Protocol for Monitoring Birds in High Elevation Habitats During Fall Migration

In North America, migrant and resident birds use high elevation habitats extensively in late summer and fall, likely because of the heterogeneity and openness of this landscape, and high food availability relative to lower elevations. The goal of this program is to determine the extent of high elevation habitat use during fall migration by monitoring birds in alpine, sub-alpine and montane habitats.

Sampling methods

We obtain estimates of population density in multiple habitat types using *distance sampling*. This method controls for differences in bird detectability between different habitats (Buckland et al. 1993). Line transects are ideal because they allow sampling across environmental gradients and are efficient for counting migrating birds (Wilson 2000).

Transects are divided into three habitat types: *alpine* (rock, grassland, tundra and krummholz; 0-5% canopy); *sub-alpine* (meadows and parkland with tree islands; 5-50% canopy), and *montane forest* (contiguous canopy with occasional openings; >50% canopy). The vegetation cover and topography may be varied within and between transect lines. It is crucial that transect lines are straight and that start points are chosen randomly within the habitat type. It is also important that transect lines are not too closely spaced, to avoid double-counting individual birds. Transect line lengths can range from 75m to 1400m but the ideal may be around 400m as this distance generates an average of 25 bird observations per line.

It is crucial in distance sampling to determine the perpendicular distance from the transect line to each detected bird. This distance is labeled "x" in Figure 1. In the field, a rangefinder is used to find the distance from the observer to the bird, and an angle rule is used to determine the bearing of each detection with respect to the transect line. Using distance and bearing field measurements, the program DISTANCE calculates x values which can be used to make population density estimates (Buckland et al. 1993).

Figure 1: Line transect and important measurements

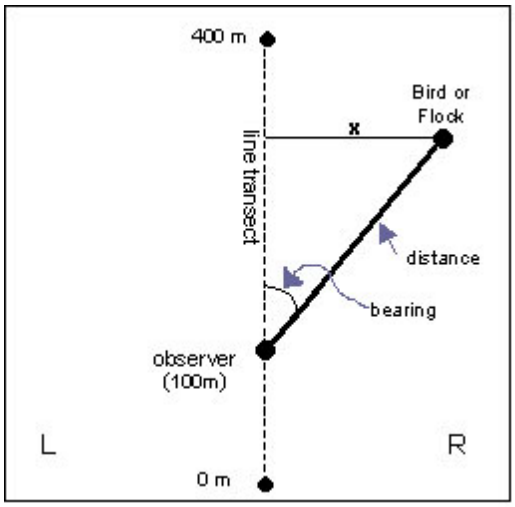
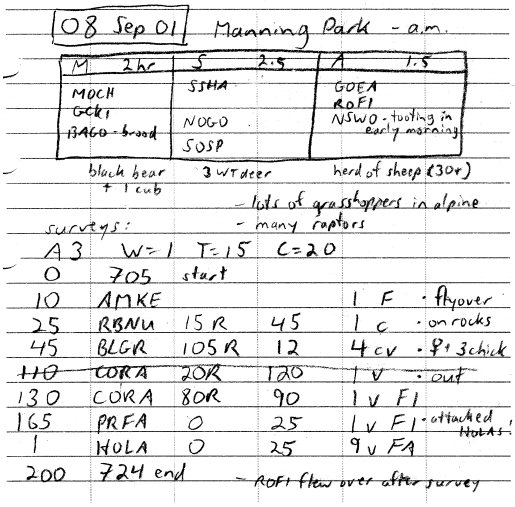


Figure 2: Sample surveying data sheet



At the start of each transect record the following variables:

Date, observer, site.
Transect number and habitat: e.g. M1= montane transect number one; S2= subalpine two;
Time: Start time (record finish time at end).
Direction traveled on transect line.

Wind: 0 = calm, 1 = light breeze, 2 = moderate breeze, 3 = strong breeze, 4 = too windy for survey
Temperature: Using portable thermometer.
Cloud cover: High/low, 0= no clouds, 1= less than 50%, 2= 50%, 3= more than 50%, 4= 100%

Survey Data : For each bird observation during a transect survey record the following variables:

Observer location: Location of observer along the line (distance from start of line). This allows post- hoc exclusion of birds that were recorded beyond the end of the transect. Also, habitat associations may be assessed within a transect.
Bird Code: Standard four-letter species code (or guild code if unsure of species; e.g. UNSP= unknown sparrow). See code list: http://birding.about.com/library/weekly/aa011601h.htm.
Angle: In degrees, to within 5°. Measured with angle rule. Specify side of transect line (left or right). 0° = straight ahead, 180° = directly behind.
Distance: From the observer to the bird, in meters. Ideally measured with laser rangefinder.
Number of individuals: The number of birds observed in a particular detection (e.g. three birds of one species in same tree constitutes one detection). Large flock sizes can be estimated.
Detection status: Record the first means of detection for an observation: singing (S), calling (C), visual (V).
Flyover status: If bird is flying; F= flying over or through site (no distance or angle readings taken); FA= flew away; FI= flew in; FS= soaring (often assigned to hovering raptors); see considerations below
Comments: Include as much information as possible if time permits (e.g. juveniles, adults with food, predatory attacks, unusual observations)

In addition to the above survey data, a species list should be kept which includes bird observations made outside of formal surveys. The list should include species, habitat, environmental parameters, and amount of time spent in each habitat type.

Methodology:

The observer walks quietly and at a moderate pace, stopping at predetermined distance intervals to listen for birds and to record observations. A sample data collection sheet is shown in Figure 2 above. Special attention must be paid to the area on and adjacent to the transect line, because the distance sampling method assumes that all birds situated on the line are recorded with a probability of one. Birds beyond either end of the transect line should not be recorded. The distance sampling method uses statistical calculations to account for differences in detectability of individuals at varying distances from the transect line. Because of this, if the observer strays from the line and detects a bird that would have not otherwise been detected, those detections should not be recorded.

Given the mobile nature of the birds, measures must be taken to ensure that the sampling provides the most representative "snapshot" of the area, (i.e. what would have been there without the observer's presence), and to ensure that individuals are not double counted. Individuals and flocks commonly fly above or over the transect line. If they do not land, they are recorded as flyovers. Species and number of individuals should be recorded for each flyover. If a bird is detected in the air, but obviously took off from a certain spot, the distance and angle to the place of take-off are recorded, and the flyover status is recorded as "FA" (flew away). If a bird flies into the count zone and lands *in front* of the observer, the distance and angle to the place of landing are recorded and the flyover status is recorded as "FI" (flew in). If the bird(s) flies into the count zone and lands to *the rear*, they are recorded as *flyovers* only. In order to avoid double counting, individuals detected behind the observer should only be recorded if they were believed to be present when the observer passed by, but were not detected. This occurs commonly when an

audio detection is made from a concealed area behind the observer. Also, it is preferable to survey *down* a valley, since flocks tend to move *up* valley systems.

Do not survey in remote areas alone. Communication through VHF radios is recommended. Pre-flagged or cairned transect lines are helpful, marked at 10-50m intervals, depending on vegetation, placed in routes to maximize efficiency (see Figure 3)

Figure 3: Site map showing transect routes

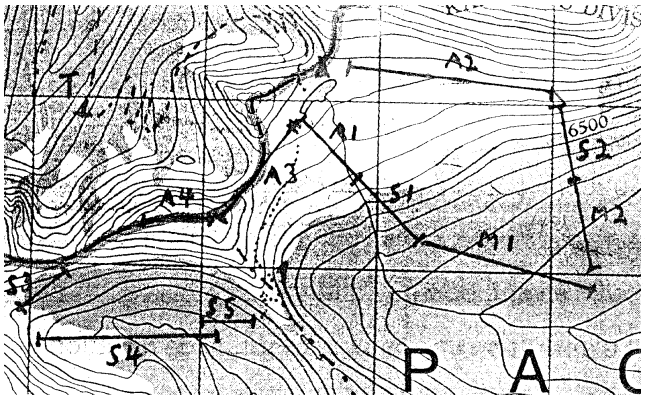
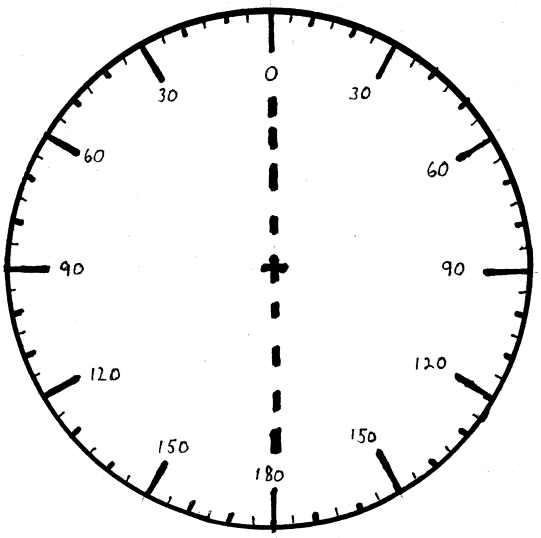


Figure 4: Angle rule



Equipment list

- Laser rangefinders (Bushnell Yardage Pro compact 600 series)
- Binoculars with high quality optics
- Field notebook, pencil, write-in-rain paper
- Angle rule: taped to front of field book ; see Figure 4.
- GPS receiver: helpful for locating transect lines
- Compass to maintain transect line bearing if flagging not visible
  **GPS navigation in conjunction with a compass could be used instead of flagged routes)

References

Buckland, S. T., D. R. Anderson, et al. (1993). Distance Sampling: Estimating abundance of biological populations. London, Chapman and Hall.

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Wilson, R.R., D.J. Twedt, A.B. Elliott. 2000. Comparison of line transects and point counts for monitoring spring migration in forested wetlands. Journal of Field Ornithology 71: 345-355

* Wilson, S. 2002. Stopover site selection and habitat use in high elevation areas by fall avian migrants. Faculty of Forestry, University of British Columbia, Vancouver, B.C. 33 pp.

* Reports available at Centre for Alpine Studies website: http://www.forestry.ubc.ca/alpine/index.htm