Monitoring Birds in a Regional Landscape: Lessons from the Nicolet National Forest Bird Survey[1]

Robert W. Howe, Amy T. Wolf and Tony Rinaldi[2]

Abstract: The Nicolet National Forest Bird Survey represents one of the first systematic bird monitoring programs in a USDA National Forest. Volunteers visit approximately 500 permanently marked points biennially (250 each year) during a single weekend of mid-June. Results from the first 6 years provide a general inventory of the Forest's avifauna, documentation of geographic gradients, and evidence of significant bird-habitat relationships. The point count method has been designed to accommodate flexibility in data analysis. Birds are recorded in 0- to 3-, 3- to 5-, and 5- to 10-minute intervals to permit adjustment of count duration. Two sets of samples have been established, one (approximately 300 points) representing major habitat categories, the other (200 points) consisting of randomly chosen points along roadsides. Mean counts from the two sampling schemes are statistically different from one another, whereas results from the same sets of sites during different years are not significantly different. Birds of localized habitats such as wetlands are less abundant in the randomized samples. Our method departs most significantly from recommended standards by allowing several observers to participate in each point count. We recommend a modification of the original method to permit observations by only a single experienced observer during the formal point count.

Large-scale monitoring programs like the North American Breeding Bird Survey (BBS) provide critical information about the status of bird populations across their ranges (Robbins and others 1986). Such programs, however, cover only a minute fraction of the area inhabited by most bird populations. Additional monitoring needs exist on a local level, where land managers often wish to know more specific information about species distributions, critical habitats, and the effects of prescribed management activities. The supervisor of a wildlife refuge, for example, might want to know which habitats should be protected for the benefit of rare species. The staff of a public park might want to identify areas of particularly high species diversity for the enjoyment of visitors. Biologists in a National Forest might want to know whether viable populations of avian indicator species persist within the forest boundaries.

Controversies about National Forest management in northern Wisconsin (Kuhlmann 1990) have underscored the need for better information about local animal and plant populations. Because they are familiar and relatively well-studied elsewhere, birds have figured prominently in recent public debates over forest management policies. Indeed, of 32 management indicator species in the Nicolet National Forest, 25 are birds (USDA Forest Service 1986). In 1987, the Northeastern Wisconsin Audubon Society and USDA Forest Service staff organized a volunteer inventory to improve information about the status and habitat preferences of birds in the 270,000-ha Nicolet National Forest. Point counts are used to monitor approximately 300 habitat-based and 200 randomized points. Results are intended to guide ecologically sound decisions by Forest Service authorities and to help document the long-term effects of management practices.

A secondary aim of the Bird Survey is to provide an opportunity for people to become familiar with the Nicolet National Forest and its biota. This purpose leads to compromises from an ideal sampling scheme, insofar as field sampling teams include both highly skilled and less skilled observers. In the long-run, however, less skilled observers gain expertise for future bird surveys and help build an informed public constituency for participation in National Forest planning.

In this paper we present some results from the first 6 years of the Bird Survey and describe how the point count method is applied toward three specific objectives: (1) a geographic inventory of bird species, (2) an assessment of species' habitat associations, (3) long-term monitoring of regional bird population trends. These objectives are likely shared by many land managers, and therefore we hope that our experiences will provide direction for future (and perhaps even existing) bird monitoring programs.

Methods

Point Selection

Sample points were chosen to represent major habitat types within the Forest (*table 1*). Six habitat types defined by dominant tree species represent 77 percent of all points. An additional 44 subcategories provide a more detailed description of each site. For example, forest subcategories are based on age and tree species (e.g., "young red pine," "mature mixed hardwoods"). Other categories are subdivided on the basis of size and widely-recognized habitat definitions ("open bog," "large upland opening," "shrub swamp"). Whenever possible, these *habitat-based* survey points were established 100 m or more within the target habitat type in order to reduce contact with adjacent habitat types or open road corridors.

The number of sample points during the first 2 years was determined by the number of qualified observers (*table 2*). In order to maximize coverage, only one-half of the forest is sampled during a given year. Since 1989, we have established a sample of approximately 310 permanent habitat-based points (150 in the southern half of the forest, 160 in the northern

[1] An abbreviated version of this paper was presented at the Workshop on Monitoring Bird Population Trends by Point Counts, November 6-7, 1991, Beltsville, Maryland.

[2] Associate Professor, Department of Natural and Applied Sciences, University of Wisconsin-Green Bay, Green Bay, WI 54311; Graduate Student, Department of Natural and Applied Sciences, University of Wisconsin-Green Bay, Green Bay, W1 54311, Present Position: PhD candidate, Graduate Group in Ecology, University of California-Davis, CA 95616; and Wildlife Biologist, USDA Forest Service, Nicolet National Forest, Rhinelander, WI 54501

Table *1-General habitat groupings and subcategories used to describe survey points in the Nicolet National Forest Bird Survey. In some cases, subcategories are further divided to indicate the relative age of the forest, size of opening, or special habitat feature. Sites labeled South are located in the southern half of the forest; sites labeled North are located in the northern half of the forest.*

Habitat groupings	Sub-categories	Number of sites	
		South	North
Aspen and birch	4	24	24
Spruce and fir	6	8	9
Conifer (Pine and Hemlock)	9	26	30
Hardwood	4	37	44
Oak	2	7	3
Lowland conifer	4	13	17
Treeless wetland	4	17	10
Pond	2	2	3
Lake riparian	5	6	9
Stream riparian	2	3	2
Rural town	1	4	4
Upland opening	1	6	7
Total	44	153	164

half). All of these points and their road access are marked to ensure that the same points are sampled from year to year. This permits flexibility in habitat definitions for alternative classification schemes or as habitat conditions change over time.

Selection of the habitat-based sample points was biased by our desire to include a wide range of habitat types (some of which are geographically rare) and the requirement that the habitat surrounding each point is extensive enough (ideally >15 ha) to adequately represent the target habitat type. Extrapolation of results to the entire forest is complicated by this nonrandom method of point selection. In order to provide a more unbiased sample of regional bird populations, we selected an additional 100 *randomized* points during 1992 in the northern half of the Forest and another 100 randomized points during 1993 in the southern half of the Forest. Each of these new permanent points is located at the road nearest randomly selected geographic coordinates, without respect to habitat type or other geographic features. All locations have been incorporated into the National Forest's Geographic Information System (GIS) in Rhinelander, Wisconsin.

Field Methods

The annual Bird Survey takes place during a single weekend in mid-June. Volunteers work in teams, led by a skilled bird observer who is designated on the basis of: (1) past participation in the North American Breeding Bird Survey, (2) current research or professional experience with birds, or (3) bird identification skills that have been demonstrated to the project organizers through recommendations or personal experience. The leader is responsible for all bird identifications. Lack of a systematic testing process for group leaders can be seen as a weakness of the project and is a legitimate concern regarding the identification of rare or easily confused species. Fortunately, the program has attracted some of the State's best birders.

Many people who wish to participate in the Bird Survey are not skilled enough in bird identification to conduct point counts on their own. In order to include these volunteers, the establishment of field teams was seen as a practical alternative. This approach has the secondary benefit of providing experience for nonleaders who eventually might acquire the expertise needed to lead a group of their own. We recognize that the use of field teams (rather than single observers) creates difficulties for comparisons with other studies, although in practice few bird detections are contributed by nonleaders.

Each morning, teams are assigned 5 to 6 habitat-based survey points and 3 to 4 randomized roadside points. Point counts are conducted between dawn and approximately 9 a.m. (Approximately 10 wetland or riparian sites, accessible only by canoe, are occasionally sampled during early evening if the number of observers is inadequate to cover them earlier.) At each point all birds seen or heard are recorded during a 10-minute period or, in the case of randomized points, a 5-minute period. With the help of preprinted data forms (*fig. 1*), the first detection of each bird (individual) is recorded within one of three time intervals (0 to 3 minutes, 3 to 5 minutes, 5 to 10 minutes) and one of two status categories: (1) within the target habitat or (2) flying over, or within an adjacent nontarget habitat. These distinctions permit flexibility in data analysis to conform with other studies or

Table 2--*Summary of general results from the Nicolet National Forest Bird Survey. Cumulative numbers of species include all birds recorded during the Bird Survey point counts through the year indicated*

	1987	1988	1989	1990	1991	1992
	South	North	South	North	South	North
Total number of points	65	116	151	159	150	156
Total number of species	95	120	108	118	103	114
Total number of species recorded in >1 count	65	89	89	89	87	85
Number of species recorded at >10 percent of sites	34	23	32	25	26	23
Mean number of individuals/count	15.5	12.4	14.0	14.0	14.1	14.2
Cumulative number of species	95	133	140	149	150	153

NICOLET NATIONAL FOREST BIRD SURVEY

FORM A

Site #:_____ Habitat Type:_____ Date:_____

Group Expert(s):_____ Marker Located? Yes No Time:_____

Wind: calm light moderate strong Temp.: <40 41-50 51-60 61-70 >70

Sky Conditions: clear partly cloudy mostly cloudy overcast foggy lt. rain/drizzle

w/in target habitat type	not in habitat (flying over, in adjacent habitat)
3 min.	
5 min.	
10 min.	
Species encountered to/from site:	

CENSUS SUMMARY

(birds in target habitat only)

Species	Code	3	5	tot.	seen?		Species	Code	3	5	tot.	seen?

Notes:

Figure 1--Sample data form used in the Nicolet National Forest Bird Survey. Horizontal blocks indicate time when individuals were first detected (3 minutes = 0 to 3 minutes, 5 minutes = 3 to 5 minutes, 10 minutes = 5 to 10 minutes).

to compare counts from habitat-based points with the randornized 5-minute counts. Bird detections also are recorded on a circular map to help estimate the abundance of common species.

Data Management

Completed data forms are returned to site envelopes and eventually filed at the Nicolet National Forest headquarters in Rhinelander. Forest Service personnel or volunteers enter the results in a computerized data base which is interfaced with the Nicolet National Forest's Geographic Information System (GIS). Each survey locality has been digitized in the GIS, where it is supplemented by information about vegetation features, site history, and geographic characteristics. Bird records are entered as observations of individual species at individual points during a single year. For example, the observation of two Red-eyed Vireos (*Vireo olivaceous*) at Site 135 during 1991 would represent a single record in the data base. This scheme permits us to sort the data by species, site, year, or any combination of these categories. Counts for each species are entered into fields representing the time of observation (0 to 3 minutes, 3 to 5 minutes, or 5 to 10 minutes) and whether or not the bird occurred in the target habitat.

Results

Inventory

Before this Bird Survey no systematic inventory of breeding birds in the Nicolet National Forest had been reported. Information was available from local experts and Breeding Bird Survey routes within the Forest, but none of these sources could give a comprehensive picture of Forest birds.

As of 1992, 153 species had been recorded during the point counts, and additional species were reported at other times during the survey weekends. Results (*table* 2) show that the majority of breeding bird species are uncommon, encountered during fewer than 10 percent of the point counts. During individual counts, most species (66 percent of 5758 detections) have been represented by only one individual; only 12 percent of all species recorded during a given point count were represented by three or more individuals. These proportions are nearly identical for both the northern and southern halves of the Forest (*fig. 2*).

Early morning point counts might be expected to underrepresent or miss certain species altogether. Nocturnal species, for example, are rarely recorded. Nevertheless, over the course of 6 years and 910 point counts, even some of the

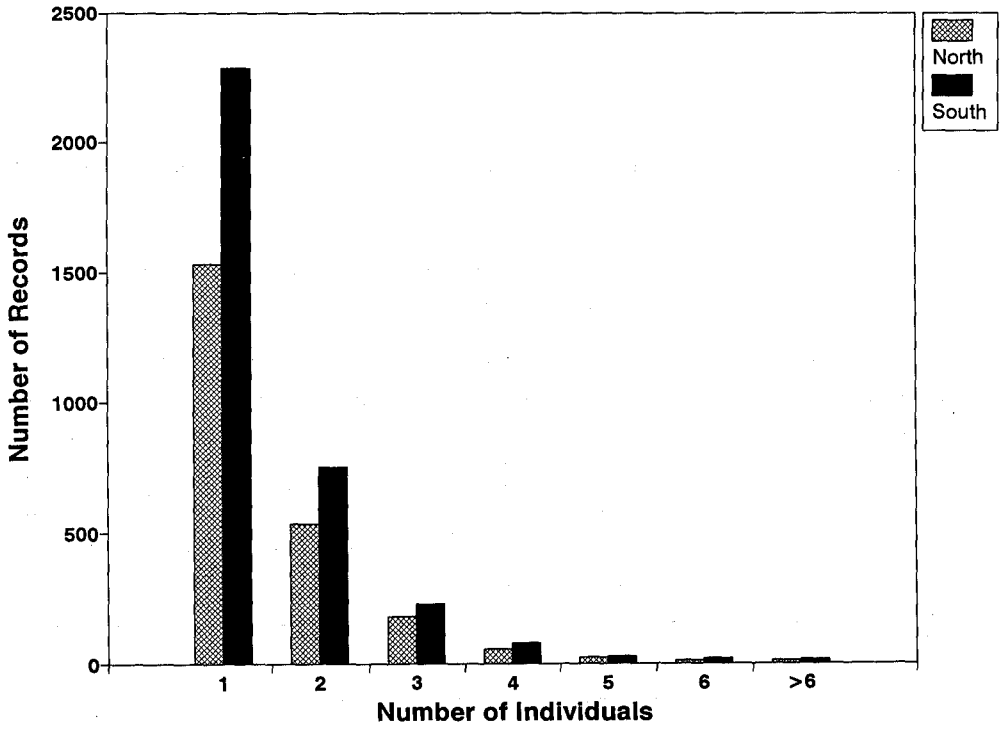
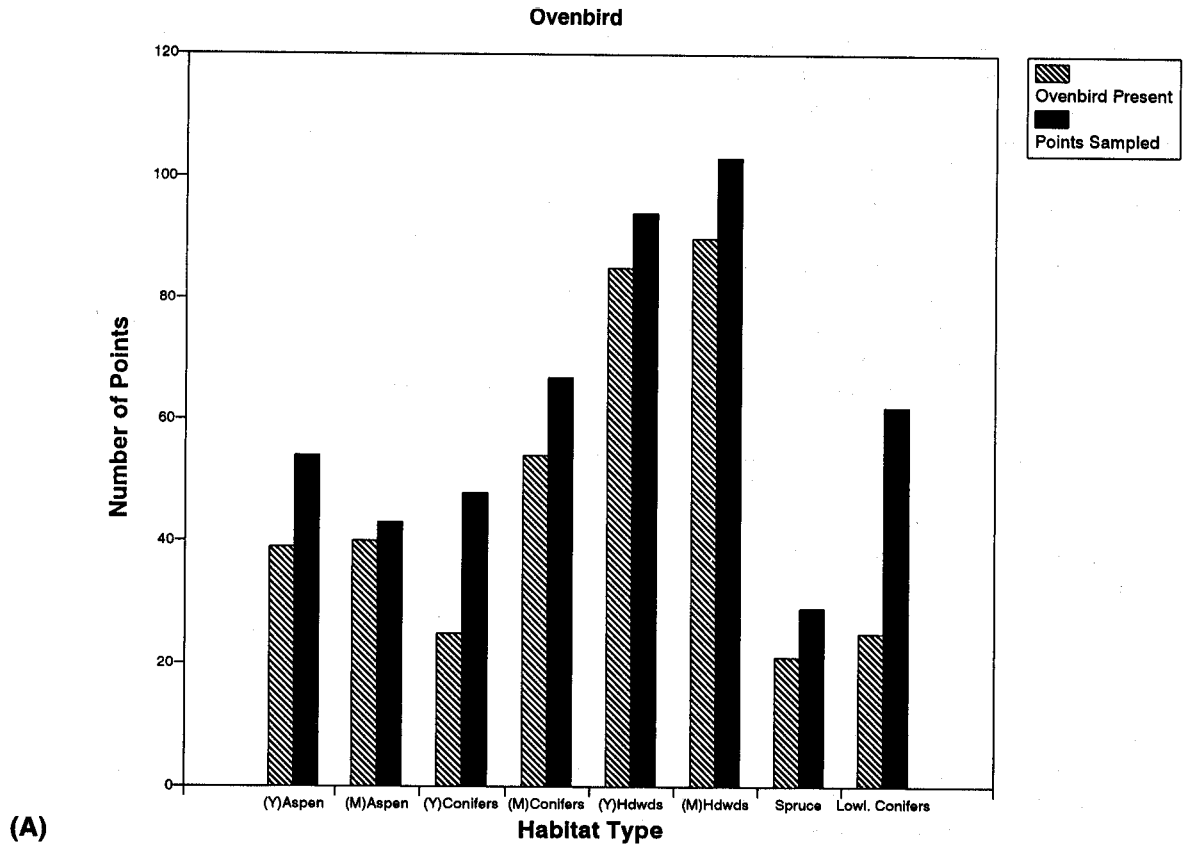


Figure 2--Relative abundance of species detected during point counts of the Nicolet National Forest Bird Survey (1987-1991). Number of records refers to the number of species detections represented by 1, 2, 3, 4, 5, 6, or >6 individual birds. Detection of three Ovenbirds in a single point count, for example, would add one record to the column labeled 3



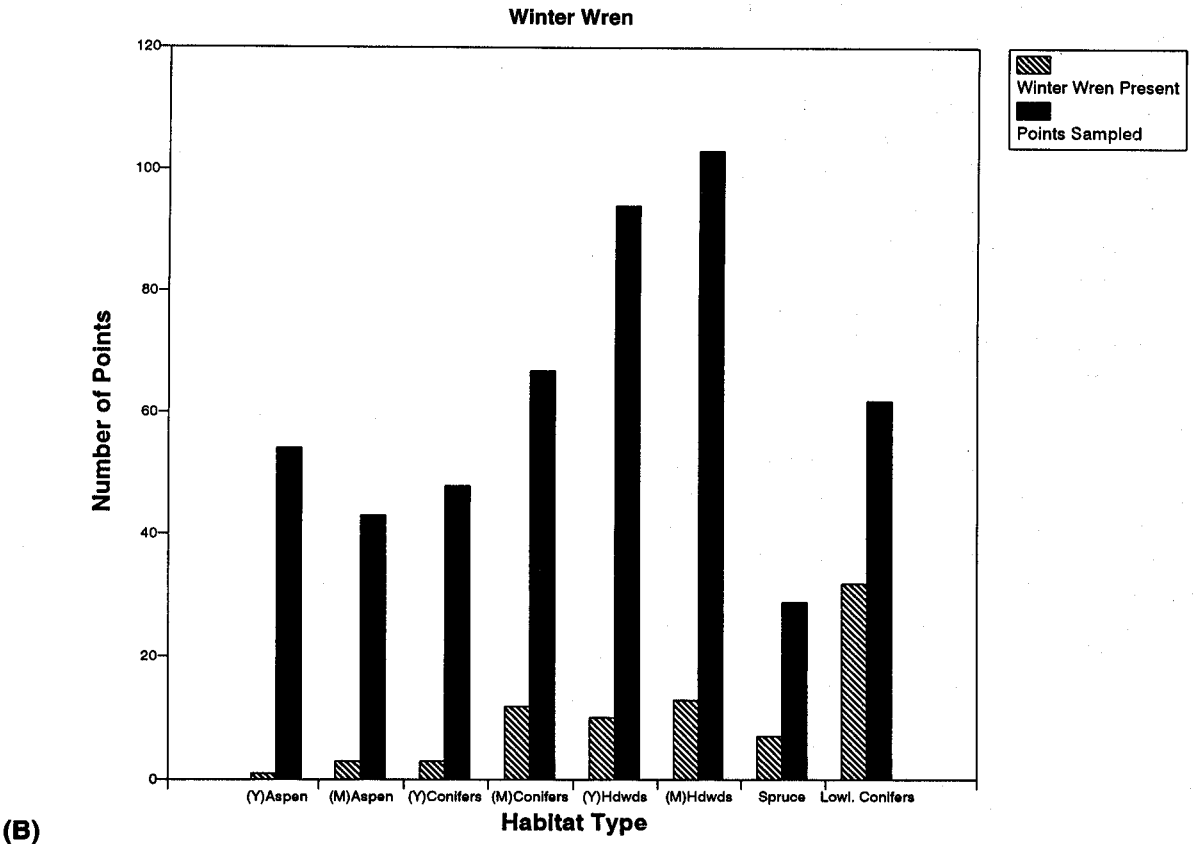


Figure 3--Distribution of Ovenbirds (A) and Winter Wrens (B) among major forest habitats in the Nicolet National Forest. Sites are characterized by the habitat categories given in *table 1* with separation into young (*Y*) and mature (*M*) stands

Forest's rarest species have been encountered, including Northern Saw-whet Owl (*Aegolius acadicus*), Red-shouldered Hawk (*Buteo lineatus*), Northern Goshawk (*Accipiter gentilis*), Yellow Rail (*Coturnicops noveboracensis*), Black-backed Woodpecker (*Picoides articus*), and Connecticut Warbler *(Oporornis agilis*). Several species such as Whip-poor-will (*Caprimulgus vociferus*), Merlin (*Falco columbarius*), and Spruce Grouse (*Dendragapus canadensis*) are known to reside in the Forest but have yet to be recorded during the 10-minute point counts; all of these have been observed at least once by participants going to or from their survey points, however, and their presence has been noted in a qualitative list of species observed during the Bird Survey weekend. Only a handful of species likely to breed in the area, including Great Gray Owl (*Strix nebulosa*), Red Crossbill (*Loxia curvirostra*), and White-winged Crossbill (*Loxia leucoptera*), have never been recorded during the Bird Survey weekends.

Habitat Associations

With the exception of aquatic birds, no species recorded consistently during the Bird Survey has been restricted to a single habitat category (as we have defined them). Most species occur in a rather wide range of structurally similar vegetation types. Habitat associations can be tested by comparing observed frequencies of birds with expected frequencies based on the numbers of point counts in the respective habitat types. Ovenbirds, the most widespread species in the Forest, have been recorded regularly in every forest habitat category (*fig. 3a*). Nevertheless, the observed distribution is statistically nonrandom (χ^2 = 19.1, df = 7, P <0.025). Winter Wrens (*Troglodytes troglodytes*) (*fig. 3b*) show a highly nonrandom distribution among habitat types (χ^2 = 67.8, P <0.001, n = 83) because of their affinity for lowland conifers where individuals were recorded at 32 of 62 sites, compared with an expected frequency of 9.22. Scarlet Tanagers (*Piranga olivacea*), on the other hand, show no statistically significant habitat preferences among major forest types (χ^2 = 7.98, P >0.25, n = 81).

Geographic Patterns

Forest Service biologists and planners are interested in the bird species composition at specific localities for assessing the effects of timber harvest or other management activities. Presence or absence of bird species at these sites can be predicted by patterns of habitat association. These predictions are not always reliable, however, because species sometimes occur in atypical habitats or are missing from habitats which are otherwise characteristic. Pine Warblers (*Dendroica pinus*), for example, show a clear preference for pine forests (χ^2> 3;84, P <0.05, 2x2 contingency test), but over the first 6 years of the Bird Survey, Pine Warblers have been recorded at only 13 of 55 points in pine-dominated forests. Predictions of local bird species composition can be improved by considering geographic patterns in addition to habitat associations. Results of our Bird Survey document two types of geographic patterns:

1. Over a distance of only 100 km, 16 species show statistically significant geographic trends in abundance (χ^2> 3.84, P <0.05, 2x2 contingency test). Yellow-billed Cuckoo (*Coccyzus americanus*), Great Crested Flycatcher (*Myiarchus crinitus*), Northern Oriole (*Icterus galbula*), Purple Finch (*Carpodacus purpureus*), Indigo Bunting (*Passerina cyanea*), Scarlet Tanager, Brown Thrasher (*Taxostoma rufum*), and Wood Thrush (*Hylocichla mustelina*) occur more frequently in the southern half of the forest; Mallard (*Anas platyrhynchos*), Olive-sided Flycatcher (*Contopus borealis*), Least Flycatcher (*Empidonax minimus*), White-throated Sparrow (*Zonotrichia albicollis*), Song Sparrow (*Melospiza melodia*), Black-throated Blue Warbler (*Dendroica caerulescens*), Chestnut-sided Warbler (*Dendroica pensylvanica*), and Black-throated Green Warbler (*Dendroica virens*) occur more frequently in the northern half of the Forest. Based on this information, protection of bogs in the northern half of the Forest, for example, will have a more positive effect on Olive-sided Flycatchers than will protection of bogs in the southern half of the Forest.

2. In addition to latitudinal patterns, results from the Bird Survey help identify centers of abundance for certain species. Northern Waterthrushes (*Seiurus novaboracensis*) typically favor wet lowland or riparian forests (Robbins 1991), but they are absent from many such areas in northern Wisconsin (*fig. 4*). Where they have been found, waterthrushes often are one of the most conspicuous and locally abundant species. Management efforts for such species obviously will be most effective if they are aimed at, or near, areas where the birds have been documented, not simply areas of appropriate habitat.

Population Trends

Overall abundances of bird species (*table 3*) generally vary less than 5 percent between years; mean variation in frequency for the 20 most abundant species was 3.9 percent between 1989 and 1991 (southern half of the forest), and 5.5 percent between 1990 and 1992 (northern half of the forest). The most striking irregularities in abundance were unusually high numbers of Rose-breasted Grosbeaks (*Phaucticus ludovicianus*) and Scarlet Tanagers during 1989 and relatively high numbers of Red-eyed Vireos in 1992.

Despite consistency on a large scale, results from individual points show considerable variation over time. On average, only about one-half of the birds recorded during the first year are counted at the same locality 2 years later (mean similarity = 47.6 percent, s.d. = 19.7). This suggests that even 10-minute point counts offer only a snapshot of the local bird community and cannot substitute for intensive inventories if one is interested in the bird species composition at a specific site.

Other Findings

Several of our results have relevance for the design of bird monitoring programs. Like other authors in these Proceedings (e.g., Buskirk and MacDonald), we found that species are added to point counts according to a nonlinear function of diminishing returns (*fig. 4*). On average, 64 percent of the bird species recorded during our 10-minute counts in forest habitats were detected during the first 3 minutes (n = 217, 1989 and 1991); 63 percent were recorded during

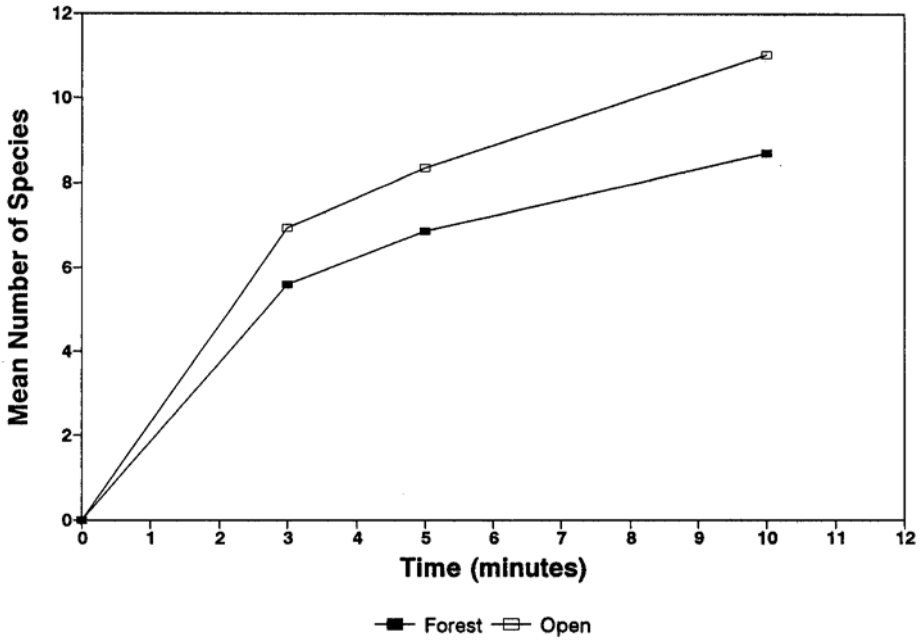


Figure 4--Increase in the number of species detected as duration of point count time increases from 3 to 10 minutes. Data are derived from 1987 and 1991 counts in the southern half of the Nicolet National Forest (*n* = 217 for forest habitats, 53 for open habitats, including treeless wetlands and grasslands).

the first 3 minutes in open habitats (*n* = 53). During the first 5 minutes, 79 percent and 76 percent of the species were recorded in forest and open habitats, respectively. As the count duration is increased, samples become complicated by movements of birds into the detectability range. We found that wide-ranging species like American Goldfinch (*Cardeulis tristis*), American Robin (*Turdus migratorius*), Cedar Waxwing (*Bombycilla cedrorum*), Scarlet Tanager, and woodpeckers were detected more frequently in the second 5 minutes of our 10-minute counts than expected according to the proportion of all species encountered (χ^2> 3.84, P < .05, 2x2 contingency test). Species like Red-eyed Vireo, Black-throated Blue Warbler, Least Flycatcher, and Winter Wren were disproportionately more abundant in the first 5 minutes. This implies that two 5-minute counts at separate points are not equivalent to a single 10-minute count, even if bird distributions are uniform in space, because the 10-minute counts will include a higher proportion of wide-ranging birds.

The distribution of species in the randomized sites (*figure 5*) differed significantly from the distribution of species in the original habitat-based sites during 1992 (χ^2 = 37.10, P <0.05, df = 19, 2x2 contingency test comparing frequencies of the 20 most abundant species). Comparisons of species distributions from year to year (1988 versus 1990, 1990 versus 1992) at the habitat-based sites showed no corresponding difference (χ^2< 17.0, P >> 0.05). Our original site selection process was biased to ensure representation of localized habitats such as wetlands and openings. As a result, species like Song Sparrow, Common Yellowthroat (*Geothlypis trichas*), and Swamp Sparrow (*Melospiza georgiana*) were represented much less frequently among the randomized sites than they were among the habitat-based sites. Typical forest species like Red-eyed Vireo, Ovenbird (*Seiurus aurocapillus*), Black-throated Green Warbler, Yellow-bellied Sapsucker (*Sphyrapicus varius*), and Scarlet Tanager were more frequent in the randomized sample. Interestingly, birds of forest edges or openings-like American Robin, Chestnut-sided Warbler, Mourning Warbler (*Opornis philadelphia),* American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), and Indigo Bunting-also were significantly more frequent in the randomized samples (χ^2 > 3.84, P < 0.05, 2x2 contingency test), suggesting that the location of randomized sites along roads affected the relative abundance of species in our results.

Discussion

The Nicolet National Forest Bird Survey was designed without the guidance of national or international standards such as those presented in this volume. Although flexibility was built into our methods to allow analysis of 3-, 5-, or 10-minute counts, several features of our Bird Survey depart from the newly recommended standards. Multiple observers were permitted because many nonexperts were interested in taking part in the project. The effects of extra observers are not known, although in practice most if not all detections of

Table 3--*Species recorded most frequently in Nicolet National Forest Bird Survey. Percent of occurrence indicates the percentage of all points sampled during a given year in which the species was recorded. Sites labeled South are located in the southern half of the forest, sites labeled North are located in the northern half of the forest*

	Percent occurrence					
	South			North		
Species	1987	1989	1991	1988	1990	1992
Ovenbird	71	69	69	54	61	56
Red-eyed Vireo	51	57	61	48	43	64
American Robin	26	30	31	34	35	37
Rose-breasted Grosbeak	32	48	29	23	27	32
Blue Jay	43	35	28	15	25	21
Hermit Thrush	20	38	31	17	27	33
White-throated Sparrow	29	26	25	37	37	39
Black-capped Chickadee	23	27	27	19	21	20
Black-throated Green Warbler	32	21	20	28	35	32
Chestnut-sided Warbler	6	13	18	19	33	26
Least Flycatcher	16	16	18	27	26	20
Nashville Warbler	19	21	17	12	26	22
Song Sparrow	23	17	17	21	25	33
Veery	15	21	18	11	16	12
Great Crested Flycatcher	29	23	19	9	10	8
Eastern Wood-Pewee	20	19	19	18	13	15
Mourning Warbler	14	18	13	13	15	21
Common Yellowthroat	25	14	15	16	17	19
Cedar Waxwing	14	17	22	9	10	16
Scarlet Tanager	11	24	15	8	9	10

birds are identified by the single group leader. Extra observers have stimulated a broad level of interest and camaraderie that has helped sustain the volunteer project over 6 years.

Selection of sites based on habitat has introduced a bias in the relative abundance of species among sample points. This procedure was employed because forest managers were interested in predicting the effects of logging and other management activities on bird populations of specific habitat types. For the same reason, our original sample points are generally located away from roads at least 125 m within the target habitat. Despite our intentions, the highly heterogeneous nature of the Forest and the small size of many forest stands have meant that many of our habitat-based sample points actually represent a mixture of habitat types. The inaccuracy of mapped forest descriptions also has introduced some complications. More detailed descriptions of habitats surrounding our sample points are needed; at least one such study is underway and others are facilitated by the fact that points are permanently marked and mapped within a computerized geographic information system.

During 1992, the addition of approximately 100 randomized points along roads proved to be well within the capacity of available volunteers and time. The addition of 100 more sites during 1993 gave us two parallel samples (habitat-based sites versus randomized sites) for comparisons with other studies. Comparison of these two alternative sampling schemes shows that selection of sample points can have a statistically significant influence on the documented relative abundances of birds. Species of rare or localized habitats like wetlands are underrepresented in the random samples. Since these species are significant for management considerations, we will continue to sample both habitat-based sites and randomized points.

Other departures from recommended standards are relatively minor or can be corrected by analysis of existing data. For example, census duration can be adjusted from 10 to 5 minutes by simply excluding birds first detected during the second 5 minutes of our counts. Evening counts have been permitted for inaccessible wetlands, but these sites comprise such a minor part of our data base that they can be ignored if desired. We will continue to sample the inaccessible sites whenever possible because they contribute to the inventory function of the survey by covering habitats that would not otherwise be represented.

From the very start, planners of the Bird Survey hoped that the project would not only provide information for local

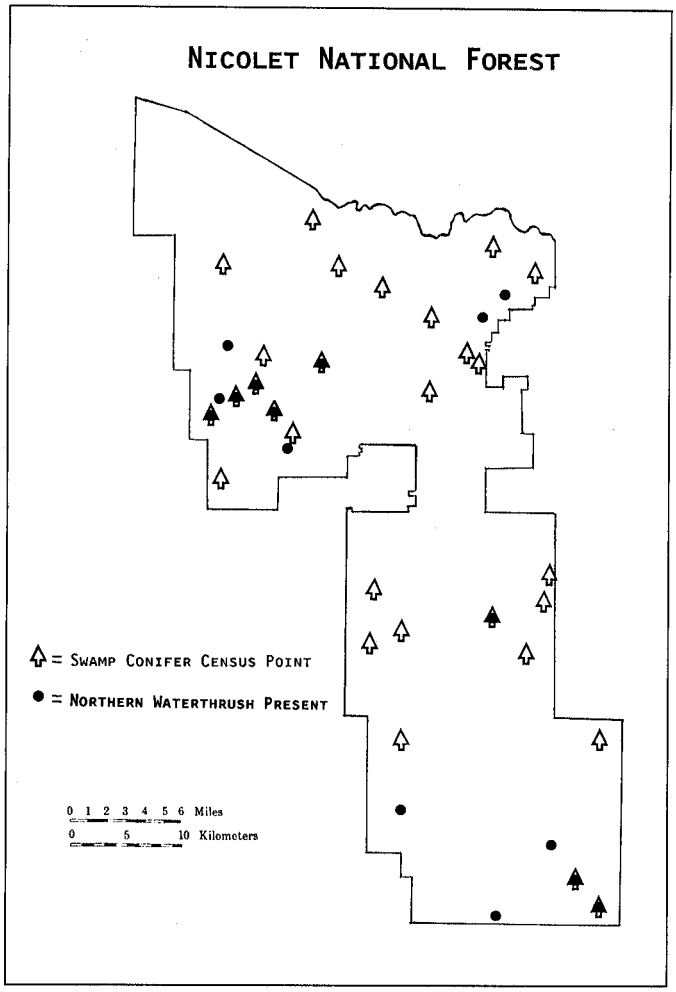


Figure 5--Geographic distribution of Northern Waterthrushes and swamp conifer habitats in the Nicolet National Forest. Solid circles that are not associated with a tree figure represent occurrences of Northern Waterthrushes in other habitats, including shrub swamp,

applications, but would also contribute to larger scale bird monitoring programs. We have succeeded in maintaining flexibility of census duration and already have modified the site selection process. We expect to introduce other changes that will facilitate comparisons with other surveys. Complications due to multiple observers, for example, might be minimized by the following: detections by only a single observer can be included in the formal point count. Observations by other participants can be added to a separate list, just as we separately record birds that are seen before and after the formal 10-minute count period. These extra records will help characterize local bird assemblage for local considerations but will not affect larger scale comparisons between point counts.

If we assume that birds can be detected within an average 150 m (Wolf and others, in this volume), the Bird Survey covers about 1.3 percent of the 270,000 ha Nicolet National Forest, more than 10 times the coverage of larger scale programs like the North American Breeding Bird Survey (Robbins and others 1986). Overall the Forest's common diurnal birds are now well documented and their observed relative abundances (*table 4*) are consistent with results from other recent studies (Hoffman and Mossman 1990, Keller, unpublished data, Mossman and others 1990, Robbins 1991, Schneider 1992). The Bird Survey also has adequately documented north-south patterns of abundance for numerous species. Patterns of habitat association also have been demonstrated, but in many cases they are less obvious than geographic patterns. In some cases (e.g., Scarlet Tanager), no habitat association has been documented beyond the species' obvious preference for forests. A finer analysis of bird-habitat associations certainly is appropriate for meeting the Bird Survey's objectives.

Only about one-half of the species recorded at a given site (on the average) have been recorded during the next visit 2 years later. Such a high degree of variation makes it difficult to establish the resident status of species at specific sites. Many sources are likely responsible for this variation, including the fact that different observers may visit sites during different years; the exact locality, prior to establishment of permanent markers, might have been different from one count to the next; and, of course, the birds themselves move to and from sites in the course of their daily activities and population dynamics. As a result of these factors, our point counts do not provide adequate descriptions of birds at specific localities, but results from many years provide at least general sketches

Table 4--*Comparison of frequencies for the 20 most abundant species in habitat-based sites versus randomized sets of point counts during 1992. The percent of occurrence indicates the percentage of all sample points where the species was recorded. For the sake of comparison, results include only species recorded during the first 5 minutes of the count.*

Species	Percent occurrence	
	Habitat-based	Randomized
Red-eyed Vireo	60	77
Ovenbird	51	83
White-throated Sparrow	36	43
Hermit Thrush	29	37
Song Sparrow	29	19
Black-throated Green Warbler	26	41
American Robin	25	56
Least Flycatcher	25	29
Chestnut-sided Warbler	24	47
Rose-breasted Grosbeak	24	39
Nashville Warbler	19	22
Mourning Warbler	17	30
Black-capped Chickadee	16	23
Blue Jay	15	24
Common Yellowthroat	15	6
Winter Wren	14	18
Eastern Wood-Pewee	13	16
Swamp Sparrow	12	3
Yellow -rumped Warbler	11	14
Cedar Waxwing	10	12

of local avifaunas. For example, presence of Winter Wrens during four of five biennial counts would argue that the species is typically resident at that site. Observations of birds before or after the formal count period can be very important also in describing the local bird community. This information should not be discarded because many applications (e.g., environmental impact analysis, site planning, etc.) require only a description of the birds at sites of interest. Such results, however, cannot be considered a substitute for detailed site inventories.

In summary, point counts of 5- or even 10-minute duration provide only a snapshot of the local bird community. Like a photograph, longer exposures (count durations) permit finer resolution of these bird communities, but the image becomes increasingly vulnerable to blur caused by movements of birds into or out of the count area. The most significant contribution of monitoring programs like the Nicolet National Forest Bird Survey is the documentation of larger scale patterns, which produce a clearer overall picture of the avifauna; these patterns, in turn, can be used to predict the composition of birds at sites of interest. As the project is continued over many years, the large-scale picture will become clearer and the reliability of site-specific predictions will almost certainly improve.

Acknowledgments

The Nicolet National Forest Bird Survey has been developed through the efforts of many individuals, including John Braastad, Denise Friedrick, Michael Grimm, Terrie Howe, Joseph Kastenholz, Gerald Lemerond, Thomas Matthiae, Jennifer Nieland, William Reardon, Michael Reed, Michael Peczynski, John Probst, Gary Zimmer, and more than 100 volunteer participants. Funding for the project, including data analysis, has come from the Nicolet National Forest and the North Central Forest Experiment Station of the USDA Forest Service and the University of Wisconsin-Green Bay.