

5-6-1998

BREEDING BIRD UTILIZATION OF SHELTERWOOD-CUT OAK STANDS IN BUCKINGHAM COUNTY, VIRGINIA

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**BREEDING BIRD UTILIZATION OF
SHELTERWOOD-CUT OAK
STANDS IN BUCKINGHAM COUNTY, VIRGINIA**

by

KIM MARIE MCDONALD

A Thesis Submitted to the Faculty of
Longwood College
in partial Fulfillment of the Requirements for the Degree of
Master of Science
Environmental Studies
May 1998

Approved by:



First Comm. Mem. (Director)



Second Comm. Mem.



Third Comm. Mem.

6 May 1998
Date Approved

ABSTRACT**BREEDING BIRD UTILIZATION OF SHELTERWOOD-CUT
OAK STANDS IN BUCKINGHAM COUNTY, VIRGINIA****Kim Marie McDonald****C. Michael Stinson
Director**

Breeding bird populations on three shelterwood cut oak stands in Buckingham County, Virginia were studied using Breeding Bird Census (BBC) techniques. The stands were cut partly or entirely during the year prior to the 1997 breeding season, when the BBCs were conducted. The plots were established as part of a study of oak regeneration following controlled burns in the Virginia piedmont. Canopy cover on the plots averaged 66.8% after the cuts and total basal area averaged 41915 cm²/acre. At least 23 species of birds had territories partly or entirely on at least one of the plots, and at least nine species bred on all three plots. Of these nine, all but one were birds characteristic of forest habitats. This supports the idea that forest species will continue to breed on shelterwood cuts similar to those studied, at least for the first year after cuts are made, though perhaps at lower densities than in uncut hardwood forests. Birds of open habitats were not very common in the BBC plots studied.

Acknowledgments

I would like to take this opportunity to thank my committee and all of the volunteers that assisted me in completing this project.

I would like to thank Thelma Dalmas for being part of my thesis committee. She was an essential part of making this project come together. Thanks for your patience and unlimited help throughout this project and my educational career.

I would like to thank Pat Keyser for being part of my thesis committee. His expertise in forestry was an essential part of this project. With his help, Longwood College was able to accept a grant from the Department of Game and Inland Fisheries, that allowed me to conduct a Breeding Bird Census on treated forest plots in central Virginia.

I would like to thank Dr. Michael Stinson for being my thesis advisor. His knowledge of the subject and experience with the subject was the reason for selecting him as my thesis advisor. The many long hours spent conducting this project is greatly appreciated.

I would like to thank the Department of Game and Inland Fisheries for providing Longwood College the grant to conduct such a project. The information gained from this project will prove to be valuable. In addition, it extends the opportunity for students to gain experience in field research and conduct research projects on a graduate level.

I would like to thank Carolyn Wells for seeing me through this project and my graduate program at Longwood College. Your guidance, wisdom and encouragement will always be appreciated.

I would like to thank Paige Guilliams for the long hours spent assisting me in this

project. Your time was an essential part of making this project come together. The long hours you devoted to helping with this project will always be greatly appreciated.

I would like to thank Carey Burnett for assisting me with the vegetation data collection. I greatly appreciate you volunteering your time during the long days spent in Buckingham County.

I would like to also thank Ross Johnson for supporting me without question. Your enduring patience and understanding throughout my graduate career will always be appreciated. Your encouragement and willingness to learn and understand my project proved to be an invaluable tool for me throughout this research.

I would last like to thank Longwood College for allowing me the opportunity to conduct such a project through the Graduate Studies Program. The faculty and staff in the Natural Sciences Department were always willing to help in anyway they could. Thank you for always giving your extra time and expertise.

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Introduction

This study is an effort to develop baseline data describing the breeding birds on three shelterwood-cut oak stands in Buckingham County, Virginia. This project was designed as part of work to understand the effects of current forestry management practices in the piedmont of Virginia on the area's breeding bird populations. This project was thus designed as the beginning of a multiple-year study. The problem presented in this project is to identify the species and densities of breeding birds that occupy recently established shelterwood oak stands. The method used for doing this was to establish three Breeding Bird Census (BBC) plots and conduct censuses on each plot. The next step in the project would be to conduct prescribed burns on some of the censused areas and continue censuses for several years after the burns to measure bird reactions to habitat alteration.

The forestry practice of prescribed burning for regeneration purposes has proven advantageous in southern pine plantations. Keyser et al. (1996) explain that long-term fire studies in loblolly pine forests, conducted in the coastal plains of South Carolina, seem to confirm the theory that regenerating oaks need occasional fire to remain competitive. Between 58 and 70 percent non-oak mortality compared with only 40 percent mortality for oak species has recently been reported following 26 years of biennial summer burning in pine stands (Keyser et al., 1996).

A variety of forestry practices are used across the world to create different habitats, with a variety of effects on non-human inhabitants. Virginia holds a large portion

of state forest and park land in the central portions of the state, including significant acreages in Buckingham County. In 1996 a study was initiated in cooperation with two state agencies that would track densities of breeding bird populations in shelterwood oak stands and their population responses to controlled burns. Both of these agencies, the Virginia Department of Forestry (VDF) and the Virginia Department of Game and Inland Fisheries (VDGIF), own lands in Buckingham County where the work described here was carried out. This area is near the geographical center of the state and in the middle of the piedmont physiographic region of Virginia. This report describes the first year's collection of baseline data for what is hoped will be a multi-year study. A second stage in the project will evaluate effects on breeding bird populations following prescribed burns.

The study plots consist of oak stands from which hardwoods have been harvested using shelterwood cutting. "The shelterwood method retains part of the canopy to shelter and to encourage tree production...leaving about 40% of the original overstory" (Annand and Thompson 1997). In the plots studied here, the intention was to leave standing only the largest and healthiest oaks. This allows the remaining overstory trees to grow while encouraging a thick understory growth. After two to three growing seasons, the understory should become dense with rapidly growing hardwoods such as tulip poplar; black gum, red maple, white oak and scarlet oak (Keyser et al., 1996). However, the oak species have a different growth strategy from the other species just mentioned. The roots of young oaks become extensive while above the ground their growth seems slow in contrast to the rich stem production of the poplars and maples. Because of this, a controlled burn conducted in the shelterwood stands should allow for more unobstructed

growth of the oaks. After the burn, there will be a clear understory, young oaks will survive due to their extensive roots, and competition from maples, poplars, and black gums will be greatly reduced. This will allow the oaks to eventually dominate the understory of the stand. A continuous cycle of such treatment will allow for the more valuable oaks to be harvested while also allowing a new crop of oaks to develop. Keyser et al. (1996) discovered that burning also stimulates production of berries, grasses and legumes on the forest floor. Resprouting hardwood regeneration has nutrient-rich foliage and serves as a horizontal cover.

The effects of controlled burning on birds have been of interest for some time, with various observations made. Stoddard (1963), for example, argued that the availability of food seems to be the most powerful attractor of birds to new burns, for stomachs and crops can be filled in minutes instead of hours. But our knowledge of the effects of forest harvesting and regeneration methods on songbird remains incomplete, especially when comparing methods similar to those described here for oak regeneration to more typical practices such as clear-cutting (Annand and Thompson 1997). Data gathered using the methods described here could show how the oak regeneration method effects breeding bird densities in the Virginia piedmont, where it is a relatively new and untried technique.

The Breeding Bird Census (BBC) method which was used as the standard method for data collection in this study was initiated in 1914 by the former US Bureau of Biological Survey. Its initial form it continued until the 1920s, after which the National Audubon Society took on the responsibility of administering the BBC program. They

published the BBC results in *Audubon Field Notes* and *American Birds* between 1937 and 1984. Since 1984, the Cornell Laboratory of Ornithology has been responsible for computerizing the BBC data. The BBC provides birders and scientists accurate information concerning numbers and densities of breeding birds in various habitats. The standardization of techniques used to conduct BBCs has the potential to produce valuable long term studies of specific areas of forest and various types of forestry practices. Data from many different censuses can be compiled and compared to show how different environmental factors effect breeding bird populations. Unfortunately the numbers of Breeding Bird Censuses conducted each year as compared to other breeding bird monitoring methods has been down during the past few years. The low number of counts may be attributed to the high initial investment of energy required to establish one plot or to the declining interest caused by the decision to cease publication of the results. This may have been reversed for a few years by the resumption of publication in *the Journal of Field Ornithology*, but publication there has now ceased as well, at least temporarily. A related problem is the tendency of observers to abandon a given census plot after making counts there for a few years even though it can be argued that the most valuable counts are those which have been made on the same plot for many successive years (Terborgh 1989).

Engstrom (1988) points out that there are four major objectives for the BBC that have been used for almost 50 years:

The BBC could be used to determine the species and densities of breeding birds found in each habitat type throughout North America; to measure the effects of various land-use practices on breeding-bird populations; to quantify the amount of yearly variation in densities of breeding birds occupying various habitat types; and to establish the nesting requirements for each species of birds.

The reliability of BBC data, like other bird counting methodologies, depends on the ability of the worker conducting each census. The worker must be able to identify bird species by both sight and sound. Detailed behaviors of birds are not recorded on the census, however, recognizable breeding behaviors, such as those which may indicate a possible nest location, may be recorded. The experience, training and knowledge of the subject by the census taker will determine the maximum potential accuracy of the project. The design, as described in more detail in the next chapter, requires the census taker to visit the plot a minimum of eight times during the breeding season. This may compensate for some errors that occur, such as birds being counted more than one time.

The BBC utilizes the spot-mapping technique to document the relative abundance, density, and territories of birds on a plot. "The spot mapping technique has been noted as the best method for measuring the relative abundances of birds over an extended period of time (Engstrom 1988)." Other methods, such as point-counts, are also valuable, depending upon the type of study being conducted. But Reynolds et al. (1980) explains that plots of fixed size, whether traversed by transects or censused from a fixed point, are more easily censused since only bird occurrences need to be noted. Counts such as Breeding Bird surveys (BBS), Christmas Bird Counts, and local area checklist compilations, even though valuable and popular, do not provide the same kind of information that is provided by BBCs. The BBS, for example, requires the volunteer to drive to a designated point on a survey route, record observations and songs for three minutes, and then drive to the next location. The 25-mile survey path is not revisited and only one count is required by the BBS. Unlike the BBC, the BBS does not account for

flyovers or birds merely visiting a plot. In addition, a BBC may note trends indicating the effects of forest fragmentation, where a BBS would not suggest such trends by examining data (Robbins et al. 1986, Engstrom 1988, Bradshaw 1992). See Ralph et al. (1993) for additional comparisons of bird-counting methods.

The BBC is designed to define territories of species during the breeding season. The BBC instructions suggest that “the purpose of the census is not to outline the precise boundaries of the territories but to determine the number of territories present” (Van Velzen, 1972). Haven Kolb (1965) points out that the goal is to secure comparable plots with similar surrounding habitats. This is the ideal situation, however, in the vast eruption of farmland and cement, it is almost impossible to encounter a purely uniform habitat of this nature. The homogeneity of habitat within each plot should be as high as possible, and a method to determine whether this is the case is thus needed.

BBC standards require that vegetation data be recorded to additionally document nature of the habitat on the plot and how it correlates with the bird populations. There are also a number of different methodologies used to survey vegetation, but a standard used for the BBC has emerged based on recommendations by James and Shugart (1970). Other methods exist; Penfound and Rice (1957), for example, describes how to analyze vegetation using a methodology known as the Arms-Length rectangle method. This method is used to find information comparable to that gathered using the methods of James and Shugart (1970), but may not be as accurate. With similar methodologies, it should be noted that the length of one's pace varies with slope, obstructions and other factors, and that the actual area of a given point would only be approximate (Penfound

1957). Since BBCs are ideally to be conducted yearly, it is important to use standard methods that will not vary by the individual collecting the data. The standard method includes counting the number of individual species and basal area of each tree species. The percentage of canopy cover and ground cover are calculated as well as the shrub density in the sample plot (Engstrom 1988).

Because of the work involved in establishing a plot, the first year of setting up a BBC is the most difficult. The perimeters should be precisely determined and survey markers should be accurate to ensure that plot maps are drawn to scale and the data are recorded accurately. Only after the plot maps are correlated with the actual plot and the markers have been placed precisely can the data collection begin. Maintenance of plot markers, such as replacing lost stakes, can best be done in the winter when the understory foliage has died back for the season. Ideally, after the initial set-up the plot will require minimal maintenance year after year.

The vegetation study, which is an essential portion of the BBC, is crucial in defining species habitat. It is particularly necessary in this project for the effects of silvicultural practices on bird populations to be adequately documented. The size requirements of the BBC methodologies can present another difficulty in establishing BBC plots. The requirement that 10 hectares be the minimum size for newly established plots, combined with the desire to find several plot locations in reasonable proximity, made this particularly crucial for this project. It is difficult in some cases to locate this amount of homogeneous habitat that can be marked and used as a census plot in one area, and this may also account for the decline in BBCs conducted over the years. Fortunately two

areas of publicly owned land were available for this project, and the encouragement of the landowners was essential in plot preparation. These lands were portions of the Appomattox-Buckingham State Forest and the Horsepen Lake Wildlife Management Area, owned by the Virginia Department of Forestry and the Virginia Department of Game and Inland Fisheries, respectively.

This project was also designed in such a way that the role that edge effect plays in bird distributions in these habitats might be. Even with the cooperation of the state foresters in cutting plots to similar specifications, no two plots have identical boundaries or adjacent habitats, contributing to the bird species diversity on each plots. Two plots are located in the state forest, border one another, and are referred to as Harris Tract East and Harris Tract West. These plots are located about 23 miles northwest of Farmville, Virginia, and lie west of U.S. Route 15, south of state route 636, and between state routes 614 and 603. The Harris Tract, as the land was already known, was shelterwood cut in late 1996 and early 1997 by loggers under contract with the state department of forestry. This tract of forest, divided into two equally sized plots for this study, was cut with this project in mind. They are nearly rectangular shaped, as suggested in the BBC guidelines.

Harris Tract West is an almost perfect parallelogram. It is bordered on the northwest (long side) by state route 614, which is a gravel road. The long southeast side is bordered on the east by Harris Tract East. The north/northeast side is bordered by a powerline cut, on the other side of which is a small area of deciduous second growth forest. The south/southwest (short side) it is bordered by an extensive area of second growth deciduous forest. In addition, a small stream located on Harris West is the upper

section of Forbes Creek, which is a feeder stream for Holiday Lake in nearby Holiday Lake State Park.

Harris Tract East borders a small residence and second growth area at the top corner, leaving the plot with an irregular border. Harris East is bordered on the long west/northwest side by Harris East (shelterwood cut); on the east/southeast (long side) by state route 603, a dead-end gravel road, across which is a large open agricultural field. The south/ southwest (shorter) side is bordered by the extensive area of second growth deciduous forest already mentioned. On the north/northeast side, the border is irregular. It runs along the same power line opening as Harris West, and then curves and runs along the small area of second growth deciduous forest that is privately owned.

The third plot, located on Horsepen Lake Wildlife Management Area, is referred to as the Route 639 plot in reference to the state route that borders it on the east. This area was partly shelterwood cut before this project was planned. About eight additional acres needed to be shelterwood cut to meet the size requirements of the project; this was done in late 1996 and early 1997 by loggers under contract with VDGIF. State route 639 forms part of the east border of this plot. The south side and part of the irregular western border is adjacent to deciduous forest also owned by VDGIF. The long, curved north side of the plot borders a gravel road (not numbered) across which is a large clear-cut several years old. A smaller clear-cut area also lies along the northwest corner of the plot. Although this plot is more irregularly shaped than the Harris Tract plots, it meets the standards and guidelines of the BBC methodology. With the varying dates of the shelterwood cutting on the plot, there was a possibility that it would show more varied vegetation than that on the

Harris Tract plots. Vegetation studies allowed this possibility to be examined, as discussed in chapter three.

With additional funding and additional years for research, the long-term goal is for these three plots to be the first of eight 10-hectare BBC plots in the Appomattox-Buckingham State Forest, Horsepen Lake Wildlife Management Area and privately owned forest land in Buckingham County. If successful, each plot will be censused each summer, and at some point four will be burned and oak regeneration studied as discussed above.

The BBCs will provide valuable information about the response of birds to these treatments. The use of the shelterwood-burn technique for oak regeneration is in its preliminary stages in Virginia, but there is a possibility that several years of data collection might show a basis for economically viable silvicultural alternatives to the pine management which is now common in the Virginia piedmont. If these alternative silviculture methods are shown to benefit the ecology of an area by allowing populations of forest birds to continue breeding on areas that would otherwise be clear-cut and replanted to pine, this would be an additional argument in favor of adaptation of these practices.

The gathering of BBC data in the project described here is a first step in this direction. This gives an initial indication of the types of avian species attracted to the shelterwood cut areas before they have been burned. It provides information on species densities, variation between plots and similarities within plots. It also gives information on visiting species and those termed "flybys." Engstrom (1988) explains that the measurement for relative abundance of birds and characteristics of habitat can be

compared directly after correcting for differences in plot size, and as already mentioned, this information would not be generated by using any single alternate methodology.

Methods

Standard techniques for establishing and surveying BBC plots were followed in this study (Cornell, n.d.). Certain features of the methods used are worth comment here. First, it is essential for an observer to know their own location during a census so that bird locations within a plot are accurately marked. The placement of stakes and flagging throughout the plots enabled observers to follow established transects with little trouble. The stakes were used to insure that it is "possible for the observer to know with sufficient accuracy his own position, and that of the bird contacted, anywhere within the plot (Robbins 1970)." A compass mounted on a tripod and a measuring tape were used to map the outlines of the plots and to establish transects within them along which observers walked while conducting bird censuses.

Once the outlines of the plots were established their borders were marked. The border was marked with 12-inch or 18-inch pine stakes and biodegradable flagging. A point 25 meters from one corner of each plot was next marked with a stake to serve as one end of a transect line, along which the observer walked during censuses. Stakes were then placed every 20 meters following a line parallel to one border of the plot. For example, one border of Harris West followed state route 614 at an azimuth of 45.8 degrees (not corrected for declination). Thus a transect line began 25 meters in from the border of the plot and extended to a point within 25 meters of the far end of the plot at an azimuth of 45.8 degrees. This line could be followed from stake to stake. Occasional pieces of flagging were also tied to vegetation along the route to aid in following it if

visibility was poor. See plot maps in Appendix 1 for locations of each transect line and stake on the three plots.

Next, a line parallel to the first was established parallel to it and 50 yards farther into the plot. This line was similarly marked with stakes and flagging. The process of establishing lines was repeated until a line was established within 25 meters of the far side of the plot. Line lengths varied depending on the dimensions and shape of the plots. By following the lines thus established, an observer would pass within 25 meters of every point of the plot during a survey, a distance that is considered sufficient to allow detection of birds in forest habitats.

In conjunction with the compass, a device known as a Reinhardt Redy Mapper (available from Forestry Suppliers, Inc., Jackson, MS) was used to draw a map of each plot. These maps are drawn in the field on transparent discs mounted on a flat piece of plastic with degree markings and grids, the main component of the Redy Mapper. The master maps, drawn to a scale determined in the field, can then be transferred to an 8 1/2 x 11 sheet of paper and copied to make field data sheets. Terrain features such as logging roads and swampy areas were indicated on the maps as desired to provide additional landmarks in the field.

One copy of the map was used for each census of a plot (see Appendix 1). The date in which each census was conducted was recorded along with start and finish times and limited weather data. Censuses were conducted from 23 May 1997 to 2 July 1997, falling within the breeding season of a majority of the birds breeding on the plots.

Counts were conducted in the mornings. "Visits should be made at times when singing activity is greatest, usually early morning. The recommended start time is within 30 minutes after local sunrise. Visits should be long enough to maximize detection of individuals of all breeding species" (Cornell, n.d.). It is recommended that forested habitats be censused at the rate of 10-12 minutes/hectare, which essentially means that a slow, steady walking pace through the plot is maintained except when the observer stops to record data or look at a bird.

Counts were not conducted during heavy rains or high winds (considered here to be above 3 using the Beaufort Wind Scale), since these conditions severely reduce bird detectability (Cornell, n.d.). The Beaufort Wind Scale (Appendix 3) is used to estimate wind speed using observations of wind effects in landscape and wind conditions at all visible distances. The Beaufort scale estimates the wind speed by assigning a number to each of a series of descriptions given of the movement of tree tops and branches. A numeric value of 3, for example, would indicate a gentle breeze with movement in the trees. The Beaufort scale is effective for bird observation reports and is useful as a description of the conditions which leads an observer to become more perceptive of how different winds affect bird life.

Each BBC plot should be visited a minimum of eight times during the breeding season; in this study, Harris East and Harris West were visited 11 times each and Route 639 was visited eight times. Dates of each census are recorded on the field data sheets, reproduced in Appendix 1, and are listed separately in Appendix 3. All censuses were performed by the writer or C. Michael Stinson, her advisor. Binoculars were used by both

observers during censuses. During each visit, the starting point was marked. These were changed from census to census between the four corners of each plot as an additional means of reducing bias. While walking through the plot, the observer did not stop to observe bird nests or behavior unless behavior was clearly associated with breeding. Nest locations and behavioral observations were sometimes noted in the plots after the censuses were completed for the day.

Standard symbols are used to identify bird species and particular behaviors observed. Hall (1964) recommended that the observer select a single letter or a brief abbreviation to represent each species. Robbins (1970) later refined the system, and his suggestions with minor modifications, were used in this study. The location of a bird detected on the plot was indicated on the map by writing the first two letters of the species name on the map at the spot corresponding to the bird's location (example: for a singing male Scarlet Tanager, *Piranga rubra*, PIRU would be written on the map). Symbols indicating male or female were also used to indicate the bird's gender when known. If a bird was singing, an "s" was placed with the species code on the map. If the species was giving a call note, a "c" was written with the species code. Other symbols followed the recommendations of Robbins (1970), such as the use of a solid line when a bird was observed flying, to indicate the same bird relocating and singing at a second location, or the use of a dashed line between two birds of the same species to indicate simultaneous singing and by implication separate territories. "Simultaneous observations of two individuals of the same species singing or seen must always be recorded carefully so that birds can still be separated from their neighbors after they have moved, which frequently

happens during a census visit" (Ralph et al., 1993). Any unusual behavior was described outside the map section of the sheet.

Following the conclusion of the census period, an individual species map was made for any species having a high number of occurrences on the plot as means of determining the actual territory numbers. A list comprising all of the species and how often they occurred on each plot during the censuses was helpful in deciding whether a species map needed to be made (Table 1). The maps were made by compiling every mark indicating a registration of a particular species from all visits onto a single map -- all observations were copied from the field maps to exactly the same location on the species summary maps (Ralph et al., 1993). Clusters of more than three registrations were considered a territory for that species (Fig. 1). Ven Velzen (1972) notes that when a territory lies within the plot and partly outside, only the fractional portion that is within the boundaries of the plot should be counted. Locations clustered on the edge of a plot were sometimes counted as one half of a territory. (Fig. 2) Species not showing a definite cluster of three or more registrations in a cluster are given a "+". These species were considered possible breeders.

Vegetation surveys were conducted later in the summer, after the breeding bird census period had ended. Following James and Shugart (1970) with slight variations, we estimated tree density, species frequency, basal area, shrub density, percent ground cover and percent canopy cover at each point. The data was collected using a two meter stick, a diameter tape, 50m tape and ocular tube. Ten random points were selected on each BBC plot to be the centers of the 10 vegetation sample areas. The location of each stake on the plot was recorded on a slip of paper and 10 were randomly selected.

| Species | Scientific Name | Abbreviation | Rt.639 | Harris E. | Harris W. |
|--------------------------|---------------------------------|--------------|--------|--------------|--------------|
| No. Bobwhite | <i>Colinus virginianus</i> | CoVi | 1 | 2 | 0 |
| Mourning Dove | <i>Zenaida macroura</i> | ZeMa | 0 | 4 | 1 |
| Yellow-billed Cuckoo | <i>Coccyzus americanus</i> | CoAm | 1 | 0 | 1 |
| Ruby-thr. Hummingbird | <i>Archilochus colubris</i> | ArCo | 4 | 1 | 0 |
| Red-bellied Woodpecker | <i>Melanerpes carolinus</i> | MeCa | 0 | 15 | 3 |
| Downy Woodpecker | <i>Picoides pubescens</i> | PiPu | 2 | 11 | 3 |
| Hairy Woodpecker | <i>Picoides villosus</i> | PiVi | 11 | 11 | 3 |
| Pileated Woodpecker | <i>Dryocopus pileatus</i> | DryPil | 1 | 5 | 3 |
| Eastern Wood-Pewee | <i>Contopus virens</i> | CoVi | 30 | 49 | 55 |
| Great Crested Flycatcher | <i>Myiarchus crinitus</i> | MyCr | 1 | 11 | 10 |
| Eastern Kingbird | <i>Tyrannus tyrannus</i> | TyTy | 0 | 10 | 0 |
| Blue Jay | <i>Cyanocitta cristata</i> | CyCy/Jay | 4 | 14 | 11 |
| American Crow | <i>Corvus brachyrhynchos</i> | Crow | 3 | 9 | 1 |
| Carolina Chickadee | <i>Parus carolinensis</i> | PaCa/ParCar | 16 | 21 | 14 |
| Tufted Titmouse | <i>Parus bicolor</i> | PaBi | 7 | 18 | 19 |
| White-br. Nuthatch | <i>Sitta carolinensis</i> | SiCa | 19 | 19 | 13 |
| Carolina Wren | <i>Thryothorus ludovicianus</i> | ThLu | 5 | 17 | 1 |
| Blue-gray Gnatcatcher | <i>Poliophtila caerulea</i> | PoCa | 26 | 7 | 31 |
| Eastern Bluebird | <i>Sialia sialis</i> | SiSi | 0 | 3 | 4 |
| Wood Thrush | <i>Hylocichla mustelina</i> | HyMu | 1 | 0 | 1 |
| American Robin | <i>Turdus migratorius</i> | TuMi | 0 | 2 | 3 |
| Mockingbird | <i>Mimus polyglottos</i> | MiPo | 0 | 14 | 0 |
| Brown Thrasher | <i>Toxostoma rufum</i> | ToRu | 0 | 12 | 2 |
| Yellow-throated Vireo | <i>Vireo flavifrons</i> | ViFl | 24 | 5 | 24 |
| Red-eyed Vireo | <i>Vireo olivaceus</i> | ViOl/REV | 37 | 16 | 37 |
| Prairie Warbler | <i>Dendroica discolor</i> | DeDi | 2 | 0 | 1 |
| Ovenbird | <i>Seiurus aurocapillus</i> | SeAu | 12 | 0 | 2 |
| La. Waterthrush | <i>Seiurus motacilla</i> | SeMo | 0 | 0 | 1 |
| Kentucky Warbler | <i>Oporornis formosus</i> | OpFo | 1 | 0 | 0 |
| Common Yellowthroat | <i>Geothlypis trichas</i> | GeTr | 1 | 0 | 1 |
| Hooded Warbler | <i>Wilsonia citrina</i> | WiCi | 12 | 0 | 0 |
| Scarlet Tanager | <i>Piranga olivacea</i> | PiOl | 12 | 11 | 11 |
| Summer Tanager | <i>Piranga rubra</i> | PiRu | 13 | 24 | 13 |
| Northern Cardinal | <i>Cardinalis cardinalis</i> | CarCar | 4 | 6 | 7 |
| Blue Grosbeak | <i>Guiraca caerulea</i> | GuCa | 0 | 2 | 0 |
| Indigo Bunting | <i>Passerina cyanea</i> | PaCy | 13 | 10 | 11 |
| Rufous-sided Towhee | <i>Pipilo erythrophthalmus</i> | PiEr | 5 | 0 | 0 |
| Chipping Sparrow | <i>Spizella passerina</i> | SpPa | 0 | 3 | 0 |
| Common Grackle | <i>Quiscalus quiscula</i> | QuQu | 0 | 8 | 4 |
| Brown-headed Cowbird | <i>Molothrus ater</i> | MoAt | 4 | 31 | 46 |
| Orchard Oriole | <i>Icterus spurius</i> | IcSp | 0 | 6 | 0 |
| Amer. Goldfinch | <i>Carduelis tristis</i> | CaTr | 2 | 3 | 2 |

Table 1. Birds recorded during BBCs, with abbreviations used on field sheets and total registrations per plot

OBSERVER _____
 DATE _____
 TEMP, START _____ END _____
 WIND, START _____ END _____
 CLOUDS, START _____

1 1/2 terr.

MARK STARTING POINT!
 Summer Tanager Census Map:
 Piru

- Census added:
- 2 July '97
 - 30 June '97
 - 25 June '97
 - 24 June '97
 - 23 June '97
 - 20 June '97
 - 19 June '97
 - 18 June '97

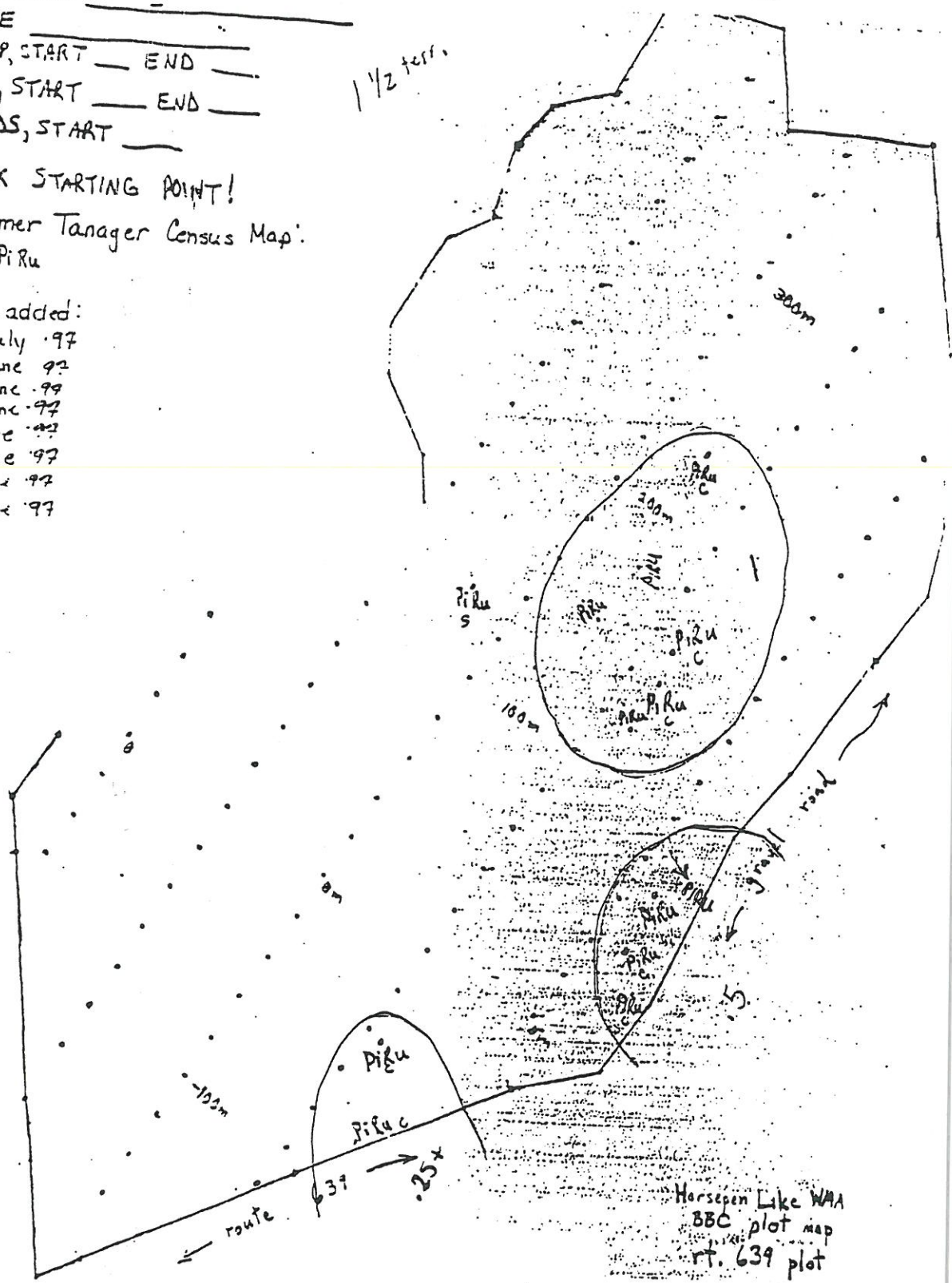


Figure 1. Example of a Species Summary Map Showing Territories: Summer Tanager.

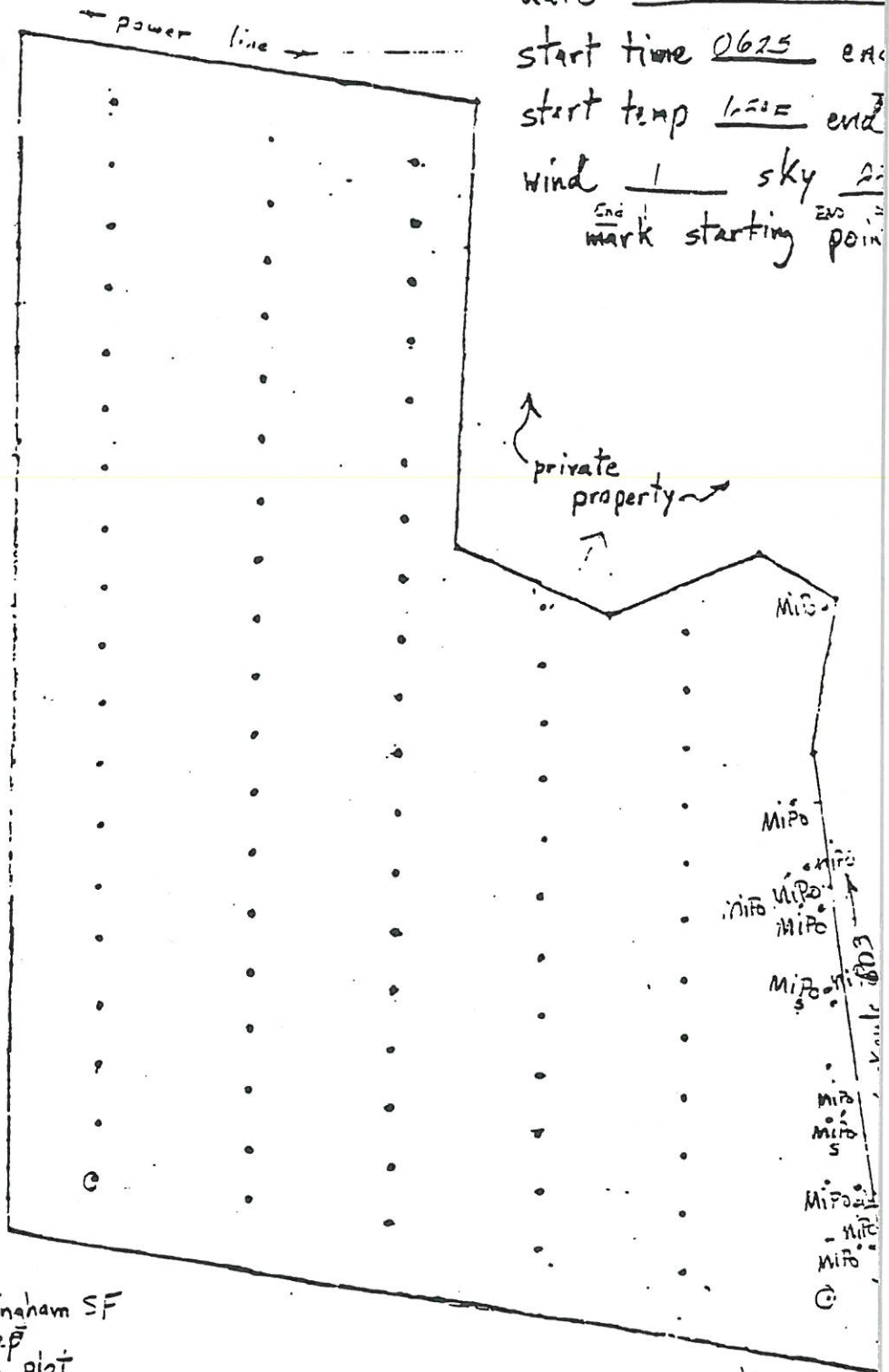
Mockingbird summary Map.

MiPo

Census added:

- 30 June '97
- 26 June '97
- 24 June '97
- 23 June '97
- 17 June '97
- 16 June '97
- 12 June '97
- 11 June '97
- 10 June '97
- 7 June '97
- 7 June '97

date 30 June 97
 start time 0625 end
 start temp 1.50E end
 wind 1 sky 2:
 mark starting point



Appomattox - Buckingham SF
 BEC plot map
 Harris tract - E plot

Figure 2. Example of a Species Summary Map Showing Partial Territories: Mockingbird.

At each of these randomly selected points, an 11.28-meter radius (0.10 acre) circle was established using the stake as the circle center. All of the measurements were taken within the circle radius. A data sheet was designed and a separate one used for each of the ten points on the plot in Appendix 3. The first measurement was to determine the diameter of the trees inside the circle. The diameter at breast height (DBH) of each tree in the sample circle was measured using a DBH tape at about 4.5 feet above the ground. All trees with a DBH greater than 3cm were recorded. The tree species and DBH were noted on the data sheet. The shrub layer was then recorded by walking two transects across each circle, one from east to west and one from north to south, with a two meter stick held at DBH height. Each time the two-meter stick contacts a shrub less than 3cm DBH, the species was recorded and counted.

Canopy cover and ground cover were measured using an ocular tube. An observer walked along the same transects just described and pointed the ocular tube upward at 20 random points, 10 on each transect. A hit "+" or a miss "-" was recorded to indicate whether green canopy (hit) or sky (miss) was visible behind the cross-hairs of the ocular tube. A similar procedure was followed to record ground cover, again at 20 points along the two transects. These numbers were then easily converted to percentages.

Summary sheets similar to those provided by James and Shugart (1970) were used to analyze the vegetation on each BBC plot (see Appendix 3). Averages for each measurement made on the three plots were determined. James (1978) defined the terms used in reference to a BBC vegetation study:

The density is simply the number of trees per unit area. The basal area, sometimes called 'dominance', is the sum of the cross sectional area of the trees at 4 1/2 feet.

It was originated by foresters as a way of estimating the stocking of a stand of timber. Here it is useful as an estimate of the amount of woody vegetation present the evenness of distribution. It is the percent of the 0.1-acre circles that has trees of the species in question.

Each of the following values were determined for each plot: the relative density, relative dominance, relative frequency, total shrub stems, ground cover percent, canopy cover percent (James and Shugart, 1970). Formulas used to determine each of these are given in Table 2.

1. Density is the number per unit area.
 - 2 if 5 circles
 - 16 if 6 circles
2. Total trees counted by X
 - 14 if 7 circles
 - 13 if 8 circles
 - 11 if 9 circles
 - 10 if 10 circles
3. Relative density is the percent of the total number of trees which are the species in question:

$$\frac{\text{number of trees of the species}}{\text{total number of trees of all species}}$$
4. Circumference was determined by:
 $C = \text{diameter}^2 (.7854)$ for each tree species
5. Basal Area is the cross sectional area of the trunk of a tree 4.5 feet (dbh)
6. Add the total circumference of each size class to give the basal area for each tree's size class.
7. Total basal area of the species
 Total basal area of all species
8. Frequency indicates the evenness of distribution of a species.
9. Number of circles in which the species occurred
 Total number of circles
10. **SHRUBS:** Total shrub stems in all transects (2 per circle) x 100, divided by the number of transects.
11. **GROUND COVER:** Total pluses (+) recorded (20 sightings per circle)x 100, divided by the total number of sightings = % ground cover.
12. **CANOPY COVER:** Total pluses (+) recorded (20 sightings per circle)x 100, divided by the total number of sightings = % canopy cover.

Table 2. Formulas Used for Vegetation Analysis.

Results

Of the three plots studied, Harris West had the largest number of territories, with 35 total identified. The Route 639 plot had 27 identified territories, while on Harris Tract East 24.5 territories were identified. A total of 23 species of birds had territories on at least one of the three plots, and nine species had territories on all three plots. The number of territories of each species found as well as lists of all visiting species identified, are found in Table 3.

Of the 43 total species observed on the three plots only 9 were found to have definitely established territories on all three stands. These species were: Eastern Wood-pewee (*Contopus virens*), Summer Tanager (*Piranga rubra*), Red-eyed Vireo (*Vireo olivaceus*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Yellow-throated Vireo (*Vireo flavifrons*), Carolina Chickadee (*Parus carolinensis*), Tufted Titmouse (*Parus bicolor*), White-breasted Nuthatch (*Sitta carolinensis*) and Indigo Bunting (*Passerina cyanea*).

Six other species were found to have territories on two of the three study plots: Great Crested Flycatcher (*Myiarchus crinitus*), Hairy Woodpecker (*Picoides villosus*), Northern Cardinal (*Cardinalis cardinalis*), Scarlet Tanager (*Piranga olivacea*), Brown-headed Cowbird (*Molothrus ater*) and the Ovenbird (*Seiurus aurocapillus*).

Mockingbirds (*Mimus polyglottos*), Red-bellied Woodpecker (*Melanerpes carolinus*), Downy Woodpecker (*Picoides pubescens*), Carolina Wren (*Thryothorus ludovicianus*), Eastern Kingbird (*Tyrannus tyrannus*), Eastern Bluebird (*Sialia sialis*), and

| Bird Species | Harris Tract E | Harris Tract W | State Route 639 |
|--|--------------------------|-------------------|--------------------|
| species with territories on three plots | | | |
| Eastern Wood-Pewee | T 5.5 | N, T 7 | T 2 |
| Carolina Chickadee | T 1 | N, T 1 | T 1 |
| Tufted Titmouse | T 1 | T 2 | T 1 |
| White-breasted Nuthatch | T 1 | T 2 | T 3 |
| Bl-gr. Gnatcatcher | T 1 | N, T 5 | T 4 |
| Yellow-throated Vireo | T 0.5 | T 3.5 | T 3 |
| Red-eyed Vireo | T 3 | T 4.5 | T 5 |
| Summer Tanager | T 3 | T 2.5 | T 1.5 |
| Indigo Bunting | T 0.5 | T 0.5 | P |
| species with territories on two plots | | | |
| Hairy Woodpecker | P | * | T 1 |
| Great Cr. Flycatcher | T 1 | T 1 | * |
| Ovenbird | * | N, T 1 | T 2 |
| Northern Cardinal | T 1 | N, T 1 | * |
| Brown-headed Cowbird | T 2 | T 3 | * |
| species with territories on one plot | | | |
| Wood Duck | - | - | N |
| Red-bellied Woodpecker | N, T 1 | * | - |
| Downy Woodpecker | T 0.5 | * | * |
| Eastern Kingbird | T 1 | - | - |
| Carolina Wren | T 1 | * | * |
| Mockingbird | T 0.5 | - | - |
| Brown Thrasher | P | * | - |
| Hooded Warbler | - | - | T 1.5 |
| Orchard Oriole | P | - | - |
| species recorded as visitors on three plots | | | |
| Pileated Woodpecker | * | * | * |
| American Crow | * | * | * |
| American Goldfinch | * | * | * |
| species recorded as visitors on two plots | | | |
| No. Bobwhite | * | - | * |
| Mourning Dove | * | * | - |
| Yellow-billed Cuckoo | - | * | * |
| Ruby-thr. Hummingbird | * | - | * |
| Wood Thrush | - | * | * |
| American Robin | * | * | - |
| Prairie Warbler | - | * | * |
| Common Yellowthroat | - | * | * |
| Common Grackle | * | * | - |
| species recorded as visitors on one plot | | | |
| Louisiana Waterthrush | - | * | - |
| Kentucky Warbler | - | - | * |
| Blue Grosbeak | * | - | - |
| Chipping Sparrow | * | - | - |
| Rufous-sided Towhee | - | - | * |
| Total Species | Total Territories | | |
| 42 | 24.5 | 35 | 27 |

Table 3. Territories, nests, and visitors found on each plot. T = territories, N = nest found, P = partial territory, * = visitor on plot only.

Kingbird (*Tyrannus tyrannus*), Eastern Bluebird (*Sialia sialis*), and the Hooded Warbler (*Wilsonia citrina*), had part or all of a defined territory located on only one of the three plots.

Species noted with a "P" in Table 3 are considered to be probable breeding species. This means that there was not enough evidence to define a true territory using BBC guidelines, but their presence on the plot was of such significance for some other reason to be of note. This was the case for the Orchard Oriole (*Icterus spurius*), Brown Thrasher (*Toxostoma rufum*), and Wood Duck (*Aix sponsa*). The remaining 42 species were classified as visitors (* in Table 3), indicating there was no evidence of breeding on any of the plots noted in the study. An "N" by a species name indicates that a nest of the species was found on the plot.

Vegetation results are summarized in Tables 4 through 7. On all three plots, White Oaks (*Quercus alba*) had the highest relative dominance, with Red Maples (*Acer rubrum*) a distant second. The distribution of the size classes of oak species on all three plots is shown in Figure 3. Since the three plots were meant to be left as oak stands following the shelterwood cuts, and since the composition of the trees left standing on the three plots should be similar if the three plots are meant to be taken together as representing a single habitat type when characterizing their breeding bird communities, these two measures were of particular interest for this study.

| Summary Sheet: Tenth-Acre Circles Harris Tract West | | | | | | | | | | | | | | | | |
|---|---|-----|------|-------|-------|-------|-------|-------|----|----|--------|----|----|----|----|----|
| SPECIES | Number of Circles Sampled: 10 | | | | | | | | | | TOTALS | | | | | |
| | Density | | | | | | | | | | | | | | | |
| | Number of trees in all circles by diameter (cm) | | | | | | | | | | | | | | | |
| | A | | B | | C | | D | | E | | F | | G | | H | |
| | 3-6 | 6-9 | 9-15 | 15-21 | 21-27 | 27-33 | 33-40 | 40-49 | | | | | | | | |
| White Oak | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red Maple | 3 | 13 | 3 | | | | | | | | | | | | | |
| Black Gum | 1 | 4 | 1 | | | | | | | | | | | | | |
| Chestnut Oak | | | 1 | | | | | 2 | | | | | | | | |
| TOTALS | 0 | 4 | 18 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Trees/Acre (class) | 0 | 10 | 180 | 30 | 10 | 20 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Relative Density (class) | 0 | 7 | 72 | 7 | 2 | 5 | 2 | 33 | | | | | | | | |
| Shrub Cover | $\frac{203}{20} \times 100$ | | | | | | | | | | | | | | | |
| Ground Cover | $\frac{117}{800} \times 100$ | | | | | | | | | | | | | | | |
| Canopy Cover | $\frac{163}{200} \times 100$ | | | | | | | | | | | | | | | |
| | 1015 | | | | | | | | | | | | | | | |
| | 74% | | | | | | | | | | | | | | | |
| | 51% | | | | | | | | | | | | | | | |

| SPECIES | Basal Area | | | | | | | | | | TOTALS |
|--------------------------|--|-------|------|------|------|------|-----|---|-----|-------|--------|
| | Cross-sectional Area of Trunk @ dbh (cm) | | | | | | | | | | |
| | A | B | C | D | E | F | G | H | | | |
| White Oak | | | 1366 | 682 | | | | | 866 | 31706 | 3772 |
| Red Maple | 187 | 4 | | | | 781 | | | 712 | | 2115 |
| Black Gum | | | | | | | | | | | 1097 |
| Chestnut Oak | | | 127 | | | | | | | 3023 | 3190 |
| TOTALS | | | 1855 | 682 | 324 | 712 | 866 | | | 3772 | 12380 |
| Trees/Acre (class) | 111 | 1855 | 682 | 324 | 712 | 866 | | | | | 12380 |
| Relative Density (class) | 1110 | 18550 | 6820 | 3210 | 7130 | 8660 | | | | | 123800 |
| Shrub Cover | $\frac{11}{119} \times 100$ | | | | | | | | | | |
| Ground Cover | $\frac{1}{119} \times 100$ | | | | | | | | | | |
| Canopy Cover | $\frac{6}{119} \times 100$ | | | | | | | | | | |
| | 1015 | | | | | | | | | | |
| | 74% | | | | | | | | | | |
| | 51% | | | | | | | | | | |

| SPECIES | Basal Area | | | | | | | | | | TOTALS |
|--------------------------|--|-------|------|------|------|------|-----|---|-----|-------|--------|
| | Cross-sectional Area of Trunk @ dbh (cm) | | | | | | | | | | |
| | A | B | C | D | E | F | G | H | | | |
| White Oak | | | 1366 | 682 | | | | | 866 | 31706 | 3772 |
| Red Maple | 187 | 4 | | | | 781 | | | 712 | | 2115 |
| Black Gum | | | | | | | | | | | 1097 |
| Chestnut Oak | | | 127 | | | | | | | 3023 | 3190 |
| TOTALS | | | 1855 | 682 | 324 | 712 | 866 | | | 3772 | 12380 |
| Trees/Acre (class) | 111 | 1855 | 682 | 324 | 712 | 866 | | | | | 12380 |
| Relative Density (class) | 1110 | 18550 | 6820 | 3210 | 7130 | 8660 | | | | | 123800 |
| Shrub Cover | $\frac{11}{119} \times 100$ | | | | | | | | | | |
| Ground Cover | $\frac{1}{119} \times 100$ | | | | | | | | | | |
| Canopy Cover | $\frac{6}{119} \times 100$ | | | | | | | | | | |
| | 1015 | | | | | | | | | | |
| | 74% | | | | | | | | | | |
| | 51% | | | | | | | | | | |

Table 5. Summary sheet of vegetation results for Harris Tract West

| Summary Sheet: Tenth-Acre Circles Harris Tract East | | | | | | | | | | | | | | | | | | | | | | |
|---|--|----|-----|----|---|----|----|-----------------------------|-----------------------------|--|------|-------|------|---|------|------|-----------------------|-------------------------|---|-------------------------|---|--|
| SPECIES | 1 Density Number of trees in all circles by diameter (cm) | | | | | | | 2 Tree/Acre (species) | 3 Relative Density | 5 Basal Area Cross-sectional Area of Trunk (@ dbh (cm)) | | | | | | | 6 Total basal Area | 7 Relative Dominance | 8 # of circles where species occurred | 9 Relative Frequency | | |
| | 4 TOTALS | | | | | | | | | 6 II | | | | | | | | | | | | |
| | A | B | C | D | E | F | G | | | A | B | C | D | E | F | G | | | | | | |
| White Oak | 1 | | | | | | 12 | 110 | 37 | 61 | 184 | | | | | 2205 | 2715 | 88 | 9 | 10 | | |
| Red Maple | 11 | 8 | | | | | 13 | 130 | 34 | 212 | 211 | | | | | 1265 | | 4 | 10 | | | |
| Black Gum | 2 | 5 | | | | | 7 | 70 | 18 | 103 | 654 | | | | | 762 | | 4 | 10 | | | |
| Tulip Poplar | 1 | 1 | | | | | 2 | 20 | 5 | | 184 | | | | | 286 | | 1 | 20 | | | |
| Hickory | | | | | | | 1 | 10 | 3 | | | | | | | 1288 | | 4 | 10 | | | |
| Chestnut Oak | 1 | | | | | | 1 | 10 | 3 | | 152 | | | | | 152 | | 1 | 10 | | | |
| TOTALS | 0 | 7 | 15 | 2 | 0 | 1 | 0 | 13 | 38 | 0 | 381 | 1750 | 579 | 0 | 735 | 0 | 735 | 0 | 0 | 0 | 0 | |
| Trees/Acre (class) | 0 | 70 | 150 | 20 | 0 | 10 | 0 | 100 | Basal Area | 0 | 3610 | 17500 | 5790 | 0 | 7350 | 0 | 7350 | 0 | 0 | 0 | 0 | |
| Relative Density (class) | 0 | 13 | 37 | 5 | 0 | 3 | 0 | 31 | Relative Basal Area (class) | 0 | 1 | 6 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | |
| Shrub Cover | $\frac{289}{20} \times 100$ | | | | | | | 1445 | | | | | | | | | | | | | | |
| Ground Cover | $\frac{96}{200} \times 100$ | | | | | | | 48% | | | | | | | | | | | | | | |
| Canopy Cover | $\frac{141}{200} \times 100$ | | | | | | | 71% | | | | | | | | | | | | | | |

Table 6. Summary sheet of vegetation results for Harris Tract East

Vegetation Comparisons Between Plots

| | Harris Tract East | | Harris Tract West | | Route 639 | |
|---------------------------|---------------------|-----------------------|-------------------|-----------------------|----------------|-----------------------|
| | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> |
| Relative Density | White Oak | 37 | White Oak | 35 | White Oak | 43 |
| | Red Maple | 34 | Red Maple | 44 | Red Maple | 18 |
| | Black Gum | 18 | Black Gum | 14 | Black Gum | 32 |
| | Tulip Poplar | 5 | - | - | Tulip Poplar | 3 |
| | Hickory sp. | 3 | - | - | - | - |
| | Chestnut Oak | 3 | Chestnut Oak | 7 | Scarlet Oak | 4 |
| Relative Dominance | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> |
| | White Oak | 88 | White Oak | 80 | White Oak | 79 |
| | Red Maple | 4 | Red Maple | 6 | Red Maple | 6 |
| | Black Gum | 2 | Black Gum | 3 | Black Gum | 5 |
| | Tulip Poplar | 1 | - | - | Tulip Poplar | 1 |
| | Hickory sp. | 4 | - | - | - | - |
| Basal Area | <u>Species</u> | <u>cm²</u> | <u>Species</u> | <u>cm²</u> | <u>Species</u> | <u>cm²</u> |
| | White Oak | 27185 | White Oak | 26608 | White Oak | 48894 |
| | Red Maple | 1265 | Red Maple | 2185 | Red Maple | 3422 |
| | Black Gum | 762 | Black Gum | 1097 | Black Gum | 3302 |
| | Tulip Poplar | 286 | - | - | Tulip Poplar | 853 |
| | Hickory sp. | 1288 | - | - | - | - |
| Relative Frequency | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> | <u>Species</u> | <u>%</u> |
| | White Oak | 90 | White Oak | 100 | White Oak | 100 |
| | Red Maple | 40 | Red Maple | 70 | Red Maple | 70 |
| | Black Gum | 40 | Black Gum | 50 | Black Gum | 70 |
| | Tulip Poplar | 20 | - | - | Tulip Poplar | 10 |
| | Hickory sp. | 10 | - | - | - | - |
| Shrub Density | | 1445 stems/acre | | 1015 stems/acre | | 1945 stems/acre |
| | Ground Cover | 48% | | 74% | | 49% |
| | Canopy Cover | 71% | | 51% | | 78.5% |

Table 7. Vegetation comparisons between all plots

Oak Size Class Distribution Between All Plots

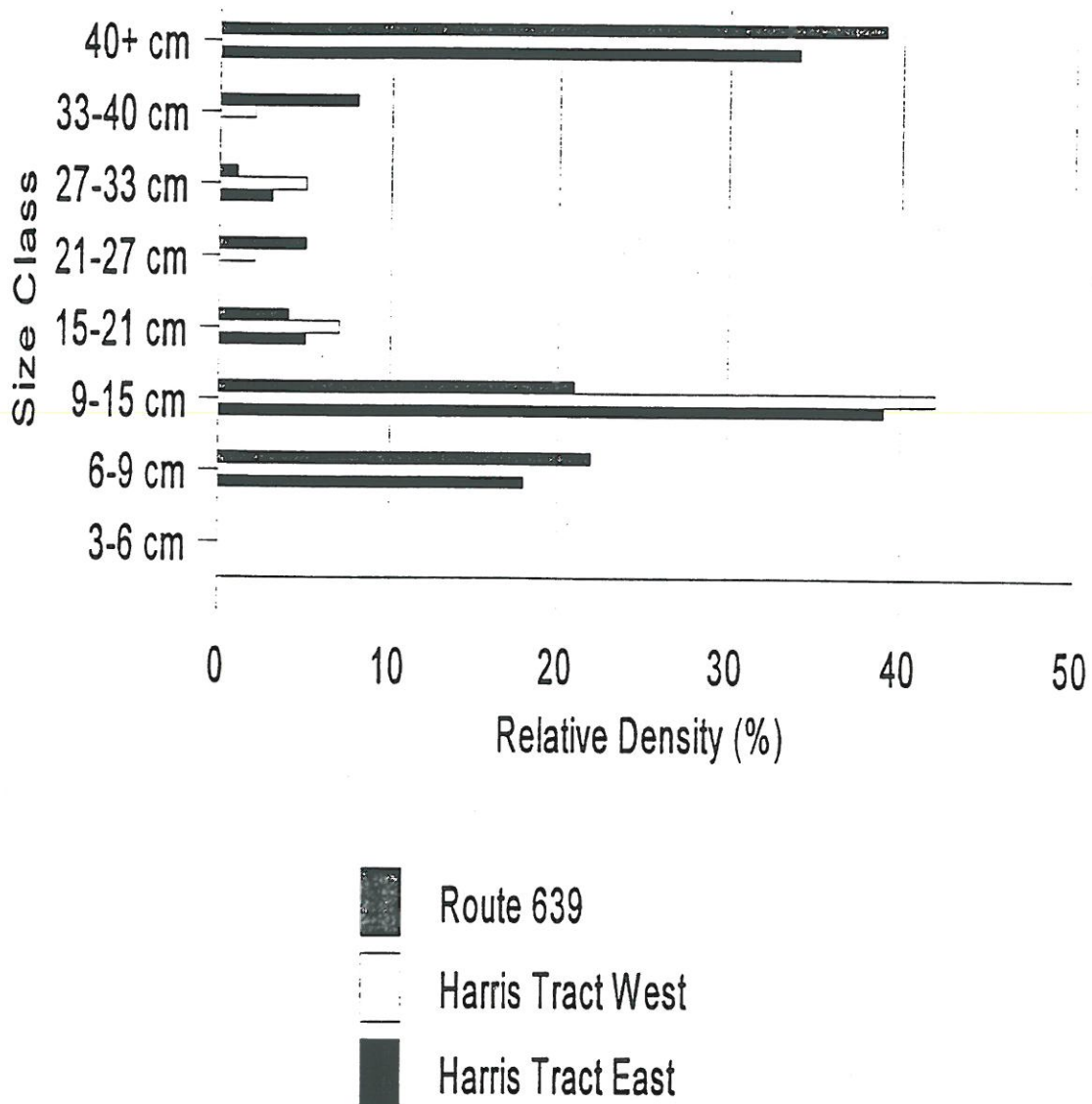


Figure 3. Oak size class distribution between all plots

Discussion

The BBCs reported here were conducted to determine what effects a shelterwood cut oak stand would have on breeding bird populations the first breeding season after cutting. Annand and Thompson (1997) compared shelterwood cuts with 4 other treatments and found that the shelterwood had greater species richness and total detections. Several of their findings are worth comparing to the results reported here. The high bird detections and species richness they reported were probably due to the dense sapling reproduction and patches of ground cover that provides dense and diverse foraging. This may not be applicable in plots cut a short time before the breeding season, when undergrowth and ground cover have not had a chance to respond to the new, more open growing conditions.

One species with relatively high numbers of territories on all three plots was the Eastern Wood-Pewee. This may be due to the openness of the habitat following the removal of many of the trees in the plots. This might be combined with the attractiveness of the currently low levels of ground cover on the plots, though this is less certain. Open forests produced by shelterwood cuts may provide increased foraging opportunities for pewees while still providing enough nest sites and perches to attract the species. As the stand thickens the number of pewees present might decrease. These findings might be true for flycatchers taken as a group as well. Flycatchers breeding in Virginia such as the Eastern Wood-Pewee and Great Crested Flycatcher (found on all three study areas) can generally be described as occupying forested habitats with a high volume of insects for feeding (Bradshaw 1992). Clawson and Callahan (1996) found Eastern Wood-Pewees

responding negatively to high shrub and tree density, which are likely to increase on the plots studied here in subsequent years. Within unburned woodlands, Eastern Wood-Pewees, Great Crested Flycatchers and Summer Tanagers avoid areas of relatively high canopy and tree coverage and high understory density, and the same tendency is seen with the White-breasted Nuthatch (Clawson and Callahan, 1996), another species present on these plots.

Several species of Neotropical migrants were found on these plots, some of them already mentioned. This group as a whole has been the focus of much conservation concern in recent years, so a few comments on some of the species in certain groups of interest found during this study are appropriate. The thrushes (the Wood Thrush is specifically relevant here), are generally found in habitats of mixed or deciduous moist forest. There were observations of Wood Thrushes on Harris West and Route 639, but the species did not defend a territory on any of the plots. This species might not occur regularly on these plots due to their more open nature; the species was heard singing frequently during the breeding season singing in adjacent uncut hardwood forest areas (C.M. Stinson, pers. comm) and may appear as the undergrowth fills in on the plots in the future.

The vireos are another group of Neotropical migrants found on these plots. The Red-eyed Vireo and Yellow-throated Vireo both maintained territories on all three study plots. Apparently the shelterwood cutting left enough mature oaks for these birds to continue to find the habitat suitable for breeding. These birds are typical of forested rather than open habitats. Similar comments apply to the tanagers, also normally found in

mature deciduous forests. Summer and Scarlet Tanagers were each recorded as occupying territories on all three study areas, with Summer Tanagers the more common species. There is no tanager species breeding in Virginia that is typical of more open habitats, but it can be pointed out that the White-eyed Vireo, a bird of brushy, young second growth areas, was not found breeding on the plots though it does occur in the general area.

The warblers are another large group of Neotropical migrants. As a group, they are found in almost all forest types. They have their greatest diversity in deciduous forests, collectively utilizing all vegetation levels from the ground to the upper canopy of the tallest trees to glean insects and spiders. This group includes both ground nesters and cavity nesters although most build cup nests in trees or shrubs. The warblers found in the study areas include the Ovenbird, Hooded Warbler, and Kentucky Warbler, but all were present in rather low numbers, and only the first two had territories on any of the plots. The populations of these species may be expected to increase as the understory begins to thicken during the next few breeding seasons, and perhaps other warbler species will appear as well. But again, it should be noted that the species of this group found are warblers of the forest rather than open-land species such as Prairie Warblers and Common Yellowthroats. Both of these species were common in the area, for example in the clear cut across the road from the Route 639 plot, but apparently found the shelterwood cuts inappropriate as breeding habitat.

The Indigo Bunting was found to occupy partial territories on all three plots. Their territories were in each case along the edge of the plots, though the birds were

occasionally seen well inside the plots. This is an additional indication that the stands as cut can generally be perceived as forest rather than open habitats, since plots that have been clear-cut, or more heavily shelterwood cut, typically host Indigo Buntings. Clear cut stands and open-habitat areas are found on the borders of these stands, which accounts for the presence of Indigo Buntings on the shelterwood stand, as also found by Clawson and Callahan (1996): "Indigo Buntings are commonly found in young (1-12 yr.) clear-cuts." Annand and Thompson (1997) also noted that Indigo Bunting numbers were higher on the clear cut stands they studied, and this correlates with the experience of many birders as well.

The impact of edge effects on bird distribution within the BBC plots studied is also worth noting here. There are areas of non-homogeneous habitat that border each of the plots studied, but the most dramatic edge effect was noted along the southeastern border of Harris East, along state route 603. The presence of bird species such as the Eastern Kingbird, Mockingbird, Brown Thrasher, Orchard Oriole, and Blue Grosbeak which can be noted on the field data sheets for Harris East is clear evidence that something other than forest habitat was available for birds which sometimes entered the plots. This was in fact the only border of any of the three plots adjacent to a large open field, and it was likewise the only area on any of the three plots where the five birds just mentioned were commonly found. The Brown Thrasher was not considered to have a territory on the plot, but was heard frequently just off the plot in a brushy area along route 603. A male Blue Grosbeak and the kingbirds were commonly seen perched on wires over the adjacent field but occasionally entered the plot. Finally, the presence of the Indigo Buntings which were

considered to have partial territories on the plot might also be partly explained by the open areas near the portions of the plots where they were found.

By contrast, a different sort of edge effect may have been operative at the Route 639 plot, where a Hooded Warbler was considered territorial but also was frequently heard singing in the thicker deciduous woods adjacent to the plot. In this case, the plot would have represented a more open habitat rather than a more closed one to a bird operating along its fringes. It has already been noted that the shelterwood cut on this plot had been carried out over a multi-year period, not entirely in the year immediately preceding the BBCs as on the other plots. Some of the shrubs on the plot had thus been regrowing for one year or more following the date of the shelterwood cutting of parts of the plot. The plot appeared to have the most heterogeneous shrub distribution of the three plots, with some areas clearly thicker than others, and it had the highest shrub count of the three plots at 1945 stems per acre (see Table 7). Subjectively, it appeared that the Hooded Warbler was likely to be found in these thicker areas of the plot, which may have attracted it from the thicker, uncut adjacent forest.

One somewhat unexpected species present on one plot was the Wood Duck. A Wood Duck nest hole was found during one of the censuses on the Route 639 plot. An adult Wood Duck was seen entering the nest cavity only once. The Route 639 plot is fairly close to Horsepen Lake, a likely reason for the bird's presence in the area, with the nest site of the bird about 1.3 kilometers from the lake. The plot itself contained only a short section of a tiny, intermittent stream. The openness of the plot may have made it

more attractive to the adult ducks as they flew to and from the nest site, but the ultimate success of the nest is uncertain.

It will be important to monitor the Brown-headed Cowbird numbers in the future to see if this treatment invites nest parasitism at a rate higher than that found in uncut woodlands nearby. Their role in the population declines of many species of Neotropical migrants, including several found during this study, has been widely discussed (e.g. Mayfield 1965, 1977, Terborgh 1989:52-58). Pretreatment data for shelterwood cut stands like those discussed here would be especially useful in investigating this problem, as would long-term censuses on nearby forest plots that remain uncut.

Brown-headed Cowbirds do not defend a nesting territory in the sense that many songbirds do, but they are active within a certain area during the breeding season that can be defined as their territory (Bent 1958:426-427). In the results reported here, it was noted that cowbirds were considered to have territories on two of the three BBC plots. This may be compared to the finding that "a high relative abundance of Brown-headed Cowbirds in the clear-cut and shelterwood cut treatments may have been due to the high density of breeding birds found there because cowbirds may select habitats with high host densities" (Annand and Thompson, 1997).

Future censuses will determine which species will return to thrive amidst the successional growth of subsequent years. During the next few years, before controlled burns, one might watch for an increase in territory numbers of forest-dwelling species due to an increase in ground vegetation that will offer additional shelter and feeding opportunities. The shelterwood method as practiced here apparently retains enough of the

canopy to shelter birds and to encourage tree reproduction, as found in some previous studies (Annand and Thompson 1997). This method also allows forest birds to remain in an area where timber harvesting has occurred during the year immediately prior to the breeding season, unlike heavier shelterwood cuts or clearcutting.

All of the results reported here should be used in the future to compare with other BBC results in similar habitats. Such comparisons would be especially valuable in an analysis of this study, but are impossible due to the lack of such studies having been conducted. In a recent year, for example, only two BBCs were reported for the entire state of Virginia (Smith 1995a, 1995b), and neither were conducted on shelterwood cut areas. In fact, no BBCs were reported from shelterwood cuts anywhere during the same year, though several counts were conducted on second-growth hardwood forests of various ages (Lowe 1995). This points to both the uniqueness of the present study and the need for similar work to be repeated. The standardized methodology of the BBC should enable different workers to conduct the censuses each year and get reliable results. This project can be used to investigate whether shelterwood stands in the central piedmont of Virginia are beneficial to Virginia's breeding birds, especially in comparison with other silvicultural methods.

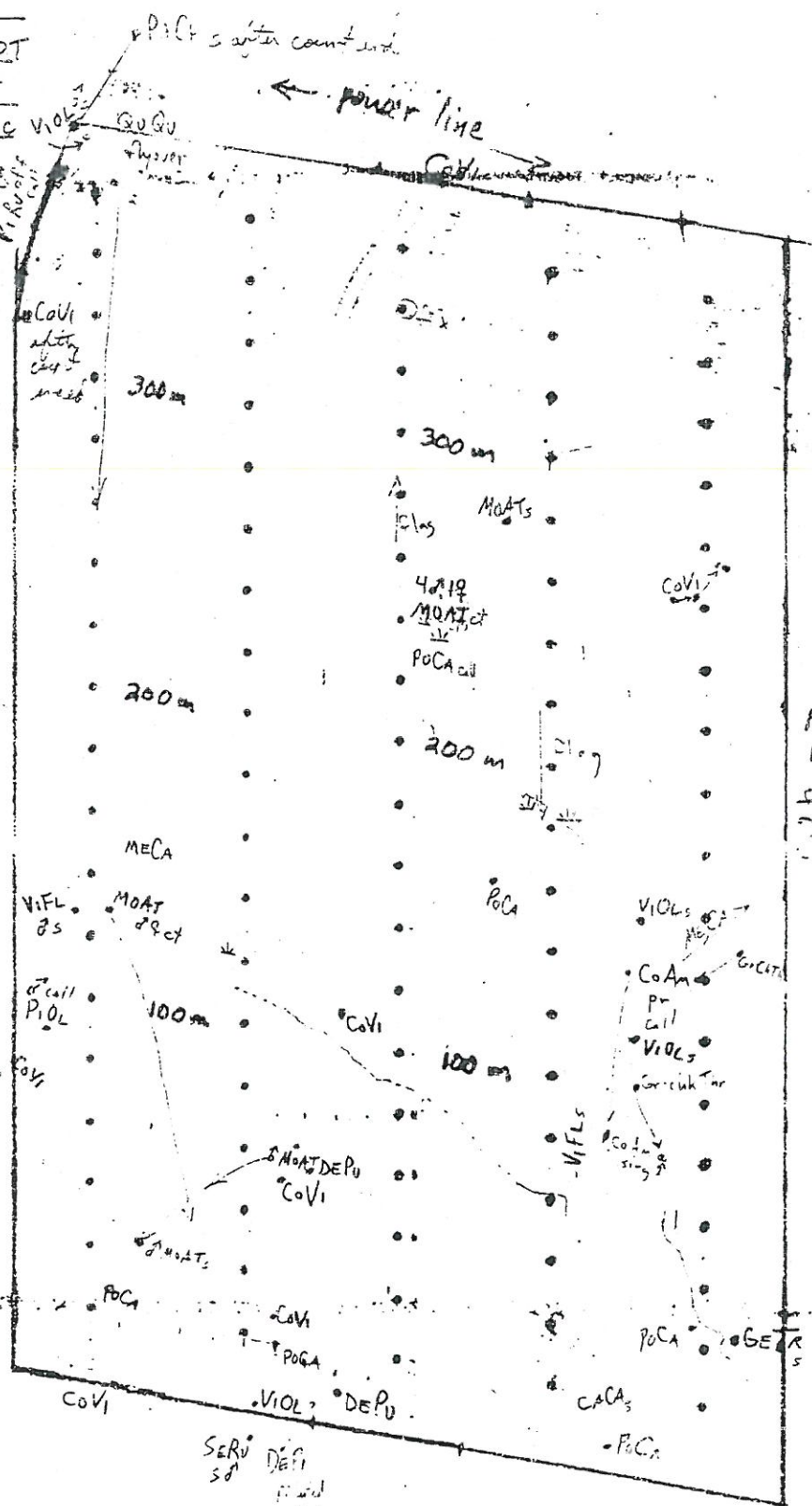
For a fuller understanding of the effects of shelterwood cutting followed by controlled burns in central Virginia, several additional components of the larger scale project envisioned by the supporting agencies should be added. Bird censuses on the plots described here should be continued. The intention of those involved in this project is that eventually eight 10-hectare plots will be established for BBCs. It is suggested that these

plots, or areas like them, be censused before cutting to determine the species inhabiting the areas before treatment as well.

Appendix 1

This appendix contains copies of all of the field data sheets produced during the 1997 field season censuses. The 11 sheets from Harris West are presented first, in chronological order, followed by the 11 sheets from Harris Tract East and the eight sheets from the Route 639 plot last. Codes used on the sheets are explained in the Methods chapter.

S. CM Simpson
 Date 22 May 1967
 A time 0633 EDT
 R time 0816 EDT
 Int temp. 8C - in 11c
 100% wind 0
 none



VIOL off

VIOL off

VIOL off
M. 6145

VIOL off
SISI off

SERV SO
DEPU
DEPI

VIOL off

SEAV off

C.M. SIMSON

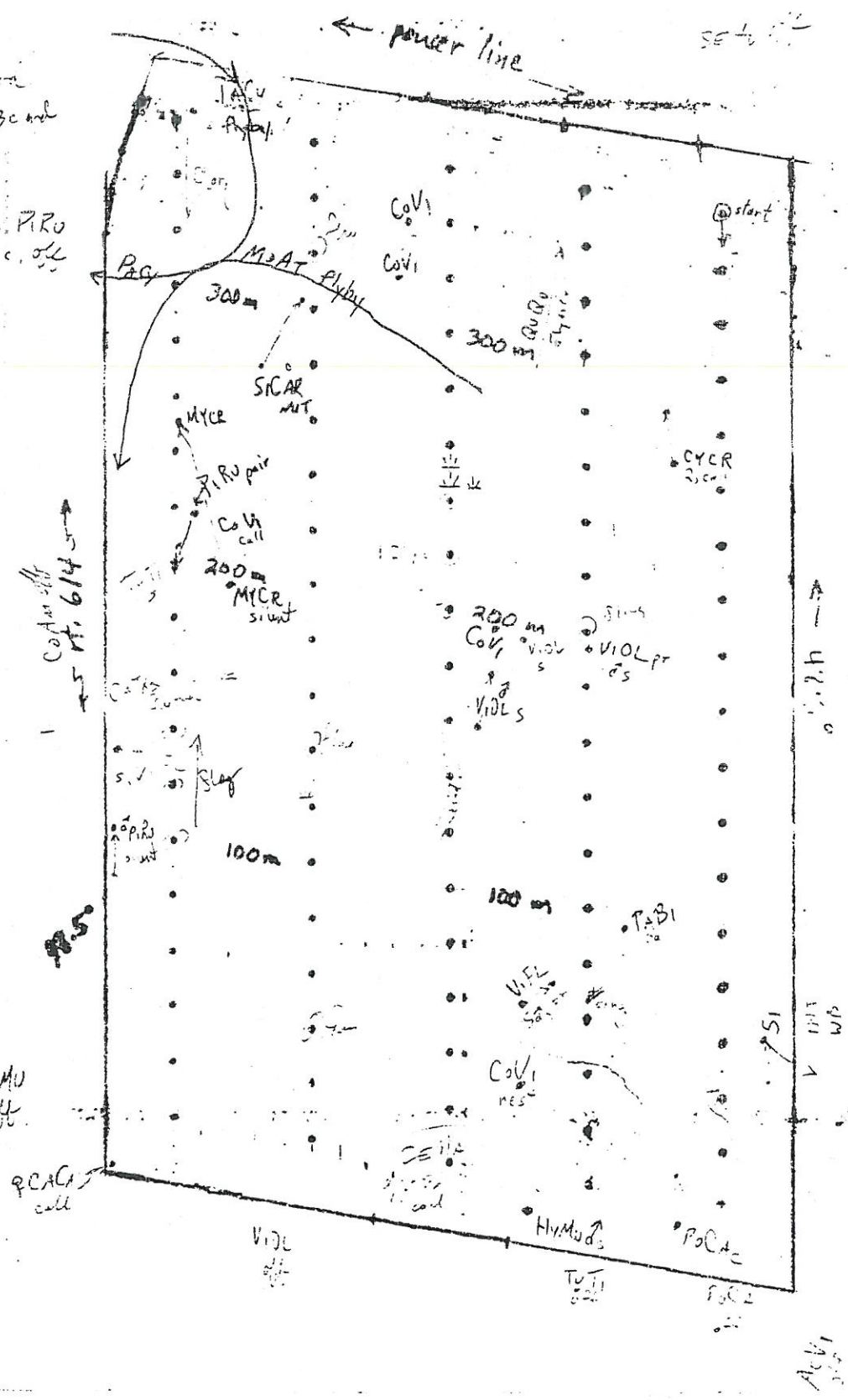
23 May 1977

sky clear
wind 2-2.5 km

temp 9 start, 13 end

start 0639

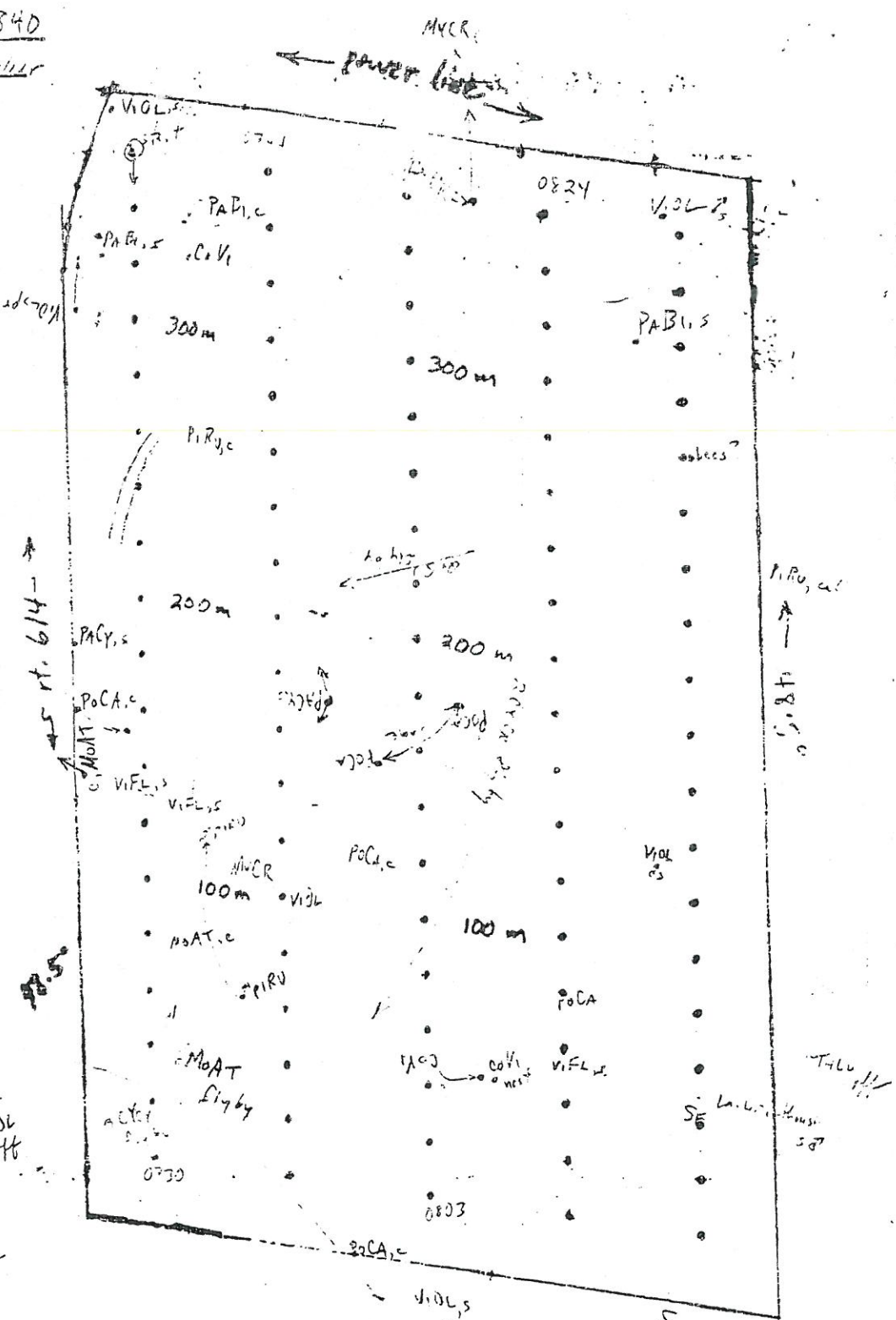
end 0826



observer:
 date 28 May 1992
 start 0702 end 0840
 wind 1 (2nd) sky 100% CLR
 temp

rt. 614 - Harris tract, W BBC plot

PACY 44
 SEAU 9/18



12.5

P10L 9/18

HVMU 9/18

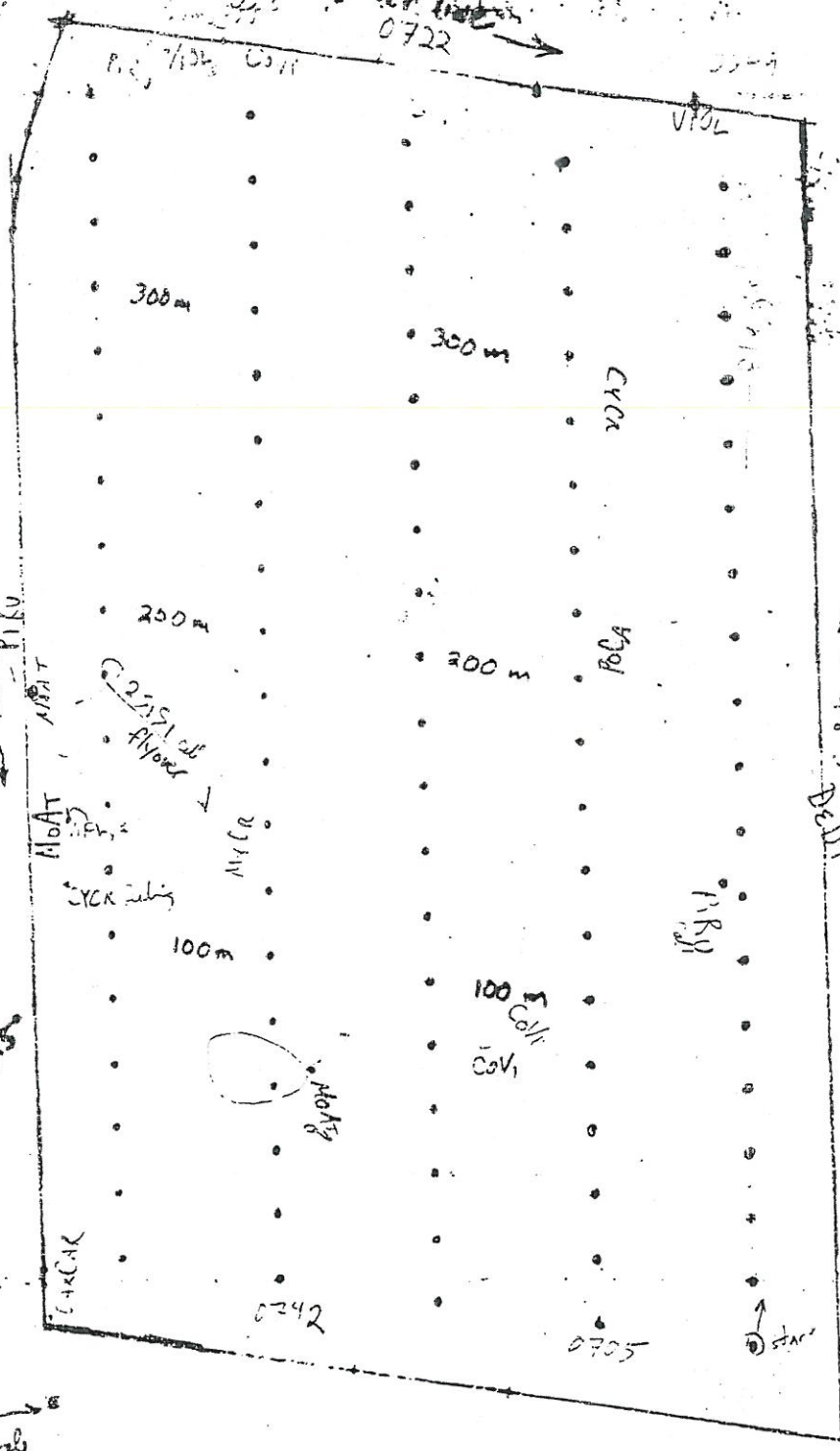
c = cat
 s = singing
 pr = pair

SEAU 9/18
 VIFL 9/18
 TALU 9/18

27 14 17 21 16

server
date 3
start 0634 end 2257
wind 2 sky 100% c.c.
emp 14-14

H. 614 - Harris Fract, W BBC plot



Piranga rubra
⊕ = nest
♀ incubating
0808 am

? sp. nest on horiz. Red. Kople 2 m fr. road

CoV
SEA

51 CAR

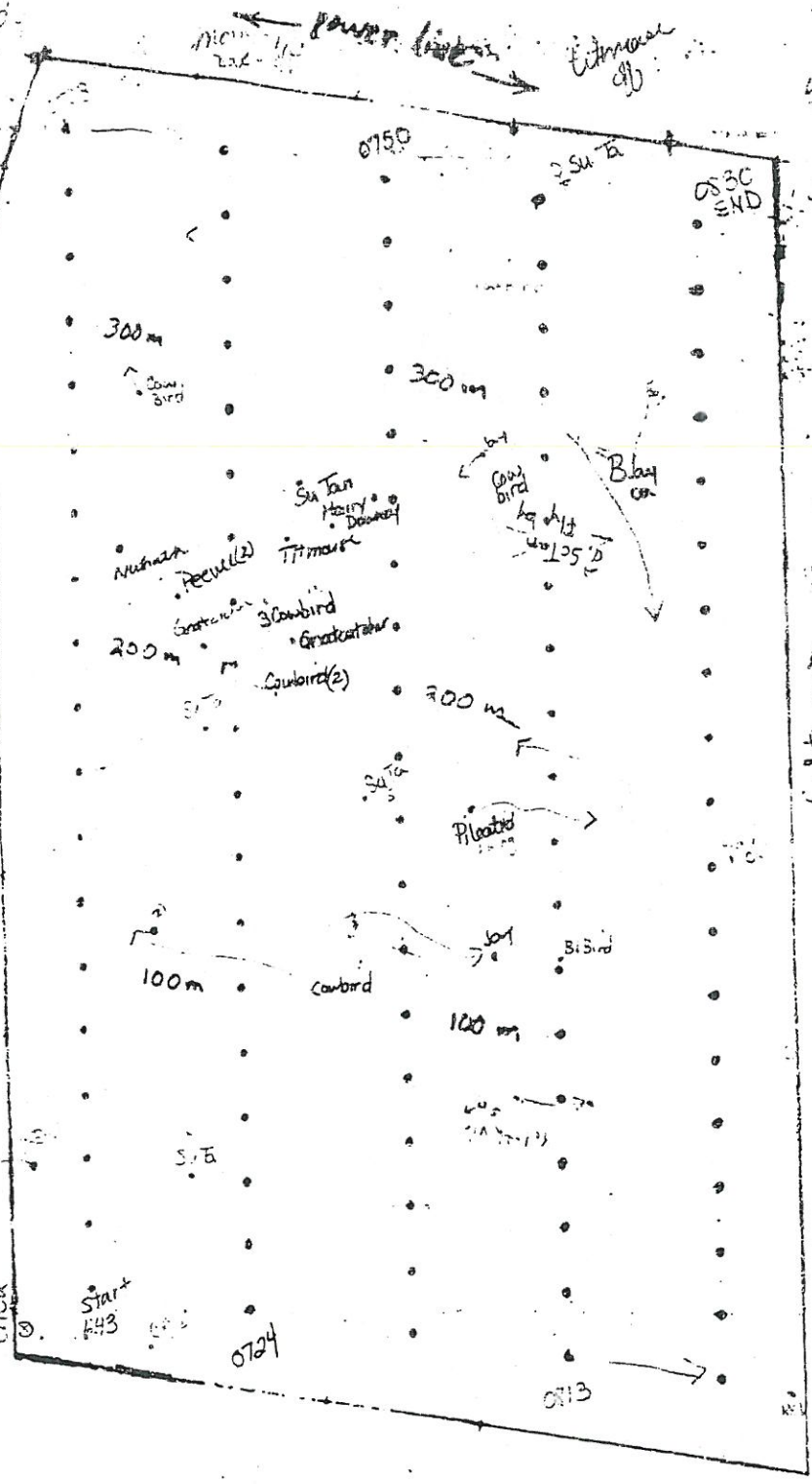
VIOL

H. 100

observer KM (4/10/00)
 late 1/2/00 27
 start 0638 end 0930
 wind 1 sky 80 to cloud
 temp 15°C
 Start End

rt. 614 - Harris tract, W BRC plot

SKY 100% cloudy
 wind 2 END



Vertical text on the left margin, possibly "11/11/2000 11:11:11 AM"

Vertical text on the bottom left margin, possibly "11/11/2000 11:11:11 AM"

LATE START

OBSERVER C.M. Stinson

DATE 7 June 97

START TIME 0752

END 0920

START TEMP 12 C

END 12 C

CLOUDS 100 %

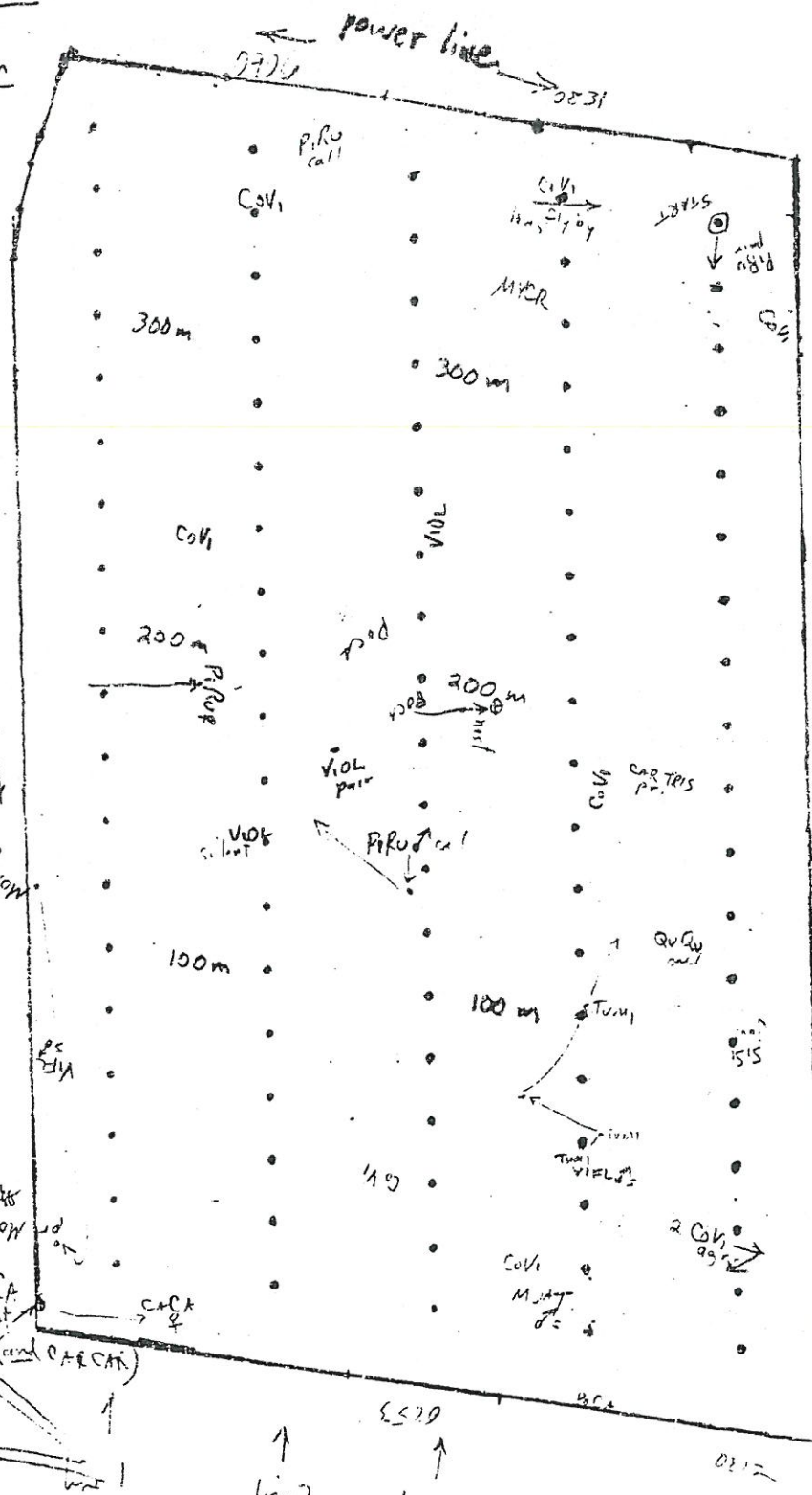
WIND 3 Beaufort

MARK STARTING POINT!

amit
Piru at tip of dead, gleaned
fr. Red Maple

Piru seen
incub. in
↓ after
count
and
up
rt. 6/14
50
ft. 140m

branch off lowest
large branch on N
side (not W side)
near broken branch
POCA
Great
(and CARCAN)



EMV
call
3/3

OBSERVER K. McDonald

DATE 9 Jun '97

START TIME 0751

END 0823

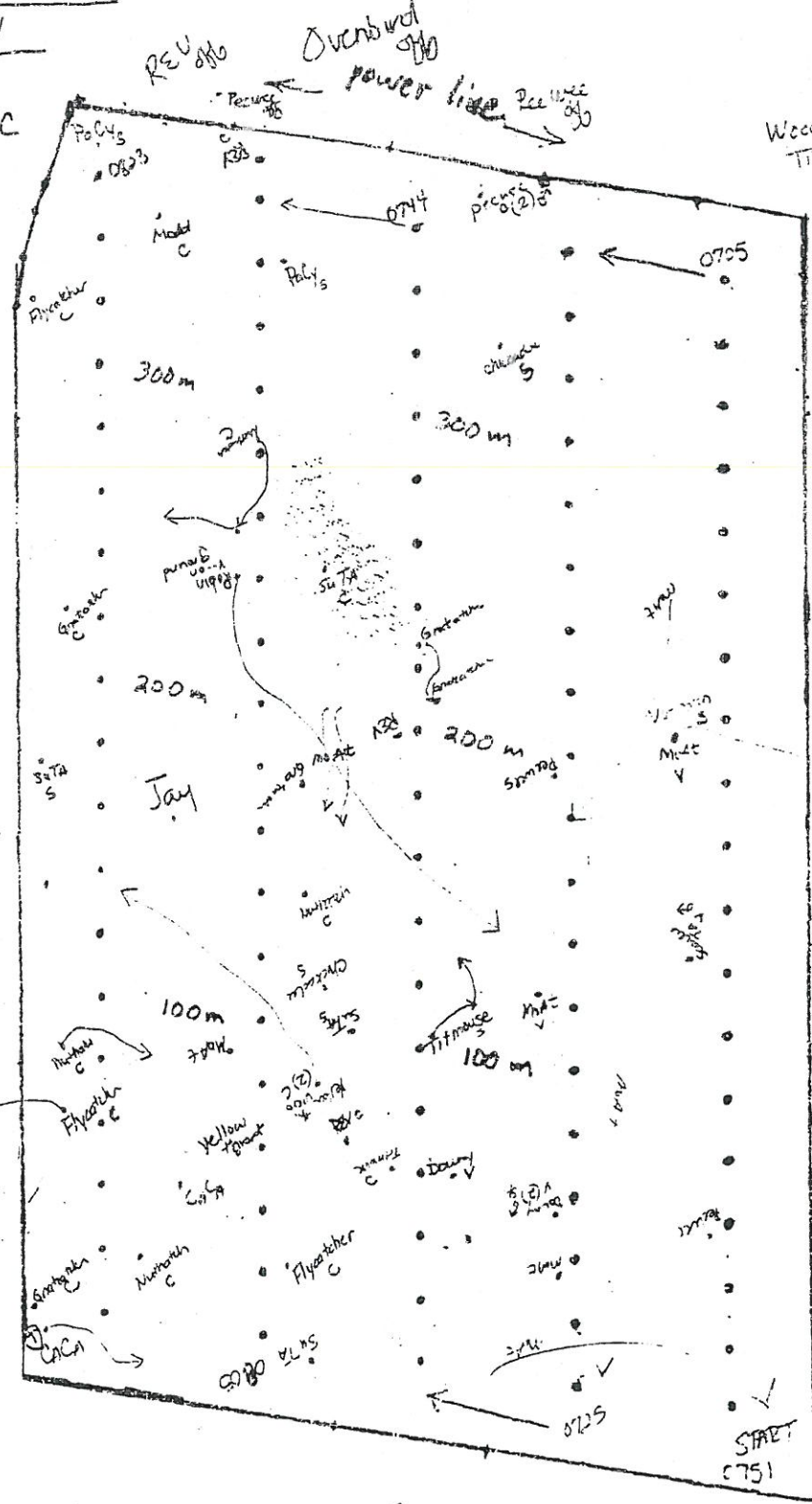
START TEMP 11 C

END 19 C

CLOUDS 70 cloudy %

WIND 0 Beaufort

MARK STARTING POINT!



* Between lines
100 + 100
sketch of?

REU 0810

REU 0810

OBSERVER M. Stinson

DATE 16 June 1997

START TIME 0638 0702

END 0828

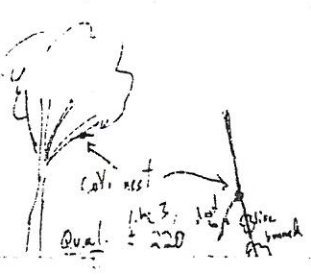
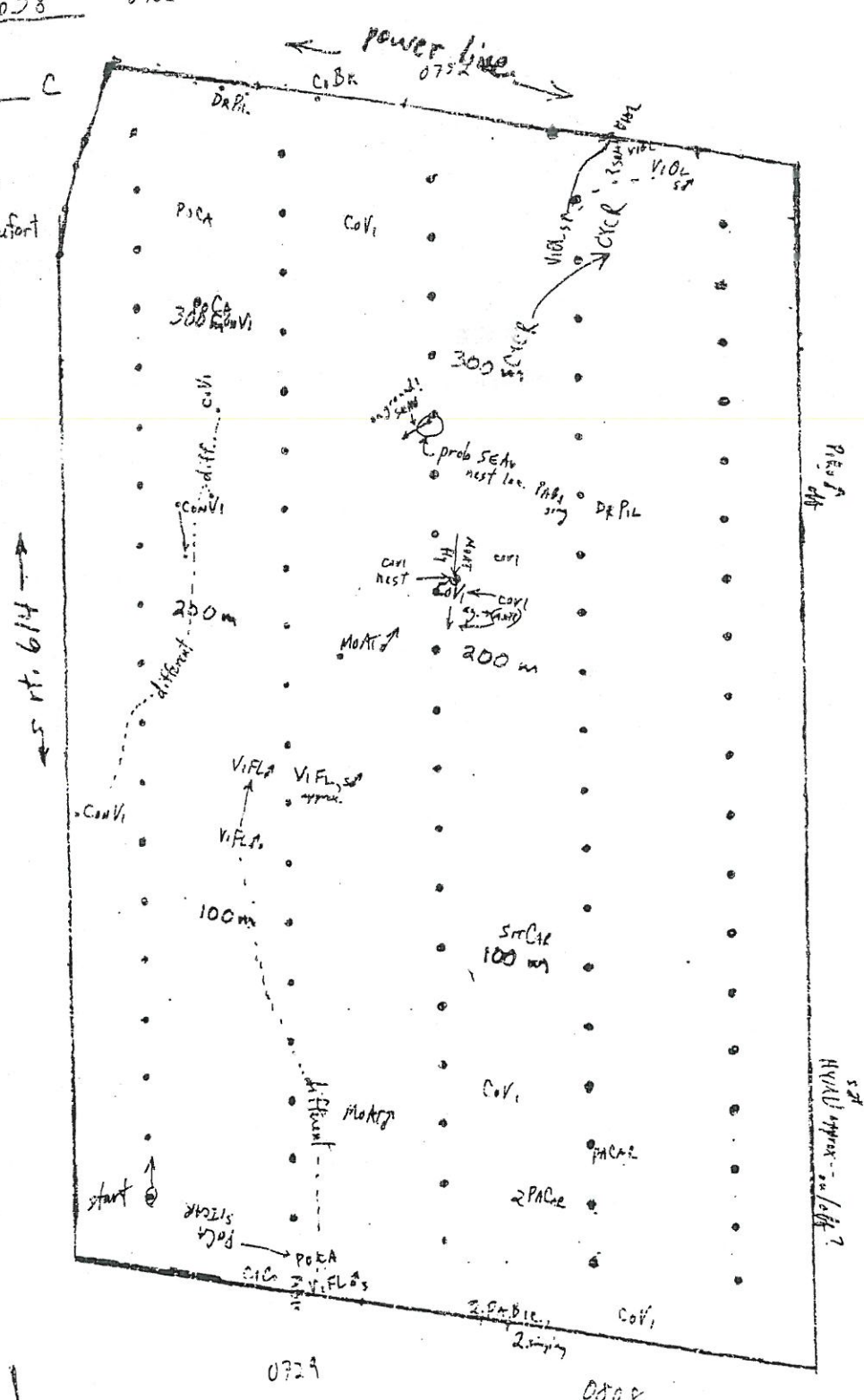
START TEMP 13 C

END 17 C

LOUDS 45 %

WIND 1 Beaufort
and 2

MARK STARTING
POINT!



OBSERVER KMM

DATE 1 July 97

START TIME 0617

END 0811

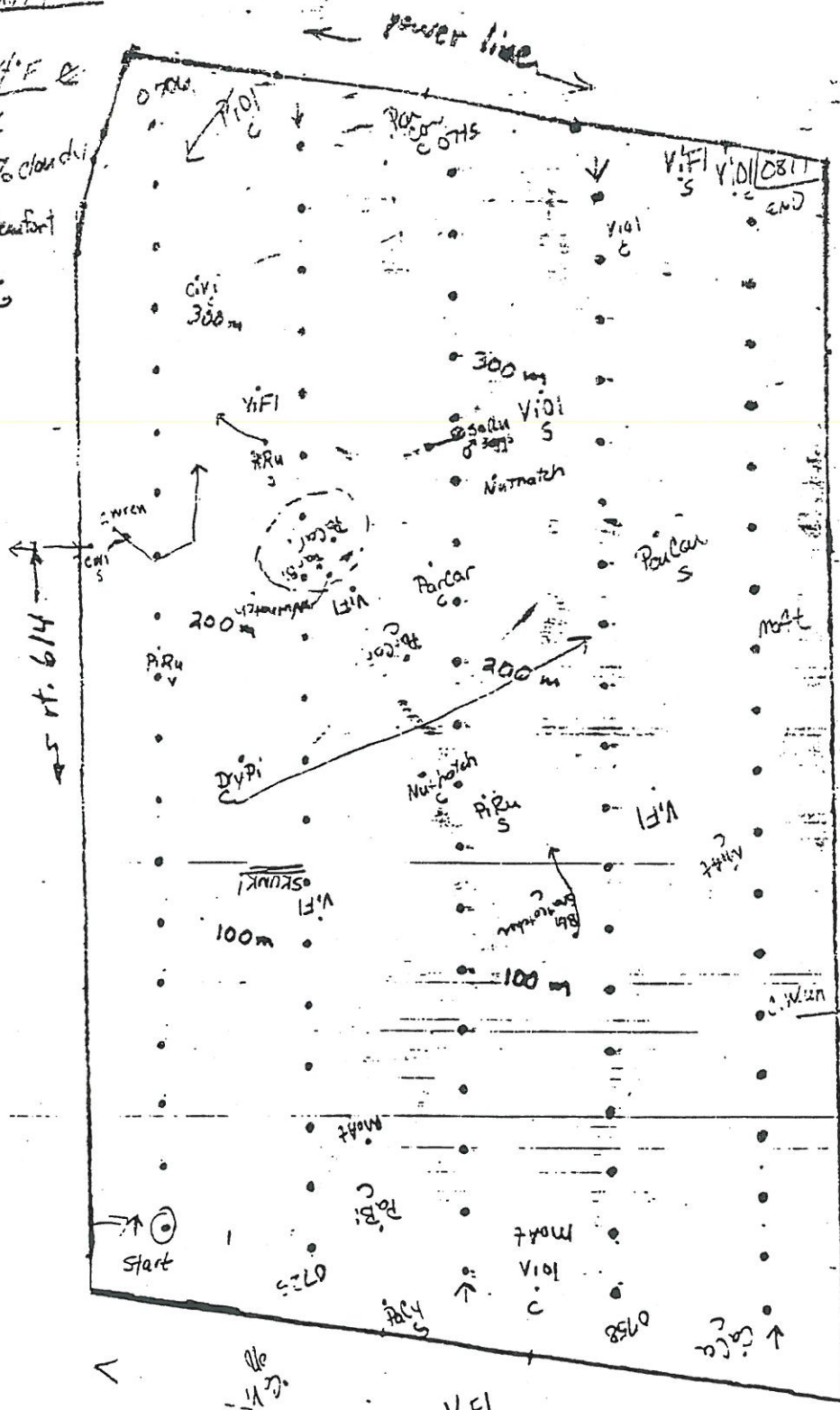
START TEMP 64°F

END 73°F

CLOUDS 100 % cloudy

WIND 1 knot

MARK STARTING POINT!



V = visual
 S = song
 C = call

⊙ = nest

Group of
 5+ of
 each species
 in circle

off
 V.F.I.
 8mm

observer Ch. Stinson

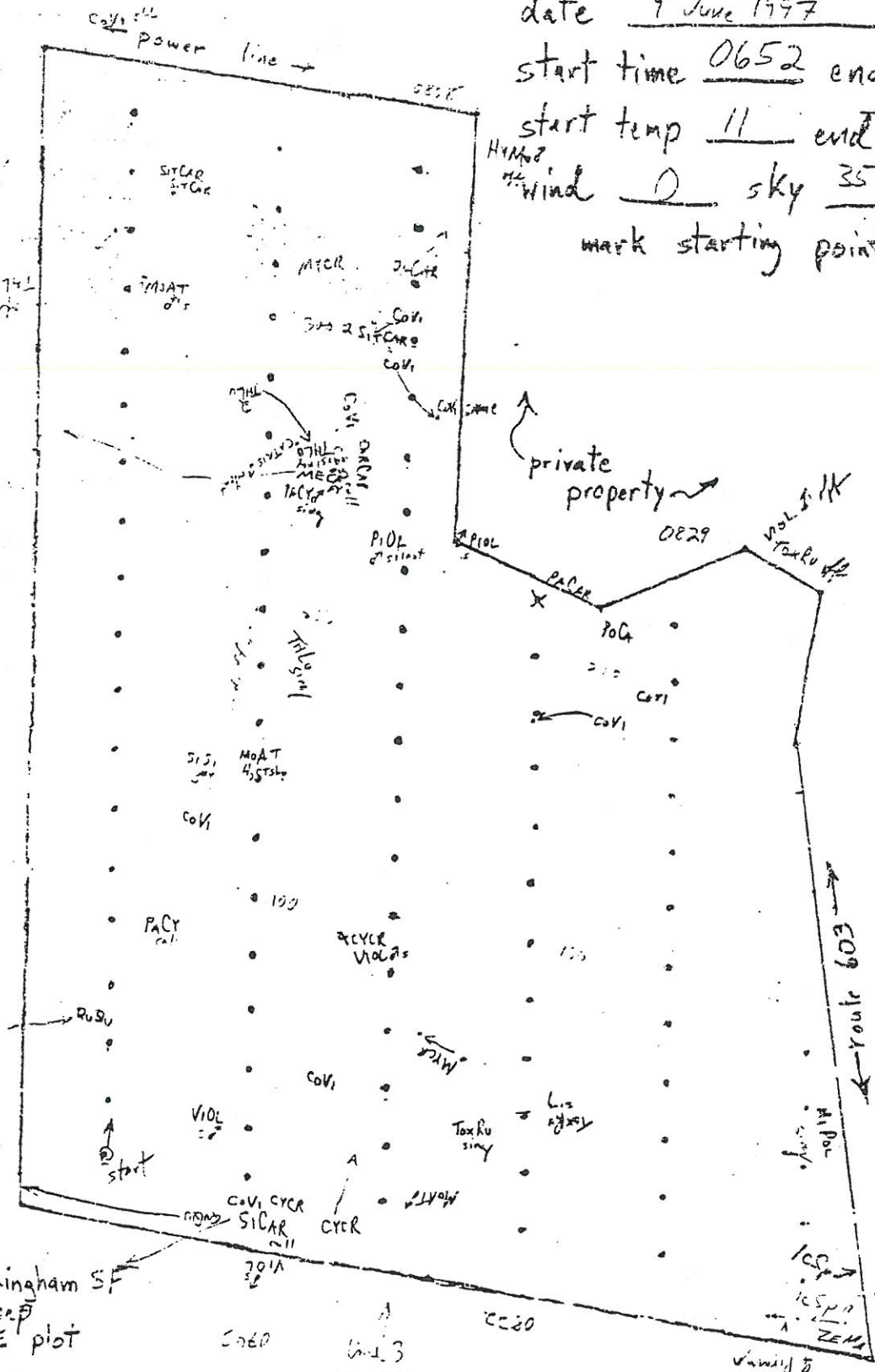
date 9 June 1997

start time 0652 end 0836

start temp 11 end 19

Humid? 0 sky 35% cloudy

mark starting point!



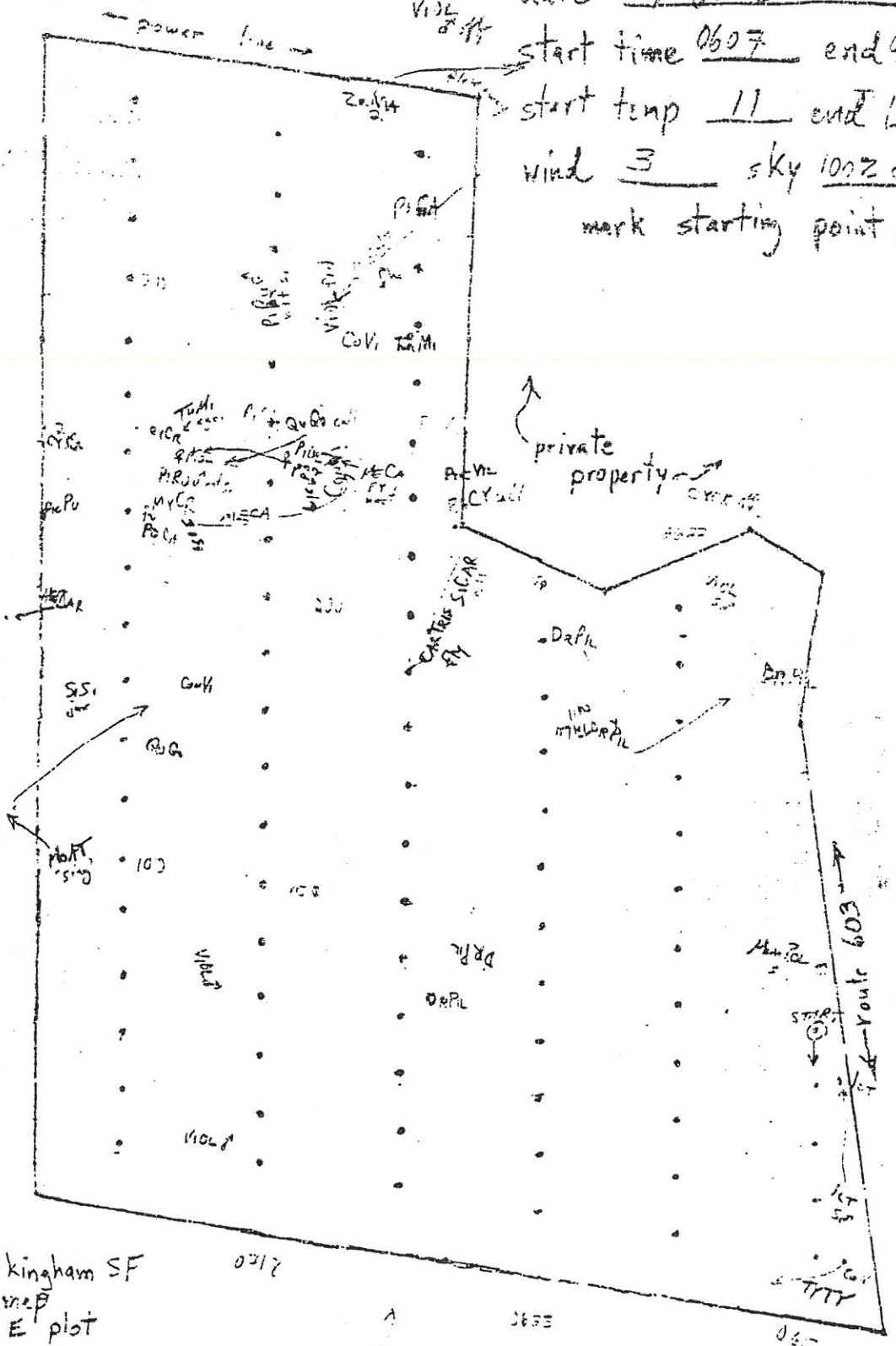
Lepomator - Buckingham SF
 DEC plot map
 Harris tract - E plot
 1" = 50 meters

Wind 3
 m/s 20 km
 small

7889

observer W. Stinson
 date 7 June '97
 start time 0607 end 0615
 start temp 11 end 12
 wind 3 sky 100% cl
 mark starting point!

♀ Pid. wing starting
 @ ~ 245g/min 2

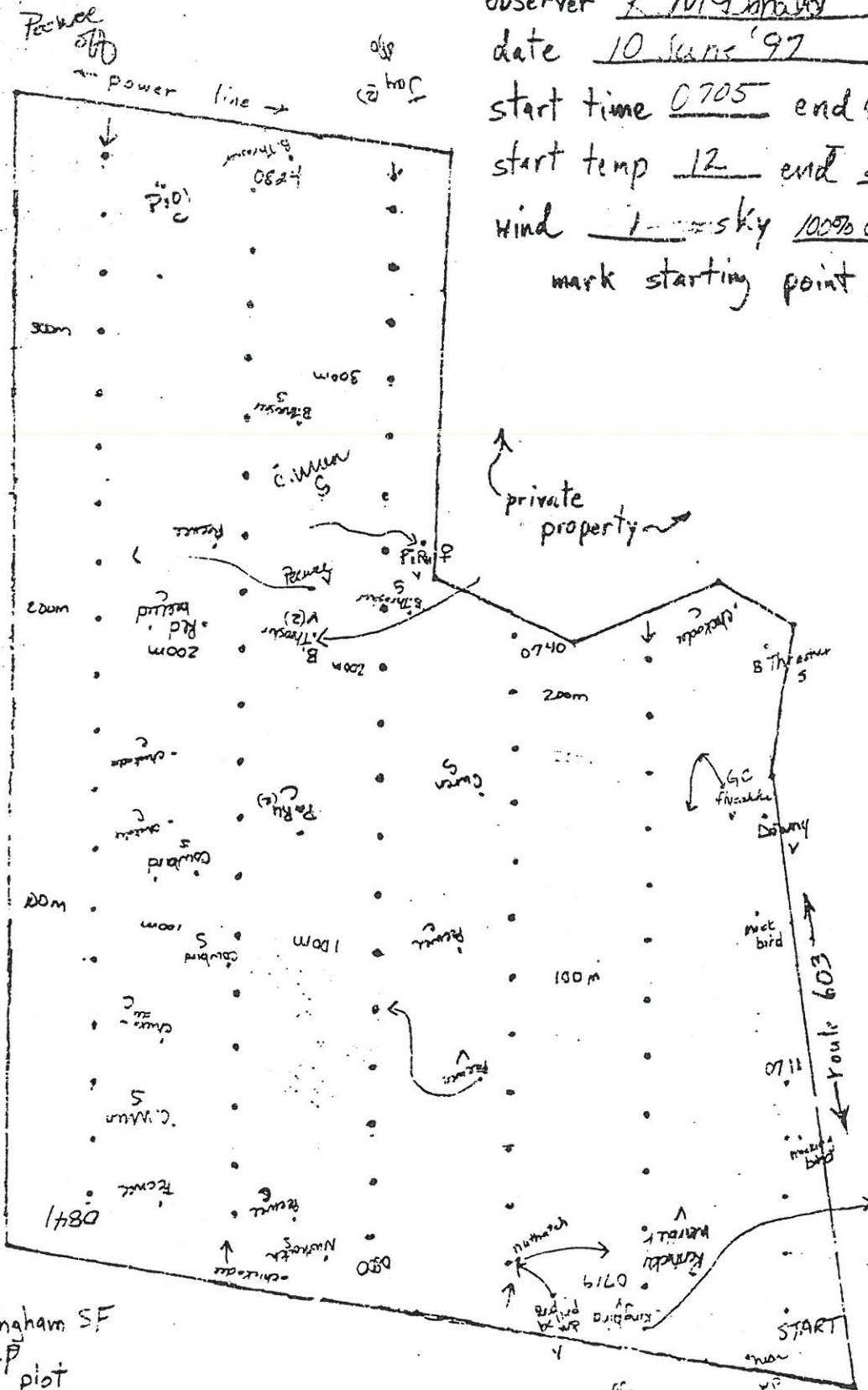


Appomattox-Buckingham SF
 SEC. plot map
 Harris tract -- E plot

1" = 50 meters
 WILCOX
 etc

0317
 0655
 065
 0657
 VILCOX
 etc
 TAM
 VICR
 PIR
 MYCR
 RSCA
 MECA
 SICAR
 DAPL
 MULDRPL
 STOP
 TTRT
 0655
 065

observer K McDonald
 date 10 June '97
 start time 0705 end 0841
 start temp 12 end 20°C
 wind 1 sky 100% clear
 mark starting point!



Pa Cy
off

visual
= call
= sang
= feeding

off
Pawee

Appomattox - Buckingham SF
 BEC plot map
 Harris tract - E plot
 1" = 50 meters

REV
off

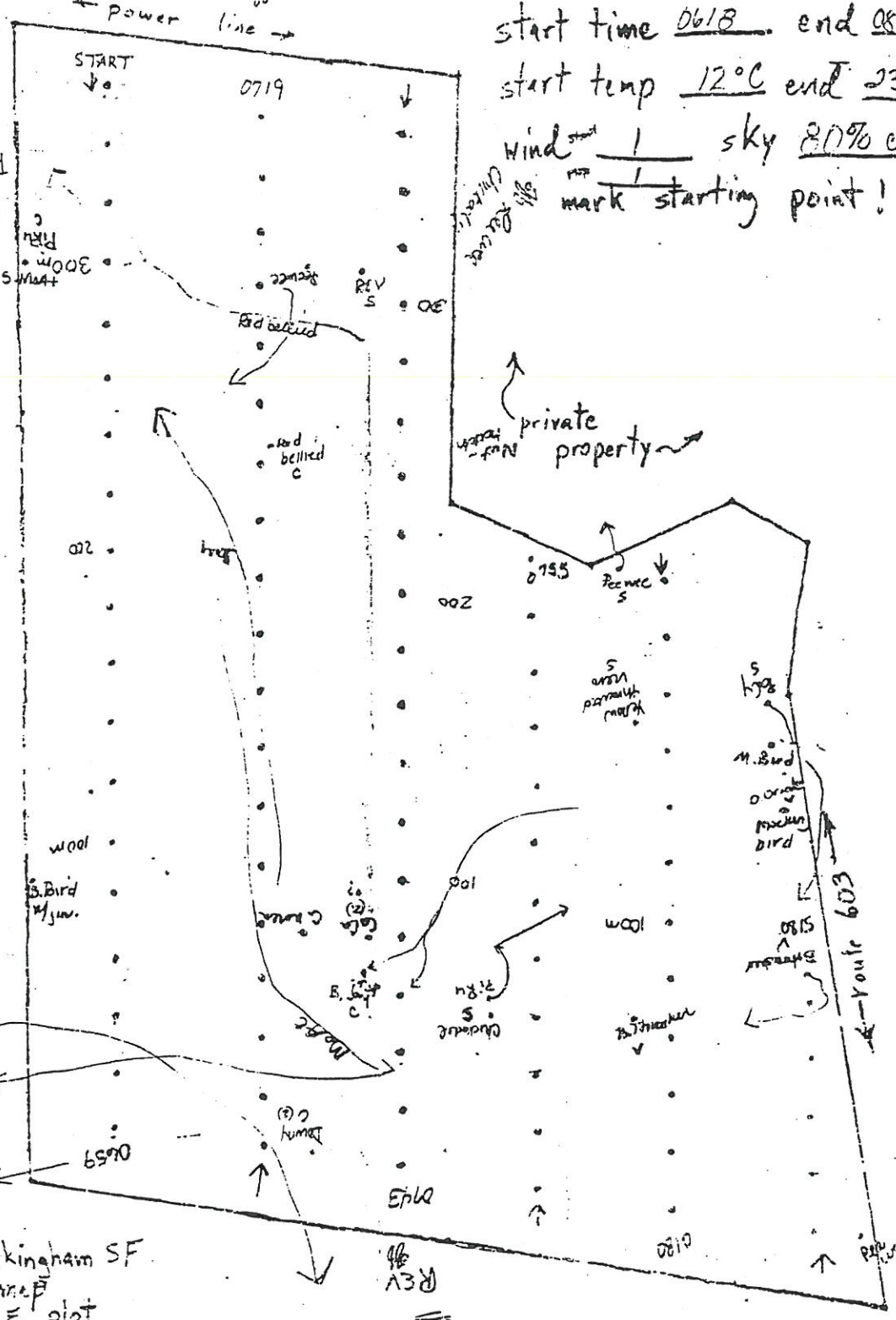
off
off

observer K. McDonald
 date 11 June 97
 start time 0618 end 0815
 start temp 12°C end 23°C
 wind 1 sky 80% clear
 mark starting point!

1/2 hr

REV 4/8
 MAR 10/97

= sight
 = song
 = call
 = feeding



Apponattox - Buckingham SF
 EEC plot map
 Harris tract -- E plot
 1" = 50 meters

observer KM 63

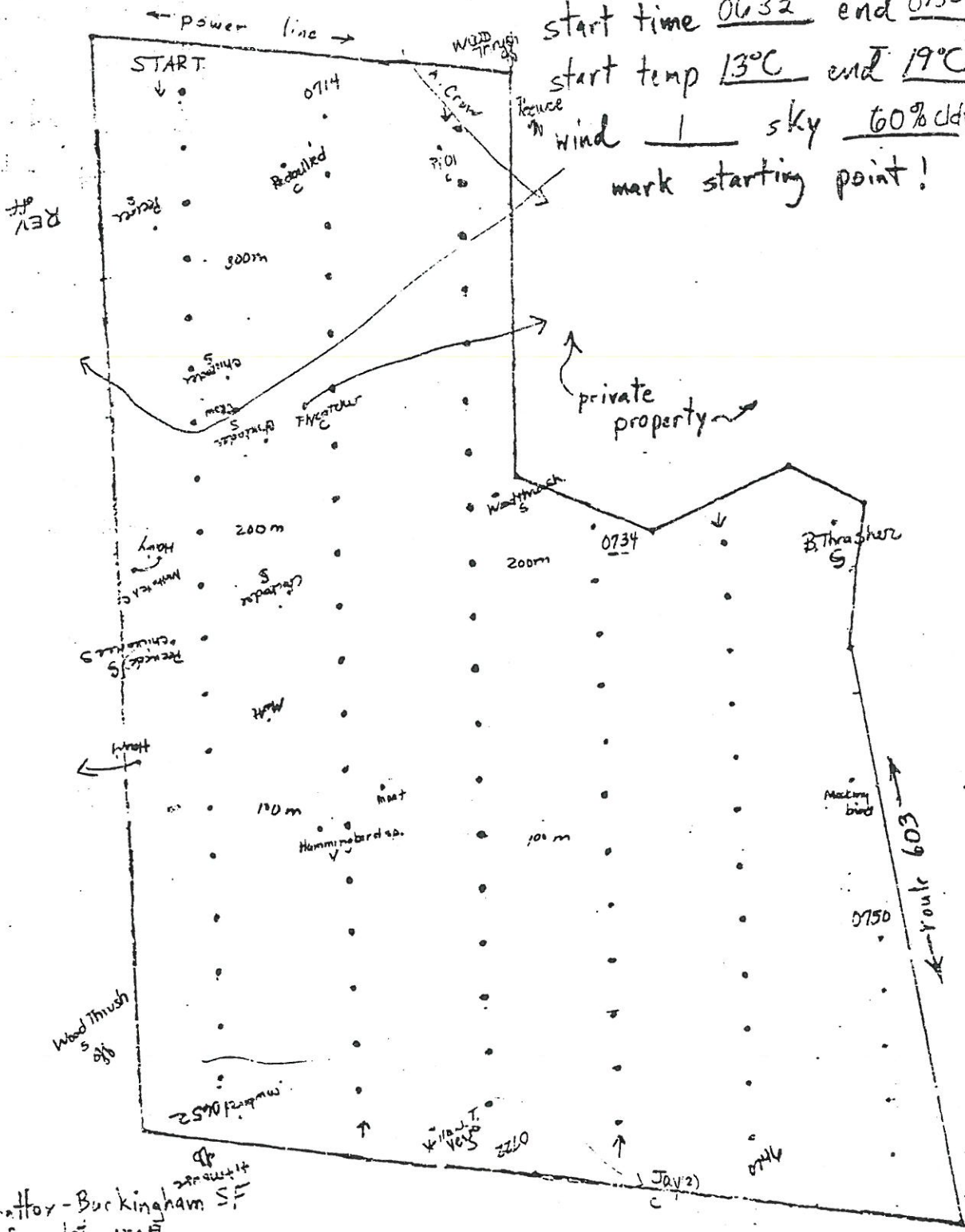
date 16 June '97

start time 0632 end 0750

start temp 13°C end 19°C

wind 1 sky 60% cdy

mark starting point!



Appomattox-Buckingham SF
EEC plot map
Harris tract - E plot

1" = 50 meters

OBSERVER CM Stinson

DATE 23 June 1997

START TIME 0655

END 0819

START TEMP off

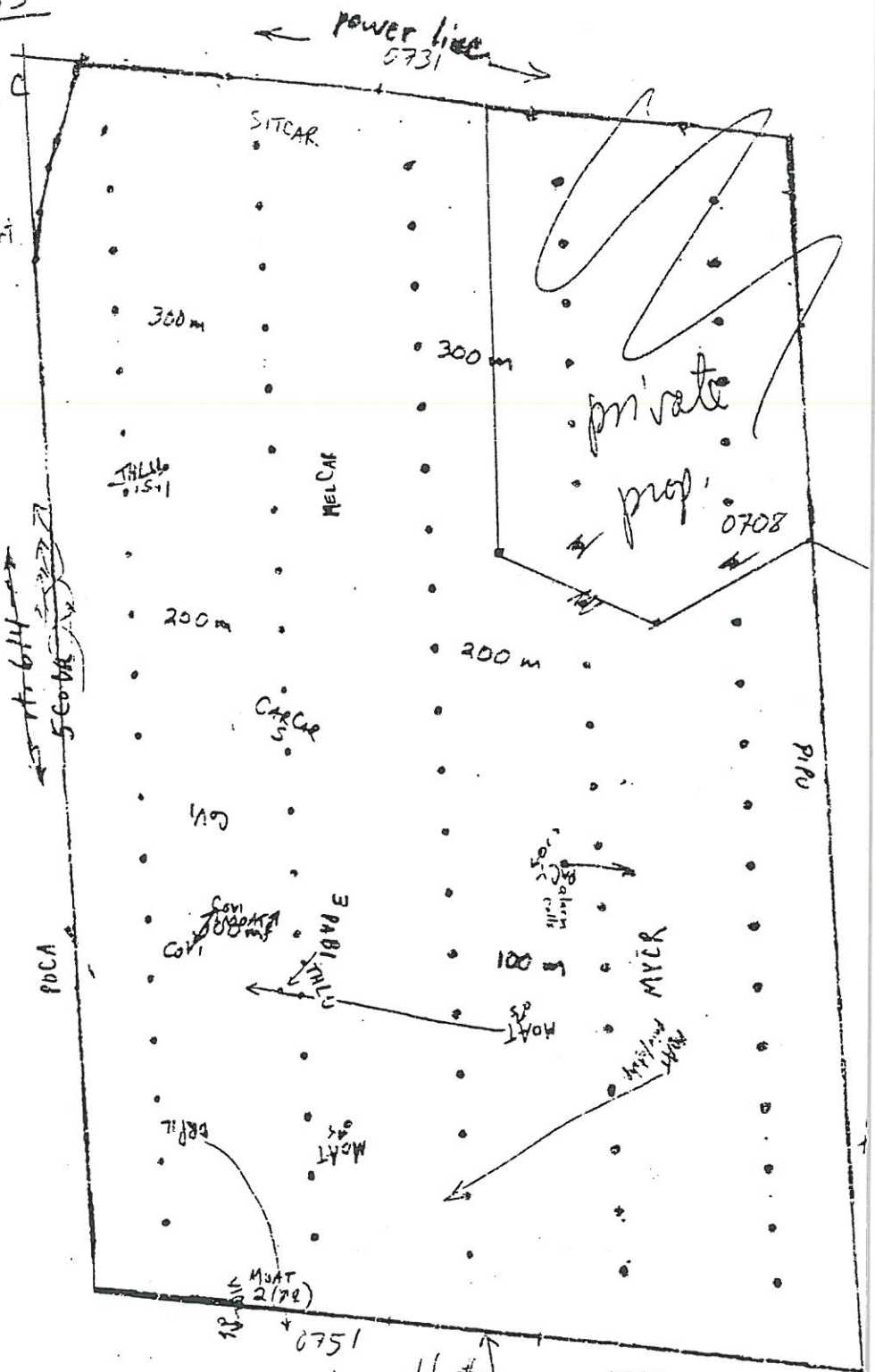
END C

CLOUDS 0-0%

WIND 2 Beaufort

MARK end 4
STARTING POINT!

East plot
(map modified)



line 3: stake #5
off - 20m

Sr PA - Chipping Sparrow

ICSP an adult ♂ (orange, not green)

observer SKM

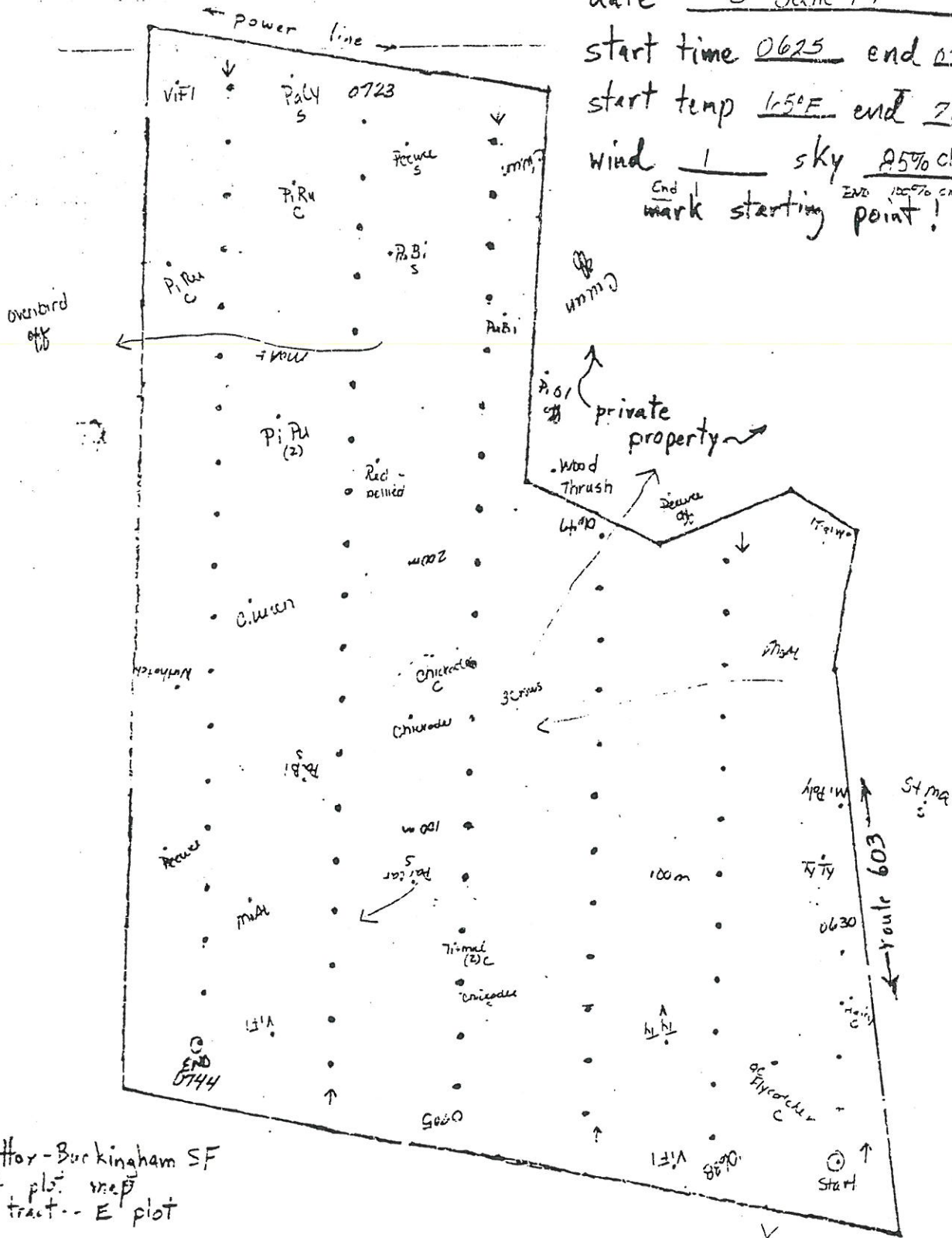
date 30 June 97

start time 0625 end 0744

start temp 65°F end 71°F

wind 1 sky 25% cloudy

End mark starting point! END 100% cloudy



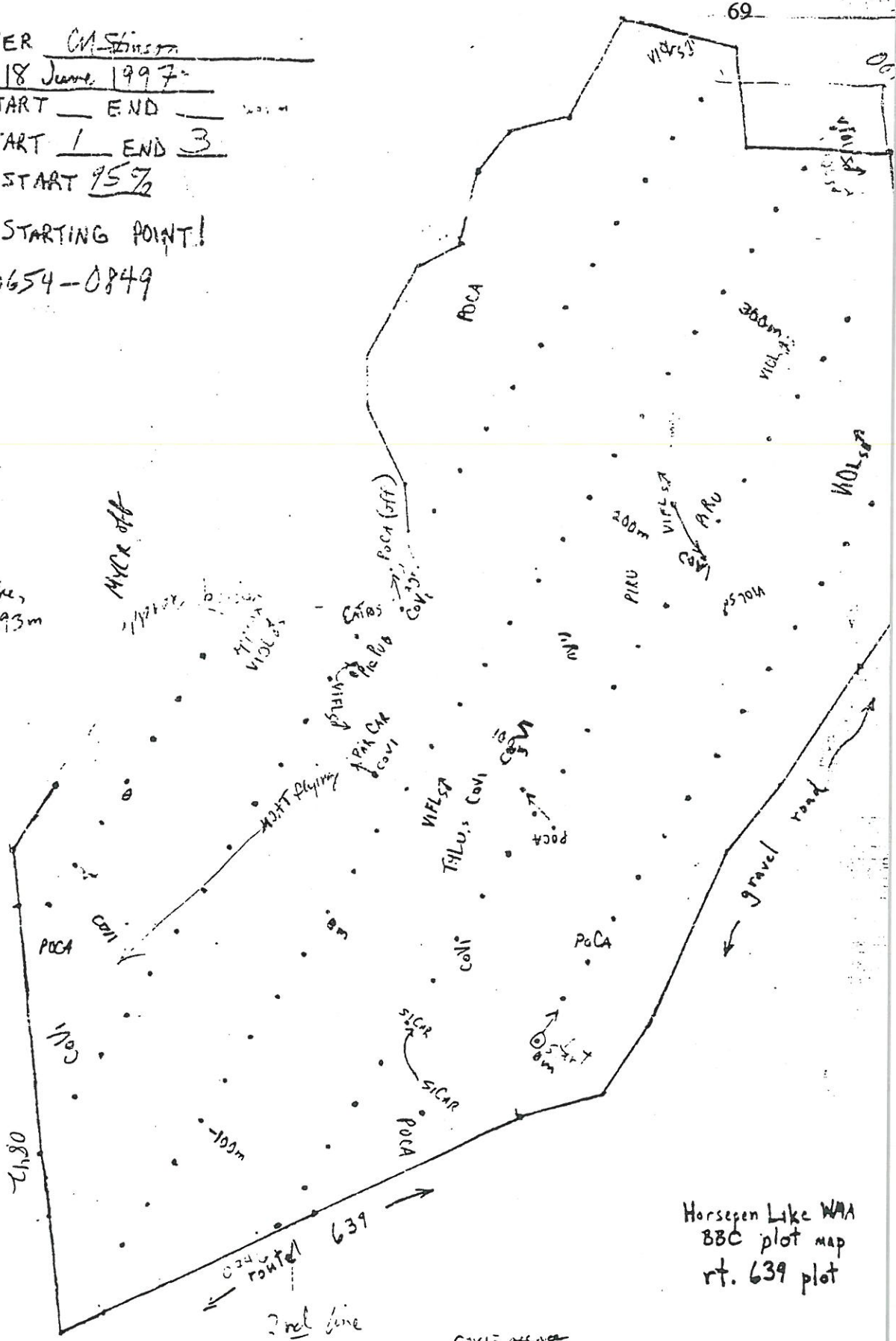
Appomattox-Burkingham SF
 BEC. plot map
 Harris tract - E plot
 1" = 50 meters

OBSERVER CM Stinson
DATE 18 June 1997
TEMP, START END
WIND, START 1 END 3
CLOUDS, START 95%

MARK STARTING POINT!

TIME: 0654-0849

Pik Rat Snake,
2nd line 793m



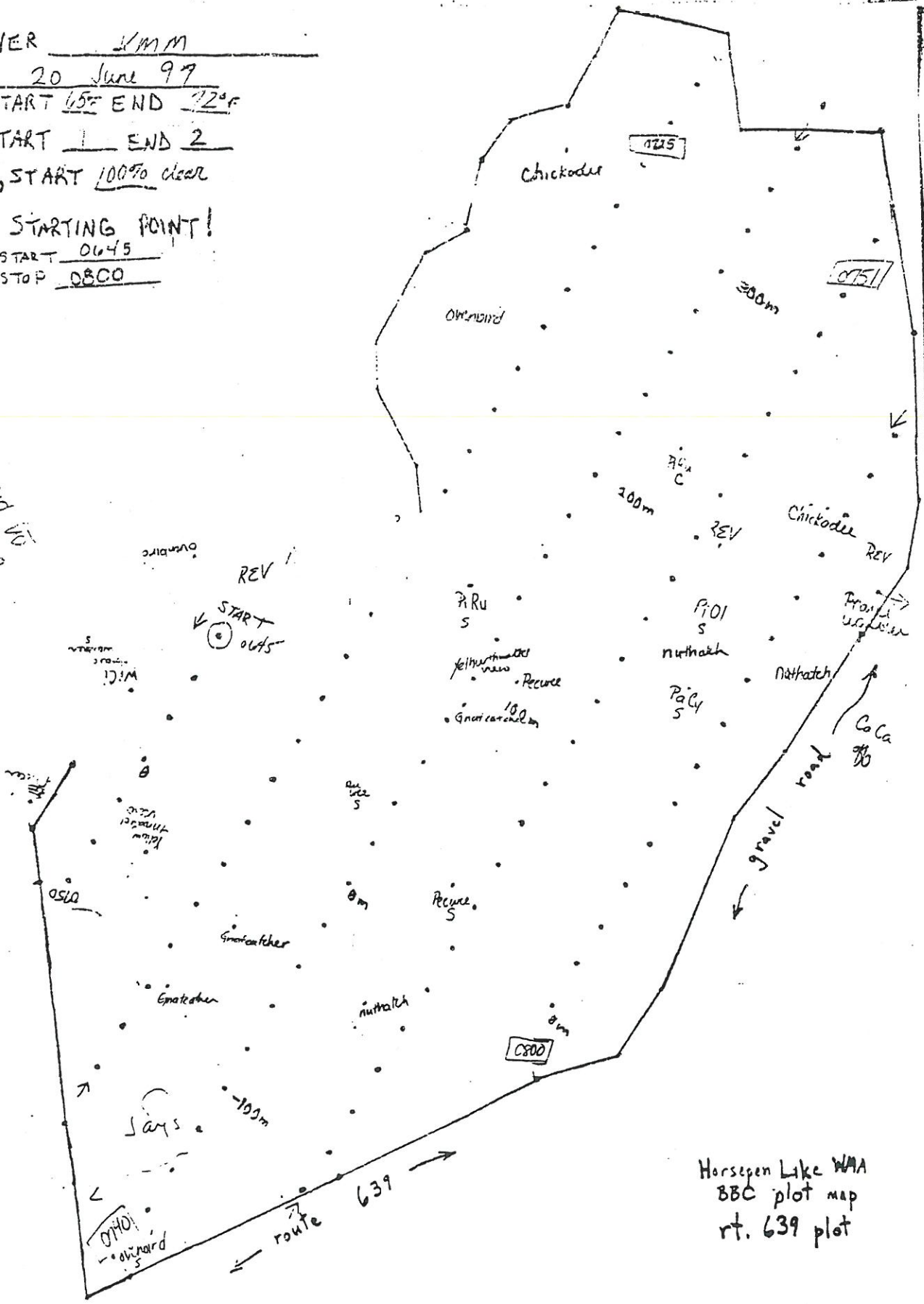
Horsepen Like WAA
BBC plot map
rt. 639 plot

COLI = perna

OBSERVER JMM
 DATE 20 June 97
 TEMP, START 65° END 72°
 WIND, START 1 END 2
 CLOUDS, START 100% clear

MARK STARTING POINT!
 TIME START 0645
 STOP 0800

15 min mark
 30 min mark
 45 min mark
 1 hr mark



Horsepen Lake WMA
 BBC plot map
 rt. 639 plot

OBSERVER CM Stinson
DATE 24 June 97
TEMP, START 21 END 27°C
WIND, START 1 END 2
CLOUDS, START 0 END 8

MARK STARTING POINT!

TIME 064-0854

SFAUPERS



Horsepen Lake WMA
BBC plot map
rt. 639 plot

COV = success

Appendix 2

This appendix contains copies of all of the field data sheets used during vegetation surveys reported here. Ten 0.1-acre circles were surveyed in each plot, as explained in the text, so one sheet representing each of these plots is contained in Appendix 2.

Vegetation Data sheet 11.2m radius circle

Plot Location: K1. 1e39

Date(s) 29 VII 97

Circle Center Location: Line #2 + 100m (3)

Tree Identification 7cm or > 7cm DBH

310° 40°

Surveyor's Name: K.M.H. / C.H.S

Diameter in (cm)

| Species | 4 | 7 | 10 | 13 | 17 | 22 | 28 | 35 | 43 | 53 | 65 | 80 | 100 |
|---------------------------------------|------|------|------|-------|-------|------|------|------|----|----|----|----|-----|
| 1. Quercus alba (White Oak) ✓ | 41.9 | 37.3 | 44.0 | 137.9 | 109.5 | | | | | | | | |
| 2. Nyssa (Black Gum) ✓ | 7.4 | 9.5 | 8.1 | 8.3 | 43.1 | 71.1 | 62.2 | 64.3 | | | | | |
| 3. Quercus prinus (Rock Chestnut Oak) | 9.1 | 6.5 | | | | | | | | | | | |
| 4. Acer rubr (Red Maple) ✓ | 10.6 | 88.2 | | | | | | | | | | | |
| 5. | | | | | | | | | | | | | |
| 6. | | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | | |
| 8. | | | | | | | | | | | | | |
| 9. | | | | | | | | | | | | | |
| 10. | | | | | | | | | | | | | |

Species: 2 m wide transect (Shrub ID: Woody Stems less than 3 inches d.b.h @ B.H.

| Species | transsect #1 | transsect #2 | total | transsect #1 | transsect #2 | total |
|---------------------------|--------------|--------------|-------|--------------|--------------|-------|
| 1. Acer rubra (Red Maple) | 18 | | 18 | 25 (41+18) | 14 | 42 |
| 2. Nyssa | 1+1+1 | | 3 | | | |
| 3. Azalea | 2+5+1 | | 8 | | | |
| 4. | | | | | | |
| 5. Sassafras | | | | | | |
| 6. Quercus alba | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |

Ground Cover

Canopy Cover

| Transsect #1 40° | Transsect #2 | Transsect #1 10° | Transsect #2 |
|------------------|-----------------|------------------|-----------------|
| --- ++ + + + + | - + --- + - - - | --- + + + + - | +++ + + - + + + |

Vegetation Data Sheet

Plot Location: 639
Date(s): VIII 97

Surveyor's Name: KMM

Circle Center Location: line 1 + 20 m (4)

Tree Identification

| Species | Diameter in (cm) | | | | |
|--------------|------------------|------|------|------|------|
| 1. white oak | 40.8 | 93.9 | 41.6 | 1307 | 1872 |
| 2. | | | | | |
| 3. | | | | | |
| 4. Black Gum | 11.0 | 7.9 | 7.7 | 951 | 494 |
| 5. | | | | | |
| 6. Dogwood | 7.5 | 44 | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|--------------|--------------|-------|--------------|-------|
| 1. Red maple | | 2 | | 5 |
| 2. Black gum | | 5 | () () | 5+ |
| 3. White oak | | 7 | | 1 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

() - trees counted on transect #1

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + - - | + + - - |
| - - + + | - - + + |
| + + - - | + + - - |
| - - + + | - - + + |

Canopy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + + | + + + + |
| + + + + | + + + + |
| + + + + | + + + + |
| + + + + | + + + + |

Vegetation Data Sheet

Plot Location: R1 (139)

Survey No. _____

Date(s) 2 VIII 97

Circle Center Location: line 4 + 80m (C) // 28m radius

Tree Identification

| Species | Diameter in (cm) | | |
|--------------|------------------|-------------|-------------|
| 1. White Oak | 51.6 | 45.2 / 45.5 | 2091 / 1612 |
| 2. Black Gum | 8.0 | 9.6 / 50' | 72' |
| 3. Red Maple | 8.9 | 62' | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------------|--------------|-------|--------------|-------|
| 1. Black Gum | 1111 | 4 | 1111 | 8+1 |
| 2. Red Maple | 11 | 2 | | 0 |
| 3. Tulip Poplar | 111 | 5 | 111 | 3 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| - - + - + | - - + - + |
| + + + + - | + + + + - |

Canopy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + - - | + + + - - |
| + + + + - | + + + + - |

Vegetation Data Sheet

Plot Location: 039 Pl. Surveyor's Name: KMM / C...
 Dates: VIII '17
 Circle Center Location: km 4 + 1000

Tree Identification

| Species | Diameter in (cm) | | | | | | | | | | |
|------------------------|------------------|------|------|------|------|-------|-------|-------|-------|-------|--|
| 1. Black Gum | 8.0 | 50.1 | | | | | | | | | |
| 2. White Oak | 30.8 | 44.8 | 36.9 | 51.2 | 41.7 | 106.4 | 157.6 | 105.9 | 206.7 | 136.6 | |
| 3. Species #1 (Birch?) | 9.2 | 66 | | | | | | | | | |
| 4. | | | | | | | | | | | |
| 5. | | | | | | | | | | | |
| 6. | | | | | | | | | | | |
| 7. | | | | | | | | | | | |
| 8. | | | | | | | | | | | |
| 9. | | | | | | | | | | | |
| 10. | | | | | | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | transsect #2 | total |
|--------------|--------------|--------------|-------|
| 1. Red Maple | | | |
| 2. Black Gum | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Ground Cover

| Transsect #1 | Transsect #2 | Transsect #1 | Transsect #2 |
|--------------|--------------|--------------|--------------|
| - - - + | - - - + | - - - + | - - - + |
| - - - + | - - - + | - - - + | - - - + |
| - - - + | - - - + | - - - + | - - - + |

Vegetation Data Sheet

Plot Location: 639

Date(s) 2 VIII 97

Circle Center Location: 5 Ave + 60 (8)

Surveyor's Name: KMM / CR

Tree Identification

| Species | Diameter in (cm) | | | |
|-----------------|------------------|-------|-------|------|
| 2. Black Gum | 17.5 | 39.5 | 241 | 1225 |
| 3. White Oak | 50.3 | 110.9 | 110.3 | 2189 |
| 4. Red Maple | 25.3 | 12.0 | 19.4 | 503 |
| 5. Tulip Poplar | 24.8 | 21.7 | 413 | 370 |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------------|--------------|-------|--------------|-------|
| 1. Red Maple | | 6 | | 6 |
| 2. Black Gum | | 5 | | 4 |
| 3. Speciosa etc | | | | 1 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + + + | + + + + + |
| - - - - - | - - - - - |
| + + + + + | + + + + + |
| - - - - - | - - - - - |

Canopy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + + + | + + + + + |
| - - - - - | - - - - - |
| + + + + + | + + + + + |
| - - - - - | - - - - - |

VEGETATION DATA SHEET

Plot Location: R1 (e39)

Date(s): 2 VII 97

Surveyor's Name:

Circle Center Location: INV #4 + 200m @

| Species | Tree Identification | | | | Diameter in (cm) |
|----------------|---------------------|--------|------|------|------------------|
| | (79) | (85) | (91) | (97) | |
| 1. Black Gum | 10.0 / | 13.1 / | 18.5 | 7.8 | 7.6 / 7.1 |
| 2. White Oak | 10.3 | 53.4 | 1276 | 2240 | |
| 3. Hickory | 7.1 | 10.6 | 8.5 | 40 | 82 57 |
| 4. Scarlet Oak | 10.9 | 1314 | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | total | |
|-----------------|-------------|---------------|
| | transact #1 | transact #2 |
| 1. Red Maple | III III III | III III |
| 2. Black Gum | III III | III III |
| 3. White Oak | III | ← (III) III I |
| 4. Tulip Poplar | | III III I |
| 5. Hickory | | I |
| 6. Scarlet Oak | | III |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

Ground Cover

Transact #1

+ + - - +

Canopy Cover

Transact #1

- + + + -

transact #2

+ + + + +

+ + + + +

vegetation data sheet

Plot Location: Rt 639

Date(s) 2 VIII 97

Surveyor's Name:

Circle Center Location: line # 3 + 300 m @

Tree Identification

| Species | K.O | 46.0 | 79 | 166.2 | Diameter in (cm) | | |
|--------------|------|-------|------|-------|------------------|------|-----|
| 1. Red Maple | 42.4 | 7.8 B | 46.3 | 14.2 | 48 | 1684 | |
| 2. White Oak | 9.4 | 9.6 | 27.6 | 8.4 | 8.1 | 69 | 122 |
| 3. Black Gum | | | | | | | 518 |
| 4. | | | | | | | 55" |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| 9. | | | | | | | |
| 10. | | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------------|--------------|-------|--------------|-------|
| 1. Black Gum | | 26 | | 55 |
| 2. Tulip Poplar | | 4 | | 5 |
| 3. P. Maple | | 6 | | 6 |
| 4. Hickory | | 1 | | 3 |
| 5. White Oak | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 | Canopy Cover | Transsect #1 | Transsect #2 |
|--------------|--------------|--------------|--------------|--------------|
| ++++ | ++ | | ++++ | ++++ |
| ++++ | ++++ | | ++++ | ++++ |
| 0 | 0 | | 0 | 0 |

Vegetation Data Sheet

Plot Location: Rt. 639

Date(s) 19 VI 97

Surveyor's Name: KMM/CMS

Circle Center Location: line 2 + 180 m (2)

Tree Identification

| Species | (1998) | (1997) | Diameter in (cm) |
|-------------------------|--------|--------|------------------|
| 1. Qu. alba | 49.8 | 23.5 | |
| 2. Acer rub (red maple) | 13.3 | 7.9 | 10.4 / 189 |
| 3. Scarlet Oak | 55.6 | 24.8 | 49.3 |
| 4. | | | 85.2 |
| 5. Dead: | | | |
| 6. Acer rub | 8.1 | 5.2 | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------------|--------------|-------|---------------|-------|
| 1. Black gum | III III | 8 | III III III | 13 |
| 2. Red Maple | II | 2 | III | 6 |
| 3. Tulip Poplar | III | 5 | III III III I | 11 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 | Canopy Cover |
|--------------|--------------|--------------|
| + - + + + | + + + + + | + + + + + |
| - - - + + | - - - + + | - - - + + |

Vegetation Data Sheet

Plot Location: R. 639

Surveyor's Name: KMM / CMS

Date(s) 19 II 97

Circle Center Location: line #2 + 220 m

Tree Identification

| Species | 43.9 | 38.5 | 42.5 | 40.6 | 113.1 | 171.5 | 115.1 | 141.9 | 129.5 |
|------------------|------|------|------|------|-------|-------|-------|-------|-------|
| 1. Scarlet Oak / | | | | | | | | | |
| 2. White Oak / | 38.0 | 46.7 | | | | | | | |
| 3. Red Maple / | 7.5 | 14 | | | | | | | |
| 4. | | | | | | | | | |
| 5. | | | | | | | | | |
| 6. | | | | | | | | | |
| 7. | | | | | | | | | |
| 8. | | | | | | | | | |
| 9. | | | | | | | | | |
| 10. | | | | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transact #1 | total | transact #2 | total |
|----------------|-------------|-------|-------------|-------|
| 1. Black Gum | 11 | 2 | 111111 | 7 |
| 2. Red Maple | | 0 | | 1 |
| 3. Hickory sp. | | 0 | | 1 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transact #1 | Transact #2 |
|-------------|-------------|
| + + + + - | + + + - + |
| - - + + + | + - - + - |

Canopy Cover

| Transact #1 | Transact #2 |
|-------------|-------------|
| + - + + - | 1 1 1 1 + |
| - - + + + | + + + + + |

TERMINAL TRAIN SHEET

Plot Location: Harris W
 Date(s): 6, VIII 97
 Circle Center Location: Line 3 3' 10" (3)
 Surveyor's Name:

Tree Identification

| Species | 183 | 100 | 183 | 183 | Diameter in (cm) |
|-----------|---------|-------|------|-------|------------------|
| 1. C. ... | 113.3 | | | | |
| 2. R. ... | 27.2(4) | 11.1A | 10.3 | 13.1A | |
| 3. W. Oak | 20.3 | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------|--------------|-------|--------------|-------|
| 1. R. ... | IIII | 6 | | 6 |
| 2. W. ... | IIII | 7 | I | 8 |
| 3. B. ... | | 0 | IIII | 4 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

| Ground Cover | | Canopy Cover | |
|--------------|--------------|--------------|--------------|
| Transsect #1 | Transsect #2 | Transsect #1 | Transsect #2 |
| IIII | IIII | | IIII |
| IIII | IIII | | IIII |

LEGEND MIAMI MARINA WISSEL
 Plot Location: Harris, W
 Date(s): 10 VII 97
 Circle Center Location: Line 3 + 180 (5)
 Surveyor's Name:

Tree Identification

| Species | DBH | 53.8 | Diometer in (cm) | transsect #1 | transsect #2 | Total |
|-------------|-----|------|------------------|--------------|--------------|-------|
| 1. W. Oak | | | | | | |
| 2. R. Maple | (3) | 1.35 | 1.35 | | | |
| 3. P. Gum | (2) | 1.1 | 1.1 | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h.

| Species | transsect #1 | transsect #2 | Total |
|--------------|--------------|--------------|-------|
| 1. W. Oak | I | | 1 |
| 2. P. Gum | III | II | 3 |
| 3. R. Maple | IIIIII | | 6 |
| 4. P. Poplar | I | | 1 |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Ground Cover

| Transsect #1 | Transsect #2 | Canopy Cover |
|--------------|--------------|--------------|
| IIII | IIII | |
| IIII | IIII | |

REGISTRATION DATA SHEET

Plot Location: Harris W. Surveyor's Name:

Dates: 10/11/97

Circle Center Location: Line 2, 100'

Tree Identification

| Species | g ⁰³⁶ | g ²³¹ | Diameter in (cm) |
|-----------|------------------|------------------|------------------|
| 1. M. Oak | 50.9 | 53.2 | |
| 2. B. Gum | 7.51 | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transact #1 | total | transact #2 | total |
|-------------------|-------------|-------|-------------|-------|
| 1. M. Oak | 1 | 1 | 11 | 2 |
| 2. P. Maple | | 12 | | 3 |
| 3. Chestnut O. B. | | 4 | | 0 |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

Transact #1: |||

Transact #2: |||

Canopy Cover

Transact #1: |

Transact #2: |

| Plot Location: Harris W | | SURVEILLANCE AREA | |
|---|---------------------|-------------------|--------------|
| Date(s) 10/11/97 | | Surveyor's Name: | |
| Circle Center Location: line 4 1300m (3) | | | |
| Species | Tree Identification | Diameter in (cm) | |
| 1. | P. Maple | 17.2 | 17.1 |
| 2. | N. Oak | 10.2 | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| Shrub ID - Woody Stems less than 3 inches d.b.h | | | |
| Species | transsect #1 | total | transsect #2 |
| 1. T. Poplar | | 5 | |
| 2. B. Gum | | 1 | |
| 3. P. Maple | | 5 | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| Ground Cover | | Canopy Cover | |
| Transsect #1 | Transsect #2 | Transsect #1 | transsect #2 |
| - - - + + + | - - - + + + | - - - + + + | - - - + + + |

VEGETATION DATA SHEET

Plot Location: 11000 Plot W Successor's Name: _____
 Dates: 97
 Circle Center Location: Lot 2 + 3000 ①

Tree Identification

| Species | Y/D.R | W/D.R | Diometer in (cm) |
|---------|-------|-------|------------------|
| 1. | | 4.3 | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|-----------------|--------------|-------|--------------|-------|
| 1. <u>11000</u> | 1 | 1 | | 1 |
| 2. <u>11000</u> | 1 | 2 | | 1 |
| 3. <u>11000</u> | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 | transsect #1 | transsect #2 |
|--------------|--------------|--------------|--------------|
| 1 1 1 1 1 | 1 1 1 1 1 | 1 1 | 1 1 |
| 1 1 1 1 1 | 1 1 1 1 1 | 1 1 | 1 1 |

TERMINAL AREA SHEET

Plot Location: Harris W
 Date(s) 10/11/97
 Circle Center Location: low 2 + 100 C

Supervisor's Name:

| Species | Tree Identification | | Diameter in (cm) |
|-----------|---------------------|------|------------------|
| | 2007 | 2492 | |
| 1. W. Oak | 50.8 | 30.1 | 56.1 |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 |
|-------------|--------------|-------|--------------|
| 1. B. Gum | 1 | 1 | 1 |
| 2. R. Maple | | | 8 |
| 3. Hickory | | 1 | 1 |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| | |
| 11-11 | 11-11 |

Candy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| --- | --- |
| 11-11 | 11-11 |

Plot Location: Harris W

Date(s) 10 VIII 97

Surveyor's Name:

Circle Center Location: line 2 + 180 (9)

Tree Identification

| Species | 1546 | Diameter in (cm) |
|-----------------|------|------------------|
| 1. W. Oak | 3.2 | 15.1 |
| 2. Chestnut Oak | 45.0 | |
| 3. R. Maple | 9.5 | |
| 4. B. Gum | 30.5 | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 |
|-------------|--------------|-------|--------------|
| 1. R. Maple | | 9 | |
| 2. B. Gum | | 3 | |
| 3. W. Oak | | 2 | |
| 4. Dogwood | | 2 | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| 1-11 | 11-11 |
| 1-11 | 11-11 |

Canopy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| 1-1-1 | 1-1-1 |
| 1-1-1 | 1-1-1 |

Plot Location: P1, 1033 11/11/11 Vegetation Data Sheet
 Date(s) 5 VIII 77 Surveyor's Name: _____

Circle Center Location: 1 mi S 7.00 m 11.26 mi N D

| Species | Tree Identification | | Diameter in (cm) |
|---------|---------------------|------|------------------|
| | 1952 | 1952 | |
| 1. | White oak | 43.0 | 42.7 |
| 2. | Hickory | 40.5 | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

| Species | Shrub ID - Woody Stems less than 3 inches d.b.h | | total |
|---------|---|-------------|-------|
| | transact #1 | transact #2 | |
| 1. | B. Maple | 1 | 8 |
| 2. | w. Oak | 1 | 1 |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

| Ground Cover | | Canopy Cover | |
|--------------|-------------|--------------|-------------|
| Transact #1 | Transact #2 | Transact #1 | Transact #2 |
| + | - | - | - |
| - | - | - | - |
| + | - | + | + |
| - | - | + | - |

VEGETATION DATA SHEET

Plot Location: 633 Harris E

Surveyor's Name:

Date(s): 5 VIII 91

Circle Center Location: UMS # 2 | 320. m | 11.28 mrad @

Tree Identification

| Species | Diameter in (cm) | transsect #1 | transsect #2 | total |
|-------------|------------------|--------------|--------------|-------|
| 1. W.D. oak | 11.5, 11.5 | | | |
| 2. B. Gum | 14.4, 14.8 | | | |
| 3. A. gum | 11.4, 11.8 | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | transsect #2 | total |
|----------------|--------------|--------------|-------|
| 1. Subp Tipton | | | 10 |
| 2. R Maple | | | 2 |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |

| Ground Cover | transsect #1 | transsect #2 | total |
|--------------|--------------|--------------|-------|
| 1. | - | - | - |
| 2. | - | - | - |
| 3. | - | - | - |
| 4. | - | - | - |
| 5. | - | - | - |
| 6. | - | - | - |
| 7. | - | - | - |
| 8. | - | - | - |
| 9. | - | - | - |
| 10. | - | - | - |

Plot Location: 110000 E.
 Date(s): 5 VIII 97
 Circle Center Location: 100m 3 + 160m (9)
 Tree Identification
 Species: B.f. W.M. oak R. Mangrove
 Diameter in (cm)
 1. 4.32 (108) 7.31 (185) 8.32 (208) 11.75 (296)
 2. 45.71 (1148)
 3. 7.13 (178) 13.8 (345) 10.9 (273) 16.4 (415) 8.64 (216) 5.8 (146)
 4.
 5.
 6.
 7.
 8.
 9.
 10.
 Shrub ID - Woody Stems less than 3 inches d.b.h
 Species: R. Mangrove thicket
 Ground Cover: + + + + + + + + + +
 Canopy Cover: + + + + + + + + + +

TOYAMAHI MATA GISS
 Surveyor's Name:

| Species | transact #1 | transact #2 | total |
|-------------|-------------|-------------|-------------|
| R. Mangrove | | | 21 |
| thicket | | | 2 |
| | | | 28 + 9 = 37 |

| Ground Cover | transact #1 | transact #2 | total |
|--------------|-------------|-------------|-------|
| | ++++ | | 14 |
| | ++ | | 2 |

| Canopy Cover | transact #1 | transact #2 | total |
|--------------|-------------|-------------|-------|
| | + | | 1 |
| | + | | 1 |

Plot Location: Hanna E. Surveyor's Name:

Date(s) 5 VIII 97 Circle Center Location: Line 5 - 200 (10) 11.28 m C.

| Species | Tree Identification | | Diameter in (cm) |
|---------|---------------------|---------------|------------------|
| | (dbh) | (dbh) | |
| 1. | Wb | 49.5 | |
| 2. | Bk | 41.5 (1/2 Wb) | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

Shrub ID - Woody Stems, less than 3 inches d.b.h.

| Species | transsect #1 | total | transsect #2 | Total |
|---------|--------------|-------|--------------|-------|
| 1. BM | 11 | 10 | 17 | 7 |
| 2. Bk | 11 | 29 | 17 | 5 |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

| Ground Cover | | Canopy Cover | |
|--------------|--------------|--------------|--------------|
| Transsect #1 | Transsect #2 | Transsect #1 | Transsect #2 |
| 1-1-1+ | 1-1-1+ | 1-1-1+ | 1-1-1+ |
| 1-1-1+ | 1-1-1+ | 1-1-1+ | 1-1-1+ |

Max Crown Height in meters:

Vegetation Data Sheet

Plot Location: 633 Haines E. Surveyor's Name:

Date(s): 5 VIII 97

Circle Center Location: line #2 + 220 m

| Tree Identification | | Diameter in (cm) | | | | | | | |
|---------------------|-------|------------------|----------------|--|--|--|--|--|--|
| Species | (DBH) | v ¹ | v ² | | | | | | |
| L. maple | 12.16 | 9.3 | | | | | | | |
| W. Oak | 8.8 | 53.4 | 20.0 | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | Transect #1 | total | Transect #2 | total |
|----------|-------------|-------|-------------|-------|
| L. maple | III III | 9 | III III | 11 |
| W. oak | | | I | 1 |
| dogwood | | | VI | 3 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| Ground Cover | | Canopy Cover | |
|--------------|-------------|--------------|-------------|
| Transect #1 | Transect #2 | Transect #1 | Transect #2 |
| + - - + + | - - - + - | | + + + + + |
| - + + + + | - + + - + | | + + + + + |

Vegetation Data Sheet

Plot Location: 633 Hammock E

Date(s): 5 VIII 97

Surveyor's Name:

Circle Center Location: 1160 m 11.25 m rad. ⊕

Tree Identification

| Species | WHY? oak | 314.1 | 208.5 | 205.4 | Diameter in (cm) |
|---------|----------|-------|-------|-------|------------------|
| 1. | | 13.51 | 51.5 | 55.91 | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | -total |
|--------------|--------------|-------|--------------|--------|
| 1. R. Alpini | | 17 | (17) | 20 |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 | Canopy Cover |
|--------------|--------------|--------------|
| - + + + | - + + + | - + + + |
| - + + + + | - + + + | - + + + + |

Max. Percent Moisture in ground:

Vegetation Data Sheet

Plot Location: 633 Harris, E Surveyor's Name:

Date(s) 5 VIII 97

Circle Center Location: Line # 3 + 320 M 11.28 m radius ⑦

| Species | Tree Identification | 297 | 1982 | Diameter in (cm) |
|---------|---------------------|------|-------|------------------|
| 1. | W. OAK | 0003 | 41194 | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

| Species | transsect #1 | transsect #2 | total | transsect #1 | transsect #2 | total |
|--------------|--------------|--------------|-------|--------------|--------------|-------|
| 1. L. Poplar | | | 7 | (7) | | |
| 2. R. maple | | | 2 | | | 19 |
| 3. White oak | | | 2 | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |

| Ground Cover | | Canopy Cover | |
|--------------|--------------|--------------|--------------|
| Transsect #1 | Transsect #2 | Transsect #1 | Transsect #2 |
| + + + + | + + + + | + + + + | + + + + |
| - - - - | - - - - | - - - - | - - - - |
| - - - - | - - - - | - - - - | - - - - |
| - - - - | - - - - | - - - - | - - - - |

Vegetation Data Sheet

Plot Location: 633 Harris E

Date(s): 5 VIII 97

Circle Center Location: 1 km N 2 1.2 km N 1.28 m r ③

Surveyor's Name:

| Species | Tree Identification | Diameter in (cm) |
|---------|---------------------|------------------|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | total | transsect #2 | total |
|--------------|--------------|-------|--------------|-------|
| 1. hickory | | 1 | | 1 |
| 2. black gum | | 0 | | 1 |
| 3. R. Maple | | 4 | | 7 |
| 4. w. oak | | 1 | | 1 |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + + + | + + + + + |
| + + + + + | + + + + + |

Canopy Cover

| Transsect #1 | Transsect #2 |
|--------------|--------------|
| + + + + + | + + + + + |
| + + + + + | + + + + + |

Vegetation Data Sheet

Plot Location: 633 Surveyor's Name:

Date(s) VIII 9-7

Circle Center Location: line 4 + 60m 11.28 m - var. ②

Tree Identification

| Species | 13.3 | 19.4 | 93.5 | Diameter in (cm) |
|--------------|------|------|------|------------------|
| 1. Red maple | 13.3 | 12.3 | 10.3 | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transect #1 | total | transect #2 | total |
|-------------|-------------|-------|-------------|-------|
| 1. C. maple | | 4 | | 4 |
| 2. W. Oak | | 3 | | 3 |
| 3. Hickory | | 0 | | 3 |
| 4. B. Gum | | 0 | | 1 |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Ground Cover

| Transect #1 | Transect #2 | Canopy Cover |
|-------------|-------------|--------------|
| ++ + + + | ++ + + + | transect #2 |
| - + + + + | - + + + + | ++ - + - |
| | | - - - + - |

Appendix 3

Four items are presented here. The first is a table showing the values for wind speed represented by the codes used in the Beaufort Wind Scale, referred to in the methods chapter. The second item is a list of dates the Breeding Bird Censuses were conducted on each plot. Third is a sample vegetation data sheet used for collecting vegetation at each of the ten sample points on each plot. Fourth is the summary data sheet compiling all the vegetation data on each plot

Beaufort Wind Force Scale

| Wind Force | Effects on land | Wind Speed (meters/second) |
|-------------------|--|-----------------------------------|
| 0 | Still; smoke rises vertically | 0-0.2 |
| 1 | Smoke drifts rise, weather vane still | 0.3-1.5 |
| 2 | Leaves rustle; wind felt on face; weather vane begins to move | 1.6-3.3 |
| 3 | Leaves and twigs move; light flags extended | 3.4-5.4 |
| 4 | Thin branches moved; dust and paper raised from ground | 5.5-7.9 |
| 5 | Entire small trees in leaf sway | 8.0-10.7 |

The scale may be extended beyond this point for higher wind speeds. The Beaufort number is also sometimes referred to as a force number, e.g. a “force 3” wind speed.

List of Dates Breeding Bird Censuses were Conducted on each Plot**Harris Tract East**

7 June 1997
9 June 1997
10 June 1997
11 June 1997
12 June 1997
16 June 1997
17 June 1997
23 June 1997
24 June 1997
26 June 1997
30 June 1997

Harris Tract West

22 May 1997
23 May 1997
28 May 1997
3 June 1997
6 June 1997
7 June 1997
9 June 1997
10 June 1997
12 June 1997
16 June 1997
1 July 1997

Route 639

18 June 1997
19 June 1997
20 June 1997
23 June 1997
24 June 1997
25 June 1997
30 June 1997
2 July 1997

Vegetation Data Sheet

Plot Location: _____

Date(s): _____

Surveyor's Name: _____

Circle Center Location: _____

Tree Identification

| Species | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) | Diameter in (cm) |
|---------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |
| 9. | | | | | | | | |
| 10. | | | | | | | | |

Shrub ID - Woody Stems less than 3 inches d.b.h

| Species | transsect #1 | transsect #1 | transsect #1 | transsect #1 | transsect #1 | transsect #1 | transsect #1 | transsect #1 | transsect #2 | transsect #2 | total |
|---------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------|
| 1. | | | | | | | | | | | |
| 2. | | | | | | | | | | | |
| 3. | | | | | | | | | | | |
| 4. | | | | | | | | | | | |
| 5. | | | | | | | | | | | |
| 6. | | | | | | | | | | | |
| 7. | | | | | | | | | | | |
| 8. | | | | | | | | | | | |
| 9. | | | | | | | | | | | |
| 10. | | | | | | | | | | | |

Ground Cover

Transsect #1

Transsect #2

Canopy Cover

Transsect #1

Transsect #2

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