

## **Bird usage among managed jack pine stands in the Kirtland's Warbler Wildlife Management Area**

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### **Introduction**

The U.S. Fish and Wildlife Service's (USFWS's) Kirtland's Warbler Wildlife Management Area (KWWMA) is an assemblage of 125 tracts of property totaling 6921 acres in the northern-central Lower Peninsula of Michigan. The primary management objective for KWWMA land has been the creation and protection of breeding habitat for the Federally Endangered Kirtland's Warbler (*Dendroica kirtlandii*). This habitat is typically characterized by densely-stocked (>2500 stems/ha) stands of young jack pine (*Pinus banksiana*) growing on sandy, nutrient-poor soils. Inhabited stands typically range from 5 to 23 years in age and 1.4 to 5.0 meters in height (Probst and Weinrich 1993). Stand and parcel-level habitat management endeavor to provide this early successional habitat by mimicking fire effects in jack pine ecosystems (Kirtland's Warbler Recovery Plan 1985). In the early summer of 2006 breeding bird surveys were conducted in KWWMA parcels to characterize usage not only within stands appropriate for Kirtland's Warbler, but across three age classes that were assumed to represent seral stages of jack pine. This report briefly summarizes the methods and results of this work, and is intended to supplement a comprehensive spreadsheet of survey data which has also been submitted to the U.S. Fish & Wildlife Service for use in developing a Comprehensive Conservation Plan for the KWWMA.

### **Methods**

#### Survey Design

Utilizing GIS-based ArcView 3.2 software, 200 random points were created (Jenness 2005) within the boundaries of a shapefile delineating all KWWMA property. To minimize the likelihood of repeated enumeration of the same breeding bird, generated points were specified to be at least 250m from each other (Ralph et al. 1993); to diminish the frequency of recording off-property individuals, points were also specified to be at least 50m from parcel edges. As a database, these points – each with a precise latitude and longitude within KWWMA boundaries – were assigned random numerical values and sorted in ascension within an Excel spreadsheet. Each locus was then given a unique identification number (e.g., 'KW001') and a jack pine stand age designation extracted from a pre-existing KWWMA database (Goebel et al. *in prep.*) which classified trees as less than 5 years old, 5-23 years old or greater than 23 years old. These three categories respectively reflect recently-harvested stands awaiting jack pine regeneration or colonization by Kirtland's Warbler, stands expected to provide appropriate Kirtland's Warbler

habitat, and mature stands awaiting treatment (i.e., timber harvesting followed by regeneration). Importantly, this pre-existing database catalogued stand age on a parcel-level basis only. Proceeding in the ascending (randomized) order of the spreadsheet, the GIS location of each generated point was then compared to an overlaid shapefile of statewide wetland areas (Michigan Geographic Data Library 2006). If a given point fell within wetland boundaries it was deleted from the associated database; otherwise it was incorporated as an official survey point and categorized by jack pine stand age as 'YOUNG' (less than 5 years), 'KW' (5-23 years) or 'OLD' (greater than 23 years). This process was repeated until 40 survey points of each age class were established. The resultant list of 120 locations incorporated 42 KWWMA parcels in Clare (10 parcels), Crawford (7), Ogemaw (17), Oscoda (7) and Roscommon (1) counties.

### Data Collection

Bird usage within KWWMA parcels was characterized via the 'unlimited point count' method of censusing (see Ralph et al. 1993). Briefly, each point was surveyed twice between 6 June and 9 July 2006 – a period coinciding with moderate to high levels of breeding activity for most terrestrial bird species in the northern Lower Peninsula of Michigan (Brewer et al. 1991). A minimum interval of two weeks was observed between visits. Counts were initiated no earlier than 15 minutes before sunrise (roughly 0545 – 0600 h) and were concluded no later than 1100 h. The second round of surveying replicated the daily routes from the initial round, but inverted the order of visitation so as to minimize bias in the average time of day in which points were bi-sampled. Counts were not executed in rain or in wind conditions exceeding 16 kph. Counts were not conducted if a survey point proved to be in a wetland area or in wet coniferous forest; counts were conducted, however, if the survey point was located in mesic mixed forest or mesic deciduous forest containing little or no mature jack pine. Each count was conducted for five minutes, during which time all discrete breeding males were noted by aural manifestation of their song. A subset of species without identifiable song – primarily corvids, raptors and woodpeckers – were also noted by aural manifestation of their call or by visual observation. If a recorded individual was unequivocally located off KWWMA property and within habitat markedly different from that proximately surrounding the survey point it was tallied in a separate 'OFF PARCEL' column on the field data sheet. The range of jack pine heights in this same proximate area (roughly a circle of 15 m radius) was also noted; the observed stand age for the survey point was recorded as 'YOUNG' if the upper limit of jack pine height was less than 1.4 m, as 'KW' if the upper limit was between 1.4 and 5.0 m, and 'OLD' if the upper limit was greater than 5.0 m.

### Data Treatment

Collected data was entered into an Excel spreadsheet and subsequently combined, edited and supplemented. Individual species inventories for each survey point were assembled by selecting the higher of the values recorded during the two sampling efforts; individuals recorded as 'OFF PARCEL' were not included in these figures. Species numbers were then tallied and sorted by stand age into two metrics of occupancy: 'frequency' recorded the percentage of sampling points in a given age class in which a particular species was noted, while 'abundance' recorded the ratio of the total number of individuals documented in a given age class over the total number of

survey points for that class. While frequencies – which sought to quantify overall species usage among various stand ages – were employed for all species documented in KWWMA parcels, abundance values – which sought to quantify the densities of breeding males in these stands – were compiled only for those species documented by song alone. See Appendix 2 for further details regarding the treatment of collected data.

## Results

A total of 97 sampling sites were ultimately inventoried across 37 KWWMA parcels in Clare (10 parcels), Crawford (6), Ogemaw (15), and Oscoda (6) counties; 23 points went unsampled because of their location in wetland or wet coniferous forest habitat. While the original survey design assumed that the parcel-level information regarding stand age taken from a pre-existing KWWMA database accurately described jack pine age across entire tracts, surveying demonstrated that this assumption of parcel-level homogeneity was erroneous: Almost one quarter of sampled points (23 of 97) expressed discrepancy between expected and observed stand age. Owing to this incongruity, and to the disproportionate number of YOUNG points that were discovered to be wetland, the final register among the three stand ages was unbalanced: 21 YOUNG, 30 KW and 46 OLD.

Sixty bird species were documented during point counts (Appendix 1); 75% were breeding species recorded on the evidence of singing males. Figure 1 compares indices of community similarity for these two species lists (all recorded birds and singing males) among the three surveyed jack pine age classes. Each index (ICS) was calculated by the formula  $ICS = 2a/b$ , where  $a$  = the number of species common to two age classes and  $b$  = the number of species recorded in either of the two compared classes. An ICS value of two indicates maximum community similarity, while a value of zero indicates no similarity. Predictably, ICS scores were higher between successional-adjacent habitats (YOUNG and KW, KW and OLD) than between the successional-disjunct YOUNG and OLD categories; values for the four successional-adjacent comparisons were notably similar (range = 0.72-0.77), and were, on average, 45% greater than the two successional-disjunct comparisons.

The primary management objective for KWWMA parcels is the creation of viable Kirtland's Warbler habitat. Among parcels classified as KW on the basis of jack pine height, 12 of 13 tracts (92.3%) contained singing male Kirtland's Warblers; among the 30 individual points sampled within these tracts, 27 (90%) registered at least one warbler. Figure 2 documents the range of Kirtland's Warbler breeding abundances for all KWWMA tracts in which singing males were recorded – 12 KW parcels as well as two YOUNG parcels. The average number of males documented per sampling point among these 14 “warbler-positive” parcels was 3.07; the average number per sampling point among the 13 sampled KW parcels was 2.80.

This value – 2.80 singing males per sampling point – rendered the Kirtland's Warbler the most abundant breeding species within KW stands of jack pine (Figure 3). Three other species – Nashville Warbler (*Vermivora ruficapilla*), Hermit Thrush (*Catharus guttatus*) and Field Sparrow

(*Spizella pusilla*) – recorded abundance values exceeding an average of one singing male per sampling point. This abundance threshold was also exceeded by four total species in both YOUNG (Field Sparrow, Vesper Sparrow [*Poecetes gramineus*], Lincoln’s Sparrow [*Melospiza lincolni*] and Brown Thrasher [*Toxostoma rufum*]) and OLD (Hermit Thrush, Ovenbird [*Seiurus aurocapilla*], Chipping Sparrow [*Spizella passerina*] and Nashville Warbler) jack pine stands (Figures 4 and 5). Across all sampled points, only Hermit Thrush and Nashville Warbler averaged greater than one singing male per point; the Kirtland’s Warbler was the third most abundant species within all KWWMA parcels, with 0.92 males per point (Figure 6).

Frequency percentages for different stand ages incorporated an additional 15 species not documented solely upon the basis of male song, and are highlighted in Figures 7, 8 and 9. Among KW stands, only the Nashville Warbler (96.7%) was noted in a higher percentage of sampled points than the Kirtland’s Warbler; Blue Jay (*Cyanocitta cristata*), Hermit Thrush and Field Sparrow were also recorded in over 80% of points. Field Sparrow, Brown Thrasher, Common Raven (*Corvus corax*) and Vesper Sparrow transcended 80% frequency in YOUNG points, while only Blue Jay and Hermit Thrush exceeded that level in OLD points. The five most frequently documented species across all KWWMA properties were Blue Jay, Nashville Warbler, Hermit Thrush, Common Raven and Mourning Dove (*Zenaida macroura*) (Figure 10).

Although from a conservation perspective YOUNG and OLD stands of jack pine are primarily regarded as “staging” sequences in the creation of Kirtland’s Warbler habitat, 2006 surveying in KWWMA tracts demonstrated that neither is depauperate in regards to the overall abundance of other breeding bird species. However, comparing the relative diversity among the three categories of jack pine stand age is somewhat complicated by the unequal number of sampled points between them. Nonetheless, Figure 11 utilizes a variety of metrics in an attempt to draw general conclusions regarding bird diversity and conservation value across the three successional stages of habitat. Row 1a lists the total number of species documented in each age class, 1b divides these figures by the total number of sampling points in each age class, and 1c expresses the total number of singing males per sampling point in each age class. Rows 2a-2c and 3a-3c employ the same format (total species, species per point, and singing males per point) with reference to conservation value: Rows 2a-2c multiply each enumerated unit (species or singing male) by the Partners In Flight (PIF) Combined Score for breeding species of Region 12, while Rows 3a-c assess stand age distribution only for the five KWWMA species identified by the USFWS service as Region 3 Conservation Priorities (Black-billed Cuckoo [*Coccyzus erythrophthalmus*], Field Sparrow, Kirtland’s Warbler, Upland Sandpiper [*Bartramia longicauda*] and Northern Flicker [*Colaptes auratus*]) (USFWS 2002, Partners In Flight 2006). For the purpose of analysis, the three documented species for which no Partners In Flight Combined Score was available (Spotted Sandpiper [*Actitis macularius*], Upland Sandpiper and Wilson’s Snipe [*Gallinago delicata*]) each received the mean Combined Score (11.7) of the other 57 KWWMA species.

Because rows 1a, 2a and 3a reflect species totals tallied from unbalanced sample sizes (21 YOUNG, 30 KW and 46 OLD), each likely overestimates the diversity and conservation value of

OLD stands and underestimates that of YOUNG stands. Conversely, because intra-habitat species variety does not linearly correlate with point count sample size (Brewer 1991), rows 1b, 2b, and 3b likely overestimate the diversity and conservation value of YOUNG stands and underestimate that of OLD stands. Consequently, rows 1c, 2c and 3c – which record only breeding species, and do so on the “balanced” basis of singing males per sampling point – presumably represent the most accurate estimations within Figure 11 of stand age diversity. The average number of singing males per sampling point in KW stands was 14.1, while averages for YOUNG and OLD stands were 10.2 and 10.8, respectively; the sum of PIF scores for singing males per sampling point in KW stands was 192, while scores for YOUNG and OLD stands were 127 and 122, respectively. Both metrics reflect notable similarity between YOUNG and OLD age classes. The average number of singing males per sampling point for KW stands was 33.8% higher than the combined average for YOUNG and OLD stands, while the average PIF score for singing males per sampling point in KW stands was 54.2% higher than the combined average for YOUNG and OLD stands. Lastly, the assessment of age class distribution of USFWS Region 3 Conservation Priority species – which involves an exceedingly limited number of species – favors KW stands moderately over YOUNG stands and heavily over OLD stands.

In summary, point counts executed on KWWMA parcels in 2006 demonstrated the broad-based success of U.S. Fish and Wildlife Service management practices in establishing habitat conducive for breeding usage by the Kirtland’s Warbler. Furthermore, surveying suggested that both early-stage and mature-stage jack pine habitat, while of lower overall regional conservation importance than 5-23 year-old stands, contribute significantly to avifaunal productivity and diversity in the northern Lower Peninsula of Michigan.

## Figures

	all recorded <u>species</u>	species recorded by <u>breeding male song</u>
OLD & KW communities	0.72	0.77
KW & OLD communities	0.75	0.74
OLD & OLD communities	0.53	0.50

Figure 1. Community Similarity Indices for bird species among three jack pine age classes in KWWMA parcels.

<u>stand age</u>	<u>county</u>	<u>tract ID</u>	<u>sampling points</u>	<u>singing Kirtland's Warblers per sampling point</u>
KW	Clare	CL-08	2	3.00
KW	Clare	CL-11	1	3.00
KW	Clare	CL-18	3	4.33
KW	Clare	CL-21	2	5.00
KW	Crawford	CR-09	1	4.00
KW	Crawford	CR-10	1	3.00
KW	Oscoda	OS-02	6	2.50
KW	Oscoda	OS-03	2	3.50
KW	Oscoda	OS-14	1	2.00
KW	Oscoda	OS-18	1	1.00
KW	Ogemaw	OG-26	3	4.33
KW	Ogemaw	OG-28	4	1.75
OLD	Ogemaw	OG-01	1	1.00
OLD	Ogemaw	OG-25	1	4.00
		TOTAL	29	3.07

Figure 2. Parcel-level abundance values for singing male Kirtland's Warblers recorded in KWWMA tracts.

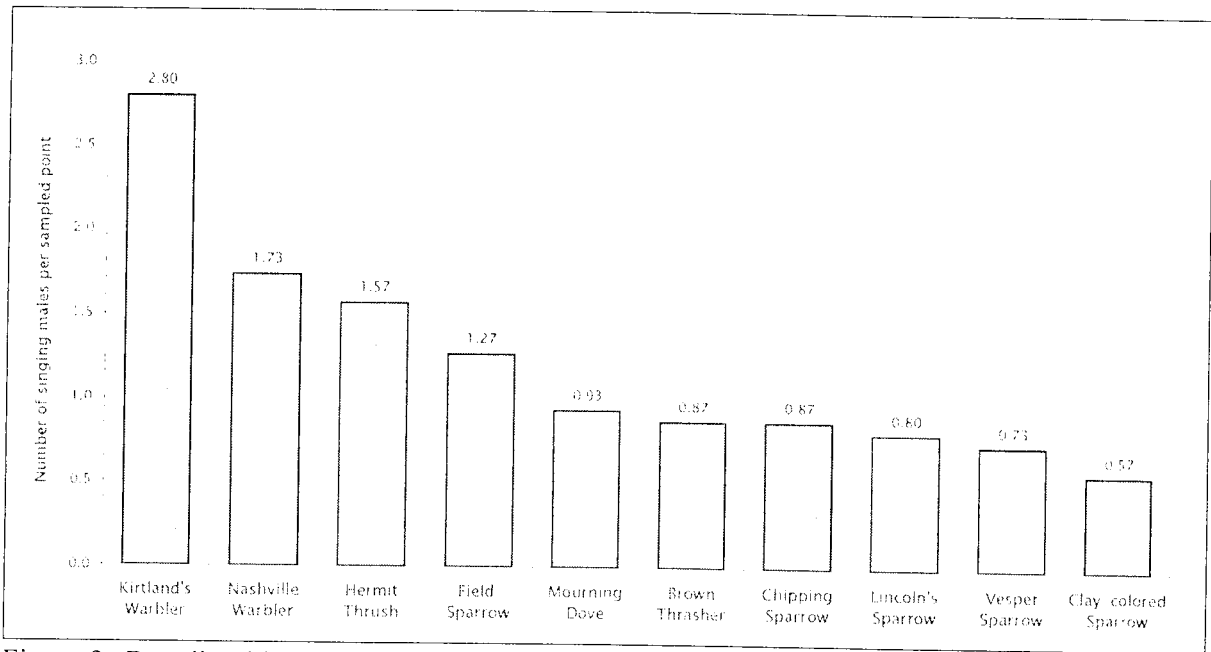


Figure 3. Breeding bird species of highest abundance in KW (5-23 years) KWWMA jack pine stands.

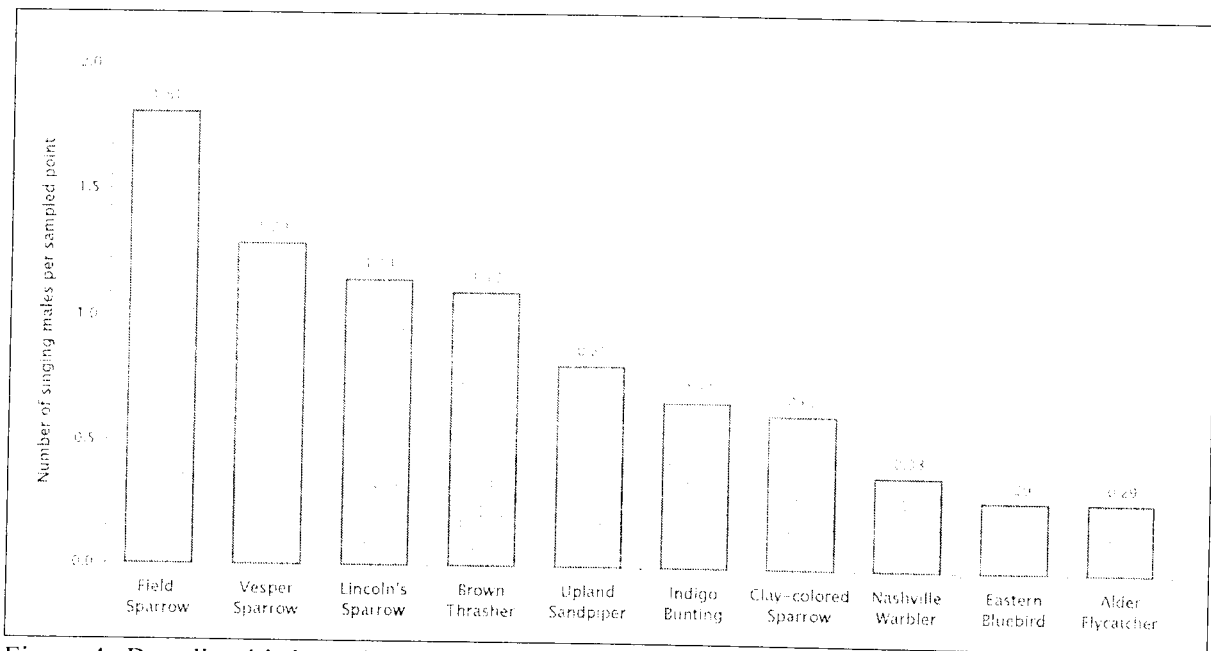


Figure 4. Breeding bird species of highest abundance in <5 year old KWWMA jack pine stands.

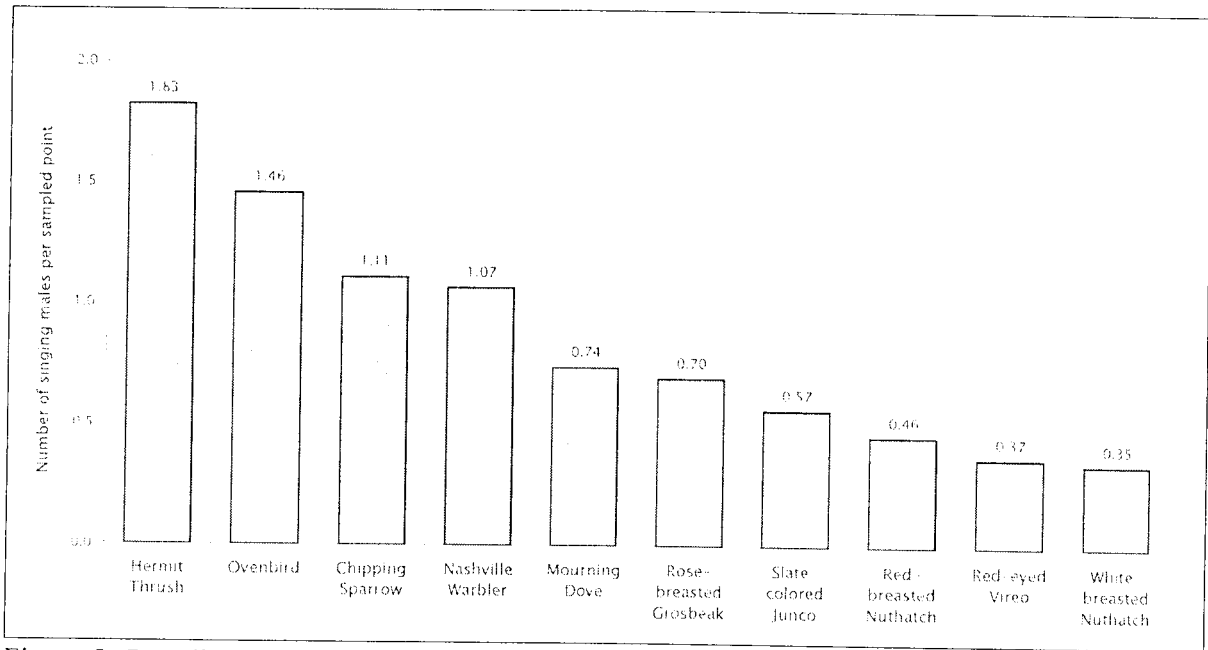


Figure 5. Breeding bird species of highest abundance in OLD (>23 years) KWWMA jack pine stands.

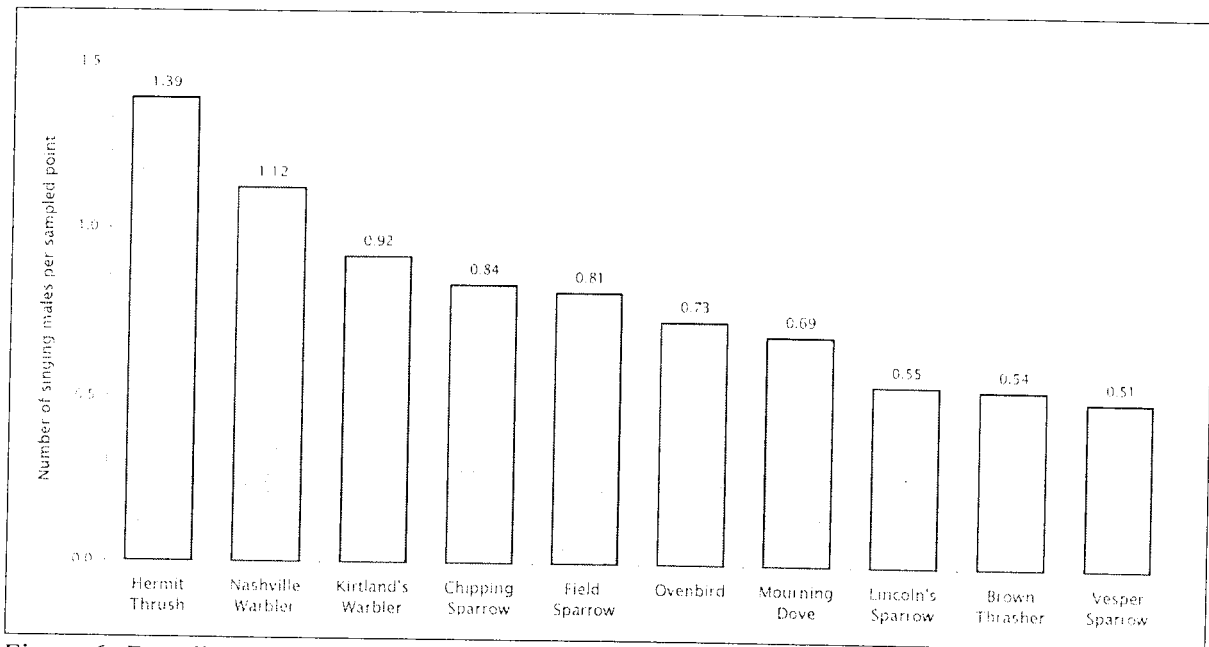


Figure 6. Breeding bird species of highest abundance in ALL KWWMA jack pine stands.



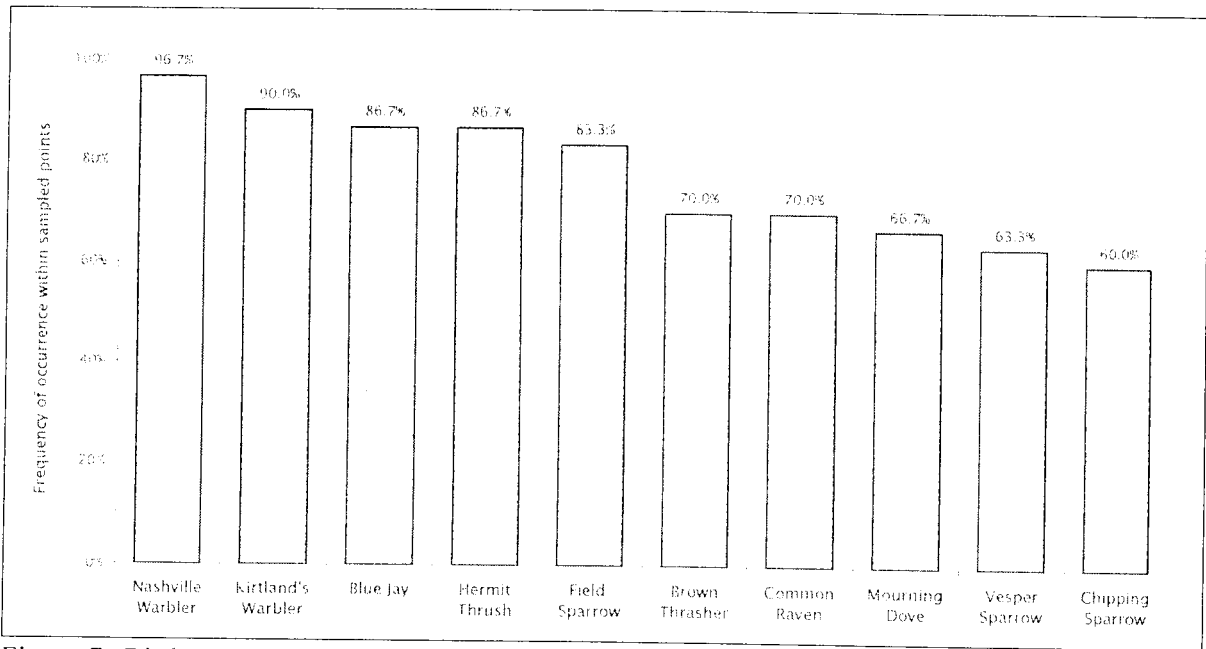


Figure 7. Bird species of highest frequency of occurrence in KW (5-23 years) KWWMA jack pine stands.

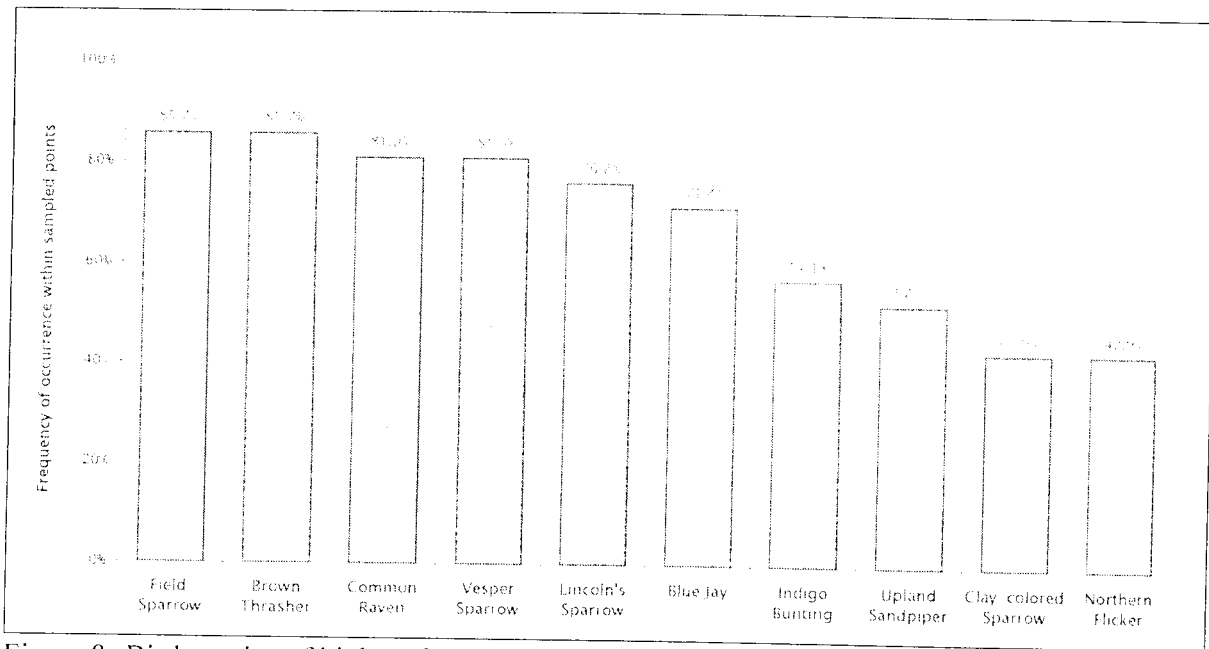


Figure 8. Bird species of highest frequency of occurrence in KW (<5 years) KWWMA jack pine stands.

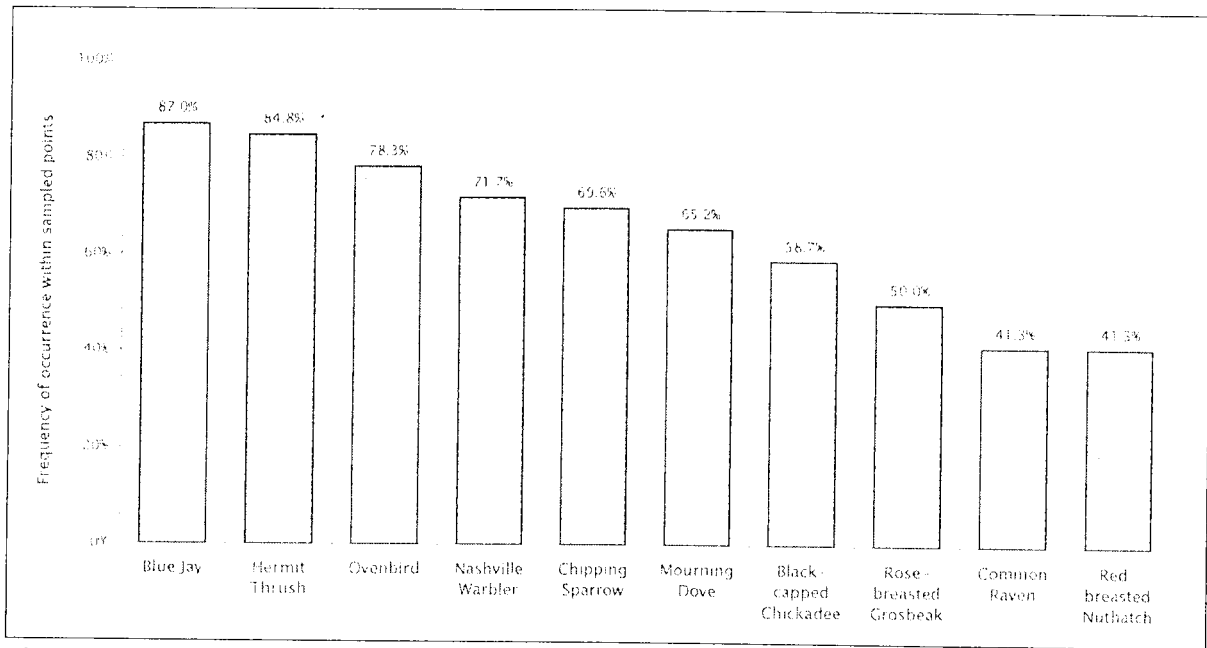


Figure 9. Bird species of highest frequency of occurrence in **OLD** (>23 years) KWWMA jack pine stands.

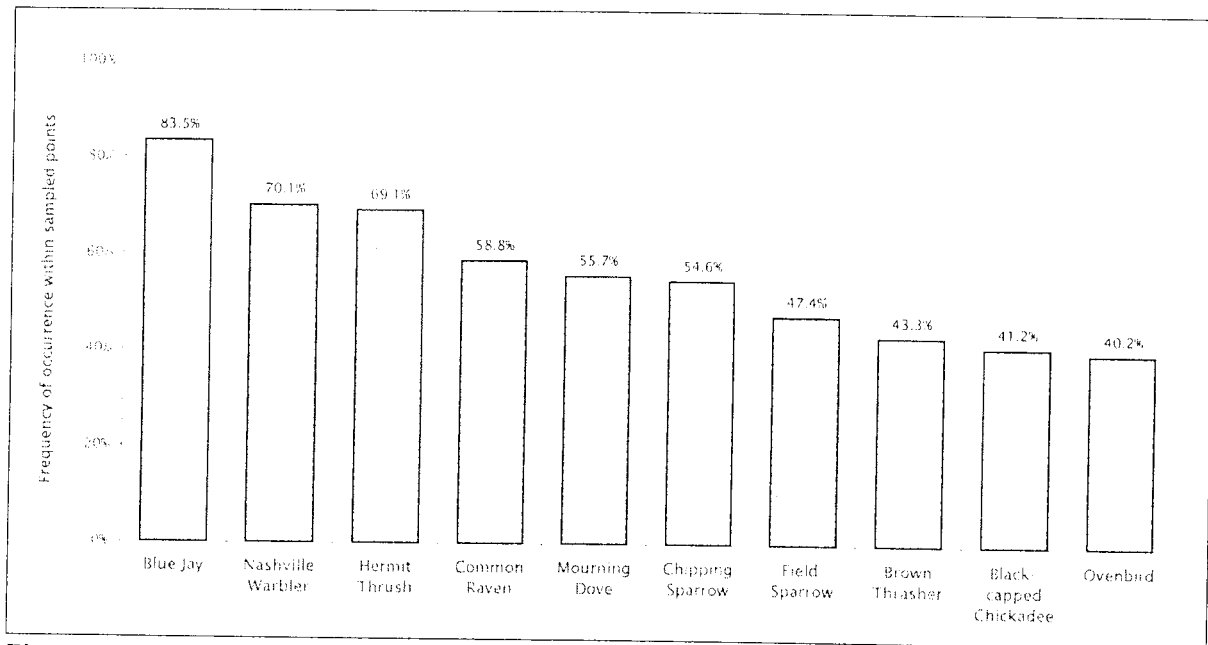


Figure 10. Bird species of highest frequency of occurrence in **ALL** KWWMA jack pine stands.

	<u>YOUNG</u>	<u>KW</u>	<u>OLD</u>
1a: total species	29	40	51
1b: total species / sampling point	1.38	1.33	1.11
1c: total singing males / sampling point	10.2	14.1	10.8
2a: sum of PIF(R12) RCS(b) scores for all species	346	474	593
2b: sum of PIF(R12) RCS(b) scores for all species / sampling point	16.5	15.8	12.9
2c: sum of PIF(R12) RCS(b) scores for all singing males / sampling point	127	192	122
3a: total FWS(R3) Conservation Priority species	5	5	3
3b: total FWS(R3) Conservation Priority species / sampling point	0.24	0.17	0.07
3c: total FWS(R3) Conservation Priority singing males / sampling point	3.14	4.30	0.11

Figure 11. Frequency, abundance and conservation-value metrics for bird species among three jack pine age classes in KWWMA parcels.

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Appendix 1. Bird species documented within KWWMA parcels, June-July 2006.

AOU	common_name	scientific_name	NEST		KW		OLD		ALL			
			LOC1	LOC2	FREQ	ABUND	FREQ	ABUND	FREQ	ABUND	FREQ	ABUND
ALFL	Alder Flycatcher [11]	<i>Empidonax alnorum</i>	SH		23.8%	0.29				5.7%	0.06	
AMCR	American Crow * [10]	<i>Corvus brachyrhynchos</i>	DT	SH	14.3%			6.5%		6.2%		
AMGO	American Goldfinch [13]	<i>Carduelis tristis</i>	SH	TR			10.0%	0.10	2.2%	0.02	4.1%	0.04
AMRE	American Redstart [12]	<i>Setophaga ruticilla</i>	DT	SH				2.1%	0.02	1.0%	0.01	
AMRO	American Robin [9]	<i>Turdus migratorius</i>	DT	CT	14.3%	0.14	2.2%	0.02	12.0%	0.15	16.3%	0.11
BDOW	Barred Owl * [10]	<i>Strix varia</i>	DT	SH				2.2%		1.0%		
BBCU	Black-billed Cuckoo [16, CP]	<i>Coccyzus erythrophthalmus</i>	DT	SN	23.6%	0.29	10.0%	0.10	4.3%	0.04	11.3%	0.11
BCCH	Black-capped Chickadee * [11]	<i>Poecile atricapillus</i>	SN		4.8%		40.0%		58.7%		41.2%	
BLJA	Blue Jay * [10]	<i>Cyanocitta cristata</i>	DT	GR	21.4%		86.7%		82.0%		83.5%	
SOVI	Blue-headed Vireo [11]	<i>Vireo solitarius</i>	CT					13.0%	0.13	6.2%	0.06	
BRCR	Brown Creeper [11]	<i>Certhia americana</i>	CT	DT				6.5%	0.07	3.1%	0.03	
BRTH	Brown Thrasher [14]	<i>Toxostoma rufum</i>	SH	GR	85.7%	1.10	70.0%	0.87	6.5%	0.07	42.3%	0.54
BHCO	Brown-headed Cowbird [12]	<i>Molothrus ater</i>	SH	GR			3.3%	0.03	2.2%	0.04	2.1%	0.03
CEDW	Cedar Waxwing * [13]	<i>Bombycilla cedrorum</i>	DT	CT			13.3%		15.2%		11.3%	
CHSP	Chipping Sparrow [11]	<i>Spizella passerina</i>	CT	DT	14.3%	0.19	60.0%	0.87	69.0%	1.11	54.6%	0.84
CCSP	Clay-colored Sparrow [12]	<i>Spizella pallida</i>	DT	CT	42.9%	0.62	41.3%	0.57			22.7%	0.31
COGR	Common Grackle * [9]	<i>Quiscalus quiscula</i>	GR		19.0%		10.0%		10.0%		12.4%	
CONI	Common Nighthawk [13]	<i>Chordeiles minor</i>	CL	CT			10.0%	0.13	10.9%	0.13	8.2%	0.10
CORA	Common Raven * [9]	<i>Corvus corax</i>	GR		81.0%		70.0%		41.3%		58.8%	
COYE	Common Yellowthroat [14]	<i>Geothlypis trichas</i>	SH		9.5%	0.10	16.7%	0.17	8.2%	0.11	11.3%	0.12
EABL	Eastern Bluebird [10]	<i>Sialia sialis</i>	SN		23.8%	0.29					5.2%	0.06
EAKI	Eastern Kingbird [13]	<i>Tyrannus tyrannus</i>	DT	SH	4.8%	0.05	3.3%	0.04			2.1%	0.02
EAPH	Eastern Phoebe [10]	<i>Sayornis phoebe</i>	BR	CL					2.2%	0.02	1.0%	0.01
EATO	Eastern Towhee [13]	<i>Pipilo erythrophthalmus</i>	GR	SH	4.8%	0.05	33.3%	0.33	2.2%	0.02	12.4%	0.12
EAWP	Eastern Wood-Pewee [13]	<i>Contopus virens</i>	DT					30.4%	0.32	14.4%	0.15	
FISP	Field Sparrow [15, CP]	<i>Spizella pusilla</i>	GR	SH	85.7%	1.51	83.3%	1.27	6.5%	0.07	42.4%	0.81
GCKI	Golden-crowned Kinglet [12]	<i>Regulus satrapa</i>	DT	SN					2.2%	0.02	1.0%	0.01
CCFL	Great Crested Flycatcher [13]	<i>Myiarchus crinitus</i>	CT				6.2%	0.07	15.2%	0.15	9.3%	0.09
HAWO	Hairy Woodpecker * [11]	<i>Picoides villosus</i>	DT	SN			3.3%		8.2%		5.2%	
HETH	Hermit Thrush [9]	<i>Catharus guttatus</i>	GR	TR	9.5%	0.19	86.7%	1.57	84.8%	1.63	69.1%	1.39
HOWR	House Wren [10]	<i>Troglodytes aedon</i>	DT	SN					4.0%	0.07	2.1%	0.03
INBU	Indigo Bunting [10]	<i>Passerina cyanea</i>	SH	TR	57.1%	0.67	3.3%	0.03	8.2%	0.09	12.5%	0.20
KIWA	Kirtland's Warbler [22, CP]	<i>Dendroica kirtlandii</i>	GR		9.5%	0.11	90.0%	2.80			20.9%	0.92

Appendix I (continued). Bird species documented with KWWMA parcels, June-July 2006.

AOU	common name	scientific name	NEST		JUN		KW		OLD		ALL	
			LOC1	LOC2	FREQ	ABUND	FREQ	ABUND	FREQ	ABUND	FREQ	ABUND
LEFL	Least Flycatcher [14]	<i>Empidonax minimus</i>	DT	SH					2.2%	0.02	1.0%	0.01
LISP	Lincoln's Sparrow [10]	<i>Melospiza lincolni</i>	GR		76.2%	1.14	43.3%	0.80	8.7%	0.11	34.0%	0.55
MODO	Mourning Dove [6]	<i>Zenaida macroura</i>	TR	GR	19.0%	0.24	66.7%	0.93	65.2%	0.74	55.2%	0.69
MOWA	Mourning Warbler [16]	<i>Oporornis philadelphia</i>	GR						7.2%	0.02	1.0%	0.01
NAWA	Nashville Warbler [13]	<i>Vermivora ruficapilla</i>	CT		28.6%	0.38	99.7%	1.73	71.7%	1.02	70.1%	1.12
NOFL	Northern Flicker * [15, CP]	<i>Colaptes auratus</i>	GR		42.9%		10.0%		23.9%		33.0%	
OVEN	Ovenbird [13]	<i>Seiurus aurocapilla</i>	SN		4.8%	0.05	6.7%	0.10	28.3%	1.46	40.2%	0.73
PIWA	Pine Warbler [10]	<i>Dendroica pinus</i>	GR						2.2%	0.04	1.0%	0.02
RBNU	Red-breasted Nuthatch [9]	<i>Sitta vireo</i>	CT						41.3%	0.46	19.0%	0.22
REVI	Red-eyed Vireo [11]	<i>Vireo olivaceus</i>	DT	SH			3.3%	0.03	34.8%	0.12	17.5%	0.19
RTHA	Red-tailed Hawk * [9]	<i>Buteo jamaicensis</i>	CT				10.0%		6.5%		6.2%	
RWBL	Red-winged Blackbird [9]	<i>Agelaius phoeniceus</i>	SH	DT			3.2%	0.02	4.0%	0.02	3.1%	0.04
RBGR	Rose-breasted Grosbeak [16]	<i>Pheucticus ludovicianus</i>	DT	CL	4.8%	0.05	3.3%	0.03	50.0%	0.70	25.8%	0.35
SCTA	Scarlet Tanager [13]	<i>Piranga olivacea</i>	RD						23.0%	0.24	11.3%	0.11
SCJU	Slate-colored Junco [11]	<i>Junco hyemalis</i>	GR	BK			16.7%	0.20	37.0%	0.52	22.7%	0.33
SOSP	Song Sparrow [12]	<i>Melospiza melodia</i>	DT	CT	23.8%	0.24	6.7%	0.07	4.3%	0.04	9.2%	0.09
SPSA	Spotted Sandpiper *	<i>Actitis macularius</i>	GR	SH					2.2%		1.0%	
TRES	Tree Swallow * [13]	<i>Tachycineta bicolor</i>	CT	DT			6.7%		2.2%		3.1%	
TUVU	Turkey Vulture * [8]	<i>Cathartes aura</i>	GR				3.3%				1.0%	
UPSA	Upland Sandpiper [CP]	<i>Bartramia longicauda</i>	SN		32.4%	0.81	13.3%	0.12			15.5%	0.22
VESP	Vesper Sparrow [12]	<i>Pooecetes gramineus</i>	CL	SN	81.0%	1.09	63.3%	0.73			27.1%	0.51
WBNU	White-breasted Nuthatch [11]	<i>Sitta carolinensis</i>	GR				3.2%	0.03	30.4%	0.35	15.5%	0.18
WTSP	White-throated Sparrow [12]	<i>Zonotrichia albicollis</i>	GR				13.2%	0.20	2.0%	0.02	5.2%	0.07
WITU	Wild Turkey * [9]	<i>Meleagris gallopavo</i>	DT		9.5%						2.1%	
COSN	Wilson's Snipe	<i>Gallinago delicata</i>	GR						6.5%	0.02	3.1%	0.03
YBSA	Yellow-bellied Sapsucker * [14]	<i>Sphyrapicus varius</i>	GR	SH					2.2%		1.0%	
MYWA	Yellow-rumped Warbler [9]	<i>Dendroica coronata</i>	DT				6.7%	0.07	2.2%	0.02	3.1%	0.03

Appendix I lists all 60 bird species recorded during point counts within KWWMA parcels in June and July 2006. The 'AOU' column records the species' four-letter code as designated by The American Ornithologists' Union (2006). An asterisk after the common name of the species indicates that during surveying it was recorded by call or visual observation; a lack of asterisk indicates that the species was recorded only by song. The number in brackets after the common

name lists the Partners in Flight (PIF) Regional Combined Score for the breeding season for Region 12 species. A 'CP' in brackets after the common name indicates that the species is a US Fish & Wildlife Service Region 3 Conservation Priority. The 'NEST' columns provide alphabetic code for the primary (LOC1) and secondary (LOC2) nest site locations commonly utilized by the species (Ehrlich et al. 1988); the designations are as follows:

BK – bank	GR – ground
BR – bridge	RD – reeds
CL – cliff	SH – shrub
CT – coniferous tree	SN – snag
DT – deciduous tree	TR – tree

The four sets of paired columns on the right half of Appendix 1 – 'YOUNG', 'KW', 'OLD' and 'ALL' – each record two different measures of species occurrence within the KWWMA parcels: 'FREQ' expresses the percentage of sampling points for the given age class (or for 'ALL' 97 sampling points combined) in which the species was recorded; 'ABUND' expresses the ratio of the total number of individuals recorded for the given age class over the total number of survey points for that class. For example, Kirtland's Warbler was recorded in 27 of the 30 'KW' survey points, so 'FREQ' = 90%; the total number of individuals recorded within these 30 points was 84, so 'ABUND' = 2.80. While 'FREQ' percentages relate to the presence or absence of all 60 species recorded during surveying, 'ABUND' values relate only those 45 species that were documented by song alone.

## Appendix 2. Supplement to KWWMA spreadsheet data.

All survey data was compiled and combined within an Excel spreadsheet (KWWMA\_0701\_data) which has been submitted with this report; this appendix describes and elaborates upon the information contained therein. In delineating the contents of the eight separate worksheets it proceeds from right to left across their tabular arrangement within the file. The bracketed letters (e.g., '[A]') under each bold-faced worksheet name (e.g., 'STAGE1') refer to the column of the worksheet; a column title described below (e.g., 'KW PT') that is repeated in subsequent worksheets is assumed to convey identical information unless otherwise noted.

**STAGE1:** lists data for both sampling events at all 97 KWWMA points surveyed in 2006

- [A] KW PT: alphanumeric identification for the randomly-generated sampling point within a KWWMA tract
- [B] TRACT: alphanumeric identification for the KWWMA tract (or 'parcel') in which the [A] KW PT is located; utilized in prior KWWMA work
- [C] LAT: latitude of sampling point expressed in decimal degrees under NAD83 projection
- [D] LONG: longitude of sampling point expressed in decimal degrees under NAD83 projection
- [E] AGE CLASS: numeric code for age of jack pine stand within KWWMA parcel as established by prior KWWMA work
- [F] TRACT AGE: alphabetic code for presumptive age of jack pine stand proximately surrounding sampling point as taken from [E] AGE CLASS data; age class 1 = tract age 'YNG' (<5 years old), age class 2 = 'KW' (5-23 years old), age classes 3 and 4 = 'OLD' (>23 years old)
- [G] PT AGE: alphabetic code for estimated age of jack pine stand proximately surrounding sampling point as determined during surveying; categorically identical to [F] TRACT AGE above
- [H] ?: '?' indicates disparity between [F] TRACT AGE and [G] PT AGE; an empty value indicates agreement
- [I] JP: estimated height range (in feet) among jack pines proximately surrounding sampling point; 'NO JP' indicates an absence of jack pines surrounding sampling point
- [J] ALFL: four-letter American Ornithologists' Union (AOU) species code for Alder Flycatcher (*Empidonax alnorum*); a value indicates the number of Alder Flycatchers identified during a five-minute surveying event
- [K] ~: indicates the number of birds, if any, identified in [J] ALFL which were unequivocally located a) beyond the KWWMA parcel boundary and b) in habitat markedly different from that proximately surrounding the survey point
- [L-DY] replicate the paired data structure of [J] and [K], with species arranged in ascending alphabetical order according to AOU coding



**STAGE2:** combines data from both sampling events for all 97 KWWMA points in highlighted yellow rows; see the Data Treatment section in the main report for details on data combination

**STAGE3:** refines sampling data by eliminating original survey values from which the combined data rows of STAGE 2 were compiled; discards all '~' columns adjacent to AOU species columns

- [K] AVG DATE: averaged date of the two survey efforts at the sampling point
- [L] AVG TIME: averaged military time of the two survey efforts at the sampling point
- [M] AVG SKY: averaged value of a numeric code designating sky conditions during the two survey efforts at the sampling point; 1 = CLEAR, 2= MOSTLY CLEAR, 3 = PARTLY CLOUDY, 4 = MOSTLY CLOUDY, 5 = CLOUDY
- [N] AVG WIND: averaged value of a numeric code designating wind conditions during the two survey efforts at the sampling point; 1 = CALM, 2 = MOSTLY CALM, 3 = LIGHT WIND, 4 = LIGHT/MODERATE WIND, 5 = MODERATE WIND

**TRACTS:** lists basic habitat information on KWWMA parcels as recorded during point surveying

- [J] JP AVG: averaged height (in feet) of the jack pine range listed in [I] JP
- [K] TRACT INFO: basic habitat information regarding surveyed and unsurveyed portions of KWWMA parcels

**SUMMARY:** summarizes species data from STAGE3 by stand age category; adds additional habitat and conservation information for recorded species

- [A] AOU: four-letter American Ornithologists' Union species code
- [B] COMMON: common name for recorded species
- [C] TYPE: alphabetic code for manner in which species was recorded during surveying; S = by song only, V = by song, call or visual observation
- [D] R3 CP: an 'x' indicates that the species is a US Fish & Wildlife Service Region 3 Conservation Priority
- [E] PIF RCS-B: the Partners in Flight (PIF) Regional Combined Score for breeding species in Region 12; see Results for further details
- [F] (NESTING) LOC1: alphabetic code for the primary nest site location commonly utilized by the species; see Appendix 1 for further details
- [G] (NESTING) LOC2: alphabetic code for the secondary nest site location, if any, commonly utilized by the species; see Appendix 1 for further details
- [H] (YOUNG) FR: the total number of survey points in YOUNG jack pine stands in which the species was recorded

- [I] (YOUNG) FREQ: the percentage of survey points in YOUNG jack pine stands in which the species was recorded
- [J] (YOUNG) AB: the total number of individuals recorded at survey points in YOUNG jack pine stands
- [K] (YOUNG) ABUND: the ratio of the total number of individuals recorded at survey points in YOUNG jack pine stands over the total number of YOUNG survey points
- [L] (YOUNG) PIF: the product of [E] PIF RCS-B and [J] (YOUNG) ABUND; see the Results section in the main report for further details
- [M-Q] replicate the formatting of [H-L] for KW jack pine stands
- [R-V] replicates the formatting of [H-L] for OLD jack pine stands
- [W-AA] replicate the formatting of [H-L] for all 97 KWWMA survey points

**UPSA:** summarizes survey data for Upland Sandpipers (*Bartramia longicauda*) recorded in KWWMA tracts

- [B] KW PT: same as [A] in STAGE1; an empty value indicates that sandpipers were noted visually on a KWWMA parcel while in transit to or from a sampling point
- [F] SONG: the number of Upland Sandpipers recorded by song during formal surveying at a KWWMA sampling point
- [G] VISUAL: the number of Upland Sandpipers recorded visually on a KWWMA parcel while in transit to or from a sampling point

**LIST:** condenses species information expressed in SUMMARY; see Appendix 1 for further details

**LIST EXPORT:** replicates LIST with formatting utilized for export (as Appendix 1) into Microsoft Word