A Standard Method for Monitoring Songbird Populations in the Great Lakes Region

The authors describe very specific, standardized protocol for counting songbirds and other diurnal bird species in the Great Lakes Region. The primary goal is to provide guidelines for managers of public and private forests, wildlife refuges, and nature reserves for monitoring birds in forested habitats, but the methods can also be applied to other environments.

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More than one hundred scientific papers and several recent books (Ralph and Scott 1981, Koskimies and Vaisanen 1991, Bibby et al. 1992, Ralph et al. 1993, Ralph et al. 1995, Hamel et al. 1996) have addressed methods for sampling bird populations. Several standard procedures have been described and are widely used today. Kendeigh (1944) and Van Velzen (1972), for example, outlined "spot-map" methods for estimating breeding bird densities in local areas. Robbins et al. (1986) introduced a more extensive method for monitoring bird populations; this procedure (a series of fifty 3-minute roadside counts) has become the foundation for the North American Breeding Bird Survey, one of the most successful standardized bird monitoring programs in the world (Robbins et al. 1986, Peterjohn et al. 1995, Price et al. 1995).

Blondel et al. (1981) and Reynolds et al. (1980) described a rigorous method for sampling birds at a single point. Point counts are effective for sampling birds in specific habitats and at a given locality over a period of time. This method is particularly desirable because it is simple, quantitative, and requires relatively few subjective decisions by the observer, especially compared to the spot-map method. In an unlimited-radius point count, the observer simply counts all birds seen and heard from a given point during a fixed period of time. Because this procedure can be followed precisely at other times or at other places, unlimited-radius point counts are ideal for comparative studies. The North Amer-

ican Breeding Bird Survey employs short duration (3-minute) point counts; longer counts are desirable if one is interested in specific habitats or localities, because many resident species are not detected during 3-minute counts (Buskirk and McDonald 1995, Dawson et al. 1995, Petit et al. 1995).

Recently, Ralph et al. (1995) formulated general standards for point counts based on contributions by numerous researchers. These standards include recommendations about count duration, spacing of census points, and other issues. Although these standards offer considerable detail, several elements are left to the discretion of the observer. Most importantly, count duration can be either 5 or 10 minutes, depending on the travel time between points.

The purpose of this paper is to describe a very specific, standardized protocol for counting songbirds and other small diurnal bird species in the Great Lakes Region of northeastern North America and adjacent Canada. We follow the recommendations of Ralph et al. (1995), with several modifications to provide explicit directions for biologists in this region. We recognize that every method is burdened by problems or trade-offs (Mayfield 1981, Johnson 1995), but numerous benefits are gained by establishing a single, standardized method. Experience has shown that large sample sizes over broad geographic areas (and over long time periods) provide valuable information about bird populations, with equally valuable implications for conservation (Howe et al. 1996). Such data bases are possible when results from several or many sources can be combined.

The method described below is appropriate for many practical applications. We are particularly interested in establishing a standard for monitoring birds in forested habitats, but the methods also can be applied to other environments. Our primary goal is to provide guidelines for managers of public and private forests, parks, wildlife refuges, and nature reserves. We assume that long term monitoring of larger areas (e.g., states, ecoregions, continents) will be provided by the North American Breeding Bird Survey (Sauer and Droege 1990). More intensive studies at a local scale can provide complementary information about bird-habitat associations, site-specific population fluctuations, and landscape-specific distribution patterns. A standard method will help biologists design local studies and will facilitate the development of more extensive regional databases.

The method described below represents a variation of the standards proposed by Ralph et al. (1995). Specific details were developed during a series of workshops organized by Gerald Niemi at the Natural Resources Research Institute at the University of Minnesota-Duluth during 1992–94. Participants included biologists from academic institutions, public agencies, conservation organizations, and private consulting companies.

Standard Point Count Protocol

1. The standard method for sampling birds is an unlimited-radius, 10-minute point count. All birds seen or heard from a specific point are recorded during a 10 minute period by a qualified observer.
2. A standard form with map (Figure 1) should be used to record data. This form requires the observer to estimate where each bird was *first en-*

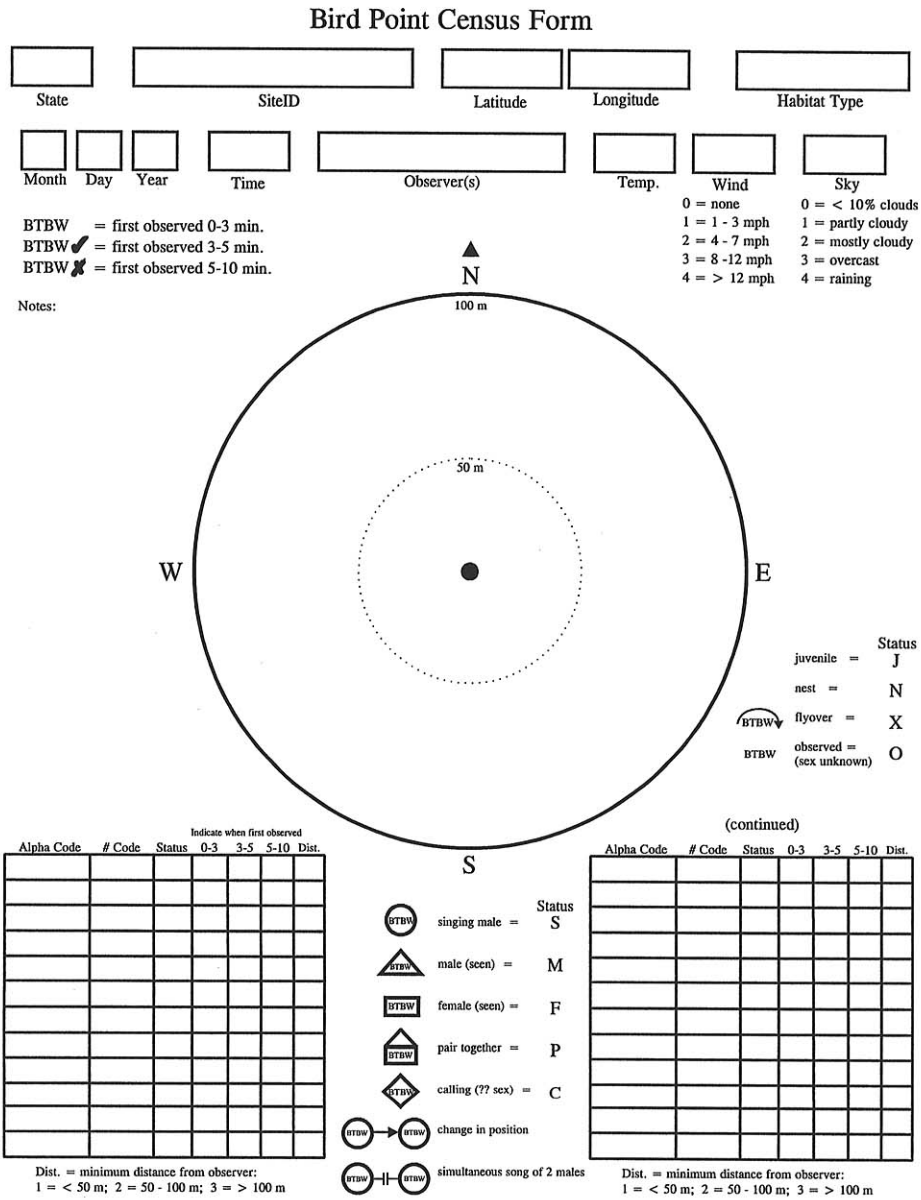

Figure 1. Sample data form for 10 minute point counts. Observers are encouraged to estimate in which concentric circle (0–50 m = 1; 50–100 m = 2; > 100 m = 3) each bird is believed to occur. If many birds are present, field observations should be recorded on map and later transcribed to tables as described below (adding # Code for each species, etc. from Appendix).

countered (< 50 m, 50–100 m, > 100 m) and when each bird was first encountered (during the first 3 minutes, next 2 minutes, or last 5 minutes of the census period). These details facilitate comparisons with other studies.

3. Birds flying over and not actively using the count area should be recorded separately as "flyovers." Forest raptors, swallows, and other species which are or appear to be hunting over the count area should be included with the main list of species (i.e., they should not be recorded as flyovers).
4. Whenever possible, sex and age (adult vs. juvenile) of each bird should be recorded. In particular, juvenile birds (e.g., recent fledglings) should be distinguished from adults in order to estimate the number of breeding pairs in the area.
5. Time of day, weather conditions, and exact locality in latitude/longitude or UTM coordinates (preferably determined from a global positioning system [GPS] should be recorded for each count locality).

Site Selection

1. Points should be located at least 250 m apart.
2. If habitat associations are an objective of the study, points should be located at least 125 m within the target habitat type. If habitat associations are not a major aim of the study, then points should be selected randomly within the area of interest.
3. Randomization can be achieved by identifying a list of potential sites, stratified (e.g., within subregions) or constrained (e.g., along roads) according to the objectives of the study. Point count localities subsequently should be selected randomly from the list of potential sites. If time is a major limitation, then a geographically stratified procedure can be employed which minimizes the time required to go from one point to another (see Hanowski and Niemi 1994).
4. Because of the inherent variability among bird counts (even at the same point over time) a large sample size is required to provide meaningful results. A single observer can complete approximately 7–15 point counts in a single morning. Comparisons among areas or years will require a minimum sample size of 20–50 points, depending on the species or variable of interest. Much larger sample sizes will be needed if the study area is large and heterogeneous. Detailed comparisons among habitats and analysis of uncommon or rare species require hundreds of samples. A general rule of thumb is the following: the more variation among samples within groups (e.g., habitats) that are being compared, the larger will be the sample size needed to compare groups (Hamel et al. 1996).

Census Schedule

1. During the breeding season, counts should be conducted between ½ hr before sunrise and 9:30 A.M.
2. Unless short-term changes are an objective of the study, or if an objective is to thoroughly sample a specific area, each site should be visited only once during a given season, leaving more time to sample additional points. In other words, the site selection strategy should maximize

the number of geographically distinct points sampled during a given year.

3. Counts should not be conducted when it is raining, during heavy fog, or when steady winds exceed 11–12 km/hr (7–10 mph). As a rule of thumb, counting should be discontinued if an observer determines that conditions cause loss of detection of 10% or more of the birds present in the count area (Ralph et al. 1995).
4. Breeding season counts should be conducted no earlier than 1 June and should be completed no later than 15 July. However, if spring phenology is delayed or accelerated, slight adjustments to these dates may be acceptable.

Data Management

1. Data should be organized in a computerized database (e.g., Paradox), with each species at a single point representing a separate record or row.
2. Each record (Figure 2) should include the standardized 4-letter species code (see Appendix), the corresponding numeric code (for error checking), the type of observation (singing male, female, juvenile, flyover, etc.), the number of individuals *first observed* during each time interval (0— 3 minutes, 3–5 minutes, 5–10 minutes), and (optionally) the minimum distance from the observer (<50 m, 50–100 m, >100 m).
3. A separate database (Figure 3) should be established to describe site characteristics (locality, habitat type, etc.). Additional databases can identify more detailed characteristics of each site (tree species composition, average canopy height, etc.) and characteristics of each species (e.g., common and scientific name, guild membership, etc.). Information can be shared among data bases as long as they are linked by one or more common data fields (e.g., site number and date, species code).

Habitat Description

A description of the habitat within 100 m of the census point should be recorded (Figure 4). Sampling efficiency can be maximized by recording habitat information after 9:30 A.M. or after the main avian nesting season (e.g., after mid–July). Minimum elements of the description include the following:

1. Habitat type(s) within 100 m according to a general scheme (Wisconsin Society for Ornithology 1995) or some other classification system relevant to the study (e.g., U.S. Forest Service *stand type*).
2. Dominant tree species (up to 5) and their respective % cover.
3. Dominant shrub/sapling species and their respective % cover.
4. Tree density (# trees/10 m radius).
5. Average canopy/vegetation height.
6. Average % cover of high canopy trees (dbh > 2.5 cm).
7. Average % cover of deciduous trees (relative to total canopy cover).
8. Average % cover of sub-canopy trees (dbh > 2.5 cm).
9. Average % cover of deciduous trees in sub-canopy (relative to total sub-canopy cover).
10. Average % cover of understory shrubs/saplings (dbh < 2.5 cm).
11. Average % cover of deciduous shrubs/saplings.

Figure 2. Database structure for recording point count results, with example from a sample count. Codes are described in Figure 1 and Appendix. Note that the nesting pair (P) of Golden-crowned Kinglets (GCKI) represents 2 individuals (= # Indiv.).

Site ID	Year	Date	Species Code	Species #	Status	0–3 min.	3–5 min.	5–10 min.	# Indiv.	Min. distance
308	1997	06/12/97	WIWR	7220	S	1		1	2	2
308	1997	06/12/97	REVI	6240	S	2	1		3	2
308	1997	06/12/97	REVI	6240	S	1			1	1
308	1997	06/12/97	BLBW	6620	M	1			1	1
308	1997	06/12/97	BLBW	6620	F	1			1	1
308	1997	06/12/97	GCKI	7480	P	1			2	1
308	1997	06/12/97	NAWA	6450	S		1		1	2
308	1997	06/12/97	CORA	4860	O	2			2	3
308	1997	06/12/97	GRAJ	4840	J	1	2		3	1

Figure 3. Database structure for recording site details and conditions, with example from several sample point counts. Note that this database can be related to the database in Figure 2 by the common fields SiteID and Date. Latitude and longitude create an additional link to large scale GIS databases. Habitat types are taken from Wisconsin Society for Ornithology (1995). For example, FLMs = *F*orested *L*owland, *M*ixed conifer/hardwood, *s*pruce dominated.

Site ID	Date	Observer	Time	Temp.	Wind	Sky	Habitat	Lat.	Long.
308	06/12/97	RWH	0611	56	0	1	FLMs	450736	882245
401	06/11/97	RWH	0648	58	0	1	SLMc	450713	881541
409	06/11/97	RWH	0713	61	1	1	SLCn	450722	881601
812	06/13/97	GJN	0601	72	2	0	FUHa	441230	891930
813	06/13/97	GJN	0638	72	2	0	FLHn	441256	891921

Point Census Habitat Description

(Estimate habitat characteristics w/in 100 m of point)

State	SiteID	Year	Date	Habitat Type*

*see Wisconsin Society for Ornithology 1995 (Breeding Bird Atlas Handbook)

Topography	Aspect	Habitat Heterogeneity	Distance to Road/Opening	Road/Opening type
			1.	1.
			2.	2.

1 = flat lowland
2 = flat ridgetop
3 = gently rolling
4 = moderate slope
5 = steep slope

N = 1
S = 5
E = 4
W = 3

1 = uniform habitat type
2 = dominant habitat > 75%
3 = mixed 2 habitat types
4 = mixed 3 habitat types
5 = mixed > 3 habitat types

1 = logging road / trail
2 = gravel road
3 = secondary blacktop
4 = primary blacktop
5 = lake/river
6 = clearing

Tree Density (w/in 10 m radius)					Average Canopy Height
none	< 5 trees	6-20 trees	21-40 trees	> 40 trees	

Estimate w/in 10 m and adjust to reflect 100 m radius

If scattered trees, estimate average height of trees only

Layer	% cover	% deciduous
High canopy		
Sub-canopy		
Shrub/sapling		
Ground (non-woody)		**********

% deciduous = % of total cover (not % of area)

Special Features (w/in 100 m)			
1. pond		5. large opening(s)	
2. stream		6. snags	
3. open wetland		7. large downed logs	
4. small opening(s)		8. rock outcrop	

other feature(s):

Tree Species (> 2.5 cm dbh)	% Cover

Shrub/Sapling Species	% Cover

Figure 4. Sample data form for habitat measurements.

12. Average % cover of non-woody ground vegetation.
13. Topography (flat, rolling, hillside, etc.).
14. Habitat heterogeneity (subjective scale)
15. Distance to road/opening.
16. Special features (rock outcrop, pond, grassy opening, etc.)

Estimation of habitat variables can be facilitated by measuring or estimating within 10 m and adjusting the re-

sult (up or down) to best represent the larger 100 m radius. More detailed vegetation sampling methods can be found in James and Shugart (1970).

Discussion

Additional details and recommendations can be found in Ralph et al. (1993, 1995). Our proposed method departs from the national recommendations by advocating a 10-minute rather than a 5-minute count. (The method of recording, however, enables 5-minute or 3-minute counts to be derived from the 10 minute total.) Experience has shown that 10-minute counts yield significantly fewer zero values for species of interest and provide a more representative (although still incomplete) picture of birds using a local area. This consideration becomes important for uncommon species, which comprise the majority of birds occurring in any region (Howe et al. 1996).

In the design of a sampling scheme, the objectives of the study must be clearly identified. These objectives will dictate choices among alternative strategies, such as the allocation of sampling points among habitat types, the number of points, etc. Randomized selection of sites must be given careful attention. One should avoid selecting sites because of desirable characteristics (e.g., nice trees, easy access), unless the area is of specific interest for the study's objectives. Any site selection procedure that does not include a random selection of sampling points from a larger pool of points will be perceived as potentially biased and violates a basic assumption of statistics. When in doubt about sampling design, consult a person who is experienced in statistical analysis or experimental design.

If the study seeks to relate bird observations to habitat information or to estimate bird densities directly, distances between birds and the census point should be recorded. Researchers should be aware, however, that estimation of distances (especially beyond 25 m) is very difficult even for experienced observers. Most forest songbirds move over relatively large areas (> 1 ha), and observations during a point count represent only a brief snapshot of the birds use of the local habitat.

No single sampling strategy is optimal for all circumstances. The method described here, for example, is not adequate for raptors and many waterbirds. By standardizing the point count method, however, observers establish opportunities for comparisons with other local, habitat-based bird surveys (e.g., references in Ralph et al. 1995). Studies conducted in small geographic areas (where sample size is necessarily limited) can be analyzed in the context of other studies using the same, standardized method. Researchers in the Great Lakes Region have begun to compile an extensive regional database that is widely accessible and archived for long term studies. Information about contributing to and using this database can be obtained through the authors or from the Natural Resources Research Institute worldwide web site. Collaborative data analysis will help promote large scale and efficient strategies for the conservation of Great Lakes bird populations.

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Appendix. Standard alphabetic and numeric codes for common species of western Great Lakes region. Codes are taken or derived from *North American Bird Banding Manual* (Environment Canada, Canadian Wildlife Service, US Fish and Wildlife Service, 1994).

Name	Species	Code
Alder Flycatcher	ALFL	4661
American Bittern	AMBI	1900
American Black Duck	ABDU	1330
American Coot	AMCO	2210
American Crow	AMCR	4880
American Goldfinch	AMGO	5290
American Green-winged Teal	AGWT	1390
American Kestrel	AMKE	3600
American Redstart	AMRE	6870
American Robin	AMRO	7610
American Wigeon	AMWI	1370
American Woodcock	AMWO	2280
Bald Eagle	BAEA	3520
Baltimore Oriole	BAOR	5070
Barn Swallow	BARS	6130
Barred Owl	BAOW	3680
Bay-breasted Warbler	BBWA	6600
Belted Kingfisher	BEKI	3900
Black-and-white Warbler	BAWW	6360
Black-billed Cuckoo	BBCU	3880
Black-capped Chickadee	BCCH	7350
Black-crowned Night-Heron	BCNH	2020
Black Tern	BLTE	0070
Black-throated Blue Warbler	BTBW	6540
Black-throated Green Warbler	BTNW	6670
Blackburnian Warbler	BLBW	6620
Blackpoll Warbler	BLPW	6610
Blue Jay	BLJA	4770
Blue-winged Teal	BWTE	1400
Blue-winged Warbler	BWWA	6410
Bobolink	BOBO	4940
Boreal Chickadee	BOCH	7400
Brewer's Blackbird	BRBL	5100
Broad-winged Hawk	BWHA	3430
Brown Creeper	BRCR	7260
Brown Thrasher	BRTH	7050
Brown-headed Cowbird	BHCO	4950
Canada Goose	CAGO	1720
Canada Warbler	CAWA	6860
Cape May Warbler	CMWA	6500
Cedar Waxwing	CEDW	6190
Cerulean Warbler	CERW	6580

Name	Species	Code
Chestnut-sided Warbler	CSWA	6590
Chimney Swift	CHSW	4230
Chipping Sparrow	CHSP	5600
Clay-colored Sparrow	CCSP	5610
Cliff Swallow	CLSW	6120
Common Goldeneye	COGO	1510
Common Grackle	COGR	5110
Common Loon	COLO	0070
Common Merganser	COME	1290
Common Nighthawk	CONI	4200
Common Raven	CORA	4860
Common Snipe	COSN	2300
Common Yellowthroat	COYE	6810
Connecticut Warbler	CONW	6780
Cooper's Hawk	COHA	3330
Dickcissel	DICK	6040
Double-crested Cormorant	DCCO	1200
Downy Woodpecker	DOWO	3940
Eastern Bluebird	EABL	7660
Eastern Kingbird	EAKI	4440
Eastern Meadowlark	EAME	5010
Eastern Phoebe	EAPH	4560
Eastern Screech-Owl	EASO	3730
Eastern Wood-Pewee	EAWP	4610
European Starling	EUST	4930
Evening Grosbeak	EVGR	5140
Field Sparrow	FISP	5630
Golden-crowned Kinglet	GCKI	7480
Golden-winged Warbler	GWWA	6420
Grasshopper Sparrow	GRSP	5460
Gray Catbird	GRCA	7040
Gray Jay	GRAJ	4840
Great Blue Heron	GTBH	1940
Great-crested Flycatcher	GCFL	4520
Great Horned Owl	GHOW	3750
Green-backed Heron	GNBH	2010
Hairy Woodpecker	HAWO	3930
Hermit Thrush	HETH	7590
Herring Gull	HERG	0510
Hooded Merganser	HOME	1310
Horned Lark	HOLA	4740
House Finch	HOFI	5190
House Sparrow	HOSP	6882
House Wren	HOWR	7210
Indigo Bunting	INBU	5980
Killdeer	KILL	2730
Least Bittern	LEBI	1910
Least Flycatcher	LEFL	4670
LeConte's Sparrow	LCSP	5480
Lesser Scaup	LESC	1490
Lincoln's Sparrow	LISP	5830
Long-eared Owl	LEOW	3660
Magnolia Warbler	MAWA	6570
Mallard	MALL	1320
Marsh Wren	MAWR	7250
Merlin	MERL	3570
Mourning Dove	MODO	3160
Mourning Warbler	MOWA	6790
Nashville Warbler	NAWA	6450
Northern (Baltimore) Oriole	BAOR	5070
Northern Cardinal	NOCA	5930
Northern Goshawk	NOGO	3340
Northern Harrier	NOHA	3310
Northern Parula	NOPA	6480
Northern Rough-winged Swallow	RWSW	6170
Northern Saw-whet Owl	NSWO	3720
Northern Waterthrush	NOWA	6750
Olive-sided Flycatcher	OSFL	4590
Osprey	OSPR	3640
Ovenbird	OVEN	6740
Palm Warbler (Western)	WPWA	6720
Philadelphia Vireo	PHVI	6260
Pied-billed Grebe	PBGR	0060
Pileated Woodpecker	PIWO	4050
Pine Siskin	PISI	5330
Pine Warbler	PIWA	6710
Purple Finch	PUFI	5170
Purple Martin	PUMA	6110
Red-bellied Woodpecker	RBWO	4090
Red-breasted Nuthatch	RBNU	7280
Red Crossbill	RECR	5210
Red-eyed Vireo	REVI	6240
Red-headed Woodpecker	RHWO	4060
Red-shouldered Hawk	RSHA	3390
Red-tailed Hawk	RTHA	3370
Red-winged Blackbird	RWBL	4980
Ring-necked Pheasant	RNPH	4175
Ring-necked Duck	RNDU	1500
Rose-breasted Grosbeak	RBGR	5950
Ruby-crowned Kinglet	RCKI	7490
Ruby-throated Hummingbird	RTHU	4280
Ruffed Grouse	RUGR	4150
Rufous-sided Towhee	RSTO	5870
Sandhill Crane	SACR	2060
Savannah Sparrow	SAVS	5420
Scarlet Tanager	SCTA	6080
Sedge Wren	SEWR	7240
Sharp-shinned Hawk	SSHA	3320
Slate-colored Junco (Dark-eyed)	SCJU	5670
Solitary Sandpiper	SOSA	2560
Solitary Vireo	SOVI	6290
Song Sparrow	SOSP	5810

Name	Species	Code
Sora	SORA	2140
Spotted Sandpiper	SPSA	2630
Swainson's Thrush	SWTH	7580
Swamp Sparrow	SWSP	5840
Tennessee Warbler	TEWA	6470
Tree Swallow	TRES	6140
Turkey Vulture	TUVU	3250
Trumpeter Swan	TRUS	1810
Unidentified Blackbird	UNBL	4999
Unidentified Corvid	UNCR	4899
Unidentified Cuckoo	UNCU	3889
Unidentified Duck	UNDU	1399
Unidentified Finch	UNFI	5199
Unidentified Flycatcher	UNFL	4599
Unidentified Hawk	UNHA	3499
Unidentified Jay	UNJA	4799
Unidentified Meadowlark	UNME	5099
Unidentified Nuthatch	UNNU	7299
Unidentified Owl	UNOW	3799
Unidentified Sparrow	UNSP	5599
Unidentified Species	UNID	9999
Unidentified Swallow	UNSW	6179
Unidentified Thrush	UNTH	7599
Unidentified Vireo	UNVI	6299
Unidentified Warbler	UNWA	6399
Unidentified Woodpecker	UNWO	3999
Upland Sandpiper	UPSA	2610
Veery	VEER	7560
Vesper Sparrow	VESP	5400
Virginia Rail	VIRA	2120
Warbling Vireo	WAVI	6270
Western Kingbird	WEKI	4470
Western Palm Warbler	WPWA	6720
Whip-poor-will	WPWI	4170
White-breasted Nuthatch	WBNU	7270
White-throated Sparrow	WTSP	5580
White-winged Crossbill	WWCR	5220
Wild Turkey	WITU	4160
Wilson's Warbler	WIWA	6850
Willow Flycatcher	WIFL	4660
Winter Wren	WIWR	7220
Wood Duck	WODU	1440
Wood Thrush	WOTH	7550
Yellow-bellied Sapsucker	YBSA	4020
Yellow-bellied Flycatcher	YBFL	4630
Yellow-billed Cuckoo	YBCU	3870
Yellow-breasted Chat	YBCH	6830
Yellow-headed Blackbird	YHBL	4970
Yellow Rail	YERA	2150
Yellow-rumped (Myrtle) Warbler	MYWA	6550
Yellow-shafted Flicker	YSFL	4120
Yellow-throated Vireo	YTVI	6280
Yellow Warbler	YWAR	6520