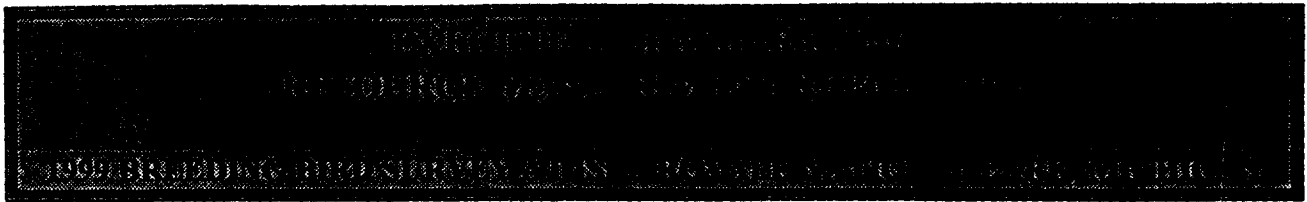


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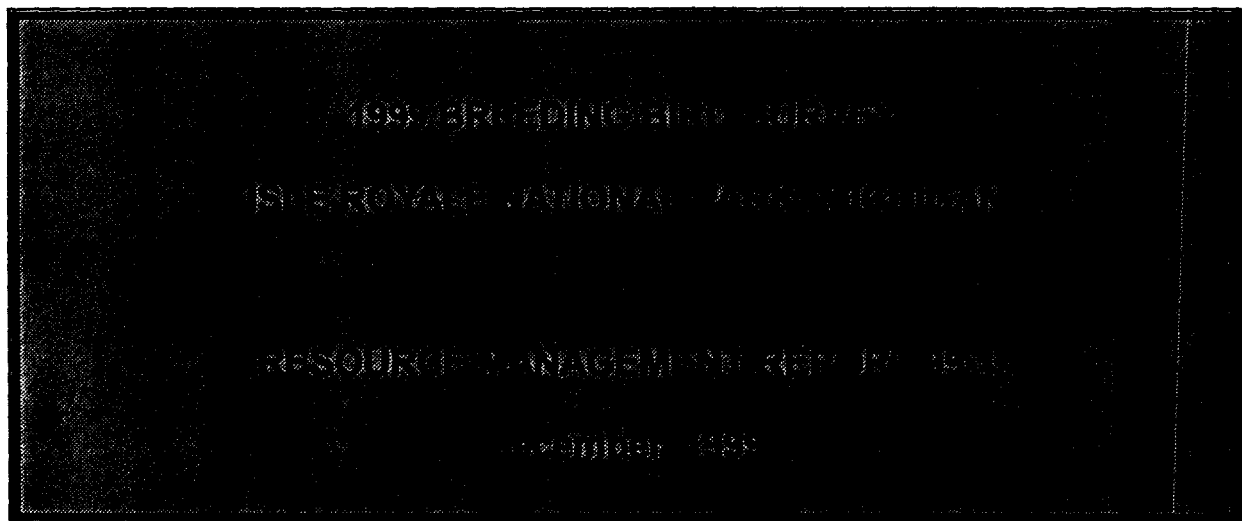
The importance of breeding bird surveys (BBS) has been illustrated by the popularity of the North American BBS program as well as the number of research projects that focus on declining neotropical migrant populations being conducted both in North America and abroad. Isle Royale National Park, Michigan, established a formal breeding bird survey in 1994 to integrate island population data with other studies being conducted in the region. This program has continued from 1995 to 1999 with the objective of determining and monitoring the size and composition of the neotropical migrant community on Isle Royale.

Point counts were conducted at Isle Royale NP from 10 June to 26 June 1999, using standardized transects on eight park trails. A total of 130 points were surveyed across the main island and on Passage Island. Species diversity values, representing the probability that two randomly drawn individuals will belong to different species, were calculated for each transect.

A total of 60 species (1610 individuals) were recorded. The number of species is average for the past four years, but the number of individuals has increased substantially from 1028 in 1998 to 1610 in 1999. The increase in numbers has been strongly noticed in the five most common species found on Isle Royale (Ovenbird, White-throated Sparrow, Winter Wren, Red-eyed Vireo, and Nashville Warbler). This increase seems to be responsible for a slight decrease in 1999 diversity of songbirds across the island, since diversity calculations are strongly influenced by large numbers of individuals within a species. Fluctuation in yearly numbers has been recorded elsewhere in the region, as well as in Isle Royale's 6 years of breeding bird studies. Overall, the number of species has remained similar between 1996 and 1999, while the number on individuals can fluctuate greatly from year to year.

Three species (5% of total species) were present at all eight transects, while 13 species (22%) were recorded at only one transect. The highest number of species (41, or 68%) was recorded on the Three Mile-Lane Cove transect, while the lowest number of species (8, or 13%) was recorded on Passage Island. Diversity values, by transect, ranged from 0.84 to 0.95 (on a 0-1 scale, which can be interpreted as a percentage) during the five-minute counts. Five transects decreased slightly in diversity, while two stayed the same. Passage Island decreased significantly due to small numbers of points and species. Higher fluctuation with Passage Island diversity appears to be a recurring component of this transect.

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ABSTRACT

The importance of breeding bird surveys (BBS) has been illustrated by the popularity of the North American BBS program as well as the number of research projects that focus on declining neotropical migrant populations being conducted both in North America and abroad. Isle Royale National Park, Michigan, established a formal breeding bird survey in 1994 to integrate island population data with other studies being conducted in the region. This program has continued from 1995 to 1999 with the objective of determining the size and composition of the neotropical migrant community on Isle Royale. This single objective approach represents a shift in focus from the 1994 survey.

Point counts were conducted at Isle Royale NP from 10 June to 26 June 1999, using eight park trails as transects. A total of 130 points were surveyed. Species diversity values were calculated for each transect.

A total of 60 species (1610 individuals) were recorded. The number of species is average for Isle Royale, but the number of individuals has increased substantially from 1028 in 1998 to 1610 in 1999. Three species were present at all eight transects, eight species were present at seven transects, while 13 species were recorded at only one transect. Diversity values, by transect, ranged from 0.84 to 0.95 (on a 0-1 scale) during the five minute counts. Each transect decreased in diversity except for the Mount Ojibway Loop and the Lake Richie-Greenstone transect which stayed the same. Albeit a small set of data, comparisons from 1996-1999 are discussed (1996 was chosen over 1994-95 due to standardization of point-count locations in that year). Recommendations are made for 2000.

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INTRODUCTION

Isle Royale National Park established a formal breeding bird survey in 1994 as a means of integrating island population data with other studies conducted within the region (Van Stappen and Doolittle 1991, 1992). Isle Royale's survey was initiated with dual objectives: 1) determine the size and composition of the neotropical migrant community, and 2) attempt to associate any observable population trends with changes in the vegetation of the island.

In 1995, the breeding bird survey was conducted at Isle Royale National Park to add to and expand on pilot data collected in 1994 (Gostomski and Oelfke, 1995). The objective was modified to focus only on determining the size and composition of the neotropical migrant community on Isle Royale.

In 1996, the breeding bird survey was conducted at Isle Royale National Park to continue expanding on data collected in 1994 and 1995 (Beeman and Oelfke, 1996). The main objective in 1996 was to determine size and composition of the neotropical migrant community on Isle Royale. A secondary objective included standardizing the survey by permanently marking observation points. A decision was also made to reduce the observation time at each point from ten to five minutes, based on recommendations elsewhere (Ralph, et al. 1993) and results from previous years' data which showed 92% of the species recorded were detected in the first five minutes (Gostomski and Oelfke, 1995).

For 1997-1999, the breeding bird survey has been conducted to expand on previously collected data. The main objective of these years has been to monitor the size and composition of the neotropical migrant community at Isle Royale, and to continue trend monitoring. A secondary objective was to make general comparisons between years. The same transects were surveyed in the years 1996-1999, but due to weather and differences in volunteer pacing the number of points that were censused varied. For further background and historical information regarding Isle Royale National Park's Breeding Bird Survey reference should be made to the 1996 Isle Royale Breeding Bird Survey Report.

METHODS

In an effort to have a standardized annual survey for neotropical migrant landbirds, a breeding bird survey was conducted from 10 June to 26 June 1999 at Isle Royale National Park, Michigan. The objective of monitoring the size and composition of the neotropical migrant community on Isle Royale was accomplished using standardized point-counts conducted along transects at various locations across the island.

Selection of study sites— Eight park trails were used as survey transects with census points located along them at intervals of approximately .4 km (.25 mi.). Transects were established in each "region" of the park (east, west, and central), as well as at one off-shore location: Passage (PASS) Island. Transects surveyed on the main island were the Mt. Franklin Trail from Three Mile to Lane Cove (TMLC), the Mt. Ojibway loop (MTOJ), the Indian Portage Trail from Lake Richie to the Greenstone Ridge (LRGR), the Indian Portage Trail from Chippewa Harbor to Lake Richie (CHLR), the Ishpeming Trail (ISTR), the Feldtmann Lake Trail (FELK), and the Greenstone Ridge Trail at Windigo (WIND) (Figure 1). The length of the transects varies as does the number of points along them (Table 1).

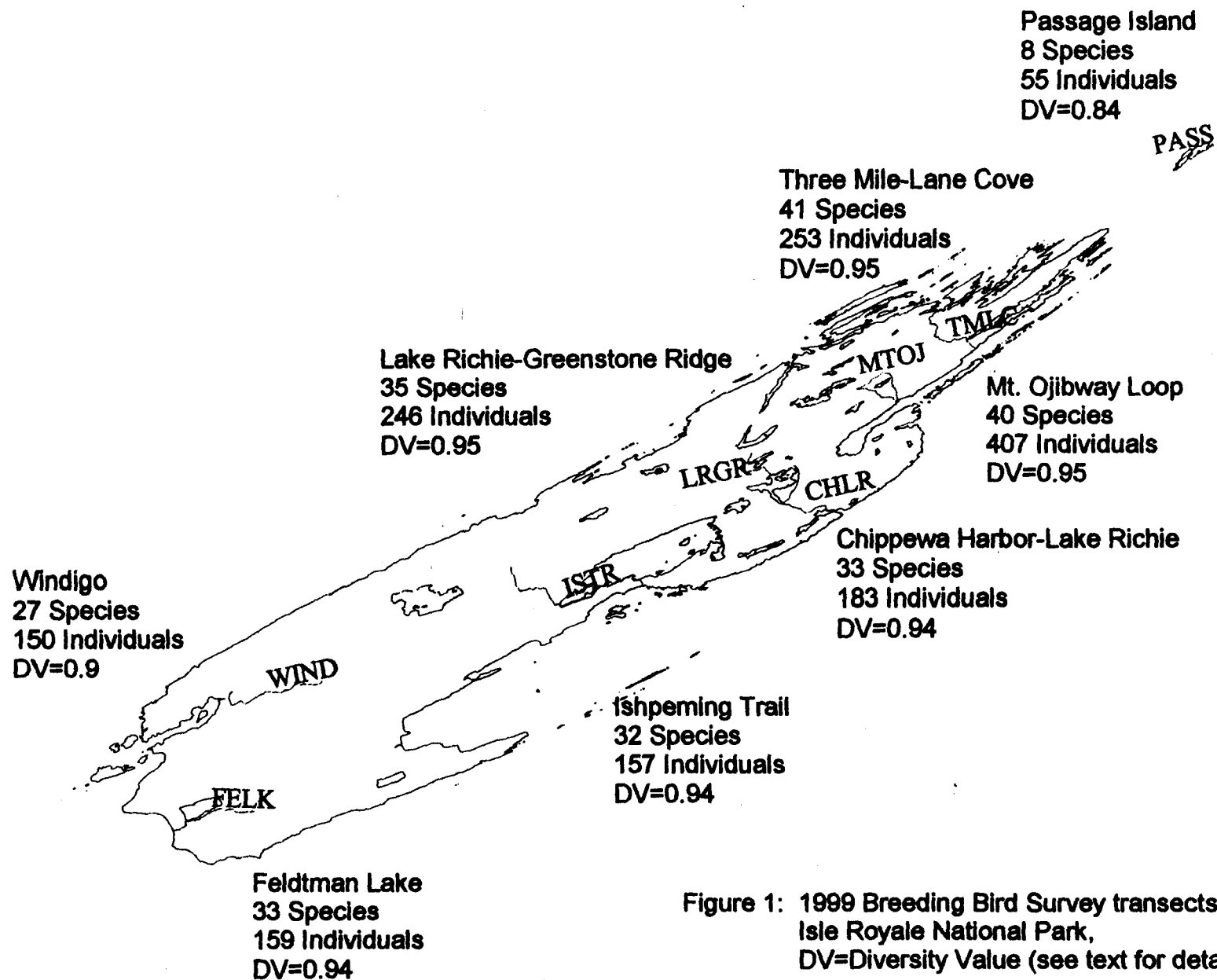


Figure 1: 1999 Breeding Bird Survey transects, Isle Royale National Park, DV=Diversity Value (see text for details)

Table 1: Transects surveyed, length of transects, number of census points, and number of points censused in 1999. Field names of transects given in text. Total number of points = 130.

Transect	Transect Length Km (Mi)	No. of Points	No. of Points Censused in 1999
PASS	1.3 (0.8)	4	4
TMLC	6.9 (4.3)	16	16
CHLR	6.4 (4.1)	16	16
MTOJ	8.2 (5.1)	19	19
LRGR	7.8 (5.0)	20	20
ISTR	7.0 (4.5)	18	18
FELK	7.0 (4.5)	16	16
WIND	8.3 (5.3)	21	21

Census Techniques— Each point was visited once between sunrise (ca. 0530) and 1000 EDT by one skilled observer and one recorder. Weather conditions were recorded upon arrival at each point, and no counts were conducted during periods of rain, heavy fog, or when wind speeds were >16 km/hr (10 mph). Point counts were 5 minutes in duration, broken down into one-minute intervals, during which all species were recorded and categorized as "seen", "heard", or "flyover". Birds heard or seen at a census point immediately before or after the count period or while walking between points were recorded as "Miscellaneous" (Appendix 2), but were not included in the data analysis.

Analysis of data— Non-focal species, such as Herring Gulls, mergansers, and Common Loons, and birds heard but not identified during point counts (recorded as unknown) were 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, if a woodpecker was heard tapping, it would be recorded as an unknown woodpecker. However, if a particular species such as a Downy Woodpecker was also identified during the count period *at that point*, the unknown was eliminated from the data. Only if no other woodpeckers were heard at that point would the unknown woodpecker be retained in the data. These unknowns were included in the calculations of the total number of individuals in the 1996 and 1997 data, but they have been dropped from the 1998 and 1999 data. If a bird cannot be identified it will not be included in any of the data analysis since no scientific value can be attached to "things we think we heard".

Species diversity values were calculated for each transect using the Simpson's Index (Hair 1980). Values range from 0 to 1 (100%) and represent the probability that two individuals, drawn at random from a population, belong to different species (Table 4). The Simpson's Index has been incorporated into Microsoft Excel files for ease of calculations. It is located in the Rmdata/Birds/Bbs folder (NRM computer) and separated by transect. In future analysis the index may be simply copied and the new data entered. A hard copy of methods and previous years calculations is also located in the Natural Resource Management files. The "Recommendations for 2000" section includes further information regarding the methods needed to update diversity values in the Excel files.

RESULTS and DISCUSSION

A total of 60 species and 1610 individuals were recorded across the island (Table 2). Field and scientific names for all species are in Appendix 1. Five species accounted for 44% of the total number of individuals recorded during the 5-min. counts. They were the White-throated sparrow (10%), Ovenbird (10%), Nashville warbler (9%), Winter wren (9%), and Red-eyed vireo (6%). These were also the most numerous species in the 1994, 1997, and 1998 surveys. Since 1994, 81 species have been recorded during the breeding bird surveys (see Appendix 6).

Three species (5% of the total) were present at all eight transects, eight species were present at seven of the transects (13% of the total), while 13 species (22% of the total) were recorded at only one transect (Table 2). The highest number of species (41, or 68%) was recorded on the TMLC transect, while the lowest number of species (8, or 13%) was recorded at the PASS transect (Table 3). Miscellaneous species, observed between sample points or after the survey time period, are listed in Appendix 2.

A total of seven species recorded in 1998 were not observed during point counts in 1999 (Appendix 3). Similarly, 6 species recorded in 1999 on point counts were not observed in 1998 (Appendix 4). Fifteen species have been recorded only once during the entire 1994-99 survey period, during 5-minute counts (Appendix 5).

Diversity values for the eight transects ranged from 0.84 (PASS) to 0.95 (TMLC, MTOJ, LRGR) in 1999 (Table 4). Diversity values decreased slightly on five transects since 1998. MTOJ and LRGR didn't change. Passage Island showed a marked decrease from 0.95 to 0.84. This decrease is likely attributed to the disproportionately high numbers of several individual species, which is traditional on this transect and immediately drops the diversity value. Higher fluctuation in Passage Island diversity appears to be a recurring event on this transect. Correspondingly, the decrease in diversity on other transects can likely be attributed to the general increase (in some cases almost a doubling) in numbers of the most common birds between 1998 and 1999 (see Appendix 6). It would be valuable to compare this phenomenon with other regional efforts.

Table 2: Total number of species and individuals recorded and the number of transects on which they were detected, 1999.

<u>Species</u>	<u>No. of Individuals</u>	<u>No. of Transects</u>
Alder Flycatcher	11	4
American Bittern	1	1
American Crow	45	6
American Redstart	41	5
American Robin	44	7
Black-and-White Warbler	20	6
Black-capped Chickadee	38	7
Blackburnian Warbler	8	5
Blue Jay	43	7
Brown Creeper	23	5
Black-throated Blue Warbler	15	5
Black-throated Green Warbler	75	7
Blue-headed Vireo	1	1
Canada Warbler	4	3
Cedar Waxwing	17	6
Chipping Sparrow	21	5
Chimney Swift	2	1

Table 2 continued:

<u>Species</u>	<u>No. of Individuals</u>	<u>No. of Transects</u>
Cape May Warbler	4	2
Common Grackle	10	3
Common Raven	28	6
Common Snipe	9	2
Common Yellowthroat	4	4
Chestnut-Sided Warbler	55	6
Downy Woodpecker	17	6
Eastern Wood-Pewee	1	1
Eastern Kingbird	1	1
Evening Grosbeak	5	1
Golden-crowned Kinglet	11	6
Gray Jay	5	2
Hairy Woodpecker	8	4
Hermit Thrush	81	6
Indigo Bunting	3	1
Least Flycatcher	3	3
Magnolia Warbler	54	6
Mourning Warbler	14	4
Nashville Warbler	147	8
Northern Flicker	18	7
Northern Parula	4	2
Northern Waterthrush	1	1
Olive-sided Flycatcher	1	1
Ovenbird	155	7
Pileated Woodpecker	11	6
Pine Siskin	10	2
Rose-breasted Grosbeak	2	2
Red-breasted Nuthatch	31	7
Red-eyed Vireo	101	7
Red-winged Blackbird	1	1
Ruby-crowned Kinglet	6	4
Purple Finch	1	1
Song Sparrow	9	5
Swamp Sparrow	10	5
Swainson's Thrush	12	3
Veery	17	3
Winter Wren	138	8
White-breasted Nuthatch	1	1
White-throated Sparrow	158	8
White-winged Crossbill	2	1
Yellow-bellied Flycatcher	12	4
Yellow-bellied Sapsucker	8	4
Yellow-rumped Warbler	32	6

60 Species

1610 total known individuals

Table 3: Total numbers of species and individuals for each transect surveyed at Isle Royale NP, 1999.

TRANSECT	NUMBER OF KNOWN SPP./INDIV.	NUMBER OF UNKNOWN INDIV. (Not included in data calculations, see page 3)
PASS	8/55	0
TMLC	41/253	2 (all woodpeckers)
CHLR	33/183	0
MTOJ	40/407	8 (all woodpeckers)
LRGR	35/246	7 (6 woodpeckers, 1 finch)
ISTR	32/157	2 (1 woodpecker, 1 blackbird)
FELK	33/159	4 (2 woodpeckers, 1 flycatcher, 1 unknown)
WIND	27/150	1 (woodpecker)

Table 4: Diversity values (Simpson's Index), ranging from 0-1 (100%), for transects surveyed in 1997-1999. Difference between 1998 and 1999 diversity values are given, 1997 is kept for comparison. Number of points surveyed on transect given in parentheses. DV = Diversity Value.

TRANSECT	1997 DV	TRANSECT	1998 DV	TRANSECT	1999 DV	DIFFERENCE (between 1998 and 1999)
PASS (4)	0.75	PASS (4)	0.95	PASS (4)	0.84	-0.11
TMLC (17)	0.94	TMLC (16)	0.96	TMLC (16)	0.95	-0.01
CHLR (16)	0.95	CHLR (16)	0.95	CHLR (16)	0.94	-0.01
MTOJ (19)	0.93	MTOJ (19)	0.95	MTOJ (19)	0.95	0.0
LRGR (16)	0.92	LRGR (20)	0.95	LRGR (20)	0.95	0.0
ISTR (18)	0.93	ISTR (18)	0.95	ISTR (18)	0.94	-0.01
FELK (14)	0.94	FELK (16)	0.96	FELK (16)	0.94	-0.02
WIND (18)	0.86	WIND (21)	0.92	WIND (21)	0.90	-0.02

Sixty species were recorded during the 1999 survey, an increase from 1996 and 1997, and a slight decrease from 1998. A moderate decrease in individuals from 1996 to 1997 was possibly due to fewer survey points in 1997 (122) than 1996 (133), so direct comparisons between those two years should not be made. An exact duplication of the number of points surveyed each year is occasionally impossible due to weather conditions, particularly wind, which can increase by the later portion of the survey along some routes. The total number of individuals decreased 19% from 1997 (1271) to 1998 (1028) for the 5-minute counts (Figure 2). Also, there was a 29% decrease in numbers of individuals over the three year period 1996-98, with about the same number of points surveyed in 1998 (130) than in 1996 (133). A dramatic increase in the number of individuals has occurred between 1998 and 1999, while the number of species has remained consistent over the past four years. As Appendix 6 shows, there can be great fluctuation in yearly numbers, which has been shown in other regional surveys as well (Niemi et al, 1997).

These numbers should be closely watched in future surveys to determine longer-term trends. It may also be helpful to investigate findings from other surveys in the region to ascertain a possible correlation between data.

Figure 2: Comparisons from 1996-1999 of species and individuals numbers, including number of points surveyed.

	1996	1997	1998	1999
Number of points surveyed	133	122	130	130
Number of species	57	58	61	60
Number of individuals	1437	1271	1028	1610

The presence or absence of a few species from year to year (as shown in Appendices 3, 4, and 5) likely reflects either the uncommon occurrence of those species on Isle Royale. Observations of these species should be expected to be infrequent during the annual breeding bird surveys.

The high species diversity observed on Isle Royale is encouraging, but there seems to be no clear pattern to the range of values relative to "region" of the park (east, west, central) or the number of points surveyed on any given transect. Since 1994 the WIND transect has typically shown lower diversity than the yearly average, possibly a result of the differing, more monotypical, forest type (maple/yellow birch) that dominates the west half of the island. In 1996 and 1997 there was a noticeable difference in mean diversity between the peripheral island transect (PASS) and the main island transects. Van Stappen and Doolittle (1992) reported similar findings from the Apostle Islands National Lakeshore in Wisconsin. They reported a mean species diversity of 0.91 for their survey of eight transects, but a relationship between the number of species observed and the area of the island covered by the transect could not be identified. As mentioned previously, the diversity on a transect such as PASS, with a very small number of survey points, has been heavily influenced by large numbers of one or two species which distinctly drops diversity values. This is punctuated by the 1997-1998 difference in diversity at PASS (a jump from 0.75 to 0.95).

In 1994, the low number (2) of Black-throated Blue warblers recorded during the breeding bird survey was noted with concern due to the historic presence of the species on Isle Royale (Gostomski and Oelfke 1994). Binford (1991) listed the western third of Isle Royale first among six areas in Michigan with high Black-throated Blue warbler concentrations. In 1995, eight Black-throated Blue warblers were recorded among three transects (ten-minute counts): WIND (2), LRGR (3), and TMLC (3). In 1996, five Black-throated Blue warblers were recorded at one transect (and between points at another transect). In 1997, eleven Black-throated Blue warblers were recorded at four transects. In 1998, eight were recorded at four transects, and four were recorded as miscellaneous. In 1999 the highest number of Black-throated Blue warblers was recorded, with 15 individuals found on five transects and three individuals recorded as miscellaneous. The Black-throated Blue warbler has been a regular nesting resident on Isle Royale, so the fluctuations are likely reflecting the inherent vagaries of sampling. Still, it is advisable to watch the development of long-range data regarding this species given their high rank (3.29 on a scale of 1-to-5) among the species of management concern in the Midwest (Thompson *et al.* 1993).

RECOMMENDATIONS FOR 2000

In 1996, the census points were permanently marked using discrete aluminum NPS research tags. Prior to conducting the 2000 surveys, transects should be flagged to assist the observers in locating the survey points. Flagging should occur the day before sampling if possible, to reduce the visual intrusion along hiking trails. It would be helpful to continue the 1998 work of entering these point count locations into the park's GIS (Geographic Information System) database to further assist survey participants in locating tags. Any uncertainty or unfound points should be noted during both flagging and observing; tagged trees could become victim to beaver cutting or windfall and the point may need to be retagged.

Minor problems can result from differing recording techniques. A brief training session to standardize recording techniques is recommended for future surveys to avoid confusion and inaccurate data entry. The use of 4-letter bird codes should be discontinued in the field if the recorder is unfamiliar with these codes. Full names are preferred, otherwise codes tend to be made-up by recorders and are sometimes difficult to interpret during data entry.

The Simpsons Index for diversity calculation has been integrated into a Microsoft Excel file. Yearly, the numbers of individuals needs to updated, as well as the formula in column D whenever the numbers are changed. An outline of how the file works was written by Steve Niemela in 1998 (NRM intern) and can be found in the BBS hardcopy files. Column D, the $n*(n-1)/N*(N-1)$ formula, must be updated from the number found in the $N(N-1)$ cell at the bottom of the worksheet. Each transect will have a different $N(N-1)$ value, and diversity values would be incorrect without this change.

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Appendix 1: Field names used for bird species. Scientific names are those accepted by the American Ornithologist's Union (7th edition A.O.U. Checklist, 1998) and its supplements.

<u>CODE NAME</u>	<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
ALFL	Alder Flycatcher	<i>Empidonax alhorum</i>
AMBI	American Bittern	<i>Botaurus lentiginosus</i>
AMCR	American Crow	<i>Corvus brachyrhynchos</i>
AMGO	American Goldfinch	<i>Carduelis tristis</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>
BBCU	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>
BBWA	Bay-breasted Warbler	<i>Dendroica castanea</i>
BCCH	Black-capped Chickadee	<i>Poecile atricapillus</i>
BEKI	Belted Kingfisher	<i>Ceryle alcyon</i>
BHCO	Brown-headed Cowbird	<i>Molothrus ater</i>
BHVI	Blue-headed Vireo	<i>Vireo solitarius</i>
BKWA	Blackburnian Warbler	<i>Dendroica fusca</i>
BLJA	Blue Jay	<i>Cyanocitta cristata</i>
BRCR	Brown Creeper	<i>Certhia americana</i>
BRTH	Brown Thrasher	<i>Toxostoma rufum</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>
CHSW	Chimney Swift	<i>Chaetura pelagica</i>
CMWA	Cape May Warbler	<i>Dendroica tigrina</i>
COGR	Common Grackle	<i>Quiscalus quiscula</i>
CORA	Common Raven	<i>Corvus corax</i>
COSN	Common Snipe	<i>Gallinago gallinago</i>
COWA	Connecticut Warbler	<i>Oporornis agilis</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>
EVGR	Evening Grosbeak	<i>Coccothraustes vespertinus</i>
GCKI	Golden-crowned Kinglet	<i>Regulus satrapa</i>
GCFL	Great Crested Flycatcher	<i>Myiarchus crinitus</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>
NAWA	Nashville Warbler	<i>Vermivora ruficapilla</i>

(Appendix 1 continued)

<u>CODE NAME</u>	<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>
NOFL	Northern Flicker	<i>Colaptes auratus</i>
NOPA	Northern Parula	<i>Parula americana</i>
NOWA	Northern Waterthrush	<i>Seiurus noveboracensis</i>
OSFL	Olive-sided Flycatcher	<i>Contopus cooperi</i>
OVEN	Ovenbird	<i>Seiurus aurocapillus</i>
PAWA	Palm Warbler	<i>Dendroica palmarum</i>
PIGR	Pine Grosbeak	<i>Pinicola enucleator</i>
PISI	Pine Siskin	<i>Carduelis pinus</i>
PIWA	Pine Warbler	<i>Dendroica pinus</i>
PIWO	Pileated Woodpecker	<i>Dryocopus pileatus</i>
PUFI	Purple Finch	<i>Carpodacus purpureus</i>
RBGR	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</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>
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>
VEER	Veery	<i>Catharus fuscescens</i>
WBNU	White-breasted Nuthatch	<i>Sitta carolinensis</i>
WIFL	Willow Flycatcher	<i>Empidonax traillii</i>
WTWR	Winter Wren	<i>Troglodytes troglodytes</i>
WTSP	White-throated Sparrow	<i>Zonotrichia albicollis</i>
WWCR	White-winged Crossbill	<i>Loxia leucoptera</i>
YBCH	Yellow-breasted Chat	<i>Icteria virens</i>
YBFL	Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>
YBSA	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>
YEWA	Yellow Warbler	<i>Dendroica petechia</i>
YHBL	Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>
YRWA	Yellow-rumped Warbler	<i>Dendroica coronata</i>

Appendix 2: Miscellaneous species recorded before, after, or in between points, 1999.

*** indicates a species of particular interest or rarity to Isle Royale.**

<u>TRANSECT</u>	<u>SPECIES</u>
TMLC	BCCH, BAWW, YBFL, CAWA, MOWA, CHSP, CORA, HAWO
PASS	CORA, GCKI, OVEN, EVGR
MTOJ	BRCR, NOFL, DOWO, EAKB*, CAWA
FELK	BTBW (2)*, MOWA, BKWA
ISTR	WTSP, CAWA, BAWW
CHLR	RBNU, GRJA, SWSP (2), NOPA, HAWO, OVEN
WIND	CHSW, BTBW*, BRCR
LRGR	YRWA, BLJA, PISI, MOWA

Appendix 3: Species recorded during point counts in 1998 but not observed in 1999. See text for details.

Barn Swallow
Bay-breasted Warbler
Belted Kingfisher
Great Crested Flycatcher
Palm Warbler
Pine Warbler
Scarlet Tanager

Appendix 4: Species recorded during point counts in 1999 but not observed in 1998. See text for details.

Eastern Kingbird
Olive-sided Flycatcher
Purple Finch
Red-winged Blackbird
Ruby-crowned Kinglet
White-breasted Nuthatch

Appendix 5: Species recorded in only one survey between 1994-1999, during 5-minute counts or miscellaneous between points.

American Goldfinch, 1996 (Misc. 1994 and 1996)
Barn Swallow, 1998 (Misc. 1994)
Black-billed Cuckoo, 1997
Brown Thrasher, 1995
Brown-headed Cowbird, (Misc. 1996)
Belted Kingfisher, 1998
Connecticut Warbler, (Misc. 1998)
Eastern Bluebird, 1994
Marsh Wren, 1994
Palm Warbler, 1998
Pine Warbler, 1998
Willow Flycatcher, (Misc. 1998)
Yellow-breasted Chat, 1997
Yellow-headed Blackbird, (Misc. 1996)
Yellow Warbler, 1994

Appendix 6: Species regularity on Isle Royale and yearly numbers during 5-minute point counts, 1994-1999.

Species	1994	1995	1996	1997	1998	1999	Yearly Total
ALFL	5	6	21	11	11	11	
AMBI			1		3	1	
AMCR	45	54	47	25	16	45	
AMGO			3				1994, 1996
AMRE	11	17	47	20	42	41	
AMRO	14	27	28	26	29	44	
BASW					1		1994
BAWW	10	9	9	20	12	20	
BBCU				3			
BBWA				1	1		
BCCH	12	20	18	9	20	38	
BEKI					2		
BHCO							1996
BHVI			1		4	1	
BKWA	1	6	6	12	15	8	
BLJA	15	36	37	11	26	43	
BRCR	3	4	1	3	17	23	
BRTH		1					
BTBW	2	5	5	11	8	15	
BTGW	39	34	77	38	58	75	
CAWA	5	2	6	6	7	4	
CEWW	10	15	20	46	2	17	
CHSP	4	15	22	21	19	21	
CHSW		4			1	2	1999
CMWA	2	8	13	14	11	4	
COGR			20	4	3	10	
CORA	16	19	24	22	10	28	
COSN	3	12	8	6	10	9	
COWA							1998
COYE	5	3	4	2	4	4	
CSWA	30	40	79	65	31	55	
DEJU	1		1				
DOWO	3	5	11	6	20	17	
EABB							1994
EAKB	1					1	1999
EAWP					2	1	
EVGR			5	14	5	5	
GCFL				2	1		
GCKI	3	9		8	14	11	
GRJA	2	2	4	1	2	5	
HAWO	2	1	7	4	3	8	
HETH	14	29	21	39	45	81	
INBU	3		2	3	1	3	
LEFL	9	12	10	6	10	3	
MAWA	27	40	38	50	41	54	
MAWR	1						

MOWA	11	13	22	15	16	14	
NAWA	82	82	145	85	61	147	
NOFL	5	2	12	5	7	18	
NOPA		1		4	1	4	
NOWA	1		3	2	2	1	
OSFL			1	2		1	
OVEN	99	94	155	135	94	155	
PAWA					1		
PIGR							
PISI				11	1	10	
PIWA					2		
PIWO	3	10	2	1	8	11	
PUFI	3	1		2		1	
RBGR			3	3	4	2	
RBNU	17	28	28	26	41	31	
RCKI		3	1	1		6	
REVI	55	45	125	111	63	101	
RWBB	1		3			1	
SCTA	1	1	1	1	2		
SOSP	6	5	4	6	4	9	
SWSP	4	3	9	10	4	10	
SWTH	24	18	17	19	11	12	
TEWA	3		6	6			
VEER	5	12	3	6	16	17	
WBNU			3			1	
WIFL							1998
WIWR	76	71	72	108	64	138	
WTSP	69	105	159	151	85	158	
WWCR			25		1	2	
YBCH				1			
YBFL	4	3	5	12	13	12	
YBSA		1	2	1	3	8	
YEWA	4						
YHBL							1996
YRWA	16	17	28	28	17	32	

Appendix 7: Total number of species and individuals at transects, 5 minute point counts, Isle Royale, 1999.

SPECIES	CHLR	FELK	ISTR	LRGR	MTDJ	PASPP	TMLC	WIND	Total ID
ALFL		4	1	3	3				11
AMBI					1				1
AMCR	4	1	4	11	21		4		45
AMRE	1	4	14	8	14				41
AMRO	2	3	3	10	13		10	3	44
BASW									0
BAWW		2	1	5	7		3	2	20
BBWA									0
BCCH	5	3	3	5	6		9	7	38
BEKI									0
BHVI								1	1

NAWA	22	21	13	17	28	11	31	4	147
NOFL	3	1	2	4	3		4	1	18
NOPA	1	3							4
NOWA	1								1
OSFL				1					1
OVEN	14	9	17	29	30		25	31	155
PAWA									0
PISI				2		8			10
PIWA									0
PIWO		1	4	3	1		1	1	11
PUII							1		1
RBGR			1			1			2
RBNU	2	4		3	4	14	3	1	31
RCKI	1	1					3	1	6
REVI	14	13	9	14	25		5	21	101
RWBB							1		1
SCTA									0
SOSP	1		2	3	2		1		9
SWSP	1	2	1		4		2		10
SWTH		3					6	3	12
VEER			2		10		5		17
WBNU								1	1
WIWR	19	18	8	28	23	5	26	11	138
WTSP	23	15	21	24	45	4	20	6	158
WWCR					2				2
YBFL				4	1		5	2	12
YBSA	1	1		5	1				8
YRWA	6	4	5	2	8		7		32

No of spec	33	33	32	35	40	8	41	27	60
No of Ind	183	159	157	246	407	55	253	150	1610