grid lines will be marked every 50 meters within the study site. Transect surveys will be conducted on alternating 50 m grid lines (100 m spacing between transect surveys).	Transect surveys at 100 m spacing will ensure the observer covers every point on the spot mapping study site, as recommended by Bibby et al. (2000).
Number and Frequency of Repeat Visits	Minimum of 8-10 visits will be completed during the breeding season. Visits to each study site will be rotated at a frequency of once every 4-6 days.	A minimum of 8-10 return visits is recommended for each study site to maximize point requirements for territory delineation from point clusters (Bibby et al. 2000; Marchant 1983). Site visits should be spaced evenly across the breeding season to create independence between samples and prevent temporal bias (Bibby et al. 2000).
Point Count VS Spot Mapping Methods	Spot mapping	While point count data provides relative abundance and course habitat association data, spot mapping data provides fine-scale territory spacing and mapping data along with fine-scale habitat use data (Bibby et al. 2000). Mapping of territory locations will also support local and micro-scale resource selection data collection and analyses (to determine selection or avoidance of disturbed habitats).
Spot Mapping VS Radio Telemetry Methods	Spot mapping	Spot mapping is less expensive than radio

		telemetry (Anich et al 2009). Additional information to estimate territory size will be achieved through other observation techniques including burst sampling, consecutive flush, and call playback.
Vegetation and Habitat	Required: Location (UTM or geographic coordinates), Ecosite Classification, Habitat type, GIS habitat/vegetation variables, ground habitat/vegetation variables.	Habitat and vegetation data (GIS, ground) should be collected for each territory to identify characteristics associated with territory spacing and placement.
Study Site Size	600 m x 600 m	Territory mapping will occur on 12 study sites (maximum number of study sites that can be surveyed during the breeding season given staff allocation). Territory mapping will also be completed for sections of territories outside the study site boundary (e.g. for territories that overlap study plots by >30%).
Analytical Techniques	Utilization Distribution	Utilization distribution techniques are classified as probabilistic or outlining methods that produce contours around different intensities of use resulting in an irregular, smoothed outer boundary and multiple centers of activity/core areas depending on the distribution of location points (Kernohan et al. 2001). The home range or territory boundary is calculated based on the

		complete distribution of location points, rather than the outermost set of points (Kernohan et al. 2001). This technique provides greater accuracy for territory area calculations while enabling concurrent examination of internal territory configuration including delineation of core areas (Barg et al. 2004).
Home Range Estimator	Adaptive or Fixed Kernel density estimation will be used to delineate home range/territory and core areas. Fixed kernel density estimation is more relevant to the cause-effect objectives of this study.	Of the home range estimators that use utilization distribution techniques, adaptive or fixed kernel methods rank highest because: (1) home range extent often stabilizes with a smaller sample size of ≤ 50 locations; (2) the estimator is less sensitive to autocorrelated data; (3) the estimator can calculate multiple centres of activity and therefore show areas of disproportionate use; (4) the estimator is less sensitive to outliers; and (5) the estimator is nonparametric, so it can better conform to irregular location distributions (Kernohan et al. 2001). Fixed kernel methods can be used to differentiate between areas within the home range (Kernohan et al. 2001). Therefore, fixed kernel methods will enable greater interpretation of important areas of use within a home range.
Required Sample Size	Minimum of 30-50 sighting	Recommendation follows

	locations will be used to delineate home range/territories using the fixed kernel method.	published guidelines for sample sizes (Seaman et al. 1999).

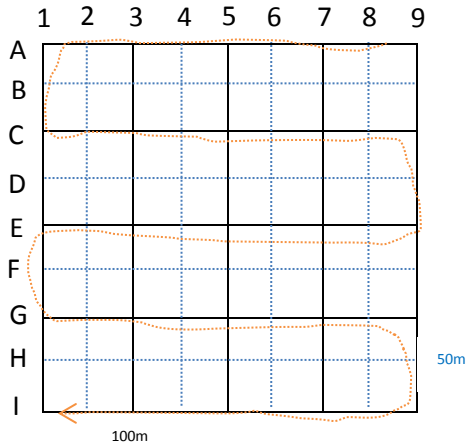
1. Establish Territory Mapping Plot

Establishment of study site 50 m grid systems will be completed mid-May prior to the start of spot mapping. The size of the spot mapping grid should be large enough to encompass the area of the home range or territory for each songbird species we will be sampling but small enough for one observer to complete the spot mapping route in one visit. Circular or square mapping grids are most effective (Bibby et al. 2000). The study site and spot mapping grid within it will be 600 m by 600 m with linear grid lines running north-south and east-west, spaced every 50 m.

1.1 Marking Spot Mapping Grid

Coordinates for spot mapping grid mark points will be predetermined using GIS and will be mapped by navigating to the predetermined grid mark point locations (GPS coordinate) within each study site. Grid lines will be marked at 50 m intervals with flagging tape/stakes labeled with the north-south grid line number (1-9) and east-west grid line letter (A-I). Grid lines running east-west will start with label A in the north and be labeled with black/green flagging tape. Grid lines running north-south will start with label 1 in the west and be labeled with white/red flagging tape.

Figure 1.1 Example spot mapping linear transect survey route (400m x 400m).



2. Visiting Spot Mapping Grid

2.1 Access Spot Mapping Grid

Pre-determined spot mapping grids should be accessed on time, efficiently, and in good weather conditions (see definitions below).

Time period for territory mapping-time of year: Surveys of breeding passerines should be conducted during the last week of May, the month of June, and the first week of July, shortly after males arrive to the boreal forest region in Alberta (Ralph et al. 1995).

Time period for territory mapping-time of day: Surveys should be conducted between official sunrise (as reported by your GPS) and 4-5 hours after sunrise depending on conditions (temperature, cloud cover, wind). This is the time period during which detectability is most stable (Bibby et al. 2000; Ralph et al. 1995).

Good weather conditions: Surveys should not be conducted when it is raining, during heavy fog or when noise from wind-blown vegetation interferes with detection (Ralph et al. 1995).

2.2 Direction of spot mapping route

To prevent bias in detection probability due to time of day, the start location for each route will be randomized by two variables: start corner and direction of travel.

2.3 Repeat Visits

- Study sites will be visited a minimum of 8-10 times during the pre-fledging breeding season (Bibby et al. 2000; Ralph et al. 1995).
- Revisits of study sites will be spaced across the breeding season at regular time intervals of approximately every 4 days (e.g. as evenly as possible given weather and access related constraints).
- Observers will rotate through study sites at regular intervals.

3. Complete Spot Mapping Survey

3.1 Complete Site and Observer Fields

Date: The date the spot mapping survey is recorded in the format DD/MM/YY.

Observer: The unique ID assigned to each observer at the start of the season (usually their 2 initials).

Study Site ID: Consisting of a two-letter code for **Disturbance Gradient (DG)**, a two-digit **Grid ID (GR)** number, and a two-digit **Transect/Direction ID**.

Territory Mapping Protocol: The type of territory mapping protocol (spot mapping-SM; burst sampling-BS; consecutive flush-CS; call playback/response elicitation-CP).

Round/Revisit: Revisit number for study site for particular territory mapping survey.

Start Time: The time the territory mapping survey is started in the format in the format HH:MM using a 24-hr clock. The start time should be recorded at the start of each linear transect survey grid line AND at the start of each territory mapping survey method (SM, BS, CS, CP) for the entire study site.

End Time: The time the territory mapping survey is ended in the format in the format HH:MM using a 24-hr clock. The start time should be recorded at the end of each linear transect survey grid line AND at the end of each territory mapping survey method (SM, BS, CS, CP) for the entire study site.

3.2 Complete Weather Fields

At the start of the spot mapping route, record weather conditions as described below.

Temp: (°C) Record the temperature as measured by the Kestrel thermometer.

Wind: (0-5) Record wind speed using standard Beaufort scale (Table 1 at the end of this document). The Kestrel may be used to help estimate wind speed, but the wind speed within the forest is often a poor approximation of the true wind speed. Sustained wind speeds over Beaufort 3 may be unsuitable for conducting spot mapping (observer and habitat dependent).

Precipitation: (0-3) Record the rain conditions using the codes in Table 2. Sustained rainfall greater than code 3 (light rain) is unsuitable for conducting spot mapping.

Cloud: (0-3) Record the cloud cover conditions using the codes in

Table 3.

Noise: (0-4) Record the level of noise interference during the duration of the point count using the codes in

Table **4**. Sustained noise levels greater than code 2 (moderate noise) are unsuitable for conducting surveys.

Overnight Rain: Record Yes or No whether the spot mapping site received rainfall overnight.

3.3 Conducting Spot Mapping

3.3.1 Prepare to Complete the Spot Mapping Route

Prepare to conduct the spot mapping route by filling in the Site, Observer, and Weather fields of the grid map data sheet. Situate your binoculars and rangefinder in a comfortable and accessible position. When possible, unidentified birds should be tracked down for positive identification or to verify position. No attracting devices or techniques (e.g. “pishing”) should be used before or during the spot mapping route.

3.3.2 Walking the spot mapping route

Record the Start Time and walk the spot mapping route along the marked grid lines to maintain consistency in your distance estimation. The route should be walked at a speed of ~1km per hour.

3.3.2 Record All Birds Seen or Heard

- Record all birds seen or heard within 50 m on either side of the grid line that you are walking (e.g. record all birds seen or heard in the spot mapping grid and within 50 m outside the spot mapping grid).
- Record only the minimum number of different individual birds as determined by counter-singing, spatial configuration of individuals, and individual song, call, or plumage differences. Use the species codes in Appendix 1.
- Record only the first detection of each individual bird. Known and assumed movement should be indicated on the grid map data sheet and will aid in keeping track of individual birds during the survey. Use the correct symbols.
- In rare instances, observers may be unable to fully identify an individual bird to species. In this case, the codes in Appendix 2 are acceptable, but should be used sparingly.

- A bird flushed within 50 meters of the spot mapping route as an observer approaches should be noted in the survey notes if this individual bird was not detected during the spot mapping survey period.

3.3.3 Record the Direction and Distance of Each Individual Bird

- Record the direction and nearest observed distance of each individual bird by placing the observation within the corresponding grid square on the grid map data sheet.

- Orient the grid map data sheet in the direction of travel. Scan both sides of the grid line during the survey.

- Place observations within the most accurate 50 m grid square.

- Use a laser rangefinder to aid in the estimation of distance to observed and heard individual birds wherever possible.

3.3.4 Record the Detection Type of Each Individual Bird

- Record the detection type for each individual bird observed using the symbol codes in Table 5. Multiple detection types can be recorded if for example a bird calling near the transect center is later observed perched in an understory shrub.

Detection Types are defined in the Sibley Field Guide to Birds (see Appendix 3):

- “Songs” are the distinctive vocalizations of most species used to establish and defend territories and to create and maintain pair bonds.

- “Calls” are generally shorter, simpler vocalizations, and each species has a variety of different calls used for different communication purposes.

3.3.5 Record the Age, Sex, and Activity of Each Individual Bird

- Record the detection type, age, sex, and activity for each individual bird observed using superscript codes (see Tables 5, 6, 7, 8, and 9).

- For all bird record the age and sex using the codes in Tables 6 and 7.

- Breeding behaviour activity codes are especially important to note as they provide an indication of territorial behaviour and will aid interpretation of clusters (see Table 8).

- Reproductive activity codes are also important to note as they provide an indication of reproductive status (see Table 9).

- A fly-over is recorded if a bird flies over the top of the vegetation canopy, never touches down in the observer's view, and does not appear to behave in any way that would suggest a link to the habitat type within the grid. Indicate the direction of travel on the grid map data sheet. Exceptions to fly-overs include raptors, swallows, and swifts which should be recorded using the same procedures for other birds.

- A fly-through is recorded if a bird flies through, or under the vegetation canopy, never touches down in the observer's view, and does not appear to behave in any way that would suggest a link to the habitat type within the grid. Indicate the direction of travel on the grid map data sheet.

- For a flock of birds, record the estimated number of individuals.

- Record the **Index of Reproductive Activity (IRA) for each territorial male/breeding pair using ranks 1-5** during each survey visit (see Table 9). The IRA will be included on home range/territory summary maps for each territorial male/breeding pair as a measure of the evidence of breeding (if no active nest is located).
- Record any additional notes useful for the interpretation of the preceding fields in the Notes section.

3.4 Complete Weather Fields

At the end of the spot mapping route, record the End Time and weather conditions as described in 3.2.

3.5 Interrupted Spot Mapping Visit

- If spot mapping visit is interrupted by rain or severe wind, wait at the location on the grid until weather passes (if possible) and continue along the route. Make note of the new Start Time for the remainder of that transect.
- If you are unable to complete a spot mapping route in one visit, record the End Time and note this information in the Notes section.

4. Complete Data Transfer to GIS

After completing spot mapping route, enter your sighting information into (ArcGIS). Store all data sheets in a secure location (file box assigned to the Field Crew Lead). Data sheets should be arranged by Study Site for ease of data entry and interpretation.

5. Supplemental Territory Mapping Data Collection

Additional techniques will be employed after the peak census hours to act as a verification of territory delineations, as well as to supplement the location data from regular spot mapping visits. Additional techniques include: burst sampling, consecutive flush, and call playback/response elicitation.

5.1 Conducting Burst Sampling:

Burst sampling is an effective method to generate large sample sizes of location and activity data in a short amount of time. This approach balances sample size requirements with logistical constraints (Barg et al. 2005). Methods for burst sampling were based on Barg et al. (2005).

Choosing a Burst Sampling Route: Although burst sampling will involve opportunistically following a sighted individual along a path determined by the individual male, sampling within each study site will be conducted in a systematic manner to obtain complete coverage of the study site during each visit.

- Two observers will visit each study site during one session of burst sampling.
- Observers will begin at opposite corners of the study site and search for individual males along a route that will loosely lead them to meet in the middle of the study site.
- Direction and route of travel can be randomized between visits to ensure complete coverage of the study site.

Locating a New Individual for Tracking: Males will be located by systematically searching the study site along a randomized search route. Greater search effort can be made in target areas that have been identified as potential territory locations through spot mapping surveys.

- Once approximate territory locations of all individual pairs in the study sites have been identified through spot mapping and burst sampling bouts, attempts will be made to locate specific individuals in a way that will increase sample sizes evenly across all individuals in need of additional data points.

Sampling Sessions: Sampling sessions will follow methods used by Barg et al. (2005). One minute time intervals were considered sufficient time for individuals to traverse a territory, providing biologically independent locations (Barg et al. 2005).

- Sampling sessions will consist of 30 minute long periods, with observations recorded at 1-minute intervals.
- Sampling sessions will begin 2 minutes after the male has been visually identified to decrease bias to conspicuously used sites. Details for study site and conditions will be completed during the first two minutes. Record the Start Time.
- Locations of each individual at each observation time will be plotted on a grid map data sheet.
- Visits to each study site will occur every 4-7 days, depending on weather and logistical constraints.
- After completing the sampling session, record the End Time.

Following distance: Observers should attempt to keep the individual male within sight at all times during the sampling survey. To prevent disturbing individuals, observers should stay at least 15 m away from individual males at all times (Barg et al. 2005).

Loss of sampling subject: If you lose sight of an individual male during the sampling period and cannot relocate in a short period of time, locations or observations that should have been obtained during this time period will be considered lost. Complete the 'End Time' and 'Weather Conditions' fields on the grid map data sheet.

Locate a New Individual for Tracking: After completion of the burst sampling session or loss of a tracking male, complete the survey Start Time and End Time and condition information. Continue along the route and search for another male.

Completion of Burst Sampling Session: Burst sampling sessions will conclude when both observers have completed coverage of the study site.

5.2 Conducting Consecutive Flush:

Consecutive flush is an effective method to define territory boundaries. Territorial males can be lured to territory boundaries by 'squeaking', 'pishing', or flushing them out of vegetation. Neighbouring territorial males may then respond at a territory boundary. This method can be useful to confirm a territory boundary but should be used sparingly to avoid excessive disturbance (e.g. only if territory boundaries require further delineation).

5.3 Conducting Call Playback/Response Elicitation:

Call playback/response elicitation is an effective method to define territory boundaries. Territorial males can be lured to territory boundaries by broadcasting a recording of a song. If the song recording is played in locations that may be territory boundaries, it might help to determine whether or not there are responses from both birds. Males

occupying isolated territories often sing less than males occupying territories that are in close proximity. A song recording could increase the chance of getting sufficient records for a cluster. In addition, many migrant birds only sing early in the breeding season, but a recording of a song can elicit a response while birds are nesting (and have lower rates of singing). This method can be useful to confirm a territory boundary but should be used sparingly to avoid excessive disturbance (e.g. only if territory boundaries require further delineation).

6. References:

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Table 1. Beaufort Wind Scale Codes and Descriptions.

Code	Speed (km/h)	Beaufort Description
0	<2	Calm. Smoke rises vertically.
1	2 – 5	Light air, smoke drift indicates wind direction, still wind vanes.
2	6 – 12	Light Breeze, wind felt on exposed skin. Leaves rustle, vanes begin to move.
3	13 – 19	Gentle Breeze, leaves and small twigs constantly moving, light flags extended.
4*	20 – 29	Moderate Breeze, dust and loose paper raised. Small branches begin to move.
5*	30 – 39	Fresh Breeze, moderate size branches move. Small trees in leaf begin to sway.
6*	40 – 49	Strong Breeze, large branches moving, wind whistling
7*	50 – 59	High Wind, whole trees in motion. Effort needed to walk against the wind.

Table 2. Precipitation Codes.

Code	Description
0	No Rain
1	Fog/Mist
2	Drizzle
3	Light Rain
4*	Moderate Rain
5*	Heavy Rain
6*	Snow

Table 3. Cloud Cover Codes.

Code	Description
0	Clear Sky/Few Clouds
1	Scattered or Variable
2	Mostly Cloudy (Broken)
3	Overcast

Table 4. Noise Codes and Descriptions.

Code	Description
0	No noise (<40 dB) during most of survey.
1	Very faint noise (40-45 dB) during at least half of the survey, but not missing birds.
2	Faint noise (45-50 dB), difficulty hearing birds > 100 m away; might be missing some high-pitched songs/calls of distant birds.
3*	Moderate noise (50-60 dB), difficulty hearing birds >50 m away; detection radius is probably substantially reduced.
4*	Loud/intense noise (>60 dB), difficulty hearing birds >25 m away; probably detecting only the closest/loudest birds.

Reference dB levels: softest sound a person can hear (0 dB), normal breathing (10 dB), soft whisper (30 dB), rainfall (50 dB), normal conversation (60 dB).

* Indicates conditions unsuitable for conducting point counts

Table 5. Detection Type Symbols.

Symbol	Description
Circle	Singing (implied male)
Diamond	Calling (sex unknown)
Underline	Visual observation
*	Nest

Table 6. Age Codes.

Code	Description
A	Adult
J	Juvenile
F	Fledgling
UA	Unknown

Table 7. Sex Codes.

Code	Description
M	Male
F	Female
P	Pair
US	Unknown

Table 8. Breeding Behaviour Activity Codes.

Code	Description
CS	Counter-Singing
DC	Distress Calling
DR	Drumming
WI	Winnowing
PE	Perching
FE	Feeding/Foraging
CH	Chasing
MO	Mobbing
AD	Aggressive Display
PD	Pair Bonding Display
CO	Copulation
FT	Fly-Through (in forest)
FO	Fly-Over (above canopy)
SO	Soaring
NM	Carrying Nest Material
IA	Incubating Adult (on nest)
CF	Carrying Food
FS	Carrying Fecal Sac
DD	Distraction Display
FY	Fledged Young
FG	Family Group
BE	Begging (J or AF)

Table 9. Index of Reproductive Activity (IRA) Rank Codes.

Rank	Definition
1	Territorial male present 4+ weeks (e.g. minimum time to complete one successful clutch; in this study approximately 34 D).
2	Territorial male and female present 4+ weeks (e.g. simultaneous observation of 2 birds within 5 m of each other showing no agonistic interactions).
3	Male or female found nest building (carrying nest material), laying, incubating eggs, giving distraction display, **or** a nest present with/without eggs.
4	First observation of adults carrying food to presumed nestlings* **or** a nest containing nestlings.
5	Evidence of fledging success e.g. observation of adults with fledged young (incapable of sustained flight); observations of adults carrying food to young for a period longer than the nestling stage (e.g. in this study 12 D).

*Must distinguish from male carrying food to female during courtship display or to female incubating eggs.

Appendix 1. Bird Species Codes (BCR-6 Boreal Taiga Plains Master Species List).

English Name	Spp Code
Landbirds	
Gray Partridge	GRAP
Ring-necked Pheasant	RNEP
Ruffed Grouse	RUGR
Spruce Grouse	SPGR
Willow Ptarmigan	WIPT
Rock Ptarmigan	ROPT
White-tailed Ptarmigan	WTPT
Dusky Grouse	DUGR
Sharp-tailed Grouse	STGR
Greater Prairie-Chicken	GRPC
Turkey Vulture	TUVU
Osprey	OSPR
Bald Eagle	BAEA
Northern Harrier	NOHA
Sharp-shinned Hawk	SSHA
Cooper's Hawk	COHA
Northern Goshawk	NOGO
Red-shouldered Hawk	RSHA
Broad-winged Hawk	BWHA
Swainson's Hawk	SWHA
Red-tailed Hawk	RTHA
Rough-legged Hawk	RLHA
Golden Eagle	GOEA
American Kestrel	AMKE
Merlin	MERL
Peregrine Falcon	PEFA
Rock Pigeon	ROPI
Mourning Dove	MODO
Yellow-billed Cuckoo	YBCU
Black-billed Cuckoo	BBCU
Great Horned Owl	GHOW
Snowy Owl	SNOW
Northern Hawk Owl	NHOW
Northern Pygmy-Owl	NOPO
Barred Owl	BADO
Great Gray Owl	GGOW
Long-eared Owl	LEOW
Short-eared Owl	SEOW
Boreal Owl	BOOW
Northern Saw-whet Owl	NSWO
Common Nighthawk	CONI
Eastern Whip-poor-will	EWPW
Chimney Swift	CHSW
Ruby-throated Hummingbird	RTHU
Calliope Hummingbird	CAHU
Rufous Hummingbird	RUHU
Belted Kingfisher	BEKI
Red-headed Woodpecker	RHWO
Yellow-bellied Sapsucker	YBSA
Red-breasted Sapsucker	RBSA
Downy Woodpecker	DOWO
Hairy Woodpecker	HAWO
American Three-toed Woodpecker	ATTW
Black-backed Woodpecker	BBWO
Northern Flicker	NOFL
Pileated Woodpecker	PIWO
Olive-sided Flycatcher	OSFL
Western Wood-Pewee	WEWP
Eastern Wood-Pewee	EAWP
Yellow-bellied Flycatcher	YBFL
Alder Flycatcher	ALFL
Willow Flycatcher	WIFL
Least Flycatcher	LEFL
Hammond's Flycatcher	HAFL
Dusky Flycatcher	DUFL
Pacific-slope Flycatcher	PSFL
Eastern Phoebe	EAPH
Say's Phoebe	SAPH
Great Crested Flycatcher	GCFL
Western Kingbird	WEKI
Eastern Kingbird	EAKI
Loggerhead Shrike	LOSH
Northern Shrike	NSHR
Yellow-throated Vireo	YTVI
Cassin's Vireo	CAVI
Blue-headed Vireo	BHVI
Warbling Vireo	WAVI
Philadelphia Vireo	PHVI
Red-eyed Vireo	REVI
Gray Jay	GRAJ
Steller's Jay	STJA
Blue Jay	BLJA
Black-billed Magpie	BBMA
American Crow	AMCR
Common Raven	CORA
Horned Lark	HOLA
Purple Martin	PUMA
Tree Swallow	TRES
Violet-green Swallow	VGSW
Northern Rough-winged Swallow	NRWS
Bank Swallow	BANS
Cliff Swallow	CLSW
Barn Swallow	BARS
Black-capped Chickadee	BCCH
Boreal Chickadee	BOCH
Gray-headed Chickadee	GHCH
Red-breasted Nuthatch	RBNU
White-breasted Nuthatch	WBNU
Brown Creeper	BRCR
House Wren	HOWR
Winter Wren	WIWR
Sedge Wren	SEWR
Marsh Wren	MAWR
Golden-crowned Kinglet	GCKI
Ruby-crowned Kinglet	RCKI
Northern Wheatear	NOWH
Eastern Bluebird	EABL

English Name	Spp Code
Mountain Bluebird	MOBL
Townsend's Solitaire	TOSO
Veery	VEER
Gray-cheeked Thrush	GCTH
Swainson's Thrush	SWTH
Hermit Thrush	HETH
Wood Thrush	WOTH
American Robin	AMRO
Varied Thrush	VATH
Gray Catbird	GRCA
Northern Mockingbird	NOMO
Brown Thrasher	BRTH
European Starling	EUST
American Pipit	AMPI
Sprague's Pipit	SPPI
Bohemian Waxwing	BOWA
Cedar Waxwing	CEDW
Lapland Longspur	LALO
Smith's Longspur	SMLO
Snow Bunting	SNBU
Ovenbird	OVEN
Northern Waterthrush	NOWA
Golden-winged Warbler	GWWA
Black-and-white Warbler	BAWW
Tennessee Warbler	TEWA
Orange-crowned Warbler	OCWA
Nashville Warbler	NAWA
Connecticut Warbler	CONW
MacGillivray's Warbler	MGWA
Mourning Warbler	MOWA
Common Yellowthroat	COYE
American Redstart	AMRE
Cape May Warbler	CMWA
Northern Parula	NOPA
Magnolia Warbler	MAWA
Bay-breasted Warbler	BBWA
Blackburnian Warbler	BLBW
Yellow Warbler	YWAR
Chestnut-sided Warbler	CSWA

English Name	Spp Code
Blackpoll Warbler	BLPW
Black-throated Blue Warbler	BTBW
Palm Warbler	PAWA
Pine Warbler	PIWA
Yellow-rumped Warbler	YRWA
Townsend's Warbler	TOWA
Black-throated Green Warbler	BTNW
Canada Warbler	CAWA
Wilson's Warbler	WIWA
Spotted Towhee	SPTO
Eastern Towhee	EATO
American Tree Sparrow	ATSP
Chipping Sparrow	CHSP
Clay-colored Sparrow	CCSP
Brewer's Sparrow	BRSP
Vesper Sparrow	VESP
Lark Sparrow	LASP
Savannah Sparrow	SAVS
Grasshopper Sparrow	GRSP
Baird's Sparrow	BAIS
Le Conte's Sparrow	LCSP
Nelson's Sparrow	NESP
Fox Sparrow	FOSP
Song Sparrow	SOSP
Lincoln's Sparrow	LISP
Swamp Sparrow	SWSP
White-throated Sparrow	WTSP
Harris's Sparrow	HASP
White-crowned Sparrow	WCSP
Golden-crowned Sparrow	GCSP
Dark-eyed Junco	DEJU
Scarlet Tanager	SCTA
Western Tanager	WETA
Northern Cardinal	NOCA
Rose-breasted Grosbeak	RBGR
Indigo Bunting	INBU
Bobolink	BOBO
Red-winged Blackbird	RWBL
Eastern Meadowlark	EAME

English Name	Spp Code
Western Meadowlark	WEME
Yellow-headed Blackbird	YHBL
Rusty Blackbird	RUBL
Brewer's Blackbird	BRBL
Common Grackle	COGR
Brown-headed Cowbird	BHCO
Orchard Oriole	OROR
Baltimore Oriole	BAOR
Pine Grosbeak	PIGR
Purple Finch	PUFI
House Finch	HOFI
Red Crossbill	RECR
White-winged Crossbill	WWCR
Common Redpoll	CORE
Hoary Redpoll	HORE
Pine Siskin	PISI
American Goldfinch	AMGO
Evening Grosbeak	EVGR
House Sparrow	HOSP

Shorebirds

American Golden-Plover	AMGP
Killdeer	KILL
Spotted Sandpiper	SPSA
Solitary Sandpiper	SOSA
Greater Yellowlegs	GRYE
Lesser Yellowlegs	LEYE
Upland Sandpiper	UPSA
Whimbrel	WHIM
Hudsonian Godwit	HUGO
Marbled Godwit	MAGO
Semipalmated Sandpiper	SESA
Least Sandpiper	LESA
Short-billed Dowitcher	SBDO
Wilson's Snipe	WISN
Wilson's Phalarope	WIPH
Red-necked Phalarope	RNPH

Waterbirds

English Name	Spp Code
Red-throated Loon	RTLO
Pacific Loon	PALO
Common Loon	COLO
Yellow-billed Loon	YBLO
Pied-billed Grebe	PBGR
Horned Grebe	HOGR
Red-necked Grebe	RNGR
Eared Grebe	EAGR
Western Grebe	WEGR
Double-crested Cormorant	DCCO
American White Pelican	AWPE
American Bittern	AMBI
Great Blue Heron	GBHE
Black-crowned Night-Heron	BCNH
Yellow Rail	YERA
Virginia Rail	VIRA
Sora	SORA
American Coot	AMCO
Sandhill Crane	SACR
Whooping Crane	WHCR
Bonaparte's Gull	BOGU
Franklin's Gull	FRGU
Mew Gull	MEGU
Ring-billed Gull	RBGU
California Gull	CAGU
Herring Gull	HERG
Caspian Tern	CATE
Black Tern	BLTE
Common Tern	COTE
Arctic Tern	ARTE
Forster's Tern	FOTE
Parasitic Jaeger	PAJA
Long-tailed Jaeger	LTJA

Waterfowl

Greater White-fronted Goose	GWFG
Snow Goose	SNGO
Ross's Goose	ROGO
Cackling Goose	CACG
Canada Goose	CANG
Trumpeter Swan	TRUS
Tundra Swan	TUSW
Wood Duck	WODU
Gadwall	GADW
American Wigeon	AMWI
Mallard	MALL
Blue-winged Teal	BWTE
Cinnamon Teal	CITE
Northern Shoveler	NSHO
Northern Pintail	NOPI
Green-winged Teal	GWTE
Canvasback	CANV
Redhead	REDH
Ring-necked Duck	RNDU
Greater Scaup	GRSC
Lesser Scaup	LESC
Common Eider	COEI
Surf Scoter	SUSC
White-winged Scoter	WWSC
Black Scoter	BLSC
Long-tailed Duck	LTDU
Bufflehead	BUFF
Common Goldeneye	COGO
Barrow's Goldeneye	BAGO
Hooded Merganser	HOME
Common Merganser	COME
Red-breasted Merganser	RBME
Ruddy Duck	RUDU

Appendix 2. Bird Species Codes for Incomplete Identifications.

Species Code	Explanation
UNKN	Unidentified Bird
UNAH	Unidentified Accipiter Hawk
UNBH	Unidentified Buteo Hawk
UNDU	Unidentified Duck
UNEF	Unidentified Empidonax Flycatcher
UNFL	Unidentified Flycatcher
UNGU	Unidentified Gull
UNHU	Unidentified Hummingbird
UNOW	Unidentified Owl
UNCH	Unidentified Chickadee
UNSA	Unidentified Sapsucker
UNSP	Unidentified Sparrow
UNTH	Unidentified Thrush
UNVI	Unidentified Vireo
UNWA	Unidentified Warbler
UNWO	Unidentified Woodpecker
UNWR	Unidentified Wren

Appendix 3. Differentiating Songs and Calls.

Here we provide guidelines for differentiating songs from calls. Most songbirds have a typical song that generally is not confused with typical call notes. An example is the Black-headed Grosbeak, whose song can be described as a high, rolling warble and whose call is a high, sharp *pik* note. Groups of birds encountered in the field that have less well-defined songs and calls include hawks and falcons, grouse and quail, owls, woodpeckers, flycatchers, jays and crows, and chickadees (particularly CBCH and BOCH). The general rule to follow for distinguishing between songs and calls for all species is to defer to vocalization descriptions in The Sibley Field Guide to Birds of Western North America with a few clarifications, described below:

Hawks and falcons: Never sing. Regard all vocalizations as **calls.**

Grouse and quail: Low hoot of SOGR and drumming of RUGR classified as **song**, all other vocalizations classified as **calls.** *Quark* of MOUQ and *Chi ca go* of CAQU classed as **songs,** all other vocalizations are **calls.**

Owls: **Songs** are defined as the typical series of hoots a male defending territory would give. This does not include any of the female and juvenile calls. The NOPO's 'submarine sonar' vocalizations and FLOW's *poop* (*tee hee*) are included as **songs.**

Woodpeckers: **Songs** are limited to rattles for most species. **Calls** are defined as all contact calls, drumming, and any other vocalizations. For NOFL and PIWO the similar sounding *wuk wuk wuk wuk wuk* vocalizations are classified as **songs**; all other vocalizations are **calls**.

Flycatchers: Well-defined by Sibley. Typical two and three note vocalizations from *empidonax* flycatchers are classified as **songs**.

Jays and crows: Never sing. Regard all vocalizations as **calls**.

Chickadees: **Song** includes MOCH's *cheeseburger*, and BCCH's *fee bee fee beeyee*. All other vocalizations for these two species should be classified as calls. CBCH and BOCH do not have a structured song—regard all vocalizations as **calls**. RBNU—difficult to distinguish calls from songs so regard all vocalizations as **calls.**