

BREEDING AND VISITING BIRD SPECIES IN OAK SAVANNA REMNANTS
OF NORTHERN ILLINOIS

BY,

S.I. Apfelbaum
Applied Ecological Services
Rt 1, Box 130
N673 Mill Road
Juda, Wisconsin 53550

Marlin Bowles
The Morton Arboretum
Lisle, Illinois 60532

INTRODUCTION

Bird species and communities have been found to be useful indicators of general vegetation characteristics (Karr, 1968; Willson, 1974; Adams, 1908). Avians can change drastically as structural aspects of habitat (McArthur, 1964) are modified by vegetation succession (Johnson and Odum, 1956; Odum, 1950), natural perturbations (Appelbaum and Haney, 1981, 1985; Bock et al., 1978; Noon et al., 1979) or by anthropogenics, or all of these. Northern Illinois during presettlement times contained a diverse mosaic of biological communities (Bailey, 1978). From the perspective of avian habitat a real dichotomy in predominant vegetation types existed where open and closed canopy oak savanna and forests contrasted with open prairies and wetlands. Since settlement changes in vegetation structure and spatial heterogeneity have resulted because of direct and indirect anthropogenic influences including logging, tillage, grazing activity, and indirectly by wildfire suppression.

Prairies and wetlands have largely been converted to agriculture-use or urbanized; forests have been logged, or, grown in with a plethora of even-aged saplings and transgressives including several naturalized shrub and tree species. Consequently, great vegetation changes have occurred regionally which if current avian habitat theories have any application to presettlement conditions would predict great changes in regional avian-use have also occurred. Monumental changes might include loss of several species such as the passenger pigeon and carolina parakeet. These species were believed to be frugivores and seedivores of the savanna (Bent, 1958). Birds of the Illinois prairie have greatly declined (Illinois Natural History Survey, unpublished ms.). Savanna species may never have been adequately understood to determine their present status, and new regional bird species such as the European starling and English house sparrow are now

present. Cognizant of these unknowns, this study attempted to quantitatively characterize avifauna-use for breeding and visitation in remnants of presettlement oak savanna now in various states of change from presumed historic conditions. Although regionally centered the sites were variable in stand origin, anthropogenic land-uses, size, dimensions, configurations, and accessibility.

The goals of this study were:

- 1) To sample breeding and visiting bird species in each of four savanna remnants with the limited support available in 1986. Study areas were Somme Woods (test and control), Reed-Turner Woodland Preserve (test and control), Wadsworth savanna, and Middlefork Savanna (Figures 1-4, Appendix 1)
- 2) To establish a permanent study transect locations and methodology for continued avian surveys in each area that takes into account limited funding opportunities and time for professional efforts; a program for volunteer continuation.
- 3) To establish where feasible in study areas, control and test plots enabling quantitative analysis of management strategy effects. Where experimental control was not possible because of small size of areas and land owners management plans, data from 1986 was to serve as baseline information to be used for determination of avian community trends, through use of repeated events analysis and trend determination statistics.

This study report presents a preliminary analysis of first season bird data.

METHODS

Birds were studied using modified Emlen (1971) transect surveying techniques. Surveying was done daily for 3-4 hours over a two week period 12-29 June 1986. Slightly slower surveying speeds than suggested (Emlen, Ibid.), because of the noise created by vehicle traffic and by moving through dense vegetation, were employed. Locations of all observed and audible individual birds were plotted on prepared survey forms. Plotting and analysis was done within 25 meter wide belts paralleling either side of the principal permanently staked study transects to a distance of 100 meters. From this, the number of individuals of each breeding and visiting bird species was determined which was then averaged over the four resurveys of each transect in each study area. Data has not been standardized with other studies, such as by reporting bird density as the number of birds in 100 hectares. However, a reductionist method for comparison within and among study areas and transects in each site was employed. This expressed avian densities and richness as a percent of the length in lineal meters of each transect. Ratios of bird population sizes and site richness were calculated. Surveying along each study transect terminated when all or a majority of the individual birds were consistently replotted in the same areas during multiple surveys. Bird nomenclature follows the U.S. Fish and Wildlife Service Bird Banding Manual (1976).

Each of the study areas was visited and the feasibility for specifically installing test (management) and control (non-management) study transects was determined. Decisions based on area size, implemented land management strategies and goals, and researcher access and time (financial limitations) were made; permanently established study transects were mapped (Appendix 1) for each of the four study areas in 1986.

VEGETATION

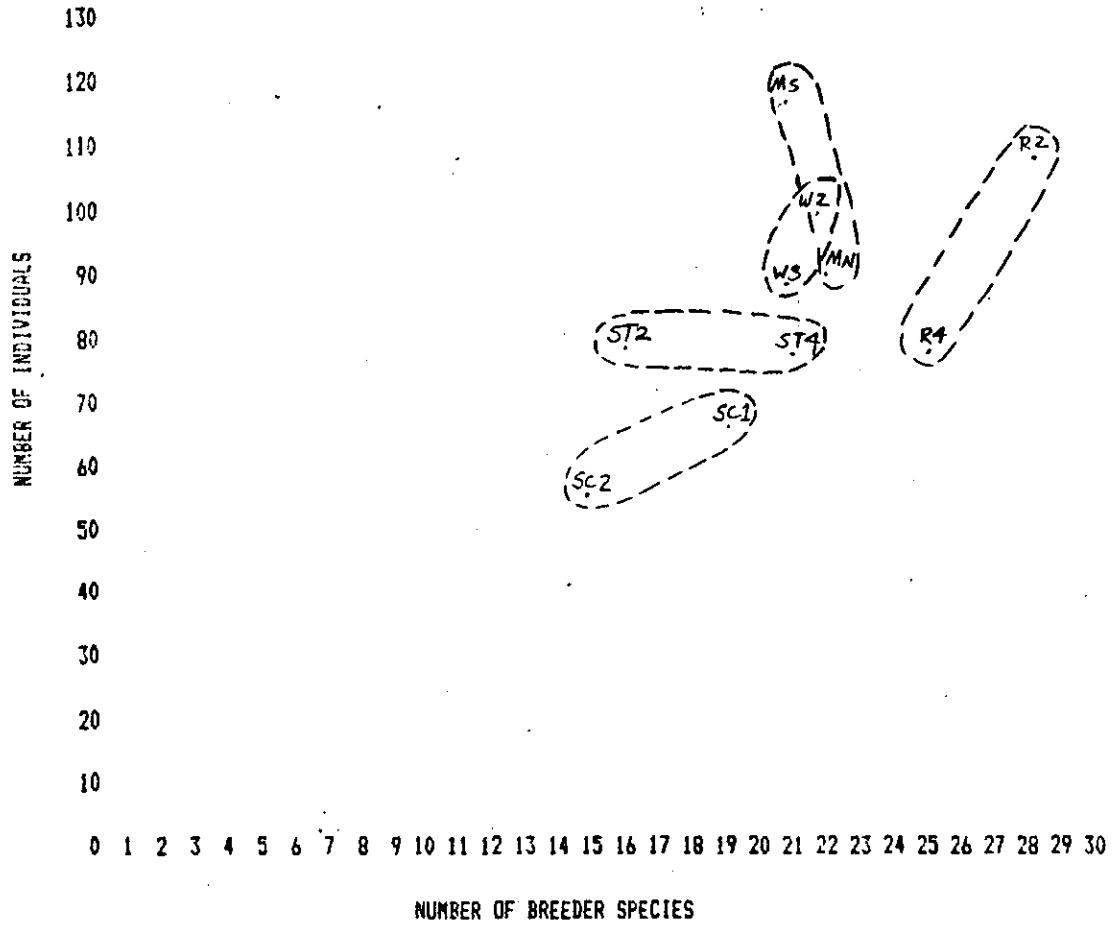
Avian study transects also served as locations in each area for vegetation study. Additional vegetation transects were also established. Vegetation studies quantified the intercept of canopy cover and stem density of woody plants greater than 1 m height. Smaller woody vegetation was included in herbaceous plant studies using meter square quadrats in which all vegetation and ground cover substrates were measured by ocular estimation for percent cover. Details of vegetation study methods are provided elsewhere.

RESULTS

The number of birds species and individual birds per lineal meter in the control and test areas along replicated transects in each study site were very similar (Tables 1-5). The maximum number of species found in any one location was 28 (Table 1) and lowest values were found in European buckthorn dominated closed canopied forests with 15-19 species. Open areas at Somme and Savanna areas at Middlefork had 21-22 species, respectively. Visiting species were fewest in the Reed-Turner Preserve (1 species); open areas at Middlefork (north Transect) and at Somme Woods (Transect 4) had maximum visitation of 5 species.

Song sparrows, red-winged blackbirds, common yellowthroats, American goldfinches, rufous sided towhees, and blue gray gnatcatchers, were the most abundant breeding bird species in open areas at Middlefork (Table 2B). Many of these same species dominated along transect #4 at Somme Woods. Closed canopied transects at Somme Woods were dominated by American robins, cardinals, red-winged blackbirds, black capped chickadee, and the wood thrush (Table 4C and 4D). Habitat edge was important to many bird species as suggested by high richness at Somme transect #4 and Middlefork north

FIGURE 5. Richness and density of breeding bird species by study transect.
 Codes used are SC-Soame controls, ST-Soame test; M-Middlefork (North or South);
 W-Wadsworth; and R-Reed-Turner Woods.



study transect. Some species that used forest interior and edge communities were important in these study areas. Included were common yellowthroats, brown thrashers, goldfinches, northern orioles and others. No bird species typical of prairies such as upland plovers, dickcissels, and grasshopper sparrows were found during these studies.

AVIFAUNA COMMUNITY SIMILARITY

Review of avian community population structure suggests both lower populations and species richnesses were found in heavily disturbed historic savannas grown in with a thick subcanopy of European buckthorn (Figure 5). With development of open areas these communities show increases in species richness and population density. Middlefork and Wadsworth transects had comparable relationships; population density at the Middlefork south transect was slightly higher than others in this cluster. Reed-Turner Woods had very different relationships characterized by a higher richness and similar population densities.

Open areas at Somme and Middlefork had relatively high species overlap. A relatively low overlay was measured between the open areas and especially closed canopied study transects at Somme (Table 6). Slight increases in similarity between closed control site #1 at Somme and Reed-Turner closed transects was calculated. Small pockets of wetland openings at Somme control may explain the slightly reduced similarity between Somme control #2 and Reed-Turner #4 which occurred in closed canopy forest.

More bird species that responded to clump farming shrubs (i.e. yellow warbler, common yellowthroat) occurred at Middlefork north compared to birds of broken dense canopy forests (i.e. northern orioles). Wadsworth had a continuous shrub and sapling canopy with several historic open grown oaks;

vegetation selected for more closed forest species such as red-bellied woodpeckers and great crested flycatchers. A graminoid wetland and ephemeral wetland at Wadsworth was used by grackles, herons, and mallard ducks.

Reed-Turner Woods had species representative of forests, forest edges, and open areas and wetland edges. Forest species included rose breasted grosbeaks, red-eye vireos, ovenbirds, gnatcatchers, red-bellied woodpeckers, and wood thrushers. Edge species included cuckoos, towhees, cowbirds, robins, grackles, and Indigo buntings. The relatively high richness at Reed-Turner Preserve may relate to the variety of different habitats present including a riparian and mesic ravine forests, and consequent high edge effect with adjacent properties.

Control and test transects for Middlefork and Reed-Turner Woods study sites showed 65-68% overlaps. Calculated overlaps were highest for some control transects; relatively low overlaps (46%) in contrast were measured between the semi-open test transect #4 and closed canopied and subcanopied test #2. Wadsworth study transects shared 50% of bird species.

DISCUSSION

Forests generally support higher bird populations than adjacent non-forested habitats; riparian forest systems have the highest density bird populations of all North American forests of equivalent area (Lacey *et al.* 1975). Avian density in forested areas is usually high compared to adjacent grasslands. Edges between forest and grassland have representative species found in both community types and species unique to the edge.

Forest habitats in and adjacent to some study areas were successional resulting from farming, logging, grazing, and fire suppression that occurred between the late 1800's and present day. Many of the larger trees at each site were of presettlement origin. No baseline data were available to this

project on the condition of the specific study areas during presettlement times. Many of the tree species present on each site reproduce vegetatively, and are not eliminated completely by logging (i.e. stump suckering, etc.). Thus, we believe the existing forest tree species mix is similar to the presettlement condition. Structural aspects of the habitat have likely been modified and have undoubtedly influenced the avifauna. This is especially so if correlations between avian communities and habitat structure found to operate elsewhere apply at the study areas (Karr, 1968; Willson, 1974; MacArthur, 1964). We believe the avian communities at Middlefork Savanna may be most similar to presettlement savanna since this study area may be the best remaining example of reasonably intact tall grass savanna. Relationships between globally extinct birds and this study are unknown. Also, because of the small size of the Middlefork study area, limitations on species packing and limits on use of the area by bird species requiring large home ranges may manifest.

Many forest birds either breed or feed in habitat edges. Disruption of edge habitat can cause great reduction of avians. Succession of historic open canopy savanna systems to densely vegetated forest was associated with a near 40% decline in bird species richness. Increasing habitat homogeneity in a two dimensional (vertical) and three dimensional spatial plane may relate closely to avian depauperization. Depauperization may also relate to the fact that where dense European buckthorn layers exists, little or no ground cover vegetation grew. Consequently seed and insect food resources for ground-brush foraging birds would be expected to be very poor. The habitat created by dense European buckthorn stands has very low perimeter to area ratios, shown to relate to poor avian and mammal wildlife richness and population densities (Patton,).

Prairies in the Midwest tended to be dominated by upland plovers, grasshopper sparrows, dickcissels, and meadowlarks. These prairie bird species would be especially attracted when the insects they feed on return or are accessible after savanna or prairie restoration. Meadowlarks and plovers eat mostly beetles, while dickcissels and grasshopper sparrows utilize lepidoptera and orthoptera insects and prairie grass seeds for food (Risser *et al.*, 1981). Both groups consequently require forb and graminoid vegetation elements that have been largely eliminated especially where dense buckthorn now grows. In Kansas, prairie and savannas of bur oak merge and expansive relatively undisturbed areas that remain have been studied. The relative numbers of birds using savanna forest and prairie habitats has been evaluated in Kansas (Johnston, 1964). The author found 23 bird species, or 13% of the 176 species in Kansas, limited to use of the prairies. Risser *et al.* (1981), found 13-15 bird species used the prairies. In Kansas, about 58% of all birds were woodland species; some were at their range limits in the study region. Similar studies of the actual habitat-uses by birds for feeding and breeding are largely unavailable for Illinois, especially in the context of historic presettlement relationships.

ACKNOWLEDGEMENTS

This project was conducted by a team of individuals whose efforts are gratefully appreciated. Included were Scott Hickman, Joel Greenberg, Darrel Johnson, David Johnson, Steve Packard, Alan Haney and members of the Warren Wilson College (Swannanoa, NC) field crew, Jerry Wilhelm, and, was made possible by partial funding by the Illinois Nongame Wildlife Checkoff Fund Program. We also acknowledge the considerable volunteer efforts by many of these individuals.

REFERENCES CITED AND PERTIENT

- Adams, C.C. 1908. The ecological succession of birds. *Auk* 25:109-153.
- American Ornithologists' Union. 1983. A.O.U. Check-list of North American Birds. Washington, D.C. Sixth Edition.
- Apfelbaum, S. and A. Haney. 1981. Bird populations before and after wildfire in a Great Lakes pine forest. *Condor* 83:347-354.
- Apfelbaum, S.I. and A. Haney. 1985. Changes in bird population during succession following fire in the northern Great Lakes Wilderness; pp 10-16. In: Proceedings: National Wilderness Research Conference: Current Research. General Technical Report INT-212 U.S. Department of Ag. Forest Service. Intermountain Research Station. 553 pp.
- Bailey, R.G. 1978. Descriptions of the ecoregions of the United States. U.S. Department of Agric. For. Serv., Ogden, UT.
- Bent, A.C. 1958. Life histories of North American birds- Series. Dover Publications, Inc. New York.
- Bock, C.E., and J.F. Lynch. 1970. Breeding bird populations of burned and unburned forests in the Sierra Nevada. *Condor* 72:182-189.
- Bock, C.E., M. Raphael, and J.H. Bock. 1978. Changing avian community structure during early post-fire succession in the Sierra Nevada. *Wilson Bulletin* 90:119-123.
- Brag, T.B. and L.C. Hulbert. 1977. Woody plant invasion of unburned Kansas bluestem prairie. *Jo. Range Management* 29(1):19-24.
- Caswell, H.H. 1976. Community structure; a neutral model analysis. *Ecological Monographs* 46:327-354.
- Curtis, J.T. 1959. The vegetation of Wisconsin. University of Wisconsin Press, Madison. 657 pp.
- Eddy, S. and A.C. Hodson. 1961. Taxonomic keys to the common animals of the north central states. Burgess Publishing Co., Minneapolis. MN. 162 pp.
- Elias, T.S. 1980. The complete trees of North American; field guide and natural history. Van Nostrand Reinhold Co. NY xi plus 940 pps.
- Emlen, J.T. 1971. Population densities of birds derived from transect counts. *Auk* 88:323-342.
- Gleason, H.A. 1952. The New Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. 3 vol. Hafner Press, NY.
- Haapanen, A. 1965. Bird fauna of the Finnish forests in relation to forest succession. I. *Annales Zoologici Fennici* 2:329-382.

- Hurlbert, S.H. 1971. The nonconcept of species diversity; critique and alternative parameters. *Ecology* 52:557-568.
- Huston, M. 1979. A general hypothesis of species diversity. *American Naturalist* 113:81-101.
- Illinois Natural History Survey. Summary of data contained in survey note publication.
- Johnson, D.W. and E.P. Odum. 1956. Breeding bird populations in relation to plant succession on the Piedmont of Georgia. *Ecology* 37(1):50-61.
- Johnston, R.F. 1964. The breeding birds of Kansas. University of Kansas publication, Museum of Natural History. 12(14):575-655.
- Karr, J.R. 1968. Habitat and avian diversity on strip mined land in east central Illinois. *Condor* 70(4):348-357.
- Kendeigh, S.C. 1944. Measurement of bird populations. *Ecological Monographs* 14:69-106.
- Kendeigh, S.C. 1946. Breeding birds of the beech-maple-hemlock community. *Ecology* 27:226-245.
- Kricher, J.C. 1973. Summer bird species diversity in relation to secondary succession on the New Jersey Piedmont. *American Midland Naturalist* 89:121-137.
- Lacey, J.R., P.R. Ogden, and K.E. Foster. 1975. Southern Arizona riparian habitat; Spatial distribution and analysis. University of Arizona, Tucson. 148 pp.
- MacArthur, R.H. 1964. Environmental factors affecting bird species diversity. *Amer. Nat.* 98:387-398.
- MacMahon, J.A. 1980. Ecosystem over time: succession and other types of change; pp. 27-58. In: Waring, R.H., Editor. Fresh perspective from ecosystem analysis: Proceedings of 40th Annual Biological Colloquium, 1980. Oregon State University, Corvallis, Oregon State University Press. 320 pp.
- Maissurow, D.K. 1941. The role of fire in the perpetuation of virgin forests in northern Wisconsin. *Journal of FOrstry* 39:201-207.
- Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, NY xx-plus 547.
- Niemi, G.J. 1978. Breeding birds of burned and unburned areas in northern Minnesota. *Loon* 50:73-84.

- Noon, B.R., V.P. Bingman, and J.P. Noon. 1979. The effects of changes in habitat on northern hardwood forest bird communities; pp 33-48. In: Degraf, R.M., and K.E. Evans, compilers. Management of Northcentral and Northeastern forests for nongame birds: workshop proceedings; 1979 January 23-25; Minneapolis, MN: General Technical report NC-51. St. Paul, MN: U.S. Department of Ag., Forest Service. Northcentral Forest Experiment Station. 268 pp.
- Odum, E.P. 1950. Bird populations of the highlands (North Carolina) plateau in relation to plant succession and avian invasion. *Ecology* 31:587-605.
- Petrides, G.A. 1972. A field guide to trees and shrubs. Peterson field guide series. Houghton Mifflin Company, Boston. 428 pp.
- Rabenold, K.N. 1978. Foraging strategies, diversity, and seasonality in bird communities of Appalachian spruce-fir forests. *Ecological Monographs* 48:397-424.
- Risser, P.G., E.C. Birney, H.D. Blocker, S.W. May, W.J. Parton, and J.A. Wiens. 1981. The true prairie ecosystem. US/IBP series. Academic press. xiv plus 557.
- Robbins, C.S., B. Brunn, and H.S. Zim. 1966. A field guide to the identification of birds of North America. Golden Press, NY. 340 pp.
- Society of American Foresters. 1954. Forest cover types of North America (exclusive of Mexico). Washington, D.C. 76 pp.
- U.S. Department of Agriculture, Fish and Wildlife Service. 1976. North American Bird Banding Manual. Vols 1 and 2.
- Whitmore, R.C. 1975. Habitat ordination of passerine birds of the Virgin River Valley, southwestern Utah. *Wilson Bulletin* 87:65-75.
- Whitmore, R.C. 1977. Habitat partitioning in a community of passerine birds. *Wilson Bulletin* 89:253-265.
- Willson, M.F. 1974. Avian community organization and habitat structure. *Ecology* 55:1017-1029.

TABLE 1: Summary statistics for breeding and visiting birds at northern Illinois oak savanna remnants. Based on four surveys during 19-29 June 1986 using techniques modified after Emlen (1971).

STUDY AREA TRANSECT	NUMBER OF SPECIES		BREEDING		IND /SPE	SIMILARITY	
	BREEDING	VISITING	/LINEAL M SPE	IND		COM	UNI
Middlefork Savanna							
South (Co)	21	2	0.07	0.38	5.5	17	3
North (T)	22	5	0.09	0.36	4.0		5
Reed-Turner Preserve							
#2 Center Wood (Co)	28	0	0.14	0.27	1.9	21	7
#4 Center Woods (T)	25	0	0.17	0.56	3.4		4
#3 Short Treatment (Co)	15	1	0.21	0.57	2.7		
Somme Woods							
Test 2 (C)	16	3	0.03	0.14	5.1	11	5
Test 4 (O)	21	5	0.04	0.15	3.6		8
Control #1 (C)	19	3	0.06	0.21	3.3	14	4
Control #2 (C)	15	3	0.05	0.19	3.8		1
Wadsworth Savanna							
North #3	21	1	0.07	0.27	3.9	14	6
South #2	22	3	0.07	0.31	4.3		8

SPE = Species
 IND = Individual
 COM = Common
 UNI = Unique
 (C) = Closed canopy
 (O) = Open canopy
 (Co) = Control transect
 (T) = Test transect

TABLE 2A. Numbers of birds tallied along the 300 meter long transect in the Middlefork south control transect. Means are based on four surveys on 12-29 June, 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Goldfinch				3 0.75	0.75	1.30	2.61	3	
American Robin	2 0.50	4 1.00	1 0.25	1 0.25	2.00	1.22	6.96	8	3
Blackcapped Chickadee	1 0.25	3 0.75	1 0.25	1 0.25	1.50	0.87	5.22	6	
Blue Jay	4 1.00	2 0.50	2 0.50	5 1.25	3.25	1.30	11.30	13	
Common Grackle	1 0.25				0.25	0.43	0.87	1	2
Common Yellowthroat		2 0.50	6 1.50	5 1.25	3.25	2.38	11.30	13	1
Downy Woodpecker		4 1.00	1 0.25		1.25	1.64	4.35	5	
Eastern Wood Pewee	1 0.25	2 0.50		2 0.50	1.25	0.83	4.35	5	
Field Sparrow		1 0.25			0.25	0.43	0.87	1	
Gray Catbird	1 0.25		1 0.25		0.50	0.50	1.74	2	
Indigo Bunting	1 0.25	1 0.25			0.50	0.50	1.74	2	
Mallard Duck									1
Morning Dove									1
Northern Cardinal		2 0.50	1 0.25	1 0.25	1.00	0.71	3.48	4	
Northern Flicker	1 0.25	2 0.50	2 0.50	1 0.25	1.50	0.50	5.22	6	
Northern Oriole	3 0.75			2 0.50	1.25	1.30	4.35	5	
Rd Winged Blackbird	1 0.25	3 0.75	6 1.50	7 1.75	4.25	2.38	14.78	17	
Rufous Sided Towhee		2 0.50	1 0.25		0.75	0.83	2.61	3	
Song Sparrow		4 1.00	5 1.25	5 1.25	3.50	2.06	12.17	14	
Wh Breasted Nuthatch			1 0.25	2 0.50	0.75	0.83	2.61	3	
Wood Thrush			1 0.25	1 0.25	0.50	0.50	1.74	2	
Yellow Bellied Flycatcher			1 0.25		0.25	0.43	0.87	1	
Yellow Warbler		1 0.25			0.25	0.43	0.87	1	
TOTAL	16	33	30	36	28.7		100		
MEAN	1.6	2.35	2.14	2.76					
STD	1.01	1.04	1.88	1.96					

TABLE 2B. Numbers of birds tallied along the 240 meter long transect in the Middlefork North transect. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDER	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Crow									1
American Goldfinch	2 0.50	2 0.50	1 0.25	1 0.25	1.50	0.50	6.82	6	3
American Robin			1 0.25	3 0.75	1.00	1.22	4.55	4	1
Blackcapped Chickadee				1 0.25	0.25	0.43	1.14	1	
Bluegray Gnatcatcher	5 1.25				1.25	2.17	5.68	5	
Chimney Swift									1
Common Yellowthroat	1 0.25	5 1.25	3 0.75	1 0.25	2.50	1.66	11.36	10	
Downy Woodpecker		3 0.75	1 0.25		1.00	1.22	4.55	4	
Eastern Wood Pewee	1 0.25	1 0.25	2 0.50		1.00	0.71	4.55	4	1
European Starling	1 0.25	1 0.25			0.50	0.50	2.27	2	
Field Sparrow		1 0.25	1 0.25		0.50	0.50	2.27	2	
Gray Catbird	1 0.25	1 0.25			0.50	0.50	2.27	2	
Great Heron									1
Indigo Bunting		1 0.25			0.25	0.43	1.14	1	
Least Flycatcher		1 0.25		3 0.75	1.00	1.22	4.55	4	1
Morning Dove									1
Northern Cardinal			1 0.25		0.25	0.43	1.14	1	
Northern Flicker			1 0.25	1 0.25	0.50	0.50	2.27	2	
Northern Oriole	2 0.50		1 0.25		0.75	0.83	3.41	3	1
Rd Eyed Vireo				1 0.25	0.25	0.43	1.14	1	
Rd Winged Blackbird		7 1.75	1 0.25	3 0.75	2.75	2.68	12.50	11	1
Rufous Sided Towhee		1 0.25	2 0.50	4 1.00	1.75	1.48	7.95	7	
Song Sparrow		6 1.50	3 0.75	3 0.75	3.00	2.12	13.64	12	1
Swamp Sparrow				1 0.25	0.25	0.43	1.14	1	
Tree Swallow									1
Wh Breasted Nuthatch		1 0.25		1 0.25	0.50	0.50	2.27	2	
Yellow Warbler	1 0.25	2 0.50			0.75	0.83	3.41	3	1
TOTAL	14	33	18	23	22		100		
MEAN	1.75	2.35	1.5	1.91					
STD	1.29	2.02	0.76	1.11					

TABLE 3A. Numbers of birds tallied along the 150 meter long transect in the Reed-Turner center woods burn 4. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL	
	MEAN	MEAN	MEAN	MEAN				BREEDERS	VISITORS
Acadian Flycatcher				2 0.50	0.50	0.87	2.70	2	1
American Robin	1 0.25	1 0.25			0.50	0.50	2.70	2	
Blackcapped Chickadee	2 0.50	2 0.50	2 0.50		1.50	0.87	9.11	6	
Bluegray Gnatcatcher		1 0.25			0.25	0.43	1.35	1	
Blue Jay	3 0.75		1 0.25	1 0.25	1.25	1.09	6.76	5	
Br Headed cowbird			2 0.50		0.50	0.87	2.70	2	
Cedar Waxwing		1 0.25			0.25	0.43	1.35	1	3
Common Grackle		3 0.75		1 0.25	1.00	1.22	5.41	4	1
Downy Woodpecker	1 0.25	2 0.50		1 0.25	1.00	0.71	5.41	4	
Eastern Wood Pewee	1 0.25			1 0.25	0.50	0.50	2.70	2	
Gray Catbird		1 0.25			0.25	0.43	1.35	1	
Gr Crested Flycatcher		1 0.25	1 0.25	2 0.50	1.00	0.71	5.41	4	
Hairy Woodpecker		1 0.25			0.25	0.43	1.35	1	
House Wren	4 1.00	1 0.25		2 0.50	1.75	1.48	9.46	7	
Indigo Bunting		3 0.75		1 0.25	1.00	1.22	5.41	4	
Northern Cardinal		1 0.25	3 0.75	1 0.25	1.25	1.09	6.76	5	
Northern Flicker		1 0.25			0.25	0.43	1.35	1	
Oven Bird	1 0.25	1 0.25			0.50	0.50	2.70	2	
Rd Bellied Woodpecker				2 0.50	0.50	0.87	2.70	2	
Rd Eyed Vireo	4 1.00	3 0.75	3 0.75		2.50	1.50	13.51	10	1
Rose Breast Grosbeak	1 0.25				0.25	0.43	1.35	1	
Rufous Sided Towhee			1 0.25		0.25	0.43	1.35	1	
Wh Breasted Nuthatch		1 0.25	2 0.50		0.75	0.83	4.05	3	
Yellow Billed Cuckoo		1 0.25			0.25	0.43	1.35	1	1
Yellow Throated Vireo	2 0.50				0.50	0.87	2.70	2	
TOTAL	20	25	15	14	18.5		100		
MEAN	2	1.47	1.87	1.4					
STD	1.18	0.77	0.78	0.48					

TABLE 3B. Numbers of birds tallied along the 200 meter long study transect in the Reed-Turner Center Woods No Burn transect 2. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
Acadian Flycatcher			1 0.25		0.25	0.43	1.06	1	
American Goldfinch	1 0.25				0.25	0.43	1.06	1	2
American Robin		2 0.50	2 0.50		1.00	1.00	4.25	4	
Blackcapped Chickadee	1 0.25	3 0.75	1 0.25		1.25	1.09	5.31	5	
Bluegray Gnatcatcher		1 0.25			0.25	0.43	1.06	1	
Blue Jay	1 0.25	3 0.75	6 1.50	1 0.25	2.75	2.05	11.7	11	
Br Headed cowbird		1 0.25	1 0.25		0.50	0.50	2.12	2	
Cedar Waxwing	1 0.25		1 0.25	1 0.25	0.75	0.43	3.19	3	1
Common Grackle	2 0.50	1 0.25			0.75	0.83	3.19	3	3
Common Yellowthroat				2 0.50	0.50	0.87	2.12	2	
Downy Woodpecker		1 0.25	1 0.25	1 0.25	0.75	0.43	3.19	3	
Eastern Wood Pewee				5 1.25	1.25	2.17	5.31	5	
European Starling				2 0.50	0.50	0.87	2.12	2	
Gray Catbird		2 0.50	1 0.25		0.75	0.83	3.19	3	
Gr Crested Flycatcher			1 0.25	4 1.00	1.25	1.64	5.31	5	
House Wren				3 0.75	0.75	1.30	3.19	3	
Indigo Bunting	1 0.25	1 0.25	1 0.25	4 1.00	1.75	1.30	7.44	7	
Morning Dove	2 0.50		2 0.50	3 0.75	1.75	1.09	7.44	7	
Northern Cardinal	1 0.25	2 0.50	1 0.25	1 0.25	1.25	0.43	5.31	5	
Northern Flicker		1 0.25			0.25	0.43	1.06	1	
Rd Bellied Woodpecker	1 0.25	3 0.75			1.00	1.22	4.25	4	
Rd Eyed Vireo	1 0.25	2 0.50	3 0.75	3 0.75	2.25	0.83	9.57	9	
Rd Winged Blackbird		1 0.25			0.25	0.43	1.06	1	
Rose Breast Grosbeak			1 0.25		0.25	0.43	1.06	1	
Swainsons Thrush			2 0.50		0.50	0.87	2.12	2	
Wh Breasted Nuthatch	1 0.25				0.25	0.43	1.06	1	
Wood Thrush			1 0.25		0.25	0.43	1.06	1	
Yellow Billed Cuckoo		1 0.25			0.25	0.43	1.06	1	
TOTALS	11	15	16	12	23.5		100		
MEAN	1.18	1.66	1.62	2.5					
STD	0.38	0.78	1.26	1.32					

TABLE 3C. Numbers of birds tallied along the 70 meter long transect in the Reed-turner No burn 3. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Crow									1
American Robin	1 0.25		2 0.50		0.75	0.83	7.50	3	2
Blackcapped Chickadee		2 0.50	3 0.75		1.25	1.30	12.50	5	
Blue Jay	1 0.25		1 0.25	6 1.50	2.00	2.35	20.00	8	
Cedar Waxwing				1 0.25	0.25	0.43	2.50	1	
Common Grackle		2 0.50			0.50	0.87	5.00	2	
Downy Woodpecker		1 0.25	1 0.25	2 0.50	1.00	0.71	10.00	4	
Eastern Wood Pewee				1 0.25	0.25	0.43	2.50	1	
Gr Crested Flycatcher			1 0.25	3 0.75	1.00	1.22	10.00	4	1
House Wren	2 0.50	1 0.25			0.75	0.83	7.50	3	
Northern Cardinal				1 0.25	0.25	0.43	2.50	1	
Northern Flicker			2 0.50		0.50	0.87	5.00	2	
Northern Oriole			1 0.25		0.25	0.43	2.50	1	
Rd Eyed Vireo			1 0.25	2 0.50	0.75	0.83	7.50	3	
Rd Winged Blackbird			1 0.25		0.25	0.43	2.50	1	
Wood Thrush		1 0.25			0.25	0.43	2.50	1	
TOTAL	4	7	13	16	10		100		
MEAN	1.33	1.4	1.44	2.28					
STD	0.47	0.48	0.68	1.66					

TABLE 4B. Numbers of birds tallied along the 500 meter long transect in the
 Some Woods transect 4. Means are based on four surveys on 12-29 June 1986.
 Birds were recorded in 25 meter wide belts from a center transect following
 methods modified after Ealen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITORS
	MEAN	MEAN	MEAN	MEAN					
American Crow									1
Acadian Flycatcher	1 0.25				0.25	0.43	1.33	1	
American Goldfinch	7 1.75	2 0.50	1 0.25		2.50	2.69	13.33	10	3
American Robin	2 0.50	1 0.25			0.75	0.83	4.00	3	4
Blackcapped Chickadee	3 0.75				0.75	1.30	4.00	3	
Br Headed cowbird		1 0.25			0.25	0.43	1.33	1	2
Brown Thrasher	1 0.25				0.25	0.43	1.33	1	1
Chestnut Sided Warbler		1 0.25			0.25	0.43	1.33	1	
Common Grackle									3
Common Yellowthroat	2 0.50				0.50	0.87	2.67	2	
Downy Woodpecker	1 0.25				0.25	0.43	1.33	1	
Field Sparrow	1 0.25	2 0.50			0.75	0.83	4.00	3	
Gray Catbird	2 0.50	1 0.25			0.75	0.83	4.00	3	1
House Wren	2 0.50	2 0.50			1.00	1.00	5.33	4	
Indigo Bunting	3 0.75	3 0.75			1.50	1.50	8.00	6	1
Northern Cardinal	4 1.00				1.00	1.73	5.33	4	3
Northern Flicker	5 1.25	1 0.25			1.50	2.06	8.00	6	1
Northern Oriole	1 0.25	1 0.25			0.50	0.50	2.67	2	
Morning Dove									2
Rd Eyed Vireo	1 0.25				0.25	0.43	1.33	1	
Rd Winged Blackbird	6 1.50	5 1.25	3 0.75		3.50	2.29	18.67	14	
Rock Dove									2
Scarlet Tanager									1
Song Sparrow	1 0.25	5 1.25			1.50	2.06	8.00	6	
Wh Breasted Nuthatch	1 0.25				0.25	0.43	1.33	1	
Yellow Warbler	1 0.25	1 0.25			0.50	0.50	2.67		
TOTAL	45	26	4	0	18.7		100		
MEAN	2.36	2	2						
STD	1.81	1.41	1						

TABLE 4C. Numbers of birds tallied along the 300 meter long study transect in the Some Woods, Control #1 transect. Means are based on the four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Crow		3 0.75			0.75	1.30	4.76	3	
American Goldfinch									4
American Robin	7 1.75				1.75	3.03	11.11	7	
Blackcapped Chickadee	10 2.50				2.50	4.33	15.87	10	2
Blue Jay	3 0.75				0.75	1.30	4.76	3	2
Br Headed cowbird		2 0.50			0.50	0.87	3.17	2	
Cedar Waxwing									1
Common Grackle	1 0.25				0.25	0.43	1.59	1	4
Downy Woodpecker	3 0.75				0.75	1.30	4.76	3	
Eastern Wood Pewee		1 0.25			0.25	0.43	1.59	1	
European Starling		1 0.25			0.25	0.43	1.59	1	
Gray Catbird	1 0.25				0.25	0.43	1.59	1	
Gr Crested Flycatcher	4 1.00				1.00	1.73	6.35	4	
Morning Dove									2
Northern Cardinal	4 1.00	1 0.25			1.25	1.64	7.94	5	2
Northern Flicker		3 0.75			0.75	1.30	4.76	3	
Northern Oriole	1 0.25				0.25	0.43	1.59	1	
Rd Eyed Vireo	1 0.25				0.25	0.43	1.59	1	
Rd Winged Blackbird	4 1.00	2 0.50			1.50	1.66	9.52	6	1
Rose Breast Grosbeak	2 0.50				0.50	0.87	3.17	2	
Song Sparrow	1 0.25				0.25	0.43	1.59	1	
Wh Breasted Nuthatch	1 0.25				0.25	0.43	1.59	1	
Wood Thrush	1 0.25	5 1.25	1 0.25		1.75	1.92	11.11	7	
TOTALS	44	18	1	0	15.7		100.0		
MEAN	2.93	2.25	1						
STD	2.54	1.29	0						

TABLE 4D. Numbers of birds tallied along the 300 meter long study transect in the Somme Woods Control #2 transect. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Robin	6 1.50	4 1.00			2.50	2.60	17.54	10	
Blackcapped Chickadee	4 1.00	3 0.75			1.75	1.79	12.28	7	3
Blue Jay	3 0.75				0.75	1.30	5.26	3	4
Br Headed cowbird	0.00	2 0.50			0.50	0.87	3.51	2	
Cedar Waxwing									1
Common Grackle									3
Downy Woodpecker	1 0.25				0.25	0.43	1.75	1	
Gray Catbird	2 0.50				0.50	0.87	3.51	2	
Hairy Woodpecker	1 0.25				0.25	0.43	1.75	1	
Northern Cardinal	5 1.25	4 1.00			2.25	2.28	15.79	9	4
Northern Flicker	1 0.25	1 0.25			0.50	0.50	3.51	2	
Northern Oriole	1 0.25				0.25	0.43	1.75	1	
Rd Eyed Vireo	1 0.25	1 0.25			0.50	0.50	3.51	2	
Rd Winged Blackbird	7 1.75	1 0.25			2.00	2.92	14.04	8	2
Ring-Billed Gull									1
Rose Breast Grosbeak	1 0.25				0.25	0.43	1.75	1	
Song Sparrow	1 0.25				0.25	0.43	1.75	1	
Wood Thrush	2 0.50	3 0.75			1.25	1.30	8.77	5	1
TOTAL	37	20	0	0	14.2		100		
MEAN	2.46	2.22							
STD	1.99	1.22							

TABLE 4A. Numbers of birds tallied along the 600 meter long transect in the Sonne Woods transect 2. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDER	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Crow									2
American Goldfinch		5	1.25		1.25	2.17	6.17	5	
American Robin	3	0.75			0.75	1.30	3.70	3	5
Barn Swallow									1
Blackcapped Chickadee	1	0.25			0.25	0.43	1.23	1	
Blue Jay	9	2.25	2	0.50	2.75	3.70	13.58	11	1
Br Headed cowbird	1	0.25			0.25	0.43	1.23	1	
Common Grackle	2	0.50	1	0.25	0.75	0.83	3.70	3	2
Downy Woodpecker	1	0.25	1	0.25	0.50	0.50	2.47	2	
Eastern Wood Pewee	2	0.50			0.50	0.87	2.47	2	
Br Crested Flycatcher	1	0.25	1	0.25	0.75	0.43	3.70	3	
Indigo Bunting		2	0.50		0.50	0.87	2.47	2	
Morning Dove		1	0.25		0.25	0.43	1.23	1	
Northern Cardinal	7	1.75	4	1.00	3.00	2.74	14.81	12	1
Northern Flicker	1	0.25	2	0.50	1.00	0.71	4.94	4	2
Northern Oriole		3	0.75		0.75	1.30	3.70	3	
Rock Dove									1
Rd Winged Blackbird	10	2.50	10	2.50	5.50	4.56	27.16	22	5
Song Sparrow	2	0.50	2	0.50	1.00	1.00	4.94	4	
TOTAL	40	36	5	0	20.2		100		
MEAN	3.33	2.76	1.25						
STD	3.19	2.39	0.43						

TABLE 5A. Numbers of birds tallied along the 300 meter long transect in the Wadsworth North 3 Transect. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDERS	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Goldfinch		2 0.50	1 0.25		0.75	0.83	3.66	3	
Blackburnian Warbler	1 0.25				0.25	0.43	1.22	1	
Blackcapped Chickadee		4 1.00	1 0.25		1.25	1.64	6.10	5	
Blue Jay	2 0.50			1 0.25	0.75	0.83	3.66	3	3
Br Headed cowbird	1 0.25				0.25	0.43	1.22	1	
Downy Woodpecker		3 0.75			0.75	1.30	3.66	3	
Eastern Wood Pewee		2 0.50	2 0.50		1.00	1.00	4.88	4	
Field Sparrow		1 0.25	1 0.25		0.50	0.50	2.44	2	
Br Crested Flycatcher	3 0.75		1 0.25		1.00	1.22	4.88	4	
Gray Catbird	2 0.50				0.50	0.87	2.44	2	
Green Heron			1 0.25		0.25	0.43	1.22	1	
Hermit Thrush			1 0.25	1 0.25	0.50	0.50	2.44	2	
Least Flycatcher	1 0.25	2 0.50			0.75	0.83	3.66	3	
Northern Cardinal	2 0.50	1 0.25	1 0.25	2 0.50	1.50	0.50	7.32	6	
Northern Flicker			1 0.25		0.25	0.43	1.22	1	
Rd Winged Blackbird	1 0.25	3 0.75	3 0.75	8 2.00	3.75	2.59	18.29	15	
Rufous Sided Towhee	1 0.25		2 0.50	2 0.50	1.25	0.83	6.10	5	
Song Sparrow		3 0.75		2 0.50	1.25	1.30	6.10	5	
Swamp Sparrow				1 0.25	0.25	0.43	1.22	1	
Tree Swallow									1
Wood Thrush		2 0.50		1 0.25	0.75	0.83	3.66	3	
Yellow Throated Vireo		5 1.25	4 1.00	3 0.75	3.00	1.87	14.63	12	
TOTAL	14	28	19	21	20.5		100		
MEAN	1.55	2.54	1.58	2.33					
STD	0.68	1.15	0.95	2.10					

TABLE 5B. Numbers of tallied birds along the 300 meter long transect in the Wadsworth South Transect 2. Means are based on four surveys on 12-29 June 1986. Birds were recorded in 25 meter wide belts from a center transect following methods modified after Emlen (1971).

SPECIES	0-25m	25-50m	50-75m	75-100m	MEAN	STD	RIV	TOTAL BREEDER	TOTAL VISITOR
	MEAN	MEAN	MEAN	MEAN					
American Robin		1 0.25	3 0.75		1.00	1.22	4.26	4	
American Goldfinch									1
Blackcapped Chickadee		4 1.00	2 0.50		1.50	1.66	6.38	6	
Blue Jay		2 0.50		2 0.50	1.00	0.87	4.26	4	1
Bluegray Gnatcatcher		1 0.25			0.25	0.43	1.06	1	
Cedar Waxwing			1 0.25		0.25	0.43	1.06	1	
Common Grackle			2 0.50		0.50	0.87	2.13	2	1
Downy Woodpecker	1 0.25	1 0.25			0.50	0.50	2.13	2	
Field Sparrow			2 0.50	5 1.25	1.75	0.87	7.45	7	
Gr Crested Flycatcher	1 0.25		2 0.50		0.75	0.83	3.19	3	
Gray Catbird	7 1.75	2 0.50	1 0.25		2.50	2.69	10.64	10	
Great Heron									1
Least Flycatcher	1 0.25				0.25	0.43	1.06	1	
Mallard Duck	2 0.50				0.50	0.87	2.13	2	
Northern Cardinal	2 0.50		2 0.50		1.00	1.00	4.26	4	
Northern Flicker	1 0.25			3 0.75	1.00	0.43	4.26	4	
Rd Bellied Woodpecker			1 0.25	1 0.25	0.50	0.43	2.13	2	
Rd Winged Blackbird	2 0.50		4 1.00	3 0.75	2.25	1.66	9.57	9	1
Rufous Sided Towhee	3 0.75	3 0.75	1 0.25	3 0.75	2.50	1.30	10.64	10	
Song Sparrow				2 0.50	0.50	0.00	2.13	2	
Tree Swallow									1
Wood Pewee	2 0.50	2 0.50	1 0.25	1 0.25	1.50	0.83	6.38	6	
Wood Thrush				3 0.75	0.75	0.00	3.19	3	
Yellow Billed Cuckoo				1 0.25	0.25	0.00	1.06	1	
Yellow Throated Vireo		1 0.25	4 1.00	5 1.25	2.50	1.64	10.64	10	
TOTAL	22	17	26	29	23.5		100		
MEAN	2.2	1.88	2	2.63					
STD	1.72	0.99	1.03	1.36					

APPENDIX 1. Study area and transect location maps.

Figure 1. Location of avian study transects (----) at the Wadsworth Savanna.

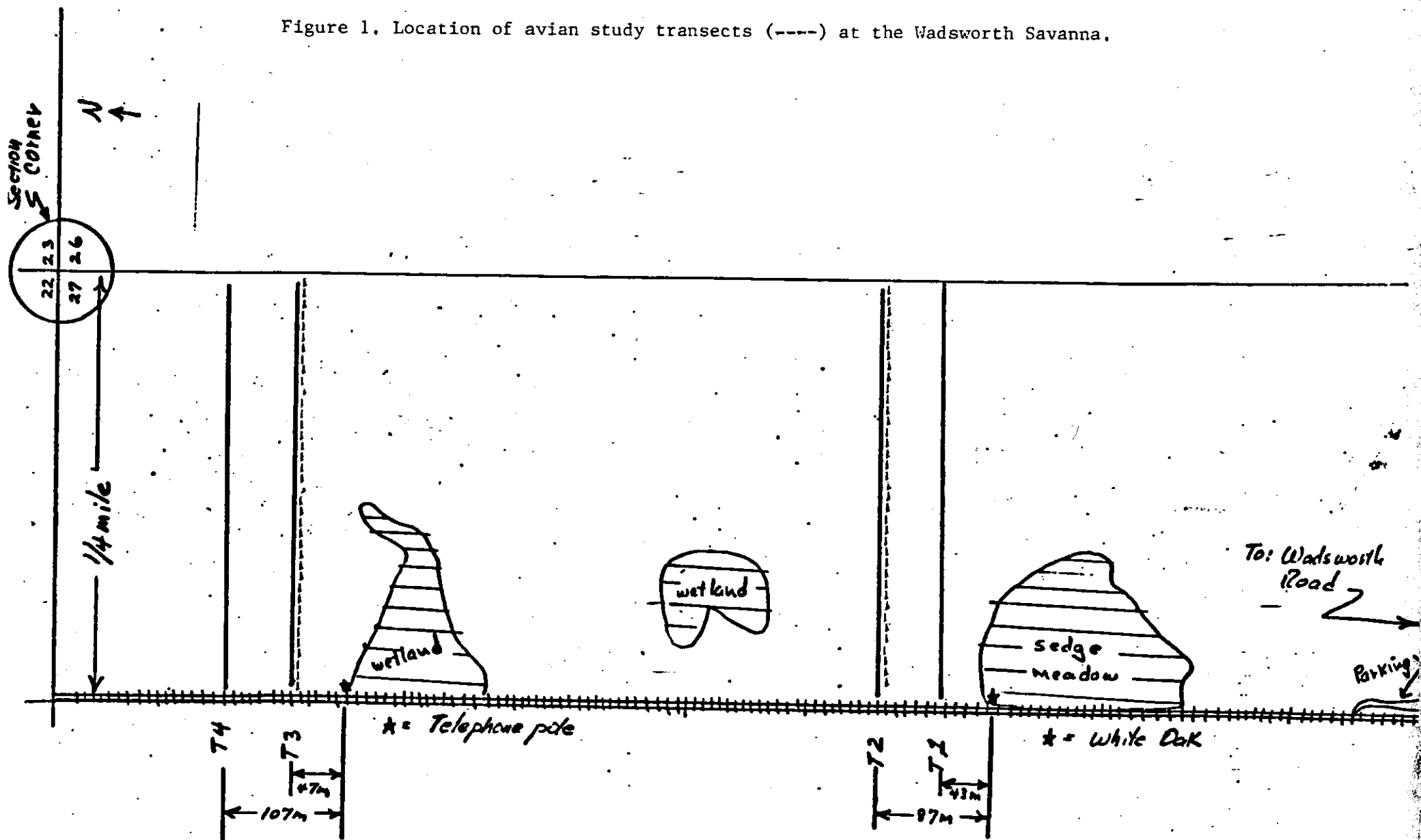


Figure 2, Location of avian study transects (---) at the Middlefork Savanna,

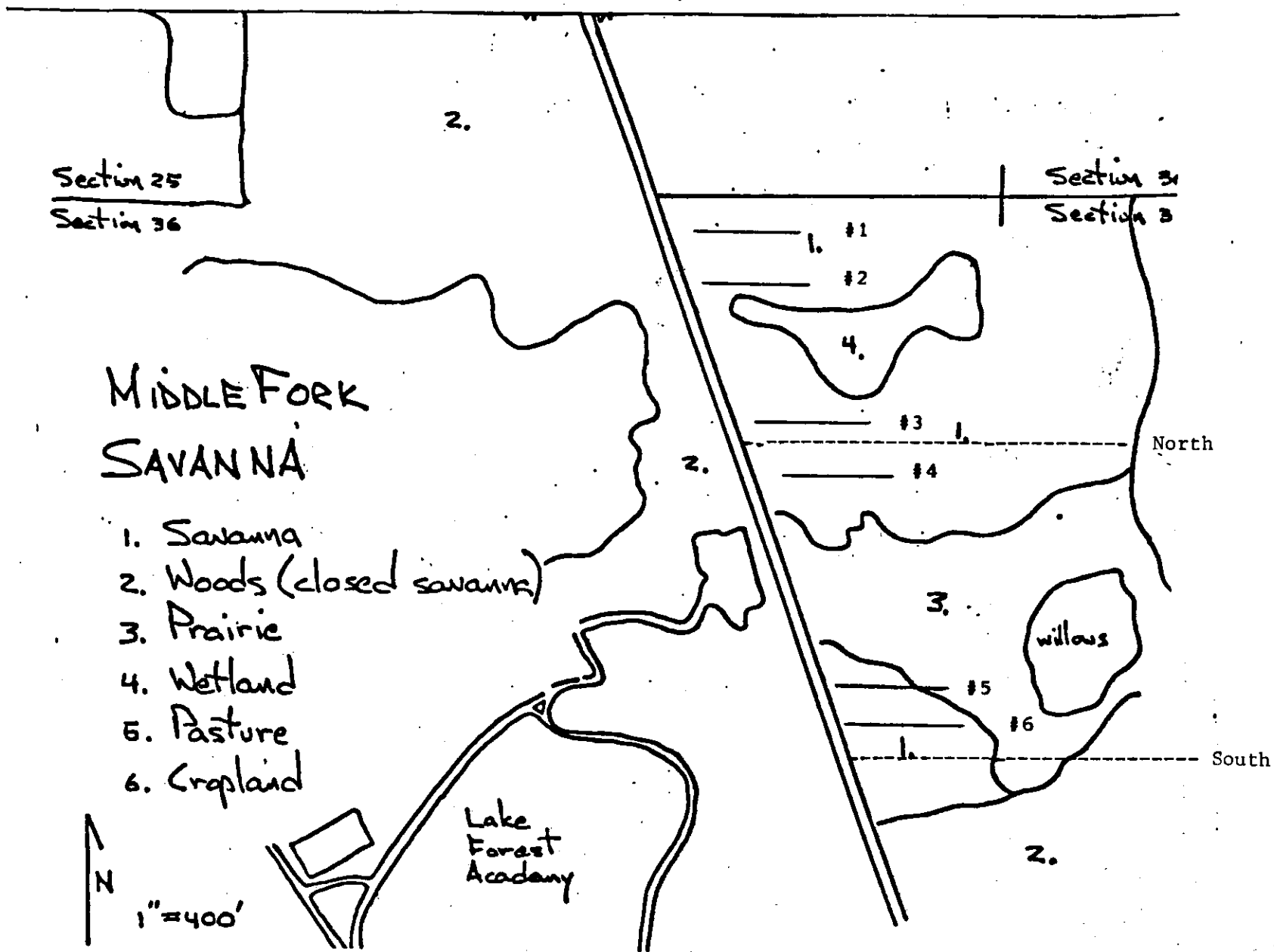


Figure 3, Location of avian transects (----) at the Somme Savanna.

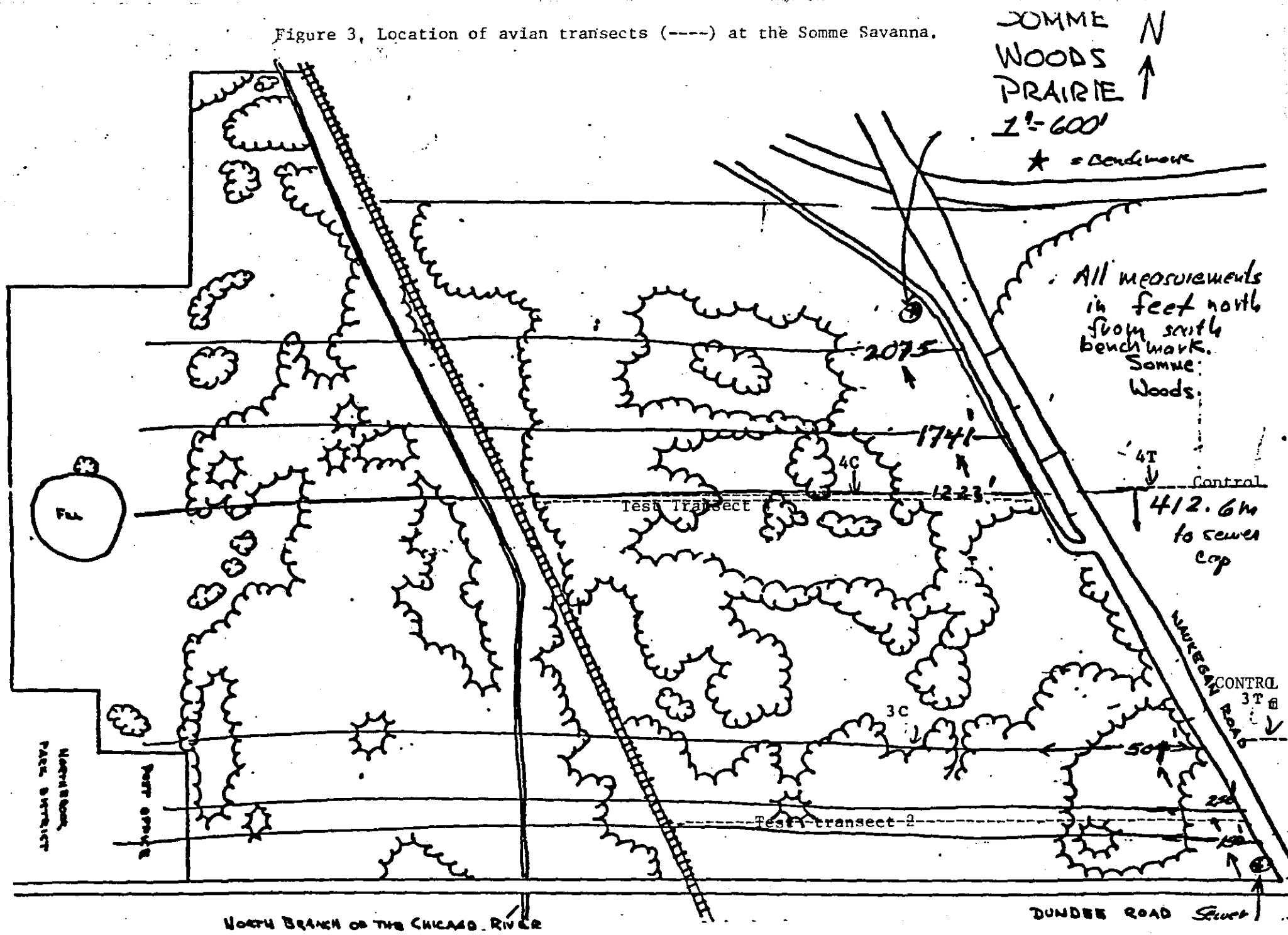


Figure 4. Location of avian transects (----) at the Reed Turner Nature Preserve.

