



RESULTS OF THE 1994 BREEDING BIRD SURVEY:
ISLE ROYALE NATIONAL PARK, MICHIGAN

RESOURCE MANAGEMENT REPORT 94-1

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ABSTRACT

Point counts were conducted from 13 June to 1 July 1994 to establish a data base on the relative abundances of neotropical migrant landbirds in Isle Royale National Park. Transects were established using six of the park's trails, along which a total of 75 points were plotted among eight different habitats using the stratified random sampling method. Each point was visited for one ten-minute period during which time all bird species seen and heard were recorded.

A total of 1008 birds comprising 56 species were identified. Aspen forests (ASP) had the highest number of species (45, or 79% of the total), while fir forests (FIR) had the lowest number (13, or 23%). The Mt. Ojibway transect (MTOJ) had the highest number of species among the transects (41, or 75%), while Passage Island (PASS) had the lowest (13, or 23%). The Simpson's Index was used to calculate diversity values for each transect and habitat. The central part of the island (MTOJ transect) showed the highest diversity (0.94 ± 0.03), while the west end (WIND transect) had the lowest (0.87 ± 0.08).

Future monitoring through point counts will help delineate any trends in species abundances, and suggestions are given that should provide for reliable data on which to base conclusions and future action plans.

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Neotropical migrants (birds that breed in North America and winter in the "new tropics," such as Mexico, Central and South America, and the Caribbean Islands) have been shown to be declining by numerous authors (see Hagan and Johnston 1992 or Finch and Stangel 1993 for an overview). Loss of habitat on the wintering grounds as well as in North America have been cited as two of the major causes for this decline and are only the impetus for a host of other problems that result, such as increased nest predation and nest parasitism (Terborgh 1992). The complex problems surrounding this issue have led to numerous projects being conducted both here in the United States and in the tropics.

A 1988 amendment to the Fish and Wildlife Conservation Act (P.L. 100-653) directs the Secretary of the Interior to undertake research and conservation activities to benefit migratory nongame birds (Senner 1993). Under this charge, the National Park Service can now play an active role in the conservation of neotropical migrants and has begun to do exactly that in the form of simple monitoring projects (e.g. Van Stappen and Doolittle 1992).

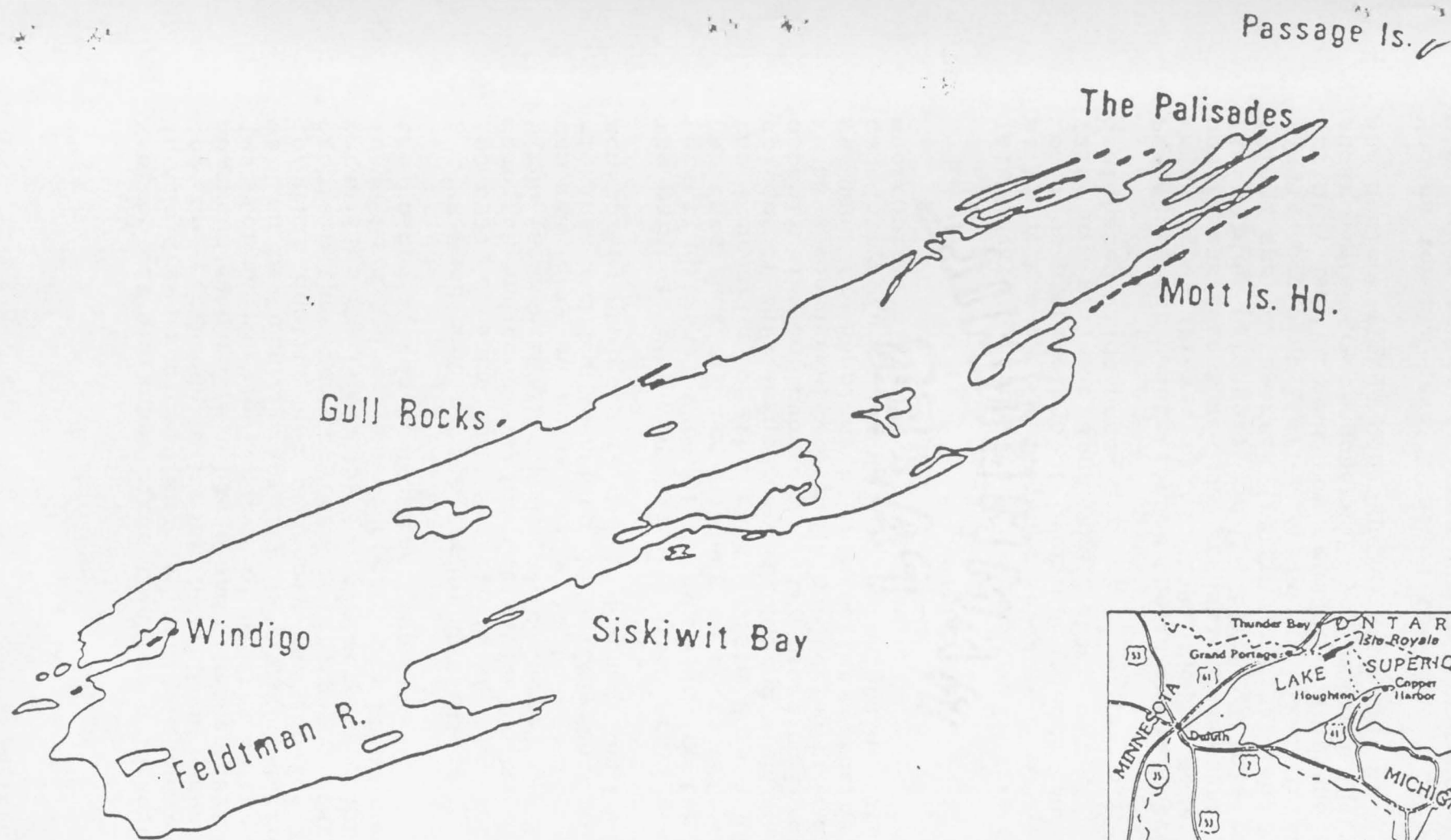
The national parks of America often provide a unique setting for this traditional type of study, allowing for surveys in numerous habitats that are not subject to certain forces that lie outside the boundaries of the park. Isle Royale National Park is the epitome of this unique condition, and with the fundamental goal of establishing an inventory of the breeding landbirds on the island, we have concurrently begun a monitoring program that can hopefully be used to supplement information gathered by the scientific community in attempting to maintain future populations of neotropical migrants.

STUDY AREA

Isle Royale National Park is located in Lake Superior, 118 km (73 mi.) northwest of Michigan's Keweenaw Peninsula (Fig. 1). It is a roadless archipelago of over 400 islands, encompassing 544 sq. km (210 sq. mi.) of land and water, 99% of which is federally-designated wilderness.

Presettlement vegetation of the island reportedly consisted of two major types (Brewer et al. 1991, McKaig 1978). A boreal and wet coniferous forest was the predominant community composed of balsam fir (Abies balsamea), white birch (Betula papyrifera), spruces (Picea spp.), tamarack (Larix laricina), and northern white-cedar (Thuja occidentalis). A mesic mixed forest occurred almost strictly on the southwest end of the island and was composed of sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis), and hemlock (Tsuga canadensis) (See Fig. 2).

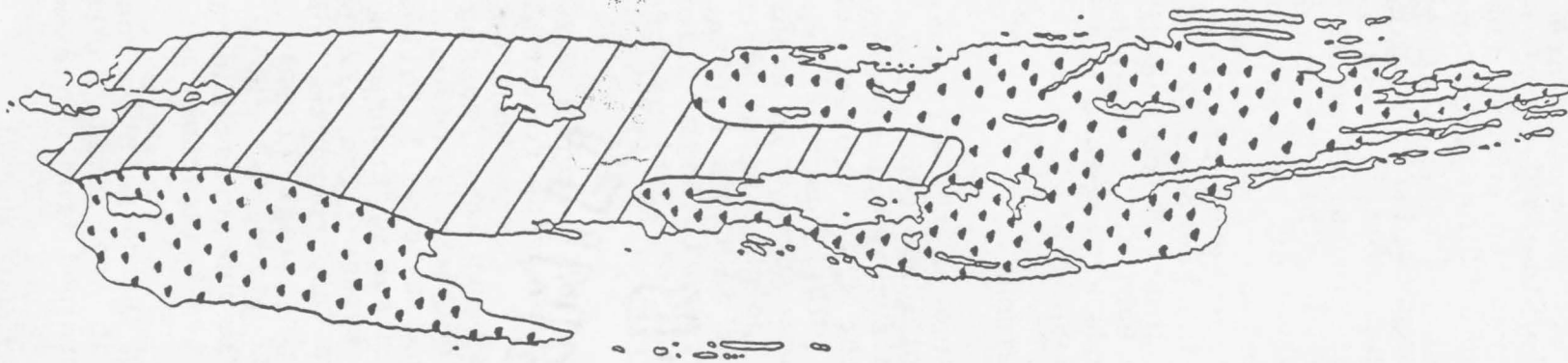
Modern forests have retained the same two communities with only minor differences in tree species present. The boreal forest, found at the lower elevations, is primarily composed of balsam fir,



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Figure 1: Isle Royale National Park, Keweenaw Co., MI. Inset: Location of Isle Royale in Lake Superior. Taken from U.S. Government publication. Inset from U.S. Geological Survey topographic map--National Park series.



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Figure 2: Presettlement vegetation of Isle Royale National Park (ca. 1847). Stippled area represents boreal and wet coniferous forest. Diagonal lines indicate a mesic mixed forest. Based on a map by McKaig 1978.

paper birch (Betula papyrifera), and white spruce (Picea glauca) with northern white-cedar (Thuja occidentalis) and quaking aspen (Populus tremuloides) interspersed among them (Slavick and Janke 1993). Common tall shrubs in this community are the thimbleberry (Rubus parviflorus) and mountain alder (Alnus viridis). The second type, found primarily on the western end of the island, is the sugar maple-yellow birch forest. Other tree species found here include red maple (Acer rubrum) and red oak (Quercus rubra), and the ground cover is typically composed of young maple species. A third community, a conifer swamp habitat, exists in the lowlands which parallel the longitudinal ridges (Slavick and Janke 1993). These areas are primarily composed of black spruce (Picea mariana) and northern white-cedar. Moreover, a mid-successional stage forest exists in the central portion of the island from Lake Desor south and east along the northern edge of Siskiwit Lake, south along the Lake Superior shoreline and east to Moskey Basin (Fig. 3). Referred to as the "1936 burn area" for the fire that consumed 27,000 acres in that year, this habitat is characterized by stands of aspen and birch in the lowlands with spruce and jack pine (Pinus banksiana) on the ridges (Shelton 1975).

METHODS

In order to establish a database on the diversity and relative abundances of neotropical migrant landbirds on Isle Royale National Park, Michigan, a breeding bird survey was conducted from 13 June to 1 July 1994. Objectives for this project were: (1) using Geographic Information Systems (GIS), describe important breeding bird habitats in the park and focus surveys in major upland habitat types; (2) through the use of point counts, determine relative abundance and diversity of birds in these habitats; and (3) use this data and that of future surveys to begin a long-term project that will monitor trends in the populations of upland forest breeding birds.

Selection of study sites--Eight habitat types were designated as focal areas through the GIS program: aspen forest (ASP), aspen-fir forest (AF), fir forest (FIR), swamp conifer (SC), upland brush/grass/rock (UBGR), lowland brush/marsh/muskeg (LBMM), yellow birch/fir forest (YBF), and northern hardwoods forest (NH). General descriptions of these habitats will follow. Six of the park's trails were then chosen as survey transects based on their presence in ≥ 2 of the habitat types. The six transects were: Passage Island (PASS), ThreeMile Campground to Lane Cove (TMLC), Mt. Ojibway Loop (MTOJ), Ishpeming Trail (ISTR), Feldtmann Lake (FELK), and Windigo (WIND). Locations of these transects are indicated in Figure 4, and Table 1a summarizes the habitats present and number of points on each of the transects.

The GIS program plotted suggested census points along the transect maps based on their presence in the focal habitats. Points actually used were randomly determined from these using the



Figure 3: 1936 burn area, Isle Royale National Park, Michigan. See text for details.



Figure 4: Location of transects used during 1994 survey on Isle Royale NP. 1= PASS, 2= TMLC, 3= MTOJ, 4= ISTR, 5= WIND, and 6= FELK.

stratified random sampling method. A total of 83 points were plotted, all of which were $\geq 150\text{m}$ apart from each other (Table 1b). Aspen (ASP) forests are dominated by quaking aspen and paper birch, but may also have balsam fir and white spruce in the understory. This habitat is most common along the MTOJ and TMLC transects, but is also encountered on the ISTR and PASS transects.

Table 1a: Habitats present and number of points at each transect. Key to field names given in text. Total number of points = 75.

<u>TRANSECT</u>	<u>HABITATS</u>	<u>NO. OF POINTS</u>
MTOJ	ASP, LBMM, UBGR, SC	17
TMLC	FIR, SC, LBMM, ASP AF, UBGR	15
FELK	LBMM, YBF, UBGR, SC	15
WIND	SC, NH	13
ISTR	ASP, FIR, UBGR	9
PASS	AF, UBGR, ASP	6

Table 1b: Number of points surveyed in each habitat.

<u>HABITAT</u>	<u>ACRES IN PARK</u>	<u>NO. OF POINTS</u>
Aspen (ASP)	56400.77	25
Northern Hardwoods (NH)	11438.85	12
Upland Brush/ Grass/Rock (UBGR)	7687.80	9
Yellow Birch-Fir (YBF)	6050.12	9
Lowland Brush/ Marsh/Muskeg (LBMM)	9360.17	6
Swamp Conifer (SC)	12664.00	6
Aspen-Fir (AF)	25900.65	5
Fir (FIR)	2756.30	3

Aspen-fir (AF) habitats are a mix of aspen, birch, and maturing stands of conifers, typically balsam fir and white spruce. These are forests in which the aspen-birch forest is mature, dying, and being replaced, or exhibiting overstory competition from the conifers. This habitat type is seen on the PASS and TMLC transects.

Fir (FIR) habitats are dominated by balsam fir and spruce and lack any deciduous species. The understory is typically composed of balsam fir saplings. This type of habitat is found along the TMLC and ISTR transects.

Swamp conifer (SC) habitats are typically the white-cedar forests found in wet/swampy areas, and are found along the TMLC, MTOJ, ISTR, FELK, and WIND transects.

The upland brush/grass/rock (UBGR) classification is a blanket term describing those areas with open ridges. This habitat is typified by exposed bedrock, grass or brush/shrubs, and small deciduous trees such as red maple. It is found on the PASS, TMLC, MTOJ, ISTR, and FELK transects.

Lowland brush/marsh/muskeg (LBMM) habitats are open, wet areas with few large trees, such as bogs and beaver ponds. These areas are found along the TMLC, MTOJ, and FELK transects.

Yellow birch-fir (YBF) forests are dominated by yellow birch and conifers, typically white spruce and balsam fir. This habitat is limited to the FELK transect.

Northern hardwood (NH) habitats are dominated by sugar maple and yellow birch. This habitat type is confined primarily to the west end of the island, and is encountered only along the WIND transect.

Census methods--Each point was visited once between sunrise (ca. 0530) and 1000 EDT by one skilled observer and one recorder. Weather conditions were recorded before and after each observation period, and counts were not conducted if wind speeds were >10 mph or if it was raining. Point counts were ten minutes in duration, during which all species seen and heard were recorded. Notation was made indicating if a bird was heard/seen during the first five minutes or the second five minutes of an observation period. This will allow comparisons to be made with other studies that use five minute observation periods as well as those using ten minute counts. The two data sets are not mutually exclusive and do not represent two different counts. The ten-minute count is a total for the survey period, with birds heard during the first five minutes simply being carried over into the totals for the ten-minute count. The data are presented as "five- and ten-minute counts" strictly for means of comparison. No individual was recorded more than once during any given point count.

Bird species heard before or after the ten minute period on a point

or while travelling between points were recorded as "Miscellaneous." Though these species were not used for diversity calculations, they are mentioned if they were not recorded during the point counts (Appendix 2).

Analysis of data--Point count data were summarized according to transect and habitat and are presented in a tabular format. Species not representative of the habitats surveyed (Common Loon, Herring Gull, Great Blue Heron, and Red-breasted Merganser) were removed from the data. Birds heard but not identified during point counts (recorded as an unknown) were also removed from the data. Unknowns that could be identified in a general way were not eliminated if no other individual of that species was heard at that point. For example, at any given point, if a woodpecker was heard tapping during the count it would be recorded as an unknown woodpecker. However, if a particular species such as a Downy Woodpecker was also identified at that point, the unknown would be eliminated from the data. Only if no other woodpeckers were heard at that point would the unknown woodpecker be kept. These unknowns were only kept for calculating diversity values for the points; they are not listed in the species totals for either the transects or the habitats.

A total of eight points were eliminated from the data due to weather. Five points along the ISTR transect, all in the 1936 burn area, were eliminated due to wind; three along the WIND transect were eliminated due to rain. As a result, only 75 points were used for data analysis.

Diversity values were calculated for each point using the Simpson's Index which measures the probability that two individuals, selected at random from a population of N individuals, will belong to the SAME species (Hair 1980). Values, then, range from 0 to 100%, or 1.0. Left alone, the Simpson's index varies inversely with heterogeneity in the habitat (i.e., a high index value means low diversity). In order for the diversity value to be directly proportional to heterogeneity, Pielou (1977 in Hair 1980) proposed that it be subtracted from its maximum value of 1, which we have done here. By subtracting the calculated value by 1, the index can be thought of as measuring the probability that two individuals, drawn at random from a population of N individuals, belong to DIFFERENT species. For example, a diversity value of 0.98 means there is a 98% probability that two individuals drawn at random from the population belong to different species. This is obviously indicative of high species diversity in that given area.

Mean diversity and standard deviation were then calculated for each transect and habitat. Mean values were then used to compare habitats and transects, respectively. Since the six transects are located at relatively different geographic locations of the island (i.e., east -vs- west -vs- central), comparisons between transects may also represent comparisons between sides of the island.

A flaw was found in the application of stratified random sampling after the survey had been conducted. As is evidenced in Table 1b, the number of points were not assigned relative to the area covered by each of the habitats. Accordingly, no firm comparisons will be made with this year's data.

RESULTS

A total of 56 species were recorded during point counts in the 1994 survey (Table 2). 788 individuals were recorded during the 5-minute period, while the 10-minute period resulted in a total of 1008 individual birds. Only five species had ≥ 50 individuals during the 5-minute counts, and these only accounted for 49% of the total number of individuals. The five species were: Ovenbird (13%), Nashville Warbler (10%), Winter Wren (10%), White-throated Sparrow (9%), and Red-eyed Vireo (7%). Eight species had ≥ 50 individuals during the 10-minute counts, composing 59% of the total number of individuals. They were: Ovenbird (11%), Nashville Warbler (9%), White-throated Sparrow (9%), Winter Wren (8%), Red-eyed Vireo (6%), Chestnut-sided Warbler (6%), Black-throated Green Warbler (5%), and American Crow (5%). Four species (7% of the total) were present at all six transects, while eleven species (20%) were present at five of the transects. Sixteen species (29%) were recorded at only one transect.

ASP had the highest number of species (45, or 79% of the total number of species), while FIR had the lowest (13, or 23%) (Table 3a). This may be due to the sampling design, as Table 1b shows that ASP had the greatest number of points and FIR had the least. Similarly, MTOJ had the highest number of species (41, or 75%), while PASS had the lowest (13, or 23%) (Table 3b). This also may be due to sampling design.

Table 4 shows the diversity values for each of the respective transects surveyed. MTOJ had the highest diversity for both the 5-minute and 10-minute periods (0.93 ± 0.03 and 0.94 ± 0.03 , respectively), while WIND had the lowest diversity for both periods (0.76 ± 0.26 and 0.87 ± 0.08 , respectively). Similarly, NH habitat-type had the lowest diversity for both the five- and ten-minute periods (0.75 ± 0.26 and 0.87 ± 0.08 , respectively; see Table 5). All 12 points in NH were located along the WIND transect.

LBMM showed the highest diversity of any of the habitats (0.94 ± 0.02) for the 5-minute period, while the previously mentioned NH showed the lowest (Table 5). For the ten-minute period, both the highest and lowest diversity values were shared between two habitats. LBMM again had the highest diversity value (0.95 ± 0.03), but this was equalled by SC with a diversity value of 0.95 ± 0.03 as well. The lowest diversity values were between NH, as mentioned above, and UBGR with 0.87 ± 0.13 .

Table 2: Total number of species and individuals recorded and the number of transects on which they were found during Isle Royale NP breeding bird survey, 1994. Species field names defined in Appendix 1.

Species	No. of Individuals		No. of Transects
	5 Min.	10 Min.	
ALFL	5	8	3
AMCR	45	53	4
AMRE	11	13	4
AMRO	14	18	3
BAWW	10	14	5
BCCH	12	15	6
BKWA	1	1	1
BLJA	15	24	5
BRCR	3	6	2
BTBW	2	2	2
BTGW	39	54	5
CAWA	5	5	2
CEWW	10	21	5
CHSP	4	4	1
CMWA	2	3	2
COGR	0	2	1
CORA	16	21	4
COSN	3	6	2
COYE	5	6	4
CSWA	30	56	4
DEJU	1	1	1
DOWO	3	6	2
EABB	0	1	1
EAKB	1	1	1
GCKI	3	7	5
GRJA	2	2	1
HAWO	2	5	5
HETH	14	19	2
INBU	3	4	1
LEFL	9	13	4
MAWA	27	31	3
MAWR	1	1	1
MERL	0	1	1
MOWA	11	19	2
NAWA	82	92	5
NOFL	5	8	4
NOWA	1	1	1
OSPR	1	1	1
OVEN	99	108	5
PISI	0	1	1
PIWO	3	3	2
PUFI	3	3	1
RBNU	17	27	6
REVI	55	61	5
RWBB	1	1	1
SCTA	1	1	1
SOSP	6	8	4
SWSP	4	5	4
SWTH	24	32	5
TEWA	3	3	2
VEER	5	10	4
WIWR	76	85	6
WTSP	69	89	6
YBFL	4	4	2
YEWA	4	4	2
YRWA	16	18	5

TOTAL: 56 Species	788	1008	

Table 3a: Total number of species and individuals for each habitat surveyed at Isle Royale NP, 1994. First five minutes and total ten minutes of point counts are indicated separately.

<u>Habitat</u>	<u>No. of Species/Indiv. (5)</u>	<u>No. of Species/Indiv. (10)</u>
AF	18/48	20/60
ASP	41/303	45/366
FIR	12/38	13/47
LBMM	30/88	33/111
NH	13/75	16/93
SC	29/67	36/99
UBGR	21/94	26/120
YBF	19/74	20/91

Table 3b: Total number of species and individuals for each transect surveyed at Isle Royale NP, 1994. First five minutes and total ten minutes of point counts are indicated separately.

<u>Transect</u>	<u>No. of Species/Indiv. (5)</u>	<u>No. of Species/Indiv. (10)</u>
PASS	11/55	13/69
TMLC	34/187	36/237
MTOJ	40/266	41/319
ISTR	20/62	25/83
FELK	28/134	32/173
WIND	18/83	20/107

DISCUSSION

Since this is the first year of data collection, little can be inferred and extreme caution should be exercised in making comparisons; trends are not yet obvious, and no predictions are

Table 4: Mean diversity values $\pm$ one standard deviation for transects surveyed, 1994. Number of points on transect given in parentheses.

<u>Transect</u>	<u>5-Min.</u>	<u>10-Min.</u>
PASS	0.87 $\pm$ 0.05 (6)	0.88 $\pm$ 0.05 (6)
TMLC	0.87 $\pm$ 0.11 (15)	0.89 $\pm$ 0.11 (15)
MTOJ	0.93 $\pm$ 0.03 (17)	0.94 $\pm$ 0.03 (17)
ISTR	0.82 $\pm$ 0.31 (9)	0.92 $\pm$ 0.03 (9)
FELK	0.77 $\pm$ 0.31 (15)	0.92 $\pm$ 0.05 (15)
WIND	0.76 $\pm$ 0.26 (13)	0.87 $\pm$ 0.08 (13)

safe. The five-minute diversity values for the transects seem to indicate a gradual decrease in diversity from east (PASS) to west (WIND), but then the ten-minute data reveal no pattern at all. Likewise, among habitats, we could say that there seems to be higher diversity in the lowlands (LBMM, SC), but the fluctuations between the first five minutes and the total ten minutes do not maintain a strong basis for that theory. What we can do is make note of some things and continue to watch them to see how they

Table 5: Mean diversity values $\pm$ one standard deviation for habitats surveyed, 1994. Number of points in each habitat given in parentheses.

<u>Habitat</u>	<u>5-Min.</u>	<u>10-Min.</u>
AF	0.87 $\pm$ 0.07 (5)	0.89 $\pm$ 0.07 (5)
ASP	0.88 $\pm$ 0.19 (25)	0.92 $\pm$ 0.04 (25)
FIR	0.89 $\pm$ 0.07 (3)	0.90 $\pm$ 0.06 (3)
LBMM	0.94 $\pm$ 0.02 (6)	0.95 $\pm$ 0.03 (6)
NH	0.75 $\pm$ 0.26 (12)	0.87 $\pm$ 0.08 (12)
SC	0.78 $\pm$ 0.38 (6)	0.95 $\pm$ 0.03 (6)
UBGR	0.76 $\pm$ 0.31 (9)	0.87 $\pm$ 0.13 (9)
YBF	0.87 $\pm$ 0.04 (9)	0.90 $\pm$ 0.05 (9)

develop in later surveys. One thing that does seem to stand out is the low diversity of the northern hardwood forests (NH) of Isle Royale.

Van Stappen and Doolittle (1992) found the greatest number of species (45) and individuals (491) in northern hardwood forests of the Apostle Islands National Lakeshore, Wisconsin. On Isle Royale, only 16 species were recorded in the NH habitat-type which was the second lowest total among habitats (Table 3a). Similarly, the WIND transect, which contained all 12 of the NH points (plus one SC point), yielded only 20 species, which also was the second lowest total (Table 3b). In the Apostle Islands, there were 57 points located in the NH forest, which was the greatest number of points in any of their habitat-types, and indeed, they note a direct relationship between the total number of birds recorded and the number of stops (points) in a given habitat (Van Stappen and Doolittle 1992). This relationship was not observed on Isle Royale where NH had the second highest number of points (Table 1b), yet very low numbers of birds. To help illustrate the point, we can look at a species whose breeding habitat is almost strictly in the northern hardwoods forest.

The Black-throated Blue Warbler (Dendroica caerulescens), or BTBW, has been described as a fairly common summer resident on Isle Royale with breeding restricted primarily to the sugar maple-yellow birch forest (Jordan and Shelton 1982, Payne 1983). Some authors have reported BTBW's to also favor aspen-birch-conifer forests as well as swamp forests (McCreary 1908, Shelton 1975), but Krefting et al. (1966) contend that individuals in those areas are most likely migrants since virtually all summer records come from the maple forest. The Michigan Breeding Bird Atlas survey found the BTBW to be most abundant in the Upper Peninsula of Michigan, and identified the western third of Isle Royale as the first of six areas of BTBW concentration in the state of Michigan (Binford 1991). During our 1994 survey, only two BTBW's were recorded, one in the NH habitat along the WIND transect, the other in the ASP forest along the TMLC transect. Binford (1991) reports that although the BTBW was once said to be one of our most abundant migrants, it has appeared to be declining state-wide, even during migration.

Again, this first year of data is strictly preliminary and should be treated as such, but it should be interesting to see what trends develop in the future, keeping an eye on species such as the Black-throated Blue Warbler.

SUGGESTIONS FOR 1995

The first year of any research project is invariably filled with room for improvement. That is a part of science. The basic methods used in this project were sound, but four items stand out that would help standardize the data collection. This would not

only expand the information gathered, but also the knowledge we can gain from it.

First, it was not until after the surveys were completed that it was discovered only three habitats had been assigned the correct number of points relative to the area they cover on the island. While this does not necessarily strike a deadly blow to the data this year, it is something which should be changed before carrying out any future surveys.

Second, marking the points used this year in order to make them standard point count centers will help to eliminate future bias. We then can definitively state that any changes observed at a given point, transect, or habitat are not due to moving the points to areas of higher bird concentrations from year to year. The technicalities involved in marking plots are well understood. The general philosophy behind a wilderness area is to leave it "untrammeled by man" and to not detract from the wilderness experience of the park visitors. Some form of marking the points would be ideal. Krumenaker et al. (1988) suggested methods of marking survey plots using metal stakes. We suggest referencing that report for guidance on this issue.

Third, it is suggested that a separate data sheet be used for each point rather than one sheet for an entire transect. The primary reason for this is to make sure that all surveys are done properly. Some points were eliminated from this year's data analysis because the recorder noted that rain began falling at a particular point, while the weather blocks at the top of the sheet gave no indication of that condition because it was only recorded at the beginning and end of the transect. Some recorders forgot to record weather data altogether, which is probably because no unusual weather was occurring, but this does create the opportunity for biased elimination of data because some people recorded weather while others did not. While it is understood that some can hear and identify birds even during light rains or winds, others may not be able to do so. Standardization of the point count methods is extremely important for ensuring an unquestionably sound data set. Having a data sheet for each point will ensure unbiased use of data after the surveys are complete because we will know that all surveys were conducted under ideal conditions.

Finally, it may be helpful to "ground truth" the GIS maps relative to the habitats that are supposed to be sampled. Some discrepancies were found between the habitat that was indicated on the map and what was actually at the point that was surveyed. This change is expected to happen over time, but it should be accounted for to be sure that the focal habitats are being sampled. Any type of basic vegetation sampling could be used: a simple qualitative description that includes percentages of hardwoods -vs- softwoods, or a more in-depth survey using measurement of tree DBH and height of woody understory to construct a vegetative profile that

describes the ground cover, secondary growth, and canopy closure. In addition to focusing the surveys in the habitats of interest, this type of vegetation survey could also lend itself to analysis of habitat use of neotropical migrants on Isle Royale.

Aside from the methods, it may be beneficial to consider advertising for volunteers through EarthWatch or a local Audubon chapter to come out and assist in the point count surveys. It would obviously be best to get people who are skilled in "birding by ear" and maybe the best way to do that is to have them submit a short letter indicating their previous experience, but perhaps by offering a free boat trip and the opportunity to camp in the backcountry for a week (suspiciously near the transects to be surveyed), qualified individuals could be attracted into contributing to the program. This would help ease the work load for NPS employees, but could also be a good source of people to use after skilled employees have moved on. Even SCA's currently working in the park could be used for this, but again, an account of their previous experience would be necessary so that a quality survey will be assured.

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CODE NAME	COMMON NAME	SCIENTIFIC NAME
ALFL	ALDER FLYCATCHER	<i>Empidonax alnorum</i>
AMCR	AMERICAN CROW	<i>Corvus brachyrhynchos</i>
AMRE	AMERICAN REDSTART	<i>Setophaga ruticilla</i>
AMRO	AMERICAN ROBIN	<i>Turdus migratorius</i>
BASW	BARN SWALLOW	<i>Hirundo rustica</i>
BAWW	BLACK-AND-WHITE WARBLER	<i>Mniotilta varia</i>
BCCH	BLACK-CAPPED CHICKADEE	<i>Parus atricapillus</i>
BKWA	BLACKBURNIAN WARBLER	<i>Dendroica fusca</i>
BLJA	BLUE JAY	<i>Cyanocitta cristata</i>
BRCR	BROWN CREEPER	<i>Certhia americana</i>
BTBW	BLACK-THROATED BLUE WARBLER	<i>Dendroica caerulescens</i>
BTGW	BLACK-THROATED GREEN WARBLER	<i>Dendroica virens</i>
CAWA	CANADA WARBLER	<i>Wilsonia canadensis</i>
CEWW	CEDAR WAXWING	<i>Bombycilla cedrorum</i>
CHSP	CHIPPING SPARROW	<i>Spizella passerina</i>
CHWA	CAPE MAY WARBLER	<i>Dendroica tigrina</i>
COGO	COMMON GOLDENEYE	<i>Bucephala clangula</i>
COGR	COMMON GRACKLE	<i>Quiscalus quiscula</i>
CORA	COMMON RAVEN	<i>Corvus corax</i>
COSN	COMMON SNIPE	<i>Gallinago gallinago</i>
COYE	COMMON YELLOWTHROAT	<i>Geothlypis trichas</i>
CSWA	CHESTNUT-SIDED WARBLER	<i>Dendroica pensylvanica</i>
DEJU	DARK-EYED JUNCO	<i>Junco hyemalis</i>
DOWO	DOWNY WOODPECKER	<i>Picoides pubescens</i>
EABB	EASTERN BLUEBIRD	<i>Sialia sialis</i>
EAKB	EASTERN KINGBIRD	<i>Tyrannus tyrannus</i>
EAWP	EASTERN WOOD-PEWEE	<i>Contopus virens</i>
GCKI	GOLDEN-CROWNED KINGLET	<i>Regulus satrapa</i>
GRJA	GRAY JAY	<i>Perisoreus canadensis</i>
HAWO	HAIRY WOODPECKER	<i>Picoides villosus</i>
HETH	HERMIT THRUSH	<i>Catharus guttatus</i>
INBU	INDIGO BUNTING	<i>Passerina cyanea</i>
LEFL	LEAST FLYCATCHER	<i>Empidonax minimus</i>
MAWA	MAGNOLIA WARBLER	<i>Dendroica magnolia</i>
MAWR	MARSH WREN	<i>Cistothorus palustris</i>
MOWA	MOURNING WARBLER	<i>Oporornis philadelphia</i>
MERL	MERLIN	<i>Falco columbarius</i>
NAWA	NASHVILLE WARBLER	<i>Vermivora ruficapilla</i>
NOFL	NORTHERN FLICKER	<i>Colaptes auratus</i>
NOWA	NORTHERN WATERTHRUSH	<i>Seiurus noveboracensis</i>
OSPR	OSPREY	<i>Pandion haliaetus</i>
OVEN	OVENBIRD	<i>Seiurus aurocapillus</i>
PISI	PINE SISKEN	<i>Carduelis pinus</i>
PIWO	PILEATED WOODPECKER	<i>Dryocopus pileatus</i>
PUFI	PURPLE FINCH	<i>Carpodacus purpureus</i>
RBNU	RED-BREASTED NUTHATCH	<i>Sitta canadensis</i>
RCKI	RUBY-CROWNED KINGLET	<i>Regulus calendula</i>
REVI	RED-EYED VIREO	<i>Vireo olivaceus</i>
RWBB	RED-WINGED BLACKBIRD	<i>Agelaius phoeniceus</i>
SCTA	SCARLET TANAGER	<i>Piranga olivacea</i>
SHCR	SANDHILL CRANE	<i>Grus canadensis</i>
CODE NAME	COMMON NAME	SCIENTIFIC NAME
SOSP	SONG SPARROW	<i>Melospiza melodia</i>
SWSP	SWAMP SPARROW	<i>Melospiza georgiana</i>
SWTH	SWAINSON'S THRUSH	<i>Catharus ustulatus</i>
TEWA	TENNESSEE WARBLER	<i>Vermivora peregrina</i>
UNFI	UNKNOWN FINCH	
UNFL	UNKNOWN FLYCATCHER	
UNWO	UNKNOWN WOODPECKER	
VEER	VEERY	<i>Catharus fuscescens</i>
WIWR	WINTER WREN	<i>Troglodytes troglodytes</i>
WTSP	WHITE-THROATED SPARROW	<i>Zonotrichia albicollis</i>
YBFL	YELLOW-BELLIED FLYCATCHER	<i>Empidonax flaviventris</i>
YEWA	YELLOW WARBLER	<i>Dendroica petechia</i>
YRWA	YELLOW-RUMPED WARBLER	<i>Dendroica coronata</i>

Scientific names are those currently accepted according to:

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Appendix 2: Miscellaneous birds observed before or after point counts or in between points, 1994.

<u>TRANSECT</u>	<u>SPECIES</u>	<u>COMMENTS</u>
PASS	MAWA ALFL BASW SOSP	Between UBGR and ASP Near AF Between AF & shoreline ---
TMLC	<i>SACR</i> SHCR COGR CAWA	Circling Tobin Creek --- ---
MTOJ	CHSP RCKI	--- ---
ISTR	TEWA COGO NAWA EABB HETH BTGW RBNU	After Pt. 5--ASP Near Pt. 8--SC Near Pt. 10--ASP Near Pt. 11--ASP At Pt. 11--ASP At Pt. 11--ASP At Pt. 11--ASP
FELK	<i>AMRO</i> MAWA AMGO DEJU BKWA NOWA	Between Pt.'s 1 & 2 Near Pt. 14--YBF After Pt. 15--UBGR After Pt. 15--UBGR After Pt. 15--UBGR
WIND	HETH EAWP	Between Pt.'s 1 & 2--SC/NH Between Pt.'s 3 & 4 (NH)

Appendix 3: Total numbers of species and individuals for FELK transect, 27 June 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
ALFL	1	2
AMCR	6	9
BAWW	3	3
BCCH	2	4
BKWA	1	1
BLJA	1	5
BRCR	2	3
BTGW	13	16
CEWW	2	4
CORA	2	4
COYE	3	3
CSWA	5	6
DEJU	1	1
EABB	0	1
GCKI	1	2
HAWO	0	1
HETH	7	9
INBU	3	4
MAWR	1	1
NAWA	12	13
NOFL	1	1
OVEN	14	14
PIWO	1	1
RBNU	5	7
REVI	12	16
SOSP	1	2
SWSP	0	1
SWTH	0	2
WIWR	21	22
WTSP	9	11
YEWA	2	2
YRWA	2	2
TOTAL: 32 Species	134	173

Appendix 4: Total numbers of species and individuals for the ISTR transect, 1 July 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMCR	1	2
AMRE	1	1
BAWW	1	2
BCCH	1	1
BLJA	0	2
BTGW	6	7
CEWW	2	4
COGR	0	2
CORA	3	5
CSWA	1	1
GCKI	1	1
HAWO	0	1
MAWA	7	7
NOWA	1	1
OSPR	1	1
OVEN	10	13
RBNU	1	1
REVI	8	8
SOSP	2	2
SWSP	1	1
VEER	0	1
WIWR	4	4
WTSP	7	11
YEWA	2	2
YRWA	2	2
TOTAL: 25 Species	63	83

Appendix 5: Total numbers of species and individuals for the MTOJ transect, 13 June 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
ALFL	3	5
AMCR	36	39
AMRE	8	10
AMRO	8	9
BAWW	4	4
BCCH	2	2
BLJA	6	7
BTGW	1	1
CAWA	4	4
CEWW	1	1
CMWA	0	1
CORA	5	6
COSN	2	4
COYE	1	1
CSWA	20	25
DOWO	1	1
EAKB	1	1
GCKI	1	1
GRJA	2	2
HAWO	1	1
HETH	7	10
LEFL	2	3
MAWA	10	13
MERL	0	1
MOWA	7	11
NAWA	28	33
NOFL	2	5
OVEN	27	31
PUFI	3	3
RBNU	3	5
REVI	13	13
RWBB	1	1
SOSP	2	2
SWSP	3	3
SWTH	2	3
TEWA	1	1
VEER	1	4
WIWR	13	13
WTSP	28	33
YBFL	3	3
YRWA	3	3
TOTAL: 41 Species	266	319

Appendix 6: Total numbers of species and individuals for the PASS transect, 24 June 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMRE	1	1
BCCH	2	3
CEWW	4	9
CORA	6	6
COYE	0	1
LEFL	1	1
NAWA	5	5
PISI	0	1
RBNU	4	6
SWTH	12	14
WIWR	7	8
WTSP	5	6
YRWA	8	8
TOTAL: 13 Species	55	69

Appendix 7: Total numbers of species and individuals at the TMLC transect, 18 June 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
ALFL	1	1
AMCR	2	3
AMRE	1	1
AMRO	5	6
BAWW	1	1
BCCH	2	2
BLJA	7	9
BRCR	1	3
BTBW	1	1
BTGW	5	8
CEWW	1	3
CHSP	4	4
CMWA	2	2
COSN	1	2
COYE	1	1
CSWA	4	4
DOWO	2	5
GCKI	0	1
HAWO	0	1
LEFL	5	8
MAWA	10	11
MOWA	4	8
NAWA	36	40
NOFL	1	1
OVEN	24	25
PIWO	2	2
RBNU	4	7
REVI	9	9
SOSP	1	2
SWTH	8	11
TEWA	2	2
VEER	3	4
WIWR	16	21
WTSP	19	24
YBFL	1	1
YRWA	1	3
TOTAL: 36 Species	187	237

Appendix 8: Total numbers of species and individuals for the WIND transect, 11 June 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMRO	1	3
BAWW	1	4
BCCH	3	3
BLJA	1	1
BTBW	1	1
BTGW	14	22
CAWA	1	1
GCKI	0	2
HAWO	1	1
LEFL	1	1
NAWA	1	1
NOFL	1	1
OVEN	24	25
RBNU	0	1
REVI	13	15
SCTA	1	1
SWTH	2	2
VEER	1	1
WIWR	15	17
WTSP	1	4

TOTAL: 20 Species	83	107

Appendix 9: Total numbers of species and individuals recorded in ASP, 1994.

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<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
ALFL	1	2
AMCR	24	25
AMRE	9	9
AMRO	4	5
BAWW	1	1
BCCH	3	4
BLJA	7	9
BRCR	0	1
BTBW	1	1
BTGW	7	9
CAWA	3	3
CEWW	2	4
CHSP	3	3
CMWA	2	2
CORA	6	9
COSN	2	3
COYE	1	1
CSWA	10	11
DOWO	3	6
EAKB	1	1
GCKI	2	3
GRJA	1	1
HAWO	0	1
HETH	3	3
LEFL	1	3
MAWA	17	19
MERL	0	1
MOWA	9	13
NAWA	38	42
NOFL	2	3
NOWA	1	1
OVEN	41	46
PIWO	1	1
PUFI	2	2
RBNU	5	7
REVI	21	21
SOSP	3	3
SWSP	1	1
SWTH	4	6
VEER	1	5
WIWR	17	19
WTSP	30	40
YEWA	2	2
YRWA	7	8

TOTAL: 44 Species

301

363

Appendix 10: Total numbers of species and individuals recorded in AF, 1994.

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<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMRE	1	1
BCCH	3	3
BLJA	2	2
BRCR	1	1
BTGW	1	1
CEWW	4	6
CHSP	1	1
CORA	2	2
COYE	0	1
CSWA	2	2
MAWA	1	1
MOWA	1	2
NAWA	4	4
OVEN	1	1
PISI	0	1
RBNU	2	4
SWTH	8	9
WIWR	7	9
WTSP	3	4
YRWA	4	5
TOTAL: 20 Species	48	60

Appendix 11: Total numbers of species and individuals recorded in
FIR, 1994.

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<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMCR	0	2
AMRO	2	4
BTGW	4	6
LEFL	4	4
MAWA	6	8
NAWA	18	14
OVEN	4	6
RBNU	4	4
REVI	2	2
SWTH	8	10
VEER	4	6
WIWR	12	14
WTSP	14	14

TOTAL: 13 Species	82	94

Appendix 12: Total numbers of species and individuals recorded in LBMM, 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
ALFL	4	6
AMCR	5	8
AMRE	1	2
AMRO	3	3
BAWW	2	2
BKWA	1	1
BLJA	2	5
BTGW	0	1
CAWA	1	1
CEWW	1	2
CORA	1	1
COSN	1	2
COYE	3	3
CSWA	3	4
HETH	2	2
LEFL	1	1
MAWA	3	4
MOWA	0	1
NAWA	12	14
NOFL	1	1
OVEN	5	5
PUFI	1	1
RBNU	2	2
RWBB	1	1
SOSP	2	4
SWSP	2	2
SWTH	0	3
TEWA	1	1
WIWR	8	8
WTSP	13	14
YBFL	2	2
YEWA	2	2
YRWA	2	2
TOTAL: 33 Species	88	111

Appendix 13: Total numbers of species and individuals recorded in
NH, 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMRO	0	2
BAWW	1	4
BCCH	3	3
BLJA	1	1
BTBW	1	1
BTGW	14	20
CAWA	1	1
GCKI	0	2
HAWO	1	1
OVEN	24	24
REVI	13	15
SCTA	1	1
SWTH	2	2
VEER	1	1
WIWR	11	13
WTSP	0	1
TOTAL: 16 Species	74	92

Appendix 14: Total numbers of species and individuals recorded in SC, 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMCR	1	1
AMRO	4	4
BAWW	2	2
BCCH	0	2
BLJA	2	3
BRCR	0	1
BTGW	2	4
CEWW	2	5
CMWA	0	1
COGR	0	2
CORA	1	2
COYE	1	1
EABB	0	1
GCKI	0	1
GRJA	1	1
HAWO	1	2
INBU	1	1
LEFL	4	6
MAWA	1	1
MAWR	1	1
NAWA	10	10
NOFL	1	1
OSPR	0	1
OVEN	1	3
PIWO	2	2
RBNU	2	5
REVI	2	3
SOSP	1	1
SWSP	1	2
SWTH	3	4
TEWA	2	2
VEER	6	1
WIWR	8	9
WTSP	6	10
YBFL	2	2
YRWA	1	1
TOTAL: 36 Species	72	99

Appendix 15: Total numbers of species and individuals recorded in
UBGR, 1994.

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<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMCR	11	11
AMRE	0	1
AMRO	2	2
BAWW	1	1
BCCH	1	1
BLJA	1	1
BTGW	3	4
CEWW	0	3
CORA	4	4
COSN	0	1
CSWA	12	16
HAWO	0	1
HETH	4	7
INBU	1	2
LEFL	1	1
MAWA	2	2
MOWA	1	3
NAWA	9	11
NOFL	0	2
OVEN	13	14
RBNU	1	3
REVI	11	11
SWTH	3	3
WIWR	3	3
WTSP	8	10
YRWA	2	2
TOTAL: 26 Species	94	120

Appendix 16: Total numbers of species and individuals recorded in
YBF, 1994.

<u>Species</u>	<u>No. of Individuals</u>	
	<u>5-Min.</u>	<u>10-Min.</u>
AMCR	4	5
BAWW	1	1
BCCH	2	2
BLJA	0	3
BRCR	2	3
BTGW	10	12
CEWW	1	1
CORA	2	3
CSWA	3	3
DEJU	1	1
GCKI	1	1
HETH	5	7
INBU	1	1
NAWA	3	4
NOFL	1	1
OVEN	12	12
RBNU	3	4
REVI	7	10
WIWR	13	14
WTSP	2	3
TOTAL: 20 Species	74	91