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Grassland Bird Monitoring at Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas

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Status Report

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EXECUTIVE SUMMARY

During the breeding seasons of 2001 through 2003, a total of 517 variable circular plots were surveyed for birds and assessed for habitat composition at Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas. Systematic 400 x 400 meter grids, originating from random start points, were used to locate 40 permanent variable circular plots in upland habitat at Agate Fossil Beds National Monument and 242 at Tallgrass Prairie National Preserve. An additional 14 permanent plots were established in the less common but important riparian habitat at Agate Fossil Beds National Monument, and 18 plots were added in riparian areas at Tall grass Prairie National Preserve. Variable circular plots in riparian habitat were spaced at 250 meter intervals throughout each area.

Surveys were conducted at Agate Fossil Beds National Monument in 2001 (27 plots) and 2003 (54 plots) and at Tallgrass Prairie National Preserve in 2001 (176 plots) and 2002 (260 plots). A total of 46 species of birds were observed at Agate Fossil Beds National Monument and 82 at Tallgrass Prairie National Preserve. The predominate species found at Agate Fossil Beds National Monument were: western meadowlark, grasshopper sparrow, lark sparrow and red-winged blackbirds in the upland bird community and red-winged blackbird, western meadowlark, common yellowthroat, killdeer and common snipe in the riparian community. The predominate species found at Tall grass Prairie National Preserve were: grasshopper sparrows, dickcissel, western meadowlark and brown-headed cowbird in the upland bird community and eastern wood-pewee, great crested flycatcher, black-capped chickadee, northern cardinal, red-bellied woodpecker, (eastern) tufted titmouse, and yellow-billed cuckoo in the riparian community.

Permanent plot and subplot measures were recorded the first time a plot was visited but not in subsequent years. Semi-permanent plot features and habitat measures were assessed each time a plot was visited. Habitat conditions at each plot varied minimally between years. Therefore, data within each park and habitat type (upland or riparian) were combined across years and reported as such. The diversity of vertical structure within habitats at each NPS unit is low. Vertical structure provides both screening cover from predators and nesting cover as well as nesting sites. Low vertical structure diversity is to be expected in the mixed grass-shortgrass prairie of Agate Fossil Beds National Monument. However, in the absence of fire and grazing, low vertical structure diversity at Tallgrass Prairie National Preserve would be less expected. Therefore, as the park General Management Plan at Tallgrass Prairie National Preserve is implemented, greater structural diversity and improved bird habitat should be observed. Upland plots at Tallgrass Prairie National Preserve are vegetated predominantly by warm-season grasses and to a lesser extent by forbs during the bird breeding season. Riparian plots at Tallgrass Prairie National Preserve and all plots at Agate Fossil Beds National Monument are vegetated predominantly by cool-season grasses and forbs.

1.0 INTRODUCTION

1.1 Background

Birds are an important component of park ecosystems, as their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. It has been suggested that management activities aimed at preserving habitat for bird populations, such as for neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Moreover, birds have a tremendous following among the public and many parks provide information on the status and trends of birds in their parks through their interpretive programs.

Once covering vast areas of the North American continent, native Great Plains grasslands are rapidly disappearing. During the last century, large portions of grassland landscapes were plowed for cropland or converted to livestock pasture (29% of shortgrass, 41% of mixed-grass, and 99% of tallgrass prairie; Knopf and Sampson 1997). Remaining grasslands have been altered through continued fragmentation and isolation, interruption of driving ecological processes such as periodic wildfire, and loss of significant faunal species, including bison (*Bos bison*), elk (*Cervus elaphus*), and wolves (*Canis lupus*).

While not affected to the extent of large native ungulates and mammalian predators, many grassland bird species have also demonstrated declining abundance as prairie habitat loss continues. Data collected during the U.S. Geological Survey's annual North American Breeding Bird Surveys (BBS) between 1966 and 1999 indicates that 70% of 29 grassland bird species show evidence of population declines (Sauer et al. 2000). Many prairie species such as the grasshopper sparrow (*Ammodramus savannarum*), eastern meadowlark (*Sturnella magna*), horned lark (*Eremophila alpestris*), bobolink (*Dolichonyx oryzivorus*), lark bunting (*Calamospiza melanocrys*) and dickcissel (*Spiza americana*) have declined at alarming rates. The destruction and fragmentation of prairie landscapes, as well as structural degradation (e.g. fire suppression, changes in grazing regimes) of remaining prairie habitats have contributed to these declines.

Accumulation of litter and standing dead material are significant components in the structural development of tallgrass prairie. In the absence of fire and grazing, tallgrass prairie develops a homogeneous canopy dominated by big bluestem (*Andropogon gerardii*) and indiangrass (*Sorghastrum nutans*), with eventual invasion by woody plants where precipitation permits (Vinton and Collins 1997). The accumulation of dead material decreases availability of nutrients and reduces solar radiation reaching the ground for shade intolerant plants. Fire tends to remove accumulated dead material more evenly in grasslands than grazing, which produces a heterogeneous mix of live and dead plant material. The timing and frequency of both fire and grazing events have varying influences on litter and standing dead material accumulation, and thus the structural development of prairie systems. Natural variations in structural development and accumulation of litter and standing dead material follow a "high" east (tallgrass) to "low" west (shortgrass) gradient with mixed-grass prairies falling somewhere in between. Net annual production and the accumulation of dead materials are significantly greater in eastern tallgrass prairies than western shortgrass prairies. The shortgrass prairie canopy, dominated by bunch grasses such as blue grama (*Bouteloua gracilis*) and shrubs, is more heterogeneous than the canopy of the tallgrass prairie (Lane 1995, Vinton and Collins 1997). Consequently, the

accumulation of litter and standing dead material in shortgrass prairie systems is minor, resulting in insignificant influences on structural prairie development.

Responses of bird communities to changes in habitat structure have received much attention in recent years (Cody 1981, 1985; Zimmerman 1997; Fitzgerald and Pashley 2000; Tappe et al. 2001). Much of this work has been carried out in forested systems, which are structurally more diverse than grassland systems. However, work done by Zimmerman (1982, 1988 and 1993) on the Konza Prairie Research Natural Area in the Flint Hills of Kansas has demonstrated how bird species respond to fire and grazing in a tallgrass prairie system. Zimmerman (1997) categorized three types of bird species: grass/forb-dependent, woody-dependent and habitat-independent inhabiting tallgrass prairie, and recorded their responses to grazing and fire. Woody-dependent species disappear from the bird community when fire and/or grazing remove woody plants from the landscape. Often these woody plants have invaded the prairie as a result of fire suppression. Grass/forb-dependent species in tallgrass prairie generally respond well to moderate grazing that increases structural diversity. Annual spring burns to promote warm-season grass production, on the other hand, have a negative influence on structural development by removing cool-season grasses and forbs, litter and standing dead material, thus reducing habitat quality for grass/forb-dependent species. While some elements of habitat-bird community relationships are clearly understood for prairie systems, such as the response following removal of woody plants, others are not. The influence of habitat alterations on invertebrate communities and the birds that feed upon them is one component that is not fully understood.

It is against a backdrop of vanishing or altered prairie ecosystems and declining grassland bird communities that we initiated a bird monitoring project on National Park Service lands. Long-term trends in bird community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity and sustainability of prairie systems. Trends in the composition and abundance of grassland bird populations have been proposed as a long-term indicator of prairie ecosystem integrity, which is defined as the capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of natural habitat of the region (Karr and Dudley 1981). During 1998 and 1999, as part of the design phase of the Prairie Cluster Prototype Long-term Ecological Monitoring (PC-LTEM) program, the U.S. Geological Survey conducted bird inventories and pilot monitoring work in eight prairie parks to identify species present at each park and assess the feasibility of using grassland birds as indicators of ecosystem integrity (Powell 2000). Work was conducted at Agate Fossil Beds National Monument (AGFO), Badlands National Park (BADL), Homestead National Monument of America (HOME), Pipestone National Monument (PIPE), Scotts Bluff National Monument (SCBL), Tallgrass Prairie National Preserve (TAPR), Theodore Roosevelt National Park (THRO) and Wilson's Creek National Battlefield (WICR). Powell (2000) concluded that Agate Fossil Beds National Monument and Tallgrass Prairie National Preserve were of sufficient size to support healthy grassland bird communities, but recommend against bird community monitoring in other PC-LTEM parks (HOME, PIPE, SCBL and WICR) because of their small size. Following Powell's recommendation, the PC-LTEM Program initiated a pilot project in the spring of 2001 to monitor bird communities at Agate Fossil Beds National Monument and Tallgrass Prairie National Preserve. Also, long-term patterns in bird community composition and abundance of bird populations in relation to changing vegetation patterns and structural diversity resulting from different fire and grazing regimes will improve our understanding of the

effects of various management actions on bird populations. Grassland bird monitoring may be of particular importance at Tallgrass Prairie National Preserve, where current management includes annual prescribed fire and heavy cattle grazing. As the park General Management Plan is implemented, greater structural diversity and improved bird habitat may be observed.

1.2 Objectives

There are two primary objectives for monitoring breeding birds at Agate Fossil Beds National Monument and Tallgrass Prairie National Preserve:

- Determine annual changes in bird community composition and abundance at each park.
- Improve our understanding of breeding bird – habitat relationships and the effects of management actions such as grazing and prescribed fire regimes on bird populations by correlating changes in bird community composition and abundance with changes in specific habitat variables.

This report summarizes two years of survey results.

2.0 METHODS

2.1 Site Selections

Permanent sampling locations or 'plots' were selected by overlaying a systematic grid of 400 x 400 meter cells (originating from a random start point) on a park. The orientation of each grid was rotated 45 degrees to prevent sampling sites from being influenced by man-made features (roads, fences, etc.) oriented along cardinal directions. If any habitat subplot extended beyond park boundaries, the plot was dropped from sampling. Using a systematic grid we established 40 permanent plots at Agate Fossil Beds National Monument (13 were sampled in 2001) and 242 plots at Tallgrass Prairie National Preserve (158 were sampled in 2001), see Figures 1 and 2, respectively.

In each park, the riparian corridor was identified as a separate stratum, with sampling extending 125 m on either side of the stream channel (Niobrara River, AGFO; Palmer and Fox Creeks, TAPR). The riparian stratum makes up 15.6% of the total park area (965 ha) at Agate Fossil Beds National Monument, and 5.3% of the total park area (4398 ha) at Tallgrass Prairie National Preserve. Within the riparian stratum, plots were located at 250 meter intervals along the extent of the stream. Plots were placed 10 meters south of the main stream channel on west-east flowing streams (Niobrara River, AGFO and Palmer Creek, TAPR) and 10 meters west of north-south flowing streams (Fox Creek, TAPR). Any plots from the overall park grid that fell within the riparian stratum were discarded. We established a total of 14 permanent riparian plots at Agate Fossil Beds National Monument and 18 plots at Tallgrass Prairie National Preserve, see Figures 1 and 2, respectively.

The site selection approach used allows us flexibility in choosing the appropriate reference frame to answer different monitoring questions. When making park-wide inferences, estimates for the two habitats are weighted according to each stratum's proportionate area contribution to give an overall park mean and variance. At the same time, the more intensive sampling in the riparian corridor ensured an adequate sample to describe habitat relationships specific to this less common, but important stratum. The systematic grid will also allow us to limit the reference frame appropriately when asking more specific monitoring questions in the

future (e.g. only those sampling plots within a particular management unit would be used to compare responses of birds to different fire or grazing regimes within that unit).

During bird surveys, sampling plots were located using a GPS unit and temporarily marked with 36 inch pin flags to aid in re-locating the plots for habitat assessment, eliminating the need for permanent plot markers. Pin flags were collected from a plot once the habitat work at that plot was completed. Each year, sampling plots were re-located.

2.2 Grassland Bird Surveys

Variable circular plot counts, a point count methodology that incorporates a measure of detectability into population estimates, were used to survey birds present (Fancy 1997). All birds seen or heard at plots during 5 minute sampling periods were recorded with their corresponding distance from observer. Bird observations were separated into two time segments: those detected during the first 3 minutes of the count (to allow future comparisons with the national Breeding Bird Survey data), and any new birds detected during the final 2 minutes of the count. All birds, regardless of distance detected from the observer are counted and recorded. For most species, each individual bird was recorded as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. Once a count was completed at a plot and the data sheet filled out, the observers navigate to the next plot using GPS. Twelve to 20 plots were sampled on a typical morning during a period when it was light enough to observe birds to four hours post sunrise. Therefore, a birder arrived at the first plot each day before sunrise and began sampling as soon as it was light enough to do so. Bird surveys were conducted between 7 May and 6 June at Agate Fossil Beds National Monument and 22 May and 15 June at Tallgrass Prairie National Preserve.

When we conducted a variable circular plot count, we were attempting to get an "instantaneous count" of all birds present. Birds flushed from the plot when approached by the observer were recorded and counts started as soon as the observer reached plot center. That way our method took into account the fact that birds close to the observer have a higher probability of being detected (if they are not flushed) than birds far from the observer, and that different species have different detection functions (i.e., the probability of detecting a bird at different distances from the observer). An important assumption of the method is that a bird exactly at the center of the plot has a probability of $p = 1$ of being detected, and that there is a high probability of detecting birds within the first 5-10 or so meters of the plot center. The most important birds to detect are those very close to the observer (within the first 5-10 meters), and it is highly desirable that estimated distances be within 1-2 meters of actual distances for any bird within 20 m of the observer. However, all birds seen or heard were recorded with an estimate of distance from the observer when possible. For this report, all birds seen or heard during the full 5 minute survey were included in the analysis.

2.3 Grassland Bird Habitat Estimates

The collection of habitat data started each morning after the first variable circular plot Count was completed. In order to avoid disturbing birds on plots where bird counts had not been completed, plots were sampled for habitat measures in the same order they were surveyed for birds. Once the habitat crew arrived at a plot, they set up subplot one (plot center) and completed all habitat measures for this subplot and the 50 meter radius plot, before locating and completing habitat measures on subplots two, three and four (Figure 3). The azimuth (^{O}) to subplot two was determined randomly, subplots three and four were positioned 120 degrees on

either side of two. Azimuths were determined the first year subplots were sampled and then maintained in subsequent years. In order to correlate bird count data with habitat conditions, an attempt was made to complete all habitat work on plots the same day they were sampled for birds. In some cases this was not possible. However, all habitat data collections were completed by 20 June.

Habitat available for bird species were characterized at a number of different scales. First, slope (^{O}), slope variability, aspect (^{O}), aspect variability and topographic position of each 50 meter radius plot were determined and recorded. These measures were taken the first time a plot was visited and not repeated in subsequent years. Vegetation types and amount of road and water cover on each plot were recorded each time a plot was visited. Second, azimuth (^{O}) to and slope (^{O}) and aspect (^{O}) of each 5 meter subplot (Figure 3) were recorded. These measures were taken the first time a plot was visited and not repeated in subsequent years. Also, for riparian subplots at Tallgrass Prairie National Preserve, trees were tallied by diameter at breast height (DBH) classes (<1.0 cm, 1.1-2.5 cm, 2.6-8.0 cm, 8.1-15.0 cm, 15.1-23.0 cm, 23.1-38.0 cm and >38.0 cm) and canopy height, canopy cover and basal area were recorded. Horizontal vegetation coverage between 0 – 0.5, 0.5 – 1.0, 1.0 – 1.5 and 1.5 – 2.0 meters were recorded each year as well as vertical structure in one meter increments to 7.5 meters in height. Vertical structure was recorded for deciduous, coniferous and herbaceous vegetations. Third, within each subplot ground and foliar cover were recorded in 1.78 meter radius nested sample plots. Ground cover included deciduous, conifer and grass litter, bare soil, rock, woody debris (>2.5 cm DBH) and un-vegetated. Foliar cover was estimated for seven plant guilds and included warm- and cool-season grasses, forbs, moss and lichens, shrubs and vines, tree seedlings and total foliar cover (<1.5 m tall).

2.4 Data Analysis

Prior to summary analysis, the resident status (permanent resident, summer resident, migrant) of each bird species recorded at Agate Fossil Beds National Monument and Tallgrass Prairie National Preserve was determined. Identifying the residency of each species was needed in order to exclude migrants from analysis of breeding birds within each park. Also the likelihood of encountering a species during a plot visit (individuals / plot visit) was determined, and results plotted from most to least common species within habitat on a park.

Bird diversity, richness and distribution evenness were calculated by plot with mean values (± SE) estimated for prairie and riparian areas from these calculations. Bird diversity for each plot was calculated using Shannon Diversity Index:

$$H' = -\Sigma(n_1/N)\ln(n_1/N)$$

were n_1/N is the proportion of the total number of individuals in a population consisting of the i^{th} species (Shannon, 1949). Species richness was determined as the total number of bird taxa recorded per plot. Species distribution evenness was calculated by plot using Pielou (J):

$$J' = H' / Hmax$$

were H' is the Shannon Diversity Index and Hmax is the maximum possible diversity for a given number of species if all species are present in equal numbers ((ln(species richness)). J' is a measure of how evenly individuals are distributed within a community when compared to the equal distribution and maximum diversity a community can have (Pielou, 1969).

Location and permanent abiotic measures on each plot and habitat subplot were recorded. Mean values (± SE) for semi-permanent plot data including road and water cover were calculated from the plot estimates for both prairie and riparian areas in each NPS unit. For riparian subplots

at Tallgrass Prairie National Preserve, trees tallied in DBH classes (<1.0 cm, 1.1-2.5 cm, 2.6-8.0 cm, 8.1-15.0 cm, 15.1-38.0 cm and >38.0 cm) were summed to illustrate size distribution of riparian trees. Average canopy height, canopy cover and basal area were also calculated for each riparian plot at Tallgrass Prairie National Preserve with a mean (± SE) estimated for this habitat. Using calculated plot averages or values, mean values (± SE) for horizontal vegetation cover between 0 – 0.5, 0.5 – 1.0, 1.0 – 1.5 and 1.5 – 2.0 meters and vertical structure diversity were estimated for prairie and riparian areas. Structural diversity values were determined for each plot using a modified Shannon Diversity Index:

$$H' = -\Sigma(n_1/N)\ln(n_1/N)$$

were n_1/N is the proportion of vegetation touching a measuring rod in the i^{th} meter increment to the total number of touches from vegetation along the rod.

Within each plot, ground cover, including deciduous, conifer and grass litter, bare soil, rock, woody debris (>2.5 cm DBH) and unvegetated were averaged across subplots with mean values (± SE) estimated for prairie and riparian areas using these averages. Foliar cover, by guild of warm- and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings and total foliar cover (<1.5 m tall) were averaged across subplots with mean values (± SE) estimated for prairie and riparian areas using these averages.

Analyses performed in this report were completed using MicroSoft Access 97® (Litwin et al. 1997) queries and/or NCSS 97® (Hintze 1997).

3.0 RESULTS

3.1 Grassland Bird Surveys

Forty-six species of birds were recorded at Agate Fossil Beds National Monument during 2001 and 2003 surveys (Table 1 and 2). Thirty-three of these species are summer residents, eleven species are year round residents and the remaining two are late season migrants that happened to be recorded during our surveys. Eighty-two species of birds were recorded at Tallgrass Prairie National Preserve during 2001 and 2002 surveys (Table 1 and 2). Forty of these species are summer residents, forty-one are year round residents and the remaining one a late season migrant that happened to be recorded during our survey.

Western meadowlark (2.0 / plot), grasshopper sparrow (0.87 / plot), lark sparrow (0.36 / plot) and red-winged blackbirds (0.34 / plot) were encountered most often during plot visits in the upland habitat at Agate Fossil Beds National Monument; and red-winged blackbird (3.79 / plot), western meadowlark (0.82 / plot), common yellowthroat (0.50 / plot), killdeer (0.25 / plot) and common snipe (0.25 / plot) encountered most commonly in the riparian habitat (Table 3). Grasshopper sparrows (0.93 / plot), dickcissel (0.73 / plot), western meadowlark (0.72 / plot) and brown-headed cowbird (0.24 / plot) were encountered most often during plot visits in the upland habitat at Tallgrass Prairie National Preserve; and eastern wood-pewee (0.53 / plot), great crested flycatcher (0.42 / plot), black-capped chickadee (0.39 / plot), northern cardinal (0.36 / plot), red-bellied woodpecker (0.33 / plot), (eastern) tufted titmouse (0.33 / plot) and yellow-billed cuckoo (0.31 / plot) encountered most commonly in the riparian habitat (Table 3). Average bird diversity per plot by habitat ranged from 0.82 ± 0.03 (TAPR, upland) to 1.19 ± 0.10 (TAPR, riparian), species richness ranged from 2.74 ± 0.07 (TAPR, upland) to 4.06 ± 0.37 (TAPR, riparian) and distribution evenness ranged from 0.72 ± 0.06 (AGFO, riparian) to 0.90 ± 0.04 (TAPR, riparian; Table 4).

3.2 Grassland Bird Habitat Estimates

Slope, slope variability, aspect, aspect variability, topographic position and habitat type (prairie or riparian) of each 50 meter radius plot are reported in Table 5. Direction (azimuth) from the center of the primary plot to the position of the subplot and the slope and aspect of each 5 meter subplot are reported in Table 6. Average cover of upland prairie, riparian woodland, paved roads, pasture roads, streams and ponds on plots are reported for prairie and riparian areas at Agate Fossil Beds National Monument and Tallgrass Prairie National Preserve in Table 7. Average values ranged from 97.5 ± 0.00% upland prairie cover on upland plots at Agate Fossil Beds National Monument to no coverage of several habitat types on other plots.

Two trees < 1.0 cm DBH were observed on 5 meter radius subplots in the riparian area of Tallgrass Prairie National Preserve, 11 trees in the 1.1-2.5 cm size class, 44 trees in the 2.6-8.0 cm size class, 63 trees in the 8.1-15.0 cm size class, 37 trees in the 15.1- 23.0 cm size class, 24 trees in the 23.1-38.0 cm size class and 27 trees in the >38.0 cm size class. Canopy height averaged 10.9 ± 0.63 m, canopy coverage 39.3 ± 2.78% and basal area 25.8 ± 1.66 m^2 for the riparian plots.

Horizontal vegetation coverage between 0.0 – 0.5 m averaged from 60.7 ± 3.24% (AGFO, upland) to 72.9 ± 1.06% (TAPR, upland), coverage between 0.5 – 1.0 m from 3.3 ± 0.79% (AGFO, upland) to 30.4 ± 3.15% (TAPR, riparian), coverage between 1.0 – 1.5 m from 0.0% (AGFO, upland) to 15.6 ± undefined% (AGFO, riparian) and between 1.5 – 2.0 m from 0.0% (AGFO, upland and riparian) to 17.0 ± 1.76% (TAPR, riparian; Table 7). Vertical structure diversity was highest on Tallgrass Prairie National Preserve riparian plots (1.27 ± 0.03) and lowest on Agate Fossil Beds National Monument upland plots (0.01 ± 0.01; Table 7).

Deciduous litter coverage averaged from 0.6 ± 0.07% (TAPR, upland) to 19.3 ± 1.88 (TAPR, riparian), conifer litter from 0.0% (AGFO, upland and riparian) to 9.4 ± undefined (TAPR, riparian) and grass litter from 6.9 ± 0.98% (TAPR, riparian) to 33.7 ± 3.56 (AGFO, riparian; Table 7). Bare soil averaged from 23.6 ± 3.21% (TAPR, riparian) to 51.4 ± 0.89% (TAPR, upland), rock coverage from 0.6 ± 0.23% (AGFO, riparian) to 9.0 ± 0.42% (TAPR, riparian), woody debris (>2.5 cm DBH) coverage from 0.1 ± 0.97% (AGFO, upland) to 3.5 ± undefined (AGFO, riparian) and un-vegetated area from 23.6 ± 3.21% (TAPR, riparian) to 51.4 ± 2.57 (TAPR, upland; Table 7). Foliar coverage of warm-season grasses averaged 0.5 ± 0.07% (AGFO, riparian) to 32.1 ± 0.77% (TAPR, upland), cool-season grasses from 5.2 ± 0.62% (TAPR, upland) to 15.3 ± 2.31% (TAPR, riparian), forbs from 8.1 ± 1.61% (AGFO, upland) to 14.8 ± 0.50% (TAPR, upland), moss and lichens from 0.7 ± 0.16% (TAPR, upland) to 1.5 ± 0.31% (AGFO, upland), shrubs and vines from 1.4 ± 0.28% (AGFO, riparian) to 7.1 ± 1.83% (TAPR, riparian), tree seedlings from 0.0% (AGFO, upland and riparian) to 0.5 ± 0.02% (TAPR, upland) and total foliar coverage (<1.5 m tall) from 18.2 ± 2.45% (AGFO, riparian) to 47.7 ± 0.67% (TAPR, upland; Table 7).

3.3 Other Observations

It was difficult to record the distance of some bird species from the observer as is required for Distance analysis (Buckland et al. 2001). These species include common snipe, northern harrier hawk, turkey vulture and upland sandpiper at Agate Fossil Beds National Monument and upland sandpiper, northern harrier hawk, American crow and common nighthawk at Tallgrass Prairie National Preserve. Often, we were unable to estimate distance for these species as they were records are of flyover. Birds such as upland sandpiper and common snipe call and display in flight. Other species such as American crow can be recorded at great

distances with accurate estimates of this distance rarely possible. It can also be difficult to determine whether or not crows are in flight or calling from trees, often both instances occur. Nevertheless, these species were recorded frequently, suggesting they are using habitats within each NPS unit.

4.0 DISCUSSION

It is of interest to note that of the 46 species of birds recorded at Agate Fossil Beds National Monument (Table 1 and 2), 76 % (35 species) are migrants. However, of the 82 species of birds recorded at Tallgrass Prairie National Preserve (Table 1 and 2) only 50% (41 species) are migrants. Both the geographic location and available habitat may play a role in these differences. Agate Fossil Beds National Monument is located approximately 445 km north of Tallgrass Prairie National Preserve and 625 km west. Agate Fossil Beds National Monument is a mixed grass-shortgrass prairie with little wooded riparian habitat for species to use year round. Tallgrass Prairie National Preserve, on the other hand, is tallgrass prairie with significant wooded riparian habitat. While differences in the numbers of year round residents is of interest, it has little influence on our bird monitoring within each park, as these differences between NPS unit will not be compared in future analysis. However, future trends in bird numbers and community composition may be influenced more by factors outside the park at Agate Fossil Beds National Monument than at Tallgrass Prairie National Preserve do to a greater percentage of migrants using the monument during the breeding season.

Knowledge of the most commonly encountered species in each habitat is valuable in that any population change here is more readily noticed and significant than less common species. Greater variability in the observations of rarely encountered species than common species, hinder their use in detecting changes related to environmental factors. Also, using Distance software to more accurately estimate population size of a species requires observations of 60 or more individuals. Rare species will require several years to accumulate enough observations to accurately estimate population sizes and a number of years more before changes in the population can be detected. Common species will also have the most influence on future analysis of bird community trends. For instance, changes in western meadowlark, grasshopper sparrow, lark sparrow and red-winged blackbirds numbers influence the bird community composition more than less commonly encountered species in the upland habitat at Agate Fossil Beds National Monument. Red-winged blackbird, western meadowlark, common yellowthroat, killdeer and common snipe influence the bird community composition more on riparian plots. At Tallgrass Prairie National Preserve, changes in grasshopper sparrows, dickcissel, western meadowlark and brown-headed cowbird numbers have more influence on the bird community composition in upland areas than less common species. Eastern wood-pewee, great crested flycatcher, black-capped chickadee, northern cardinal, red-bellied woodpecker, (eastern) tufted titmouse and yellow-billed cuckoo have the most influence on the bird community on riparian plots.

Higher average bird diversity, species richness and distribution evenness per plot in the riparian area at Tallgrass Prairie National Preserve may relate to higher vertical structure diversity when compared to the other habitats at Tallgrass Prairie National Preserve and Agate Fossil Beds National Monument. Greater structural diversity provides greater nesting opportunities for a wider range of bird species. Seventeen percent (14 species) of the 82 bird species recorded at Tallgrass Prairie National Preserve were found only on riparian plots. Only

thirty-five percent (8 species; cattle egret, eastern kingbird, field sparrow, greater prairie-chicken, grasshopper sparrow, horned lark, northern harrier hawk and western kingbird) of the 23 species recorded on upland plots can be considered prairie obligates, most of the remaining 15 species could easily be recorded on riparian plots in future surveys. Forty-five species of birds were recorded on both prairie and riparian areas at Tallgrass Prairie National Preserve.

Higher accumulations of litter on plots at Agate Fossil Beds National Monuments than upland plots at Tallgrass Prairie National Preserve may give some indication of how litter accumulation on upland plots at Tallgrass Prairie National Preserve may progress if prescribed fires occur less frequently. With net annual production, thus accumulation of dead materials significantly greater in eastern tallgrass prairies than western shortgrass prairies, the greater potential for litter accumulation on upland plots at Tallgrass Prairie National Preserve exists. Short and mixed-grass prairies such as that at Agate Fossil Beds National Monument develop a more heterogeneous and sparser canopy layer than tallgrass prairie (Lane 1995, Vinton and Collins 1997). With reduced fire and grazing, upland plots at Tallgrass Prairie National Preserve will develop a more homogeneous canopy of taller grasses when compared to the mixed-grass prairie of Agate Fossil Beds National Monument. With prolonged absence of fire and grazing, upland plots may eventually be invaded by woody plants if precipitation permits. If fire and/or grazing is introduced into the management regime at Agate Fossil Beds National Monument then litter accumulation may decrease. However, the sparser nature of mixed-grass prairie may be limiting litter accumulation already. Therefore the effects of fire and grazing may be less discernable than in a tallgrass prairie.

The use of annual prescribed fire on upland plots at Tallgrass Prairie National Preserve may be seen in the high percent of warm-season grasses compared to cool-season grasses. Fire in tallgrass prairie is used to promote warm-season grasses for cattle grazing. Cool-season grasses dominated riparian plots at Tallgrass Prairie National Preserve and all plots at Agate Fossil Beds National Monument during late spring.

Responses of bird communities to changes in habitat structure have received much attention in recent years (Cody 1981, 1985; Zimmerman 1997; Fitzgerald and Pashley 2000; Tappe et al. 2001). While some elements of habitat-bird community relationships are clearly understood for prairie systems, such as the response following removal of woody plants, others are not. Although habitats and management practices within each park have remained relatively unchanged for many years, future management action may alter habitats available to birds. In particular, if Tallgrass Prairie National Preserve lengthens their burning cycle from annual to three or more years, reduces cattle stocking rates and introduces other year round grazers, significant effects on habitats can be expected. The introduction of burning and large grazers into the management regime at Agate Fossil Beds National Monument will also influence available bird habitat. Within each park, proposed changes in management strategies will move the parks toward more heterogeneous landscapes, thus making them more appealing to a wider range of bird species. Numbers of individuals of certain species may drop but the overall species richness can be expected to increase. Our sampling design will effectively capture changes in bird community compositions related to variations in available habitat.

5.0 PLANS FOR 2004

a) Using power analysis, determine the required intensity and frequency of our bird monitoring effort in order to detect changes within a breeding bird community.

b) Utilize Distances Software to estimating bird species abundance adjusted for detectability. May not be fully able to develop until after several years (> 5 yr.) of data have been collected.
c) Examining species-habitat relationships using correlation analysis. May not be fully able to develop until after several years (> 5 yr.) of data have been collected.
d) Explore other possible approaches for data analysis including, but not limited to; data visualization, geostatistics and time-series analysis. May not be fully able to develop until after several years (> 5 yr.) of data have been collected.

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Table 1. Species recorded at Agate Fossil Beds National Monument, Nebraska (2001 and 2003) and Tallgrass Prairie National Preserve, Kansas (2001 and 2002) during breeding bird surveys by habitat type.

			AGFO		TAPR	
Common name	Species name	AOU code	Upland	Riparian	Upland	Riparian
Acadian flycatcher	*Empidonax virescens*	ACFL			SR[1]	SR
American crow	*Corvus brachyrhynchos*	AMCR			R[2]	R
American goldfinch	*Carduelis tristis*	AMGO			R	R
Bank swallow	*Riparia riparia*	BANS	SR	SR	SR	
Barred owl	*Strix varia*	BDOW				R
Barn swallow	*Hirundo rustica*	BARS		SR	SR	
Black-billed cuckoo	*Coccyzus erythropthalmus*	BBCU				SR
Black-capped chickadee	*Parus atricapillus*	BCCH			R	R
Belted kingfisher	*Ceryle alcyon*	BEKI				R
Bewick's wren	*Thryomanes bewickii*	BEWR			R	R
Blue-grey gnatcatcher	*Polioptila caerulea*	BGGN			SR	SR
Brown-headed cowbird	*Molothrus ater*	BHCO	SR	SR	R	R
Blue jay	*Cyanocitta cristata*	BLJA		R	R	R
Brown thrasher	*Toxostoma rufum*	BRTH			R	R
Blue-winged teal	*Anas discors*	BWTE		SR		
Cattle egret	*Bubulcus ibis*	CAEG			SR	
Canada goose	*Branta canadensis*	CAGO			R	
Carolina wren	*Thryothorus ludovicianus*	CARW				R
Chipping sparrow	*Spizella passerina*	CHSP	SR	SR		
Clay-colored sparrow	*Spizella pallida*	CCSP	SR			
Cliff swallow	*Hirundo pyrrhonota*	CLSW	SR		SR	SR
Common grackle	*Quiscalus quiscula*	COGR	SR		R	
Common nighthawk	*Chordeiles minor*	CONI	SR		SR	SR
Common snipe	*Gallinago gallinago*	COSN	SR	SR		
Common yellowthroat	*Geothlypis trichas*	COYE	SR	SR	SR	SR
Dickcissel	*Spiza americana*	DICK	SR		SR	SR
Downy woodpecker	*Picoides pubescens*	DOWO			R	R
Eastern bluebird	*Sialia sialis*	EABL			R	
Eastern kingbird	*Tyrannus tyrannus*	EAKI	SR	SR	SR	

Table 1. Species recorded, cont'd.

			AGFO		TAPR	
Common name	Species name	AOU code	Upland	Riparian	Upland	Riparian
Eastern meadowlark	*Sturnella magna*	EAME			R	
Eastern phoebe	*Sayornis phoebe*	EAPH				SR
Eastern wood-pewee	*Contopus virens*	EAWP			SR	SR
Field sparrow	*Spizella pusilla*	FISP			R	
Great crested flycatcher	*Myiarchus crinitus*	GCFL			SR	SR
Great horned owl	*Bubo virginianus*	GHOW			R	
Gray catbird	*Dumetella carolinensis*	GRCA				SR
Greater prairie-chicken	*Tympanuchus cupido*	GRCH			R	
Grasshopper sparrow	*Ammodramus savannarum*	GRSP	SR	SR	SR	
Great blue heron	*Ardea herodias*	GBHE		SR	R	
Great-tailed grackle	*Quiscalus mexicanus*	GTGR			SR	
Hairy woodpecker	*Picoides villosus*	HAWO			R	
Horned lark	*Eremophila alpestris*	HOLA			R	
House wren	*Troglodytes aedon*	HOWR		SR		
Indigo bunting	*Passerina cyanea*	INBU			SR	SR
Killdeer	*Charadrius vociferus*	KILL	R	R	R	
Lark bunting	*Calamospiza melanocorys*	LARB	SR	SR		
Lark sparrow	*Chondestes grammacus*	LASP	SR	SR	SR	
Loggerhead shrike	*Lanius ludovicianus*	LOSH			R	
Mallard	*Anas platyrhynchos*	MALL		R		
Marsh wren	*Cistothorus palustris*	MAWR		SR		
Mourning dove	*Zenaida macroura*	MODO	R	R	R	
Northern bobwhite	*Colinus virginianus*	NOBO			R	
Northern cardinal	*Cardinalis cardinalis*	NOCA			R	R
Northern flicker	*Colaptes auratus*	NOFL			R	
Northern parula	*Parula americana*	NOPA				SR
Northern rough-winged swallow	*Stelgidopteryx serripennis*	NRWS		SR	SR	
Orchard oriole	*Icterus spurius*	OROR			SR	SR
Prothonotary warbler	*Protonotaria citrea*	PROW				SR
Red-bellied woodpecker	*Melanerpes carolinus*	RBWO			R	R

Table 1. Species recorded, cont'd.

			AGFO		TAPR	
Common name	Species name	AOU code	Upland	Riparian	Upland	Riparian
Red-eyed vireo	*Vireo olivaceus*	REVI				SR
Red-headed woodpecker	*Melanerpes erythrocephalus*	RHWO				R
Red-tailed hawk	*Buteo jamaicensis*	RTHA	R		R	R
Ring-necked pheasant	*Phasianus colchicus*	RPHE	R	R	R	
Red-winged blackbird	*Agelaius phoeniceus*	RWBL	R	R	R	R
Rock wren	*Salpinctes obsoletus*	ROWR	SR			
Say's pheobe	*Sayornis saya*	SAPH	SR			
Sedge wren	*Cistothorus platensis*	SEWR			SR	
Scarlet tanager	*Piranga olivacea*	SCTA			SR	
Scissor-tailed flycatcher	*Tyrannus forficatus*	STFL			SR	
Sharp-tailed grouse	*Tympanuchus phasianellus*	STGR	R			
Sora	*Porzana carolina*	SORA	SR			
Summer tanager	*Piranga rubra*	SUTA			SR	SR
(Eastern) Tufted titmouse	*Parus bicolor*	ETTI			R	R
Turkey vulture	*Cathartes aura*	TUVU			SR	SR
Upland sandpiper	*Bartramia longicauda*	UPSA	SR		SR	SR
Vesper sparrow	*Pooecetes gramineus*	VESP	SR			
White-breasted nuthatch	*Sitta carolinensis*	WBNU			R	R
Western kingbird	*Tyrannus verticalis*	WEKI	SR	SR	SR	
Western meadowlark	*Sturnella neglecta*	WEME	R	R	R	R
White-eyed vireo	*Vireo griseus*	WEVI				SR
Wild turkey	*Meleagris gallopavo*	WITU			R	R
Wood duck	*Aix sponsa*	WODU		M[3]		
Yellow-breasted chat	*Icteria virens*	YBCH			SR	
Yellow-billed cuckoo	*Coccyzus americanus*	YBCU			SR	SR
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	YHBL	SR	SR		
Yellow-throated vireo	*Vireo flavifrons*	YTVI			SR	SR
Yellow warbler	*Dendroica petechia*	YWAR	SR	SR	SR	SR

[1] SR = summer resident.
[2] R = year round resident.
[3] M = late migrant.

Table 2. Additional bird species observed at Agate Fossil Beds National Monument, Nebraska (2001 and 2003) and Tallgrass Prairie National Preserve, Kansas (2001 and 2002) during the breeding season but outside of variable circular plot counts.

Common name	Species name	AOU code	AGFO	TAPR
American avocet	*Recurvirostra Americana*	AMAV	SR[1]	
American robin	*Turdus migratorius*	AMRO		R[2]
Baltimore (Northern) oriole	*Icterus galbula*	BAOR		SR
Belted kingfisher	*Ceryle alcyon*	BEKI	R	
Blue grosbeak	Guiraca caerulea	BLGR		SR
Common snipe	*Gallinago gallinago*	COSN		M[3]
Gray partridge	Perdix perdix	GRPA	R	
Green (Green-backed) heron	*Butorides virescens*	GRHE		SR
House finch	*Carpodacus mexicanus*	HOFI		R
Northern harrier hawk	*Circus cyaneus*	NOHA	SR	R
Pileated woodpecker	*Dryocopus pileatus*	PIWO		R
Spotted (Rufous-side) towhee	*Pipilo maculates*	SPTO	SR	
Swainson's hawk	*Buteo swainsoni*	SWHA	SR	
Turkey vulture	*Cathartes aura*	TUVU	SR	
Whip-poor-will	*Caprimulgus vociferus*	WPWI		SR
White-crowned sparrow	*Zonotrichia leucophrys*	WCSP	M	
Wood duck	*Aix sponsa*	WODU		R

[1] SR = summer resident.
[2] R = year round resident.
[3] M = late migrant.

Table 3. Species ranked by park, habitat type and frequency of encounter (individuals/plot visit). Species were recorded at Agate Fossil Beds National Monument, Nebraska (2001 and 2003) and Tallgrass Prairie National Preserve, Kansas (2001and 2002) during breeding bird surveys. Individuals recorded as flyovers were not included in these frequency estimates.

Agate Fossil Beds National Monument				Tallgrass Prairie National Preserve			
Upland n = 53 plots		Riparian n = 28 plots		Upland n = 400 plots		Riparian n = 36 plots	
Species	Freq.	Species	Freq.	Species	Freq.	Species	Freq.
Western meadowlark	2.000	Red-winged blackbird	3.786	Grasshopper sparrow	0.925	Eastern wood-pewee	0.528
Grasshopper sparrow	0.868	Western meadowlark	0.821	Dickcissel	0.733	Great crested flycatcher	0.417
Lark sparrow	0.358	Common yellowthroat	0.500	Western meadowlark	0.715	Black-capped chickadee	0.389
Red-winged blackbird	0.340	Killdeer	0.250	Brown-headed cowbird	0.368	Northern cardinal	0.361
Lark bunting	0.245	Common snipe	0.250	Red-winged blackbird	0.238	Red-bellied woodpecker	0.333
Rock wren	0.132	Marsh wren	0.143	Upland sandpiper	0.230	(Eastern) Tufted titmouse	0.333
Sharp-tailed grouse	0.113	Grasshopper sparrow	0.143	Eastern meadowlark	0.110	Yellow-billed cuckoo	0.306
Ring-necked pheasant	0.113	Chipping sparrow	0.143	Lark sparrow	0.080	White-breasted nuthatch	0.250
Mourning dove	0.094	Eastern kingbird	0.143	Greater prairie-chicken	0.065	Wild turkey	0.194
Brown-headed cowbird	0.075	Yellow warbler	0.107	Brown thrasher	0.043	American crow	0.194
Chipping sparrow	0.075	Blue-winged teal	0.107	(Eastern) Tufted titmouse	0.043	Bewick's wren	0.167
Yellow warbler	0.057	Lark bunting	0.107	Eastern kingbird	0.038	Acadian flycatcher	0.167
Killdeer	0.038	Mourning dove	0.071	Canada goose	0.035	Downy woodpecker	0.167
Western kingbird	0.038	Ring-neck pheasant	0.036	Killdeer	0.035	Red-eyed vireo	0.139
Red-tailed hawk	0.038	House wren	0.036	Blue jay	0.028	Common yellowthroat	0.139
Vesper sparrow	0.038	Mallard	0.036	Northern cardinal	0.023	Dickcissel	0.139
Clay-colored sparrow	0.038			Mourning dove	0.023	Indigo bunting	0.139
Common yellowthroat	0.019			Northern bobwhite	0.023	American goldfinch	0.111
Sora	0.019			Red-bellied woodpecker	0.020	Yellow warbler	0.111
Say's phoebe	0.019			American crow	0.018	Northern parula	0.111
Cliff swallow	0.019			Yellow-breasted chat	0.018	Western meadowlark	0.111
Upland sandpiper	0.019			Yellow-billed cuckoo	0.018	Eastern phoebe	0.083
Eastern kingbird	0.019			Common nighthawk	0.015	White-eyed vireo	0.083
Dickcissel	0.019			Great crested flycatcher	0.015	Blue jay	0.083
Common snipe	0.019			Summer tanager	0.010	Brown-headed cowbird	0.083
				Horned lark	0.008	Carolina wren	0.083
				Orchard oriole	0.008	Orchard oriole	0.083
				Eastern bluebird	0.008	Prothonotary warbler	0.060
				White-breasted nuthatch	0.008	Red-tailed hawk	0.060
				Black-capped chickadee	0.008	Yellow-throated vireo	0.060
				Yellow warbler	0.005	Barred owl	0.060
				Great blue heron	0.005	Black-billed cuckoo	0.060
				Acadian flycatcher	0.005	Red-winged blackbird	0.060

Table 3. Species ranked, cont'd.

Agate Fossil Beds National Monument				Tallgrass Prairie National Preserve			
Upland		Riparian		Upland		Riparian	
Species	Freq.	Species	Freq.	Species	Freq.	Species	Freq.
				Downy woodpecker	0.005	Gray catbird	0.028
				Eastern wood-pewee	0.005	Red-headed woodpecker	0.028
				American goldfinch	0.005	Summer tanager	0.028
				Common yellowthroat	0.003	Brown thrasher	0.028
				Blue-gray gnatcatcher	0.003	Blue-gray gnatcatcher	0.028
				Bewick's wren	0.003		
				Western kingbird	0.003		
				Yellow-throated vireo	0.003		
				Wild turkey	0.003		
				Ring-necked pheasant	0.003		
				Great horned owl	0.003		
				Field sparrow	0.003		
				Indigo bunting	0.003		
				Loggerhead shrike	0.003		
				Northern flicker	0.003		
				Scarlet tanager	0.003		
				Scissor-tailed flycatcher	0.003		
				Sedge wren	0.003		
				Hairy woodpecker	0.003		

Table 4. Plots "n" (plots surveyed) and mean (± SE) bird diversity, richness and evenness by habitat type at Agate Fossil Beds National Monument, Nebraska (2001 and 2003) and Tallgrass Prairie National Preserve, Kansas (2001 and 2002) during the bird breeding season. Plots were dropped from the analysis if no individuals or only flyovers were recorded for that plot.

	n	Diversity	Richness	Evenness
AGFO	80 (81)	0.83 ± 0.051	2.85 ± 0.15	0.767 ± 0.036
Upland	52 (53)	0.83 ± 0.064	2.79 ± 0.19	0.794 ± 0.049
Riparian	28 (28)	0.83 ± 0.089	2.96 ± 0.25	0.716 ± 0.061
TAPR	416 (436)	0.85 ± 0.025	2.85 ± 0.07	0.788 ± 0.017
Upland	381 (400)	0.82 ± 0.025	2.74 ± 0.07	0.778 ± 0.018
Riparian	35 (36)	1.19 ± 0.095	4.06 ± 0.37	0.899 ± 0.039

Table 5. Abiotic features of plots sampled for breeding birds at Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
AGFOTweety1	2	medium	165	medium	mid-slope	upland
AGFOTweety2	15	high	45	high	mid-slope	upland
AGFOTweety3	15	high	240	high	upper-slope	upland
AGFOTweety4	5	medium	355	high	mid-slope	upland
AGFOTweety5	5	medium	215	high	mid-slope	upland
AGFOTweety6	4	low	217	high	mid-slope	upland
AGFOTweety7	2	low	333	low	lower-slope	upland
AGFOTweety8	1	low	313	low	lower-slope	upland
AGFOTweety9	13	medium	348	high	mid-slope	upland
AGFOTweety10	1	low	335	medium	lower-slope	upland
AGFOTweety11	2	medium	300	high	mid-slope	upland
AGFOTweety12	4	medium	327	medium	mid-slope	upland
AGFOTweety13	6	low	31	low	mid-slope	upland
AGFOTweety14	4	medium	310	high	mid-slope	upland
AGFOTweety15	2	medium	310	high	mid-slope	upland
AGFOTweety16	1	low	355	medium	mid-slope	upland
AGFOTweety17	1	low	335	medium	lower-slope	riparian
AGFOTweety18	3	medium	0	low	level	riparian
AGFOTweety19	2	low	317	low	level	riparian
AGFOTweety20	0	low	135	low	level	riparian
AGFOTweety21	0	low	85	low	level	riparian
AGFOTweety22	1	low	155	low	level	riparian
AGFOTweety23	2	medium	300	high	mid-slope	riparian
AGFOTweety24	0	low	97	low	level	riparian
AGFOTweety25	0	medium	104	medium	level	riparian
AGFOTweety26	2	low	289	low	level	riparian
AGFOTweety27	0	low	105	low	level	riparian
AGFOTweety28	0	low	120	low	level	riparian
AGFOTweety29	1	low	10	low	level	riparian
AGFOTweety30	1	low	32	low	level	riparian
AGFOTweety31	2	low	130	medium	lower-slope	upland
AGFOTweety32	5	medium	85	high	mid-slope	upland
AGFOTweety33	5	medium	125	medium	mid-slope	upland
AGFOTweety34	1	low	90	low	lower-slope	upland
AGFOTweety35	4	medium	198	medium	mid-slope	upland
AGFOTweety36	2	medium	97	medium	lower-slope	upland
AGFOTweety37	3	low	171	medium	mid-slope	upland
AGFOTweety38	4	low	122	low	lower-slope	upland
AGFOTweety39	1	low	155	low	lower-slope	upland
AGFOTweety40	6	low	153	medium	lower-slope	upland
AGFOTweety41	5	low	122	medium	lower-slope	upland
AGFOTweety42	8	medium	150	medium	mid-slope	upland
AGFOTweety43	3	low	168	low	lower-slope	upland
AGFOTweety44	3	low	151	low	lower-slope	upland
AGFOTweety45	23	low	148	low	level	upland
AGFOTweety46	0	low	120	low	level	upland
AGFOTweety47	6	medium	341	medium	lower-slope	upland
AGFOTweety48	1	low	150	low	lower-slope	upland
AGFOTweety49	1	low	165	low	level	upland
AGFOTweety50	6	medium	19	high	mid-slope	upland
AGFOTweety51	1	low	130	low	level	upland

Table 5. Abioitic features, cont'd.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
AGFOTweety52	0	high	20	high	crest	upland
AGFOTweety53	13	high	320	high	lower-slope	upland
AGFOTweety54	7	high	233	high	mid-slope	upland
TAPRTweety1	2	medium	226	medium	upper-slope	upland
TAPRTweety2	8	medium	318	medium	lower-slope	upland
TAPRTweety3	4	medium	33	low	upper-slope	upland
TAPRTweety4	9	low	105	low	upper-slope	upland
TAPRTweety5	6	high	100	high	draw	upland
TAPRTweety6	6	medium	351	low	upper-slope	upland
TAPRTweety7	3	medium	96	medium	mid-slope	upland
TAPRTweety8	4	low	279	low	upper-slope	upland
TAPRTweety9	4	low	95	low	upper-slope	upland
TAPRTweety10	3	low	245	low	upper-slope	upland
TAPRTweety11	5	low	150	low	upper-slope	upland
TAPRTweety12	4	--	50	--	crest	upland
TAPRTweety13	1	low	354	low	upper-slope	upland
TAPRTweety14	8	low	343	low	mid-slope	upland
TAPRTweety15	5	high	42	high	mid-slope	upland
TAPRTweety16	7	medium	171	medium	upper-slope	upland
TAPRTweety17	0	low	251	medium	upper-slope	upland
TAPRTweety18	9	high	8	high	upper-slope	upland
TAPRTweety19	6	medium	360	low	--	upland
TAPRTweety20	5	medium	322	high	draw	upland
TAPRTweety21	1	low	98	low	upper-slope	upland
TAPRTweety22	2	low	90	low	upper-slope	upland
TAPRTweety23	2	high	127	high	draw	upland
TAPRTweety24	11	low	334	low	upper-slope	upland
TAPRTweety25	6	high	178	high	draw	upland
TAPRTweety26	3	medium	135	high	draw	upland
TAPRTweety27	8	low	213	low	upper-slope	upland
TAPRTweety28	5	low	69	low	upper-slope	upland
TAPRTweety29	2	high	93	high	draw	upland
TAPRTweety30	5	low	136	low	upper-slope	upland
TAPRTweety31	4	medium	236	medium	upper-slope	upland
TAPRTweety32	4	low	183	low	upper-slope	upland
TAPRTweety33	8	low	50	medium	upper-slope	upland
TAPRTweety34	2	low	200	low	upper-slope	upland
TAPRTweety35	3	low	227	low	draw	upland
TAPRTweety36	0	high	295	high	crest	upland
TAPRTweety37	4	high	22	high	draw	upland
TAPRTweety38	8	medium	322	medium	upper-slope	upland
TAPRTweety39	3	low	156	low	mid-slope	upland
TAPRTweety40	4	high	19	high	draw	upland
TAPRTweety41	3	low	6	medium	draw	upland
TAPRTweety42	7	medium	52	low	upper-slope	upland
TAPRTweety43	6	low	25	medium	upper-slope	upland
TAPRTweety44	6	medium	167	low	upper-slope	upland
TAPRTweety45	4	medium	144	high	draw	upland
TAPRTweety46	2	low	182	low	upper-slope	upland
TAPRTweety47	4	medium	37	high	draw	upland
TAPRTweety48	5	high	200	high	draw	upland
TAPRTweety49	2	high	333	high	draw	upland
TAPRTweety50	4	low	123	low	upper-slope	upland

Table 5. Abioitic features, cont'd.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
TAPRTweety51	8	high	141	low	upper-slope	upland
TAPRTweety52	8	medium	25	medium	upper-slope	upland
TAPRTweety53	2	low	67	low	crest	upland
TAPRTweety54	2	medium	200	medium	draw	upland
TAPRTweety55	2	low	22	low	upper-slope	upland
TAPRTweety56	3	low	125	low	mid-slope	upland
TAPRTweety57	2	low	154	medium	upper-slope	upland
TAPRTweety58	12	low	35	low	upper-slope	upland
TAPRTweety59	6	medium	190	high	--	upland
TAPRTweety60	1	low	193	low	--	upland
TAPRTweety61	2	low	243	low	upper-slope	upland
TAPRTweety62	3	low	56	low	mid-slope	upland
TAPRTweety63	8	low	71	low	upper-slope	upland
TAPRTweety64	3	high	209	high	draw	upland
TAPRTweety65	2	low	60	low	upper-slope	upland
TAPRTweety66	9	medium	128	medium	upper-slope	upland
TAPRTweety67	2	low	150	low	crest	upland
TAPRTweety68	1	low	192	low	crest	upland
TAPRTweety69	5	low	129	low	mid-slope	upland
TAPRTweety70	3	medium	101	high	mid-slope	upland
TAPRTweety71	2	low	253	low	mid-slope	upland
TAPRTweety72	7	high	49	low	mid-slope	upland
TAPRTweety73	10	high	260	high	mid-slope	upland
TAPRTweety74	12	medium	100	low	upper-slope	upland
TAPRTweety75	2	low	195	low	mid-slope	upland
TAPRTweety76	4	low	29	low	mid-slope	upland
TAPRTweety77	4	low	295	low	mid-slope	upland
TAPRTweety78	11	high	329	high	upper-slope	upland
TAPRTweety79	7	high	63	high	mid-slope	upland
TAPRTweety80	4	low	215	low	mid-slope	upland
TAPRTweety81	2	low	31	low	crest	upland
TAPRTweety82	5	low	255	medium	upper-slope	upland
TAPRTweety83	1	low	57	low	crest	upland
TAPRTweety84	9	high	230	high	mid-slope	upland
TAPRTweety85	1	low	73	low	lower-slope	upland
TAPRTweety86	4	medium	175	medium	mid-slope	upland
TAPRTweety87	3	low	52	low	upper-slope	upland
TAPRTweety88	7	high	190	medium	lower-slope	upland
TAPRTweety89	2	high	204	high	--	upland
TAPRTweety90	3	medium	159	high	upper-slope	upland
TAPRTweety91	2	high	122	medium	crest	upland
TAPRTweety92	1	low	326	medium	upper-slope	upland
TAPRTweety93	2	medium	155	low	upper-slope	upland
TAPRTweety94	8	high	218	high	mid-slope	upland
TAPRTweety95	3	medium	138	medium	upper-slope	upland
TAPRTweety96	4	high	43	high	mid-slope	upland
TAPRTweety97	2	high	169	high	mid-slope	upland
TAPRTweety98	2	low	35	medium	upper-slope	upland
TAPRTweety99	0	high	211	high	crest	upland
TAPRTweety100	2	high	107	high	lower-slope	upland
TAPRTweety101	1	low	126	low	upper-slope	upland
TAPRTweety102	1	low	57	low	lower-slope	upland
TAPRTweety103	1	low	61	low	crest	upland

Table 5. Abioitic features, cont'd.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
TAPRTweety104	5	medium	257	high	mid-slope	upland
TAPRTweety105	11	high	195	medium	upper-slope	upland
TAPRTweety106	3	low	216	low	mid-slope	upland
TAPRTweety107	3	medium	35	medium	upper-slope	upland
TAPRTweety108	4	high	164	high	draw	upland
TAPRTweety109	4	high	122	high	mid-slope	upland
TAPRTweety110	3	low	59	low	lower-slope	upland
TAPRTweety111	10	high	285	high	upper-slope	upland
TAPRTweety112	8	high	220	high	draw	upland
TAPRTweety113	3	low	41	low	upper-slope	upland
TAPRTweety114	0	low	0	low	level	upland
TAPRTweety115	2	high	104	high	mid-slope	upland
TAPRTweety116	5	medium	114	low	draw	upland
TAPRTweety117	4	low	227	low	--	upland
TAPRTweety118	5	low	115	low	upper-slope	upland
TAPRTweety119	1	low	25	low	crest	upland
TAPRTweety120	2	low	60	low	upper-slope	upland
TAPRTweety121	3	low	22	low	mid-slope	upland
TAPRTweety122	2	low	69	low	crest	upland
TAPRTweety123	8	medium	320	medium	--	upland
TAPRTweety124	8	low	1	low	mid-slope	upland
TAPRTweety125	13	high	259	high	upper-slope	upland
TAPRTweety126	3	high	241	high	draw	upland
TAPRTweety127	5	low	101	low	upper-slope	upland
TAPRTweety128	2	low	130	low	lower-slope	upland
TAPRTweety129	6	high	40	low	upper-slope	upland
TAPRTweety130	0	medium	225	high	draw	upland
TAPRTweety131	1	low	135	high	--	upland
TAPRTweety132	7	low	205	low	--	upland
TAPRTweety133	2	low	201	low	crest	upland
TAPRTweety134	4	low	326	low	upper-slope	upland
TAPRTweety135	4	medium	124	low	mid-slope	upland
TAPRTweety136	5	high	275	high	upper-slope	upland
TAPRTweety137	7	low	140	medium	mid-slope	upland
TAPRTweety138	9	high	75	high	draw	upland
TAPRTweety139	5	high	358	high	mid-slope	upland
TAPRTweety140	3	low	171	low	mid-slope	upland
TAPRTweety141	3	high	197	high	mid-slope	upland
TAPRTweety142	2	low	109	medium	upper-slope	upland
TAPRTweety143	3	low	355	low	upper-slope	upland
TAPRTweety144	4	low	125	low	upper-slope	upland
TAPRTweety145	7	medium	120	high	upper-slope	upland
TAPRTweety146	4	medium	58	low	mid-slope	upland
TAPRTweety147	3	low	149	low	lower-slope	upland
TAPRTweety148	0	medium	94	medium	crest	upland
TAPRTweety149	5	high	355	high	draw	upland
TAPRTweety150	3	high	253	medium	mid-slope	upland
TAPRTweety151	1	low	41	low	crest	upland
TAPRTweety152	8	high	232	high	--	upland
TAPRTweety153	3	medium	133	high	draw	upland
TAPRTweety154	5	medium	13	low	--	upland
TAPRTweety155	1	medium	193	medium	lower-slope	upland
TAPRTweety156	1	low	316	low	crest	upland

Table 5. Abioitic features, cont'd.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
TAPRTweety157	1	high	311	high	crest	upland
TAPRTweety158	4	low	64	low	mid-slope	upland
TAPRTweety159	1	--	131	--	--	riparian
TAPRTweety160	24	high	345	high	mid-slope	riparian
TAPRTweety161	2	medium	354	medium	lower-slope	riparian
TAPRTweety162	2	low	18	low	lower-slope	riparian
TAPRTweety163	0	low	115	low	level	riparian
TAPRTweety164	0	low	64	low	level	riparian
TAPRTweety165	3	low	82	low	level	riparian
TAPRTweety166	1	medium	247	low	level	riparian
TAPRTweety167	2	medium	127	low	lower-slope	riparian
TAPRTweety168	1	medium	164	low	level	riparian
TAPRTweety169	3	medium	84	low	level	riparian
TAPRTweety170	2	medium	116	low	level	riparian
TAPRTweety171	1	medium	31	low	level	riparian
TAPRTweety172	2	low	112	low	level	riparian
TAPRTweety173	5	low	33	low	level	riparian
TAPRTweety174	1	low	75	low	lower-slope	riparian
TAPRTweety175	10	low	70	low	lower-slope	riparian
TAPRTweety176	2	low	149	low	lower-slope	riparian
TAPRTweety177	1	medium	205	medium	crest	upland
TAPRTweety178	2	low	241	low	upper-slope	upland
TAPRTweety179	8	medium	52	medium	mid-slope	upland
TAPRTweety180	1	low	212	low	mid-slope	upland
TAPRTweety181	9	low	192	low	lower-slope	upland
TAPRTweety182	2	low	155	low	lower-slope	upland
TAPRTweety183	4	medium	115	medium	upper-slope	upland
TAPRTweety184	5	low	35	low	upper-slope	upland
TAPRTweety185	5	high	30	high	draw	upland
TAPRTweety186	2	low	234	low	upper-slope	upland
TAPRTweety187	8	high	205	high	draw	upland
TAPRTweety188	2	low	170	low	upper-slope	upland
TAPRTweety189	5	low	241	low	upper-slope	upland
TAPRTweety190	2	low	233	medium	upper-slope	upland
TAPRTweety191	4	medium	140	medium	draw	upland
TAPRTweety192	6	low	156	low	upper-slope	upland
TAPRTweety193	8	high	292	high	upper-slope	upland
TAPRTweety194	2	low	199	low	lower-slope	upland
TAPRTweety195	2	medium	349	medium	lower-slope	upland
TAPRTweety196	3	low	83	medium	upper-slope	upland
TAPRTweety197	2	low	290	low	upper-slope	upland
TAPRTweety198	11	medium	250	low	upper-slope	upland
TAPRTweety199	2	low	62	low	mid-slope	upland
TAPRTweety200	7	high	355	high	draw	upland
TAPRTweety201	2	high	282	medium	crest	upland
TAPRTweety202	3	low	274	low	mid-slope	upland
TAPRTweety203	13	high	283	low	upper-slope	upland
TAPRTweety204	4	medium	101	medium	mid-slope	upland
TAPRTweety205	2	high	185	high	draw	upland
TAPRTweety206	2	low	105	low	lower-slope	upland
TAPRTweety207	4	low	225	medium	mid-slope	upland
TAPRTweety208	5	medium	80	medium	lower-slope	upland
TAPRTweety209	5	medium	330	medium	upper-slope	upland

Table 5. Abioitic features, cont'd.

Plot number	Slope (^{O})	Slope variability	Aspect (^{O})	Aspect variability	Topographic position	Habitat type
TAPRTweety210	5	low	45	low	mid-slope	upland
TAPRTweety211	4	medium	80	low	lower-slope	upland
TAPRTweety212	9	high	222	medium	mid-slope	upland
TAPRTweety213	3	low	245	low	mid-slope	upland
TAPRTweety214	7	low	132	low	upper-slope	upland
TAPRTweety215	7	high	240	high	mid-slope	upland
TAPRTweety216	4	high	178	high	mid-slope	upland
TAPRTweety217	4	low	69	low	lower-slope	upland
TAPRTweety218	3	high	295	high	mid-slope	upland
TAPRTweety219	1	low	218	low	upper-slope	upland
TAPRTweety220	6	medium	210	low	lower-slope	upland
TAPRTweety221	1	low	209	low	mid-slope	upland
TAPRTweety222	5	medium	132	medium	mid-slope	upland
TAPRTweety223	2	low	169	low	level	upland
TAPRTweety224	8	medium	55	low	upper-slope	upland
TAPRTweety225	1	low	55	low	lower-slope	upland
TAPRTweety226	2	high	40	high	draw	upland
TAPRTweety227	5	medium	256	medium	upper-slope	upland
TAPRTweety228	10	high	240	high	draw	upland
TAPRTweety229	4	low	132	low	mid-slope	upland
TAPRTweety230	13	high	290	high	upper-slope	upland
TAPRTweety231	2	low	113	low	lower-slope	upland
TAPRTweety232	0	medium	55	medium	lower-slope	upland
TAPRTweety233	7	high	298	high	draw	upland
TAPRTweety234	1	low	43	low	crest	upland
TAPRTweety235	5	high	115	medium	mid-slope	upland
TAPRTweety236	8	medium	218	high	--	upland
TAPRTweety237	8	high	140	low	mid-slope	upland
TAPRTweety238	6	low	40	low	upper-slope	upland
TAPRTweety239	8	medium	106	medium	upper-slope	upland
TAPRTweety240	5	medium	136	medium	mid-slope	upland
TAPRTweety241	3	high	140	high	draw	upland
TAPRTweety242	1	low	150	medium	crest	upland
TAPRTweety243	3	low	222	low	mid-slope	upland
TAPRTweety244	2	medium	144	medium	upper-slope	upland
TAPRTweety245	3	medium	185	medium	upper-slope	upland
TAPRTweety246	1	medium	196	low	lower-slope	upland
TAPRTweety247	2	low	21	low	lower-slope	upland
TAPRTweety248	4	medium	202	medium	draw	upland
TAPRTweety249	3	low	180	low	mid-slope	upland
TAPRTweety250	3	high	135	high	lower-slope	upland
TAPRTweety251	12	medium	358	medium	upper-slope	upland
TAPRTweety252	4	medium	301	medium	draw	upland
TAPRTweety253	6	medium	221	low	mid-slope	upland
TAPRTweety254	0	low	248	low	level	upland
TAPRTweety255	12	high	238	high	mid-slope	upland
TAPRTweety256	5	low	142	low	upper-slope	upland
TAPRTweety257	1	low	136	low	lower-slope	upland
TAPRTweety258	7	high	116	high	upper-slope	upland
TAPRTweety259	4	high	193	medium	lower-slope	upland
TAPRTweety260	4	medium	231	low	mid-slope	upland

-- Indicates missing data.

Table 6. Location and abiotic features of subplots sampled for breeding bird habitat at Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
AGFOTweety1	1	C	1	165	
AGFOTweety1	2	340	3	160	
AGFOTweety1	3	220	12	92	
AGFOTweety1	4	100	9	170	
AGFOTweety2	1	C	18	47	
AGFOTweety2	2	340	5	24	
AGFOTweety2	3	100	10	71	
AGFOTweety2	4	220	26	194	Horizontal vegetation profile read from south (180^{o}).
AGFOTweety3	1	C	10	217	
AGFOTweety3	2	290	7	263	
AGFOTweety3	3	170	21	25	Horizontal vegetation profile read from south (180^{o}).
AGFOTweety3	4	50	25	130	
AGFOTweety4	1	C	9	31	
AGFOTweety4	2	300	6	338	
AGFOTweety4	3	180	17.5	102	
AGFOTweety4	4	60	1.5	267	
AGFOTweety5	1	C	5	76	
AGFOTweety5	2	58	10	54	
AGFOTweety5	3	178	16	28	
AGFOTweety5	4	298	6	244	
AGFOTweety6	1	C	5	216	
AGFOTweety6	2	123	8	242	
AGFOTweety6	3	243	3	211	
AGFOTweety6	4	3	7	177	Subplot partially on pasture road.
AGFOTweety7	1	C	4	6	
AGFOTweety7	2	330	3	316	
AGFOTweety7	3	210	3	328	
AGFOTweety7	4	90	3	9	
AGFOTweety8	1	C	2	316	
AGFOTweety8	2	86	3	210	
AGFOTweety8	3	326	3	203	
AGFOTweety8	4	206	2	8	
AGFOTweety9	1	C	9	26	
AGFOTweety9	2	162	7	37	
AGFOTweety9	3	282	10	0	
AGFOTweety9	4	42	6	274	
AGFOTweety10	1	C	8	116	
AGFOTweety10	2	268	3	194	
AGFOTweety10	3	148	4.5	7	
AGFOTweety10	4	28	14	247	
AGFOTweety11	1	C	6	237	
AGFOTweety11	2	310	6	274	
AGFOTweety11	3	70	10	238	
AGFOTweety11	4	190	8	39	
AGFOTweety12	1	C	6	213	
AGFOTweety12	2	69	5	179	
AGFOTweety12	3	189	3	308	
AGFOTweety12	4	309	6	156	
AGFOTweety13	1	C	6	77	
AGFOTweety13	2	306	8	85	
AGFOTweety13	3	66	2	18	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (°)	Slope (°)	Aspect (°)	Comments
AGFOTweety13	4	186	10	53	
AGFOTweety14	1	C	5	324	
AGFOTweety14	2	172	9.5	22	
AGFOTweety14	3	52	9	262	
AGFOTweety14	4	292	4	344	
AGFOTweety15	1	C	6	20	Subplot in gravel wash.
AGFOTweety15	2	210	5	220	
AGFOTweety15	3	330	1	320	
AGFOTweety15	4	90	0	345	
AGFOTweety16	1	C	1	355	
AGFOTweety16	2	270	1	305	
AGFOTweety16	3	30	2	350	
AGFOTweety16	4	150	1	325	
AGFOTweety17	1	C	14	297	Horizontal vegetation profile read from south (180°).
AGFOTweety17	2	173	6	254	
AGFOTweety17	3	53	4.5	9	
AGFOTweety17	4	293	0	210	Horizontal vegetation profile read from south (180°).
AGFOTweety18	1	C	12	327	Horizontal vegetation profile read from south (180°).
AGFOTweety18	2	256	2.5	331	Horizontal vegetation profile read from south (180°).
AGFOTweety18	3	136	7	26	
AGFOTweety18	4	16	--	--	Subplot in Niobrara River, not sampled.
AGFOTweety19	1	C	29	272	
AGFOTweety19	2	122	2	291	
AGFOTweety19	3	242	0	358	
AGFOTweety19	4	2	1	333	
AGFOTweety20	1	C	1.5	147	Horizontal vegetation profile read from south (180°).
AGFOTweety20	2	325	0	143	Horizontal vegetation profile read from south (180°).
AGFOTweety20	3	205	1	96	
AGFOTweety20	4	85	0.5	173	
AGFOTweety21	1	C	1	34	
AGFOTweety21	2	131	4	23	Subplot partially in water.
AGFOTweety21	3	251	3	12	
AGFOTweety21	4	11	0	184	
AGFOTweety22	1	C	2	246	Subplot partially in water.
AGFOTweety22	2	308	--	--	Subplot in Niobrara River, not sampled.
AGFOTweety22	3	188	1	124	Horizontal vegetation profile read from south (180°).
AGFOTweety22	4	68	1	168	
AGFOTweety23	1	C	3	326	Horizontal vegetation profile read from south (180°).
AGFOTweety23	2	162	0	356	
AGFOTweety23	3	42	0.5	315	
AGFOTweety23	4	282	1	180	Subplot partially in water.
AGFOTweety24	1	C	0.5	66	Horizontal vegetation profile read from south (180°).
AGFOTweety24	2	167	9.5	188	
AGFOTweety24	3	287	1	12	Horizontal vegetation profile read from south (180°).
AGFOTweety24	4	47	0.5	180	
AGFOTweety25	1	C	1	83	Horizontal vegetation profile read from south (180°).
AGFOTweety25	2	173	2	312	
AGFOTweety25	3	53	2.5	155	
AGFOTweety25	4	293	3	142	
AGFOTweety26	1	C	2	273	Horizontal vegetation profile read from south (180°).
AGFOTweety26	2	93	1.5	279	
AGFOTweety26	3	213	1	8	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (°)	Slope (°)	Aspect (°)	Comments
AGFOTweety26	4	333	6	281	Subplot partially in water. Horizontal vegetation profile read from south (180°).
AGFOTweety27	1	C	1.5	35	
AGFOTweety27	2	290	--	--	Subplot in Niobrara River, not sampled.
AGFOTweety27	3	170	0.5	154	Subplot partially in water.
AGFOTweety27	4	50	1	166	
AGFOTweety28	1	C	1	175	Subplot partially in water. Horizontal vegetation profile read from south (180°).
AGFOTweety28	2	37	4	200	
AGFOTweety28	3	157	--	--	Subplot in Niobrara River, not sampled.
AGFOTweety28	4	277	0	22	Horizontal vegetation profile read from south (180°).
AGFOTweety29	1	C	0.5	17	Subplot partially in water. Horizontal vegetation profile read from south (180°).
AGFOTweety29	2	159	6	21	
AGFOTweety29	3	39	2	27	Horizontal vegetation profile read from south (180°).
AGFOTweety29	4	279	4	126	
AGFOTweety30	1	C	0.5	14	
AGFOTweety30	2	202	1	288	Horizontal vegetation profile read from south (180°).
AGFOTweety30	3	82	2.5	96	
AGFOTweety30	4	322	13	248	
AGFOTweety31	1	C	3	100	
AGFOTweety31	2	140	1	290	
AGFOTweety31	3	260	14	109	Subplot north of highway.
AGFOTweety31	4	20	1	115	Subplot north of highway.
AGFOTweety32	1	C	6	74	
AGFOTweety32	2	90	4	40	
AGFOTweety32	3	210	20	5	
AGFOTweety32	4	330	3	110	
AGFOTweety33	1	C	6	118	
AGFOTweety33	2	54	2	295	
AGFOTweety33	3	174	1	210	
AGFOTweety33	4	294	9	310	
AGFOTweety34	1	C	0	150	
AGFOTweety34	2	330	0	110	Subplot north of highway.
AGFOTweety34	3	90	1	240	Subplot north of highway.
AGFOTweety34	4	210	1	240	
AGFOTweety35	1	C	3	195	
AGFOTweety35	2	350	4	210	
AGFOTweety35	3	110	5	195	
AGFOTweety35	4	230	3	200	
AGFOTweety36	1	C	3	172	Subplot on top of underground sewage tanks.
AGFOTweety36	2	215	2	2	
AGFOTweety36	3	335	2	147	
AGFOTweety36	4	95	3	191	
AGFOTweety37	1	C	1	165	
AGFOTweety37	2	160	2	169	
AGFOTweety37	3	40	4	198	
AGFOTweety37	4	280	10	185	
AGFOTweety38	1	C	3	107	
AGFOTweety38	2	305	5	124	
AGFOTweety38	3	65	11	140	
AGFOTweety38	4	185	4	145	Horizontal vegetation profile read from south (180°).
AGFOTweety39	1	C	1	150	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
AGFOTweety39	2	43	1	178	
AGFOTweety39	3	163	2	145	
AGFOTweety39	4	283	1	145	
AGFOTweety40	1	C	6	151	
AGFOTweety40	2	175	6	157	
AGFOTweety40	3	295	8	165	Horizontal vegetation profile read from south (180^{o}).
AGFOTweety40	4	55	2	165	
AGFOTweety41	1	C	1	226	
AGFOTweety41	2	185	5	147	
AGFOTweety41	3	305	2	190	
AGFOTweety41	4	65	0	282	
AGFOTweety42	1	C	10	190	
AGFOTweety42	2	30	8	130	
AGFOTweety42	3	150	6	140	
AGFOTweety42	4	270	4	260	
AGFOTweety43	1	C	2	170	
AGFOTweety43	2	100	0	140	
AGFOTweety43	3	220	0	120	
AGFOTweety43	4	340	11	144	
AGFOTweety44	1	C	2	141	
AGFOTweety44	2	185	3	170	
AGFOTweety44	3	305	3	132	
AGFOTweety44	4	65	2	190	
AGFOTweety45	1	C	9	351	Subplot partially on highway.
AGFOTweety45	2	350	1	195	
AGFOTweety45	3	110	0	137	
AGFOTweety45	4	230	4	353	
AGFOTweety46	1	C	2	21	
AGFOTweety46	2	25	1	120	
AGFOTweety46	3	145	2	122	
AGFOTweety46	4	265	0	120	
AGFOTweety47	1	C	9	137	
AGFOTweety47	2	115	16	179	
AGFOTweety47	3	235	5	284	
AGFOTweety47	4	355	3	304	
AGFOTweety48	1	C	1	148	
AGFOTweety48	2	300	3	120	
AGFOTweety48	3	60	1	192	
AGFOTweety48	4	180	0	140	
AGFOTweety49	1	C	0	170	
AGFOTweety49	2	130	1	322	
AGFOTweety49	3	250	1	111	
AGFOTweety49	4	10	1	205	
AGFOTweety50	1	C	6	195	
AGFOTweety50	2	60	4	186	
AGFOTweety50	3	180	10	230	
AGFOTweety50	4	300	11	245	
AGFOTweety51	1	C	0	165	
AGFOTweety51	2	50	0	90	
AGFOTweety51	3	170	10	35	Subplot partially in water. Horizontal vegetation profile read from south (180^{o}).
AGFOTweety51	4	290	5	210	
AGFOTweety52	1	C	1	331	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (°)	Slope (°)	Aspect (°)	Comments
AGFOTweety52	2	156	28	145	
AGFOTweety52	3	276	--	--	Subplot on cliff face, not sampled.
AGFOTweety52	4	36	0	10	
AGFOTweety53	1	C	8	330	
AGFOTweety53	2	320	11	190	
AGFOTweety53	3	80	9	115	Horizontal vegetation profile read from south (180°).
AGFOTweety53	4	200	1	85	
AGFOTweety54	1	C	8	200	
AGFOTweety54	2	230	8	270	
AGFOTweety54	3	350	13	200	
AGFOTweety54	4	110	20	3	
TAPRTweety1	1	C	1.5	189	
TAPRTweety1	2	14	2.5	182	
TAPRTweety1	3	134	3	122	
TAPRTweety1	4	254	3	256	
TAPRTweety2	1	C	5	294	
TAPRTweety2	2	320	2.5	15	Subplot partially in water.
TAPRTweety2	3	200	4	342	
TAPRTweety2	4	80	15.5	251	
TAPRTweety3	1	C	5	54	
TAPRTweety3	2	144	2.5	41	
TAPRTweety3	3	24	14	67	
TAPRTweety3	4	264	2	354	
TAPRTweety4	1	C	10	97	
TAPRTweety4	2	60	6	98	
TAPRTweety4	3	300	3.5	93	
TAPRTweety4	4	180	9.5	98	
TAPRTweety5	1	C	6.5	56	
TAPRTweety5	2	243	3.5	84	
TAPRTweety5	3	3	6.5	82	
TAPRTweety5	4	123	10	300	
TAPRTweety6	1	C	5	316	
TAPRTweety6	2	223	8	327	
TAPRTweety6	3	103	8	350	
TAPRTweety6	4	343	16	331	
TAPRTweety7	1	C	2.5	140	
TAPRTweety7	2	245	3	145	
TAPRTweety7	3	5	3	77	
TAPRTweety7	4	125	5	165	
TAPRTweety8	1	C	4	284	
TAPRTweety8	2	359	4	260	
TAPRTweety8	3	239	7	260	
TAPRTweety8	4	119	2	271	
TAPRTweety9	1	C	3	94	
TAPRTweety9	2	15	3	88	
TAPRTweety9	3	135	5	71	
TAPRTweety9	4	255	1	23	
TAPRTweety10	1	C	3	209	
TAPRTweety10	2	10	2.5	303	
TAPRTweety10	3	130	3	130	
TAPRTweety10	4	250	3	198	
TAPRTweety11	1	C	6	175	
TAPRTweety11	2	128	8	151	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety11	3	8	0.5	100	
TAPRTweety11	4	248	5	147	
TAPRTweety12	1	C	0	40	
TAPRTweety12	2	164	2	140	
TAPRTweety12	3	44	1.5	44	
TAPRTweety12	4	284	2	277	
TAPRTweety13	1	C	1	351	
TAPRTweety13	2	18	1.5	357	
TAPRTweety13	3	258	1.5	264	
TAPRTweety13	4	138	0.5	354	
TAPRTweety14	1	C	7	325	
TAPRTweety14	2	66	5	320	
TAPRTweety14	3	306	5	320	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety14	4	186	5	325	
TAPRTweety15	1	C	5	52	
TAPRTweety15	2	223	4	11	
TAPRTweety15	3	103	2	348	
TAPRTweety15	4	343	4	38	
TAPRTweety16	1	C	7.5	171	
TAPRTweety16	2	70	8	187	
TAPRTweety16	3	190	8	30	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety16	4	310	3	164	
TAPRTweety17	1	C	0.5	229	
TAPRTweety17	2	3	1	32	
TAPRTweety17	3	243	1	210	
TAPRTweety17	4	123	1	50	
TAPRTweety18	1	C	10	10	
TAPRTweety18	2	68	9	324	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety18	3	308	10	346	
TAPRTweety18	4	188	9	59	
TAPRTweety19	1	C	9	337	
TAPRTweety19	2	133	8	120	
TAPRTweety19	3	253	6	346	
TAPRTweety19	4	13	11	352	
TAPRTweety20	1	C	6	353	
TAPRTweety20	2	210	4	341	
TAPRTweety20	3	90	9.5	262	
TAPRTweety20	4	330	3	272	
TAPRTweety21	1	C	2	109	
TAPRTweety21	2	40	2	42	
TAPRTweety21	3	160	0	135	
TAPRTweety21	4	280	2	224	
TAPRTweety22	1	C	2.5	86	
TAPRTweety22	2	148	5	121	
TAPRTweety22	3	268	2.5	102	
TAPRTweety22	4	28	5	42	
TAPRTweety23	1	C	7	181	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety23	2	177	4.5	94	
TAPRTweety23	3	297	4	142	
TAPRTweety23	4	57	3	180	
TAPRTweety24	1	C	11	345	
TAPRTweety24	2	40	5	18	
TAPRTweety24	3	280	6.5	307	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety24	4	160	0	339	
TAPRTweety25	1	C	11	212	
TAPRTweety25	2	315	10	218	
TAPRTweety25	3	195	8	63	
TAPRTweety25	4	75	5	204	
TAPRTweety26	1	C	7	202	
TAPRTweety26	2	293	6	168	
TAPRTweety26	3	53	4	205	
TAPRTweety26	4	173	3.5	359	
TAPRTweety27	1	C	8	202	
TAPRTweety27	2	95	9	214	
TAPRTweety27	3	215	5	193	
TAPRTweety27	4	335	3	203	
TAPRTweety28	1	C	4	76	
TAPRTweety28	2	10	2.5	98	
TAPRTweety28	3	130	5	84	
TAPRTweety28	4	250	8	83	
TAPRTweety29	1	C	0.5	131	
TAPRTweety29	2	10	5.5	165	
TAPRTweety29	3	130	7.5	14	
TAPRTweety29	4	250	11	14	
TAPRTweety30	1	C	6	134	
TAPRTweety30	2	248	7	134	
TAPRTweety30	3	128	4	156	
TAPRTweety30	4	8	7	147	
TAPRTweety31	1	C	5	222	
TAPRTweety31	2	43	1.5	186	Subplot on pasture road.
TAPRTweety31	3	283	1	220	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety31	4	163	4.5	300	
TAPRTweety32	1	C	4	215	
TAPRTweety32	2	72	3	193	
TAPRTweety32	3	192	5	209	
TAPRTweety32	4	312	4.5	214	
TAPRTweety33	1	C	11	14	
TAPRTweety33	2	129	9	82	
TAPRTweety33	3	9	7	8	
TAPRTweety33	4	249	3	50	
TAPRTweety34	1	C	2	204	
TAPRTweety34	2	145	2	199	
TAPRTweety34	3	265	3	218	
TAPRTweety34	4	25	0	230	
TAPRTweety35	1	C	2	206	
TAPRTweety35	2	295	3	226	
TAPRTweety35	3	175	3	334	
TAPRTweety35	4	55	2	215	Subplot on pasture road.
TAPRTweety36	1	C	1	104	
TAPRTweety36	2	20	6.5	4	
TAPRTweety36	3	140	12	194	
TAPRTweety36	4	260	6	171	
TAPRTweety37	1	C	1.5	34	
TAPRTweety37	2	253	12	9	
TAPRTweety37	3	13	1	79	
TAPRTweety37	4	133	8	30	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety38	1	C	8.5	307	
TAPRTweety38	2	282	4.5	299	
TAPRTweety38	3	42	5.5	1	
TAPRTweety38	4	162	9	107	
TAPRTweety39	1	C	4.5	161	
TAPRTweety39	2	245	3	161	
TAPRTweety39	3	125	2	142	
TAPRTweety39	4	5	8	161	
TAPRTweety40	1	C	5.5	358	
TAPRTweety40	2	258	4	64	
TAPRTweety40	3	18	15	100	
TAPRTweety40	4	138	3	0	
TAPRTweety41	1	C	3	343	
TAPRTweety41	2	197	9	0	
TAPRTweety41	3	317	3	4	
TAPRTweety41	4	77	3	241	
TAPRTweety42	1	C	6	65	
TAPRTweety42	2	52	6	86	
TAPRTweety42	3	292	9	19	
TAPRTweety42	4	172	9	76	
TAPRTweety43	1	C	6	5	
TAPRTweety43	2	304	6	339	
TAPRTweety43	3	184	2	294	
TAPRTweety43	4	64	6	12	
TAPRTweety44	1	C	6	143	
TAPRTweety44	2	142	5.5	149	
TAPRTweety44	3	262	4	148	
TAPRTweety44	4	22	2	97	
TAPRTweety45	1	C	5.5	148	
TAPRTweety45	2	4	4	97	
TAPRTweety45	3	124	4	121	
TAPRTweety45	4	244	4	170	
TAPRTweety46	1	C	1	165	Was not sampled in 2001
TAPRTweety46	2	272	2	173	Was not sampled in 2001
TAPRTweety46	3	152	4	193	Was not sampled in 2001
TAPRTweety46	4	32	1	185	Was not sampled in 2001
TAPRTweety47	1	C	6	32	
TAPRTweety47	2	6	14	13	Subplot located in deep ravine.
TAPRTweety47	3	126	5	330	
TAPRTweety47	4	246	8	16	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety48	1	C	4	193	
TAPRTweety48	2	4	7.5	163	
TAPRTweety48	3	124	4.5	227	
TAPRTweety48	4	244	5	198	
TAPRTweety49	1	C	11.5	76	
TAPRTweety49	2	318	14	273	
TAPRTweety49	3	78	7	247	
TAPRTweety49	4	198	10	37	
TAPRTweety50	1	C	2	198	
TAPRTweety50	2	195	1	172	
TAPRTweety50	3	75	2	156	
TAPRTweety50	4	315	3	164	
TAPRTweety51	1	C	7.5	154	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety51	2	358	4	114	
TAPRTweety51	3	118	5	153	
TAPRTweety51	4	238	4	170	
TAPRTweety52	1	C	9	5	
TAPRTweety52	2	17	8	11	
TAPRTweety52	3	257	11	349	
TAPRTweety52	4	137	4	99	
TAPRTweety53	1	C	2.5	83	
TAPRTweety53	2	203	2	61	
TAPRTweety53	3	323	1.5	342	
TAPRTweety53	4	83	4	96	
TAPRTweety54	1	C	1.5	305	
TAPRTweety54	2	312	3.5	251	
TAPRTweety54	3	192	3	178	
TAPRTweety54	4	72	2.5	335	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety55	1	C	2	11	
TAPRTweety55	2	26	2	358	
TAPRTweety55	3	146	3	352	Subplot partially on pasture road.
TAPRTweety55	4	266	2	5	
TAPRTweety56	1	C	2.5	131	
TAPRTweety56	2	119	2.5	181	
TAPRTweety56	3	239	2.5	173	
TAPRTweety56	4	359	2	132	
TAPRTweety57	1	C	3	170	
TAPRTweety57	2	204	2	190	
TAPRTweety57	3	84	3	158	
TAPRTweety57	4	324	4	144	
TAPRTweety58	1	C	8.5	8	
TAPRTweety58	2	8	5	20	
TAPRTweety58	3	128	8	34	
TAPRTweety58	4	248	9	6	
TAPRTweety59	1	C	8	181	
TAPRTweety59	2	35	7	121	
TAPRTweety59	3	275	6	239	
TAPRTweety59	4	155	6	163	
TAPRTweety60	1	C	1	232	
TAPRTweety60	2	149	4	129	
TAPRTweety60	3	269	5	266	
TAPRTweety60	4	29	2.5	201	
TAPRTweety61	1	C	2	259	
TAPRTweety61	2	146	3	187	
TAPRTweety61	3	266	5	259	
TAPRTweety61	4	26	2	239	
TAPRTweety62	1	C	4	53	
TAPRTweety62	2	298	5	83	
TAPRTweety62	3	178	8	56	
TAPRTweety62	4	58	3	38	
TAPRTweety63	1	C	11	52	
TAPRTweety63	2	195	9	63	
TAPRTweety63	3	75	4.5	71	
TAPRTweety63	4	315	5	77	
TAPRTweety64	1	C	8	269	
TAPRTweety64	2	183	6	225	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety64	3	303	8.5	139	
TAPRTweety64	4	63	2	233	
TAPRTweety65	1	C	2	84	
TAPRTweety65	2	43	3	42	
TAPRTweety65	3	283	1	63	
TAPRTweety65	4	163	2	92	
TAPRTweety66	1	C	14	107	
TAPRTweety66	2	2	6	92	
TAPRTweety66	3	122	11	108	
TAPRTweety66	4	242	2	223	
TAPRTweety67	1	C	2	147	
TAPRTweety67	2	128	3	163	
TAPRTweety67	3	8	2	163	
TAPRTweety67	4	248	1	121	
TAPRTweety68	1	C	1.5	183	
TAPRTweety68	2	119	4	243	
TAPRTweety68	3	239	4	202	
TAPRTweety68	4	359	1	224	
TAPRTweety69	1	C	5	114	
TAPRTweety69	2	150	3	126	
TAPRTweety69	3	30	3.5	98	
TAPRTweety69	4	270	7.5	135	
TAPRTweety70	1	C	3	47	
TAPRTweety70	2	85	1.5	70	Subplot partially in a spring with standing water.
TAPRTweety70	3	325	12	200	
TAPRTweety70	4	205	7	75	
TAPRTweety71	1	C	1.5	254	
TAPRTweety71	2	123	2.5	234	
TAPRTweety71	3	243	2	241	
TAPRTweety71	4	3	2	265	
TAPRTweety72	1	C	3	47	
TAPRTweety72	2	57	2	148	
TAPRTweety72	3	297	2	35	
TAPRTweety72	4	177	9.5	38	
TAPRTweety73	1	C	10	77	Subplot partially in pond. Horizontal vegetation profile read from west (270^{o}).
TAPRTweety73	2	292	0	178	
TAPRTweety73	3	52	--	--	Subplot in pond, not sampled.
TAPRTweety73	4	172	8	3	
TAPRTweety74	1	C	8.5	116	
TAPRTweety74	2	78	5	96	
TAPRTweety74	3	198	7	115	
TAPRTweety74	4	318	3	108	
TAPRTweety75	1	C	3	180	
TAPRTweety75	2	259	2.5	201	
TAPRTweety75	3	139	2.5	192	
TAPRTweety75	4	19	2	211	
TAPRTweety76	1	C	3	26	
TAPRTweety76	2	263	4	56	
TAPRTweety76	3	23	2.5	55	
TAPRTweety76	4	143	8	349	
TAPRTweety77	1	C	2	263	
TAPRTweety77	2	140	2	263	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety77	3	20	2	270	
TAPRTweety77	4	260	1	263	
TAPRTweety78	1	C	12	312	
TAPRTweety78	2	16	13.5	338	
TAPRTweety78	3	256	4	28	
TAPRTweety78	4	136	2	41	
TAPRTweety79	1	C	9	75	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety79	2	7	3.5	149	
TAPRTweety79	3	127	6	338	
TAPRTweety79	4	247	8	48	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety80	1	C	1	173	
TAPRTweety80	2	227	1.5	243	
TAPRTweety80	3	107	1.5	124	
TAPRTweety80	4	347	0.5	128	
TAPRTweety81	1	C	3	36	
TAPRTweety81	2	88	4	31	
TAPRTweety81	3	328	2	16	
TAPRTweety81	4	208	1	10	
TAPRTweety82	1	C	2	318	
TAPRTweety82	2	229	4	303	
TAPRTweety82	3	349	1.5	169	
TAPRTweety82	4	109	2	296	
TAPRTweety83	1	C	1	62	
TAPRTweety83	2	296	1	26	
TAPRTweety83	3	56	2	55	
TAPRTweety83	4	176	1	115	
TAPRTweety84	1	C	14	229	
TAPRTweety84	2	15	5	276	
TAPRTweety84	3	255	9	255	
TAPRTweety84	4	135	8.5	181	
TAPRTweety85	1	C	1	80	
TAPRTweety85	2	160	1.5	81	
TAPRTweety85	3	280	1	78	
TAPRTweety85	4	40	1	77	
TAPRTweety86	1	C	5	167	
TAPRTweety86	2	25	2	145	
TAPRTweety86	3	265	4.5	207	
TAPRTweety86	4	145	4.5	172	
TAPRTweety87	1	C	3	49	
TAPRTweety87	2	26	4	57	
TAPRTweety87	3	266	2.5	59	
TAPRTweety87	4	146	2	57	
TAPRTweety88	1	C	4	186	
TAPRTweety88	2	317	17	174	
TAPRTweety88	3	77	4	183	
TAPRTweety88	4	197	4	343	
TAPRTweety89	1	C	2.5	99	Subplot partially in flowing water.
TAPRTweety89	2	3	20	93	Subplot partially in flowing water.
TAPRTweety89	3	123	12.5	283	
TAPRTweety89	4	243	11.5	98	
TAPRTweety90	1	C	2.5	148	
TAPRTweety90	2	200	3	167	
TAPRTweety90	3	80	7	111	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety90	4	320	3	170	
TAPRTweety91	1	C	2.5	57	
TAPRTweety91	2	206	9	159	
TAPRTweety91	3	326	2.5	15	
TAPRTweety91	4	86	5	75	
TAPRTweety92	1	C	1.5	323	
TAPRTweety92	2	46	0.5	72	
TAPRTweety92	3	286	1.5	219	
TAPRTweety92	4	166	1	344	
TAPRTweety93	1	C	3	142	
TAPRTweety93	2	232	1	177	
TAPRTweety93	3	112	6	113	
TAPRTweety93	4	352	2	135	
TAPRTweety94	1	C	6	225	
TAPRTweety94	2	140	6	211	
TAPRTweety94	3	260	4	243	
TAPRTweety94	4	20	4	258	
TAPRTweety95	1	C	2	154	
TAPRTweety95	2	298	1	103	
TAPRTweety95	3	178	4	117	
TAPRTweety95	4	58	3	141	
TAPRTweety96	1	C	6	35	
TAPRTweety96	2	36	--	--	Subplot in pond, not sampled.
TAPRTweety96	3	276	4	33	
TAPRTweety96	4	156	9	316	
TAPRTweety97	1	C	3.5	160	
TAPRTweety97	2	143	6.5	181	
TAPRTweety97	3	263	4.5	203	
TAPRTweety97	4	23	2	74	
TAPRTweety98	1	C	2	43	
TAPRTweety98	2	37	4.5	37	
TAPRTweety98	3	157	1.5	59	
TAPRTweety98	4	277	2	56	
TAPRTweety99	1	C	0	283	
TAPRTweety99	2	230	2	301	
TAPRTweety99	3	350	1.5	295	
TAPRTweety99	4	110	3.5	107	
TAPRTweety100	1	C	1	116	
TAPRTweety100	2	63	2	174	
TAPRTweety100	3	303	3.5	157	
TAPRTweety100	4	183	3	46	
TAPRTweety101	1	C	2	147	
TAPRTweety101	2	271	2	164	
TAPRTweety101	3	31	2.5	28	
TAPRTweety101	4	151	1.5	155	
TAPRTweety102	1	C	1	85	
TAPRTweety102	2	117	1	127	
TAPRTweety102	3	357	1	58	
TAPRTweety102	4	237	1	67	
TAPRTweety103	1	C	1	109	
TAPRTweety103	2	32	2	32	
TAPRTweety103	3	152	0	198	
TAPRTweety103	4	272	1	117	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (°)	Slope (°)	Aspect (°)	Comments
TAPRTweety104	1	C	4	249	
TAPRTweety104	2	95	1	235	
TAPRTweety104	3	215	5	244	
TAPRTweety104	4	335	3	268	
TAPRTweety105	1	C	9	209	
TAPRTweety105	2	126	14	233	
TAPRTweety105	3	246	9	135	
TAPRTweety105	4	6	5	198	
TAPRTweety106	1	C	4	208	
TAPRTweety106	2	19	5	201	
TAPRTweety106	3	139	3	198	
TAPRTweety106	4	259	2	219	
TAPRTweety107	1	C	2	34	
TAPRTweety107	2	276	0	63	
TAPRTweety107	3	36	11.5	36	
TAPRTweety107	4	156	0	141	
TAPRTweety108	1	C	5	168	
TAPRTweety108	2	117	4.5	212	
TAPRTweety108	3	237	6	95	
TAPRTweety108	4	357	5	201	
TAPRTweety109	1	C	3.5	123	
TAPRTweety109	2	45	8.5	74	
TAPRTweety109	3	165	13	39	
TAPRTweety109	4	285	3	132	
TAPRTweety110	1	C	3	109	
TAPRTweety110	2	55	2	205	
TAPRTweety110	3	295	2	78	
TAPRTweety110	4	175	1	103	
TAPRTweety111	1	C	11	276	
TAPRTweety111	2	146	17	306	
TAPRTweety111	3	266	16.5	295	
TAPRTweety111	4	26	14	219	
TAPRTweety112	1	C	7.5	186	
TAPRTweety112	2	116	6	217	
TAPRTweety112	3	356	0	189	
TAPRTweety112	4	236	9.5	188	
TAPRTweety113	1	C	3.5	7	
TAPRTweety113	2	300	4	6	
TAPRTweety113	3	60	2.5	30	
TAPRTweety113	4	180	4	15	
TAPRTweety114	1	C	3	240	
TAPRTweety114	2	60	1.5	239	Subplot partially in spring with flowing water.
TAPRTweety114	3	180	0	294	
TAPRTweety114	4	300	1.5	115	
TAPRTweety115	1	C	2	86	
TAPRTweety115	2	70	5	204	
TAPRTweety115	3	310	3	130	
TAPRTweety115	4	190	2.5	139	
TAPRTweety116	1	C	5	132	
TAPRTweety116	2	52	5.5	180	Horizontal vegetation profile read from south (180°).
TAPRTweety116	3	292	12	107	
TAPRTweety116	4	172	5	115	
TAPRTweety117	1	C	3	235	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety117	2	113	2	222	
TAPRTweety117	3	233	11	257	
TAPRTweety117	4	353	3	225	
TAPRTweety118	1	C	5	98	
TAPRTweety118	2	334	8.5	116	
TAPRTweety118	3	94	4	119	
TAPRTweety118	4	214	5	170	
TAPRTweety119	1	C	2	48	
TAPRTweety119	2	132	2	18	
TAPRTweety119	3	12	4	46	
TAPRTweety119	4	252	1	172	
TAPRTweety120	1	C	1	105	
TAPRTweety120	2	166	2	84	
TAPRTweety120	3	46	2	45	
TAPRTweety120	4	286	1.5	63	
TAPRTweety121	1	C	3	14	
TAPRTweety121	2	28	5	10	
TAPRTweety121	3	148	3	23	
TAPRTweety121	4	268	5	45	
TAPRTweety122	1	C	1	356	
TAPRTweety122	2	57	3	18	
TAPRTweety122	3	297	2.5	45	
TAPRTweety122	4	177	2	157	
TAPRTweety123	1	C	9	322	
TAPRTweety123	2	272	6	346	
TAPRTweety123	3	32	6	309	
TAPRTweety123	4	152	1.5	329	
TAPRTweety124	1	C	5	11	
TAPRTweety124	2	33	5.5	13	
TAPRTweety124	3	153	10.5	20	
TAPRTweety124	4	273	7.5	12	
TAPRTweety125	1	C	15	257	
TAPRTweety125	2	117	17	121	
TAPRTweety125	3	237	13	262	
TAPRTweety125	4	357	6	226	
TAPRTweety126	1	C	18.5	155	
TAPRTweety126	2	42	5	170	
TAPRTweety126	3	162	7	308	
TAPRTweety126	4	282	5.5	205	
TAPRTweety127	1	C	8	110	
TAPRTweety127	2	51	4	84	
TAPRTweety127	3	291	2	85	
TAPRTweety127	4	171	5	124	
TAPRTweety128	1	C	2.5	191	
TAPRTweety128	2	340	2.5	178	
TAPRTweety128	3	220	5.5	63	
TAPRTweety128	4	100	1.5	165	
TAPRTweety129	1	C	6	65	
TAPRTweety129	2	353	16	49	
TAPRTweety129	3	113	9	343	
TAPRTweety129	4	233	3	54	
TAPRTweety130	1	C	1	195	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety130	2	2	19	143	Horizontal vegetation profile read from south (180^{o}).

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety130	3	242	5	136	
TAPRTweety130	4	122	2	288	
TAPRTweety131	1	C	0	50	
TAPRTweety131	2	142	2.5	158	
TAPRTweety131	3	262	2	2	
TAPRTweety131	4	22	3	0	
TAPRTweety132	1	C	5	174	
TAPRTweety132	2	60	11.5	203	
TAPRTweety132	3	300	6.5	197	
TAPRTweety132	4	180	1	98	
TAPRTweety133	1	C	2	187	
TAPRTweety133	2	45	1.5	173	
TAPRTweety133	3	165	5	166	
TAPRTweety133	4	285	7	266	
TAPRTweety134	1	C	2.5	356	
TAPRTweety134	2	193	1.5	288	
TAPRTweety134	3	313	8.5	348	
TAPRTweety134	4	73	3	313	
TAPRTweety135	1	C	1.5	111	
TAPRTweety135	2	131	5	16	
TAPRTweety135	3	251	3	152	
TAPRTweety135	4	11	1	150	
TAPRTweety136	1	C	11	339	
TAPRTweety136	2	20	16.5	238	
TAPRTweety136	3	260	9	335	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety136	4	140	12	1	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety137	1	C	7	135	
TAPRTweety137	2	300	11	149	
TAPRTweety137	3	180	8	123	
TAPRTweety137	4	60	5	125	
TAPRTweety138	1	C	9	85	
TAPRTweety138	2	330	15	44	
TAPRTweety138	3	90	9	313	
TAPRTweety138	4	210	7	65	
TAPRTweety139	1	C	10	42	
TAPRTweety139	2	350	3	333	
TAPRTweety139	3	110	0.5	70	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety139	4	230	5	355	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety140	1	C	2	154	
TAPRTweety140	2	307	3	172	
TAPRTweety140	3	187	2	169	
TAPRTweety140	4	67	3	129	
TAPRTweety141	1	C	17	271	
TAPRTweety141	2	52	5	251	
TAPRTweety141	3	292	4.5	139	
TAPRTweety141	4	172	18	239	
TAPRTweety142	1	C	2	124	
TAPRTweety142	2	172	6	48	
TAPRTweety142	3	292	0.5	80	
TAPRTweety142	4	52	4	56	
TAPRTweety143	1	C	3	356	
TAPRTweety143	2	202	4.5	316	
TAPRTweety143	3	82	3	344	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety143	4	322	1.5	348	
TAPRTweety144	1	C	3.5	68	
TAPRTweety144	2	305	3	113	
TAPRTweety144	3	185	5	89	
TAPRTweety144	4	63	3	213	
TAPRTweety145	1	C	12.5	104	
TAPRTweety145	2	274	3	148	
TAPRTweety145	3	154	10.5	141	
TAPRTweety145	4	34	8.5	101	
TAPRTweety146	1	C	4.5	78	
TAPRTweety146	2	5	3.5	63	
TAPRTweety146	3	245	7	63	
TAPRTweety146	4	125	5	350	
TAPRTweety147	1	C	3	148	
TAPRTweety147	2	190	4	148	
TAPRTweety147	3	70	2.5	178	
TAPRTweety147	4	310	3.5	203	
TAPRTweety148	1	C	0	127	
TAPRTweety148	2	303	1.5	30	
TAPRTweety148	3	183	2	184	
TAPRTweety148	4	63	0	94	
TAPRTweety149	1	C	3.5	37	
TAPRTweety149	2	303	4.5	65	
TAPRTweety149	3	183	7	326	
TAPRTweety149	4	63	5.5	307	
TAPRTweety150	1	C	2.5	271	
TAPRTweety150	2	282	2	230	
TAPRTweety150	3	162	2	265	
TAPRTweety150	4	42	3	274	
TAPRTweety151	1	C	1	40	
TAPRTweety151	2	282	0.5	340	
TAPRTweety151	3	162	1	41	
TAPRTweety151	4	42	2	25	
TAPRTweety152	1	C	6	278	
TAPRTweety152	2	3	5	216	
TAPRTweety152	3	243	8	100	
TAPRTweety152	4	123	10	250	
TAPRTweety153	1	C	4	122	
TAPRTweety153	2	201	2	161	
TAPRTweety153	3	81	9	160	
TAPRTweety153	4	321	2	150	
TAPRTweety154	1	C	3.5	9	
TAPRTweety154	2	209	7	7	
TAPRTweety154	3	329	6	356	
TAPRTweety154	4	89	2	41	
TAPRTweety155	1	C	2.5	335	
TAPRTweety155	2	51	8.5	297	
TAPRTweety155	3	171	8	265	
TAPRTweety155	4	291	3.5	180	
TAPRTweety156	1	C	1.5	273	
TAPRTweety156	2	252	1	323	
TAPRTweety156	3	132	1	160	
TAPRTweety156	4	12	3	321	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety157	1	C	0	302	
TAPRTweety157	2	192	8	252	
TAPRTweety157	3	312	3.5	3	
TAPRTweety157	4	72	1.5	333	
TAPRTweety158	1	C	4	56	
TAPRTweety158	2	225	5	84	
TAPRTweety158	3	105	3	96	
TAPRTweety158	4	345	4	50	
TAPRTweety159	1	C	5	26	
TAPRTweety159	2	12	0	204	
TAPRTweety159	3	252	17	356	
TAPRTweety159	4	132	7.5	74	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety160	1	C	25	345	
TAPRTweety160	2	300	3	105	Subplot partially in Fox Creek.
TAPRTweety160	3	60	0	45	
TAPRTweety160	4	180	5	5	
TAPRTweety161	1	C	0.5	88	
TAPRTweety161	2	135	0.5	68	
TAPRTweety161	3	15	2.5	180	
TAPRTweety161	4	255	1	60	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety162	1	C	1	103	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety162	2	293	2.5	51	Subplot partially in Fox Creek.
TAPRTweety162	3	173	14	5	
TAPRTweety162	4	53	0	70	
TAPRTweety163	1	C	1	20	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety163	2	99	0	72	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety163	3	339	3	131	
TAPRTweety163	4	219	19	14	
TAPRTweety164	1	C	0.5	191	Horizontal vegetation profile read from west (270^{o}).
TAPRTweety164	2	177	15	233	
TAPRTweety164	3	57	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety164	4	297	0.5	173	
TAPRTweety165	1	C	3	83	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety165	2	43	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety165	3	163	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety165	4	283	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety166	1	C	5	166	
TAPRTweety166	2	320	4	256	
TAPRTweety166	3	80	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety166	4	200	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety167	1	C	2.5	123	
TAPRTweety167	2	182	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety167	3	302	1	292	
TAPRTweety167	4	62	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety168	1	C	3	216	
TAPRTweety168	2	96	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety168	3	216	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety168	4	336	0	159	
TAPRTweety169	1	C	6	33	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety169	2	295	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety169	3	55	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety169	4	175	1.5	201	
TAPRTweety170	1	C	4	102	Horizontal vegetation profile read from south (180^{o}).

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety170	2	105	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety170	3	225	2	103	
TAPRTweety170	4	345	2	89	
TAPRTweety171	1	C	2	40	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety171	2	283	0	92	
TAPRTweety171	3	43	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety171	4	163	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety172	1	C	4	142	
TAPRTweety172	2	144	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety172	3	264	0.5	305	
TAPRTweety172	4	24	1	136	
TAPRTweety173	1	C	0	192	
TAPRTweety173	2	224	22	226	
TAPRTweety173	3	104	--	--	Subplot in Fox Creek, not sampled.
TAPRTweety173	4	344	2	173	
TAPRTweety174	1	C	1	199	
TAPRTweety174	2	359	1.5	219	
TAPRTweety174	3	119	--	--	Subplot east of Fox Creek, not sampled.
TAPRTweety174	4	239	1.5	178	
TAPRTweety175	1	C	6	49	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety175	2	267	12	268	
TAPRTweety175	3	27	--	--	Subplot in or east of Fox Creek, not sampled.
TAPRTweety175	4	147	5.5	5	
TAPRTweety176	1	C	4	153	
TAPRTweety176	2	130	4.5	100	Subplot partially in flowing water.
TAPRTweety176	3	250	4	77	
TAPRTweety176	4	10	3.5	197	
TAPRTweety177	1	C	0	154	
TAPRTweety177	2	301	1	260	
TAPRTweety177	3	61	3	98	
TAPRTweety177	4	181	1	210	
TAPRTweety178	1	C	2	251	
TAPRTweety178	2	282	5	248	
TAPRTweety178	3	42	1	260	
TAPRTweety178	4	162	2	275	
TAPRTweety179	1	C	1	56	
TAPRTweety179	2	345	3	12	
TAPRTweety179	3	105	14	89	
TAPRTweety179	4	225	1	56	
TAPRTweety180	1	C	1	215	
TAPRTweety180	2	140	3	145	
TAPRTweety180	3	260	1	262	
TAPRTweety180	4	20	1	223	
TAPRTweety181	1	C	5	198	Subplot on seep with standing water.
TAPRTweety181	2	159	2	74	
TAPRTweety181	3	279	4	195	
TAPRTweety181	4	39	22	199	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety182	1	C	2	150	
TAPRTweety182	2	296	2	170	
TAPRTweety182	3	56	2	185	
TAPRTweety182	4	176	2	187	
TAPRTweety183	1	C	4	120	
TAPRTweety183	2	46	5	110	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety183	3	166	8	118	
TAPRTweety183	4	286	3	65	
TAPRTweety184	1	C	2	40	
TAPRTweety184	2	173	2	44	
TAPRTweety184	3	293	5	2	
TAPRTweety184	4	53	2	42	
TAPRTweety185	1	C	4	29	
TAPRTweety185	2	22	5	96	
TAPRTweety185	3	142	5	43	
TAPRTweety185	4	262	6	353	
TAPRTweety186	1	C	1	250	
TAPRTweety186	2	155	2	58	
TAPRTweety186	3	275	2	250	
TAPRTweety186	4	35	1	241	
TAPRTweety187	1	C	6	201	
TAPRTweety187	2	108	1	241	
TAPRTweety187	3	228	2	25	
TAPRTweety187	4	348	2	235	
TAPRTweety188	1	C	2	172	
TAPRTweety188	2	334	2	173	
TAPRTweety188	3	214	2	160	
TAPRTweety188	4	94	7	92	
TAPRTweety189	1	C	7	223	
TAPRTweety189	2	340	9	240	
TAPRTweety189	3	220	6	220	Subplot in Gas House pasture.
TAPRTweety189	4	100	6	205	
TAPRTweety190	1	C	2	236	
TAPRTweety190	2	318	2	294	
TAPRTweety190	3	198	2	228	
TAPRTweety190	4	78	5	198	
TAPRTweety191	1	C	4	262	
TAPRTweety191	2	85	2	180	
TAPRTweety191	3	205	2	334	
TAPRTweety191	4	325	2	163	
TAPRTweety192	1	C	5	147	
TAPRTweety192	2	14	6	116	
TAPRTweety192	3	134	6	153	
TAPRTweety192	4	254	4	125	
TAPRTweety193	1	C	8	290	
TAPRTweety193	2	215	6	256	
TAPRTweety193	3	95	6	135	
TAPRTweety193	4	335	4	311	
TAPRTweety194	1	C	2	196	
TAPRTweety194	2	25	2	195	
TAPRTweety194	3	145	1	178	
TAPRTweety194	4	265	0	129	
TAPRTweety195	1	C	2	40	
TAPRTweety195	2	224	4	314	
TAPRTweety195	3	104	11	303	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety195	4	344	8	146	Horizontal vegetation profile read from west (270^{o}).
TAPRTweety196	1	C	1	88	
TAPRTweety196	2	120	2	40	
TAPRTweety196	3	240	2	63	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety196	4	0	3	175	
TAPRTweety197	1	C	2	284	
TAPRTweety197	2	68	1	310	
TAPRTweety197	3	188	4	266	
TAPRTweety197	4	308	3	309	
TAPRTweety198	1	C	11	250	
TAPRTweety198	2	310	8	248	
TAPRTweety198	3	190	8	264	
TAPRTweety198	4	70	1	219	
TAPRTweety199	1	C	1	78	
TAPRTweety199	2	27	3	30	
TAPRTweety199	3	147	1	134	
TAPRTweety199	4	267	1	82	
TAPRTweety200	1	C	7	302	
TAPRTweety200	2	269	3	354	
TAPRTweety200	3	149	3	352	Subplot in Windmill pasture.
TAPRTweety200	4	29	17	329	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety201	1	C	1	280	
TAPRTweety201	2	133	1	150	
TAPRTweety201	3	13	1	259	Subplot in Gas House pasture.
TAPRTweety201	4	253	11	304	
TAPRTweety202	1	C	3	289	
TAPRTweety202	2	48	4	282	
TAPRTweety202	3	168	3	284	
TAPRTweety202	4	288	2	269	
TAPRTweety203	1	C	15	270	
TAPRTweety203	2	350	14	269	
TAPRTweety203	3	230	10	270	
TAPRTweety203	4	110	1	325	
TAPRTweety204	1	C	5	57	
TAPRTweety204	2	178	3	122	
TAPRTweety204	3	298	5	67	
TAPRTweety204	4	58	6	144	
TAPRTweety205	1	C	0	271	
TAPRTweety205	2	68	6	222	
TAPRTweety205	3	188	3	67	Subplot partially in stream, Horizontal vegetation profile read from east (90^{o}).
TAPRTweety205	4	308	32	52	Subplot partially in stream.
TAPRTweety206	1	C	2	115	
TAPRTweety206	2	30	2	88	
TAPRTweety206	3	150	3	98	
TAPRTweety206	4	270	2	38	
TAPRTweety207	1	C	5	224	
TAPRTweety207	2	123	3	230	
TAPRTweety207	3	243	2	156	
TAPRTweety207	4	3	4	240	
TAPRTweety208	1	C	1	142	
TAPRTweety208	2	136	9	60	
TAPRTweety208	3	256	10	60	
TAPRTweety208	4	16	2	350	
TAPRTweety209	1	C	2	335	
TAPRTweety209	2	105	2	355	
TAPRTweety209	3	225	2	325	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety209	4	345	6	337	
TAPRTweety210	1	C	3	40	
TAPRTweety210	2	338	12	45	
TAPRTweety210	3	218	9	30	
TAPRTweety210	4	98	3	35	
TAPRTweety211	1	C	8	10	
TAPRTweety211	2	275	5	65	
TAPRTweety211	3	155	4	20	
TAPRTweety211	4	35	3	94	
TAPRTweety212	1	C	13	203	
TAPRTweety212	2	82	5	209	
TAPRTweety212	3	202	7	226	
TAPRTweety212	4	322	8	234	
TAPRTweety213	1	C	1	216	
TAPRTweety213	2	332	2	210	
TAPRTweety213	3	92	1	205	
TAPRTweety213	4	212	1	217	
TAPRTweety214	1	C	5	133	
TAPRTweety214	2	200	6	148	Subplot on seep with standing water.
TAPRTweety214	3	80	6	116	Subplot on seep with standing water.
TAPRTweety214	4	320	4	157	
TAPRTweety215	1	C	4	245	
TAPRTweety215	2	127	3	157	
TAPRTweety215	3	247	5	90	
TAPRTweety215	4	7	4	165	
TAPRTweety216	1	C	5	118	
TAPRTweety216	2	150	8	234	
TAPRTweety216	3	270	4	123	
TAPRTweety216	4	30	7	241	
TAPRTweety217	1	C	3	42	
TAPRTweety217	2	268	4	30	
TAPRTweety217	3	28	1	45	
TAPRTweety217	4	148	1	102	
TAPRTweety218	1	C	2	285	
TAPRTweety218	2	7	1	313	Subplot in Windmill pasture.
TAPRTweety218	3	127	2	115	
TAPRTweety218	4	247	4	311	
TAPRTweety219	1	C	1	214	
TAPRTweety219	2	224	4	234	
TAPRTweety219	3	344	5	269	Horizontal vegetation profile read from east (90^{o}).
TAPRTweety219	4	104	1	172	
TAPRTweety220	1	C	6	198	
TAPRTweety220	2	308	5	208	
TAPRTweety220	3	68	5	195	
TAPRTweety220	4	188	2	225	Subplot partially on pasture road.
TAPRTweety221	1	C	1	198	
TAPRTweety221	2	333	1	224	
TAPRTweety221	3	93	1	190	
TAPRTweety221	4	213	1	180	
TAPRTweety222	1	C	4	127	
TAPRTweety222	2	296	3	152	
TAPRTweety222	3	176	7	137	
TAPRTweety222	4	56	2	212	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety223	1	C	2	162	
TAPRTweety223	2	120	2	177	
TAPRTweety223	3	240	2	170	
TAPRTweety223	4	0	2	172	
TAPRTweety224	1	C	14	57	
TAPRTweety224	2	136	6	105	
TAPRTweety224	3	256	9	226	
TAPRTweety224	4	16	8	52	Subplot on seep with standing water.
TAPRTweety225	1	C	0	40	
TAPRTweety225	2	152	0	80	
TAPRTweety225	3	272	0	99	
TAPRTweety225	4	32	2	109	
TAPRTweety226	1	C	2	98	Subplot partially in stream.
TAPRTweety226	2	0	1	161	Subplot partially in stream.
TAPRTweety226	3	120	3	17	
TAPRTweety226	4	240	5	358	
TAPRTweety227	1	C	4	254	
TAPRTweety227	2	280	12	220	
TAPRTweety227	3	40	2	25	
TAPRTweety227	4	160	6	243	
TAPRTweety228	1	C	5	340	
TAPRTweety228	2	264	4	15	
TAPRTweety228	3	24	5	200	
TAPRTweety228	4	144	4	351	
TAPRTweety229	1	C	3	119	
TAPRTweety229	2	282	6	110	Subplot on seep with standing water.
TAPRTweety229	3	42	3	98	Subplot partially on cow trail.
TAPRTweety229	4	162	5	171	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety230	1	C	15	308	
TAPRTweety230	2	10	8	325	
TAPRTweety230	3	130	16	272	
TAPRTweety230	4	250	15	274	
TAPRTweety231	1	C	2	116	Subplot partially on cow trail.
TAPRTweety231	2	46	1	75	
TAPRTweety231	3	166	1	83	
TAPRTweety231	4	286	2	99	
TAPRTweety232	1	C	1	240	
TAPRTweety232	2	220	0	297	
TAPRTweety232	3	340	0	34	
TAPRTweety232	4	100	1	54	
TAPRTweety233	1	C	9	355	
TAPRTweety233	2	136	8	8	Horizontal vegetation profile read from west (270^{o}).
TAPRTweety233	3	256	3	0	
TAPRTweety233	4	16	5	294	
TAPRTweety234	1	C	0	55	
TAPRTweety234	2	60	2	74	
TAPRTweety234	3	180	0	44	
TAPRTweety234	4	300	0	49	
TAPRTweety235	1	C	5	113	
TAPRTweety235	2	294	4	131	
TAPRTweety235	3	54	1	124	
TAPRTweety235	4	174	11	85	
TAPRTweety236	1	C	10	214	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety236	2	282	8	180	
TAPRTweety236	3	42	9	6	
TAPRTweety236	4	162	8	201	Subplot on seep with standing water.
TAPRTweety237	1	C	4	145	
TAPRTweety237	2	269	3	169	
TAPRTweety237	3	149	7	96	Horizontal vegetation profile read from west (270^{o}).
TAPRTweety237	4	29	5	150	
TAPRTweety238	1	C	5	38	
TAPRTweety238	2	101	6	39	
TAPRTweety238	3	341	7	42	
TAPRTweety238	4	221	3	68	
TAPRTweety239	1	C	4	110	
TAPRTweety239	2	188	2	176	Subplot in Crusher Hill pasture.
TAPRTweety239	3	308	3	116	
TAPRTweety239	4	68	7	75	
TAPRTweety240	1	C	6	141	
TAPRTweety240	2	200	6	335	
TAPRTweety240	3	320	4	149	
TAPRTweety240	4	80	18	242	
TAPRTweety241	1	C	3	141	
TAPRTweety241	2	80	8	261	
TAPRTweety241	3	320	3	146	
TAPRTweety241	4	200	5	117	
TAPRTweety242	1	C	1	144	
TAPRTweety242	2	128	0	125	
TAPRTweety242	3	248	1	211	
TAPRTweety242	4	8	1	330	
TAPRTweety243	1	C	2	240	
TAPRTweety243	2	320	3	234	
TAPRTweety243	3	80	2	251	
TAPRTweety243	4	200	2	192	
TAPRTweety244	1	C	8	259	
TAPRTweety244	2	280	2	161	
TAPRTweety244	3	40	4	250	
TAPRTweety244	4	160	2	94	
TAPRTweety245	1	C	4	186	
TAPRTweety245	2	29	3	204	
TAPRTweety245	3	149	11	308	
TAPRTweety245	4	269	2	198	
TAPRTweety246	1	C	1	193	
TAPRTweety246	2	45	1	163	
TAPRTweety246	3	165	5	152	
TAPRTweety246	4	285	2	139	
TAPRTweety247	1	C	2	21	
TAPRTweety247	2	250	2	1	
TAPRTweety247	3	10	1	66	
TAPRTweety247	4	130	4	37	
TAPRTweety248	1	C	6	275	
TAPRTweety248	2	70	6	255	
TAPRTweety248	3	310	5	168	
TAPRTweety248	4	190	3	198	
TAPRTweety249	1	C	3	185	
TAPRTweety249	2	109	3	164	

Table 6. Location, cont'd.

Plot number	Subplot number	Azimuth (^{O})	Slope (^{O})	Aspect (^{O})	Comments
TAPRTweety249	3	229	2	188	
TAPRTweety249	4	349	3	215	
TAPRTweety250	1	C	4	143	
TAPRTweety250	2	2	5	38	
TAPRTweety250	3	122	1	45	
TAPRTweety250	4	242	4	140	
TAPRTweety251	1	C	18	4	
TAPRTweety251	2	40	9	4	
TAPRTweety251	3	160	13	40	
TAPRTweety251	4	280	15	333	
TAPRTweety252	1	C	4	356	
TAPRTweety252	2	250	4	11	
TAPRTweety252	3	130	4	9	
TAPRTweety252	4	10	3	295	
TAPRTweety253	1	C	5	220	
TAPRTweety253	2	244	4	148	
TAPRTweety253	3	4	7	243	
TAPRTweety253	4	124	6	251	
TAPRTweety254	1	C	0	270	
TAPRTweety254	2	303	20	342	Horizontal vegetation profile read from south (180^{o}).
TAPRTweety254	3	183	0	266	
TAPRTweety254	4	63	1	269	
TAPRTweety255	1	C	12	240	
TAPRTweety255	2	345	8	264	
TAPRTweety255	3	105	10	166	
TAPRTweety255	4	225	7	232	
TAPRTweety256	1	C	4	142	
TAPRTweety256	2	90	3	131	
TAPRTweety256	3	210	3	157	
TAPRTweety256	4	330	5	158	
TAPRTweety257	1	C	2	182	
TAPRTweety257	2	98	3	68	
TAPRTweety257	3	218	2	62	
TAPRTweety257	4	338	0	220	
TAPRTweety258	1	C	6	136	
TAPRTweety258	2	240	3	104	
TAPRTweety258	3	0	6	125	
TAPRTweety258	4	120	8	111	
TAPRTweety259	1	C	4	195	
TAPRTweety259	2	336	3	225	
TAPRTweety259	3	96	4	152	
TAPRTweety259	4	216	5	198	
TAPRTweety260	1	C	4	236	
TAPRTweety260	2	275	5	277	
TAPRTweety260	3	155	4	225	
TAPRTweety260	4	35	10	277	

-- Indicates missing data.

Table 7. Mean (± SE) values for habitat parameters by habitat type at Agate Fossil Beds National Monument, Nebraska (2001 and 2003) and Tallgrass Prairie National Preserve, Kansas (2001 and 2002) during the bird breeding season.

Habitat Parameter	AGFO		TAPR	
	Upland	Riparian	Upland	Riparian
50 meter plot				
Upland prairie coverage (%)	97.5 ± 0.00	62.5 ± 0.00	96.6 ± 0.28	37.5 ± undefined
Riparian woodland coverage (%)	N/A	N/A	4.0 ± 1.67	88.2 ± 4.01
Paved road coverage (%)	17.6 ± 7.20	N/A	N/A	N/A
Pasture road coverage (%)	3.0 ± 0.00	N/A	3.4 ± 0.80	N/A
Stream coverage (%)	3.0 ± 0.00	36.1 ± 2.97	6.3 ± 2.11	25.6 ± 2.81
Pond coverage (%)	N/A	N/A	36.2 ± 6.50	N/A
5 meter subplot				
Horizontal vegetation profile				
0.0 – 0.5 m	60.7 ± 3.24	61.2 ± 7.38	72.9 ± 1.06	64.7 ± 2.77
0.5 – 1.0 m	3.3 ± 0.79	9.0 ± 1.91	9.4 ± 1.00	30.4 ± 3.15
1.0 – 1.5 m	N/A	15.6 ± undefined	6.6 ± 0.44	9.7 ± 1.95
1.5 – 2.0 m	N/A	N/A	14.8 ± 0.50	17.0 ± 1.76
Vertical structure diversity	0.01 ± 0.01	0.07 ± 0.03	0.02 ± 0.01	1.27 ± 0.03
1.78 meter sample plot				
Deciduous litter coverage (%)	1.5 ± 0.28	5.4 ± 1.23	0.6 ± 0.08	19.3 ± 1.88
Conifer litter coverage (%)	N/A	N/A	0.1 ± undefined	9.4 ± undefined
Grass litter coverage (%)	26.1 ± 1.66	33.7 ± 3.56	21.1 ± 0.96	6.9 ± 0.98
Bare soil (%)	38.1 ± 2.01	23.7 ± 3.61	51.4 ± 0.89	23.6 ± 3.21
Rock coverage (%)	2.6 ± 0.58	0.6 ± 0.23	8.4 ± 1.40	9.0 ± 0.42
Woody debris coverage (%)	0.1 ± 0.97	3.5 ± undefined	0.6 ± undefined	2.5 ± 0.05
Unvegetated coverage (%)	38.1 ± 2.01	23.7 ± 3.61	51.4 ± 2.57	23.6 ± 3.21
Warm-season grass coverage (%)	0.7 ± 0.09	0.5 ± 0.07	32.1 ± 0.77	9.2 ± 1.39
Cool-season grass coverage (%)	14.7 ± 1.34	13.2 ± 1.78	5.2 ± 0.62	15.3 ± 2.31
Forb coverage (%)	8.1 ± 1.61	10.8 ± 0.88	14.8 ± 0.50	8.6 ± 0.97
Moss and lichen coverage (%)	1.6 ± 0.31	1.1 ± 0.37	0.7 ± 0.16	0.7 ± 0.05
Woody shrub and vine coverage (%)	1.5 ± 0.25	1.4 ± 0.28	5.0 ± 0.27	7.1 ± 1.83
Tree seedling coverage (%)	N/A	N/A	0.5 ± 0.02	0.3 ± 0.05
Total foliar coverage (%)	19.5 ± 1.49	18.2 ± 2.45	47.7 ± 0.67	29.8 ± 2.12

N/A - Not Applicable.

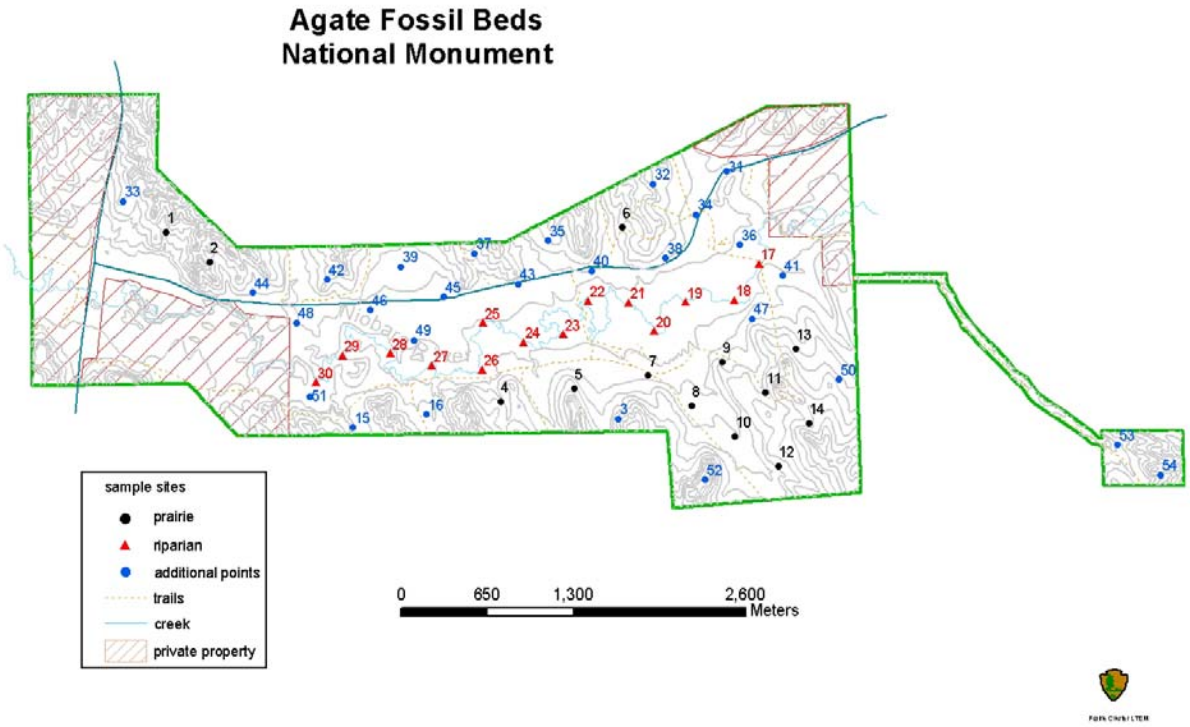

Figure 1. Map showing VCP locations at Agate Fossil Beds National Monument, Nebraska.

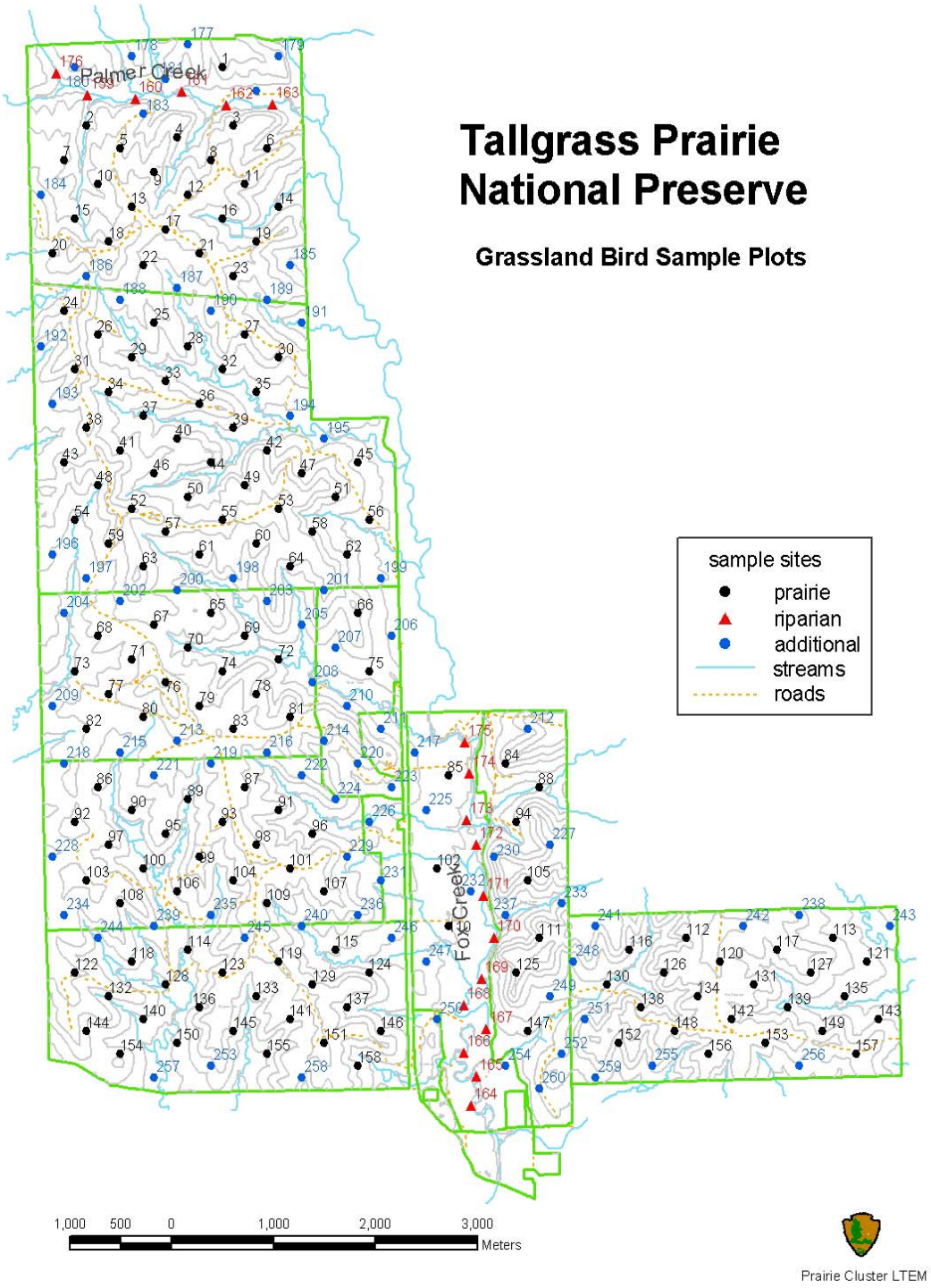

Figure 2. Map showing VCP locations at Tallgrass Prairie National Preserve, Kansas.

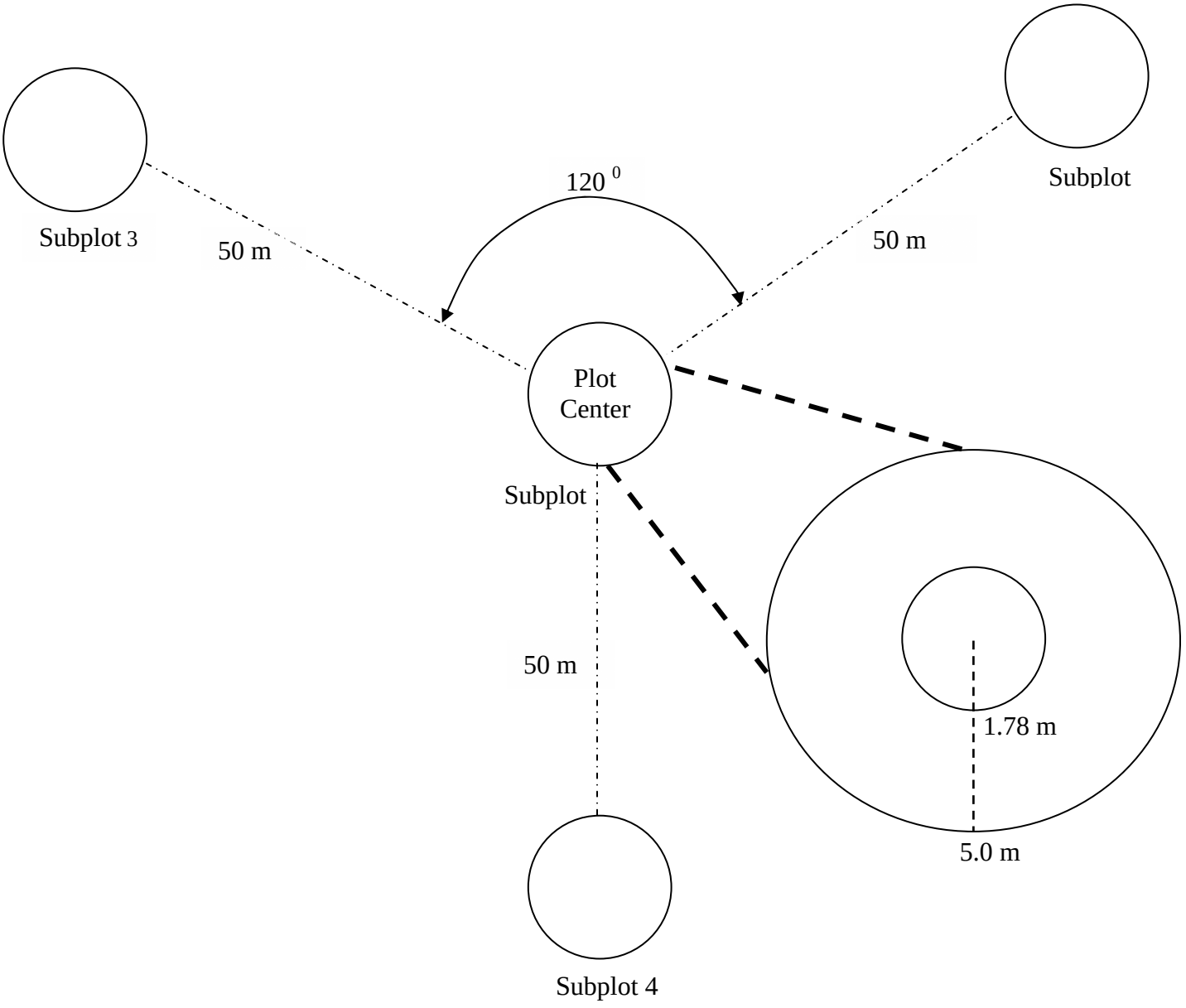

Figure 3. Spatial arrangement of vegetation subplots.