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Brood-rearing Period Cover Use By Wild Turkey Hens in Southcentral South Dakota

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BROOD-REARING PERIOD COVER USE BY WILD TURKEY HENS IN SOUTHCENTRAL SOUTH DAKOTA

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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BROOD REARING PERIOD COVER USE BY WILD TURKEY HENS IN SOUTHCENTRAL SOUTH DAKOTA

ABSTRACT

Brood-rearing period cover use by wild turkey (Meleagris gallopavo) hens with broods and those without, in Gregory County, South Dakota, was determined in order to formulate management suggestions for a grassland/riparian woodland habitat. Two hens with broods and 12 hens without broods were studied through telemetry and direct observations from 5 July through 2 August and 3 August through 17 August of 1982 and 1983. Vegetational data were collected in 1983. Hens with broods selected for the grass/forb-dominated understory and 52% open canopy of south-facing savannah woodlands while their broods were less than 4 weeks of age. After 4 weeks, broods moved to the shrubby understory and 7% open canopy of north-facing bur oak forest. Brood hens did not appear to use cultivated fields, farmsteads, or bottomlands, and grasslands were avoided or used in proportion to availability. Hens without broods used cultivated fields, farmsteads, and bottomlands in proportion to availability, generally avoided grasslands, and selected woodlands.

Key words: wild turkey, South Dakota, savannah, telemetry, cover use

INTRODUCTION

Within the past 30 years, wild turkeys (Meleagris gàllopavo) have become reestablished in the grassland/riparian woodland habitat of southcentral South Dakota (Petersen and Richardson 1975). Although this area is listed within the original range limits of wild turkeys (Schorger 1966), the encroachment of modern civilization had resulted in the local extermination of this popular game species. Stocking of the Merriam's (M. g. merriami) and Rio Grande (M. g. intermedia) subspecies by private individuals and the South Dakota Department of Game, Fish and Parks returned wild turkeys to southcentral South Dakota, where they now are numerous and produce a harvestable surplus. In 1982, more than 500 hunting permits for turkeys were allocated for Gregory County, South Dakota, alone. Turkeys are popular as a gamebird and as an aesthetic component of the environment, but they can cause damage to crops, particularly grain. Wintering flocks of over 100 wild turkeys can be observed daily near some corn piles. Korschgen (1967) estimated that a flock of 100, 4.5-kg turkeys could consume about 1000 kg of food per month. Farmers and ranchers who experience crop depredations by wild turkeys often request control measures be taken by the state wildlife agency. The usual method of management response is in the form of supplemental feeding. Feeding often proves ineffective, expensive, and time-consuming. Some landowners may demand that wild turkey population levels be lowered through increased harvest quotas or supplemental shooting, but state sportsmen and other interested parties may request the population be maintained or expanded. Wild turkey population

management requires knowledge of what the public and private sectors desire and how to best accommodate these interests without jeopardizing the sustained-yield productivity of the resource. This study is an effort toward developing a wild turkey management plan in southcentral South Dakota.

Habitat of the Missouri River Breaks in southcentral South Dakota is a mixture of deciduous riparian woodlands, prairie grasslands, farmsteads, open water, and both cultivation and pasture agriculture. The topography of the region can be characterized generally as rugged. Wild turkey management strategies developed from and for other regions may not be directly applicable. To formulate a sound management plan for the Missouri River Breaks' wild turkey population, research should recognize and be oriented toward the Breaks' environmental characteristics.

Lindzey (1967) stated that the most important research needs concerning wild turkeys were to determine the value of factors affecting productivity and to find methods for maintaining desired levels of poult production. The first step in meeting these needs for the wild turkey population in question was to gain an understanding of the region's brood-rearing habitat through study of brood/habitat interactions. Therefore, this project was designed to evaluate the movements and habitat use of wild turkey hens with broods and those without during the brood-rearing period, for the purpose of developing a management strategy for brood habitat. The research was developed with the following null hypothesis: wild turkey hens use cover in proportion to cover availability.

Field objectives were: (1) to characterize cover with respect to aspect, land use, and vegetation; (2) to determine the extent of movements of hens with broods and those without during the summer brood-rearing period; (3) to diagnose temporal changes in use of cover during brood rearing; and (4) to analyze cover selection and avoidance over time.

STUDY AREA

The study area was a 6.4 by 4.8 km site consisting of 12 sections of privately owned land located approximately 5 km north-northeast of St. Charles, South Dakota, in Gregory County. The site is part of the Missouri River Breaks physiographical complex in the Pierre Hills division of the Missouri Plateau. Normal annual precipitation is 56 cm, and average annual air temperature is 8.9 C (June-August average: 23 C). Soils are mostly loams, sandy loams, silty clays, and clays, within 0-50% slope. The area is characterized by a dendritic drainage pattern. Secondary drainages intersect the major drainages and the enclosing slopes form a series of ridges and swales. Grasses dominate the uplands, while the valley floor is wooded with fingers of trees growing up the lateral drainageways. Over 90% of the area is grazed by cattle. Some flat-to-gently rolling upland areas are cropped for hay and small grain crops.

Vegetational zones on the study area are characterized by 3 designated land-use types: farmsteads (FARM); cultivated land (CULT) (corn, cane, oat, and alfalfa fields); and permanent water (WATR).

Also, there are 5 designated cover types including north-facing grasslands (NFGL), south-facing grasslands (SFGL), north-facing woodlands (NFWD), south-facing woodlands (SFWD), and bottomland (BOTT) (Table 1). Northerly (including northeast and northwest) and southerly (including southeast and southwest) aspects were chosen due to the mainly east/west drainage pattern.

METHODS AND MATERIALS

Vegetation

Vegetational cover types were chosen subjectively, based on observed, physical structure differences. To quantify these differences, sampling was conducted on vegetative attributes of cover types that I felt might be important to cover-type selection by wild turkeys (Appendix 1). Variables sampled included all tree species and any plant species encountered at a frequency ≥10% in any cover type (grasslands and wooded lands considered separately). Descriptions of the cover types were derived through analysis of the sampled vegetation. In addition, plants were collected on the study area to serve as a reference (Appendix 2).

Vegetational data from the cover types were collected from 12 August through 3 September 1983. Sampling sites consisted of 2 parallel 50 m transects set 10 m apart. Five of these pairs were established in grasslands and in each of the 3 wooded cover types. Transects ran parallel to ground contours and were placed within a representative stand of a cover type. Ten plots were spaced along the transect line at 10 m intervals. Each plot encompassed 0.001 ha as determined by a

Table 1. Cover and land-use types investigated on the 6.4 by 4.8 km study area in Gregory County, South Dakota.

COVER OR LAND-USE TYPE	TOTAL HA	PROPORTION OF STUDY AREA
North-facing grasslands	1119	0.36
South-facing grasslands	905	0.29
North-facing woodlands	471	0.15
South-facing woodlands	307	0.10
Cultivated land	233	0.08
Bottomland	35	0.01
Farmsteads	13	<0.01
Permanent water	5	<0.01

circle with a 178 cm radius. A 50 by 50 cm sampling frame was randomly placed in each plot quadrat. Within the frame, presence or absence of all plant species was recorded, along with the amount of ground coverage in cm^2 for tree, shrub, grass, forb, and seedling categories. Vertical woody stems with a diameter-at-breast-height (dbh) of ≥5 cm were categorized as trees; those with a dbh <5 cm were considered seedlings. Additional data collected on woodland plots included ground vegetational density (visual obstruction) using a vertical-profile board (Nudds 1977), canopy cover using a single Model C densiometer reading from ground level (Lemmon 1957), and number of shrub stems. The point-centered quarter technique (Cottam and Curtis 1956) was used to calculate tree frequency, density, and average basal area by species from measurements of tree composition, dbh, and distance from the plot center.

Capture and marking

Turkeys were captured from May through July 1982, and January through June 1983, using a cannon net (Austin 1965) and walk-in traps (Petersen and Richardson 1975) at sites prebaited with whole corn. Captured hens were aged, weighed, and individually marked with colored and numbered yellow or white patagial tags (Knowlton et al. 1964). Each hen was banded with an aluminum, butt-end leg band of size 24 (National Band and Tag Company, Newport, KY). Healthy adult hens and/or those with a brood patch were fitted with a radio transmitter.

Telemetry

Lithium battery-powered radio transmitters (Wyoming Biotelemetry, Inc. [WB], Longmont, CO; Advanced Telemetry Systems, Inc. [ATS], Bethel, MN) were placed on the back of the forementioned hens, between the wings, and attached with a loop of cord or cable around the proximal end of each wing and the neck. Transmitters obtained from ATS used a plastic-coated, stainless steel cable with aluminum crimps for securing the wing and neck loops. These proved easier to attach and more secure than the parachute cord attachments of the WB models. Also, ATS transmitters did not suffer antenna fraying and resultant signal loss that occurred with the WB models.

Receivers used were an AVM Instrument Co. (Dublin, CA) Model LA12 and 2 comparable models from Telemetry Systems, Inc. (Mequon, WI). The frequency range was 150.850-151.500 MHz in 0.05 MHz increments.

The radioed hens were monitored using tandem, parallel, 4-element Yagi antennas mounted on mobile platforms similar to those discussed by Hallberg et al. (1974). A null-peak system was employed. Seven telemetry stations were established at benchmarks recognizable on topographic maps. Turkey locations were derived by intersecting simultaneous angular readings from 2 stations (triangulation), which had been chosen to optimize antenna accuracy in relation to bird location. Accuracy of the telemetry system was unknown, but based on daily antenna calibrating, proximizing the antenna stations to the subjects (especially on hens with broods), deleting aberrant azimuth readings from analyses, and because of the number of readings acquired, I feel that the data were adequate for determining habitat-use patterns.

Monitoring occurred during the brood-rearing period of mid-June to mid-August for both years. Telemetry readings were taken every 1/2 hr during prolonged monitoring periods that were conducted about once per week. All hens were visually observed at least once per month to determine brood status. These observations were added to the telemetry data.

Cover mapping and telemetry plotting

Cover maps were created using a Prime 400 computer system in conjunction with an electronic table digitizer, both available at the Remote Sensing Institute (RSI) at South Dakota State University. The digitizer was capable of creating a coordinate system for a map of the site under consideration, given the northeastern and northwestern corner nodes (points) and a node along the southern border. Also, areas of cover were determined by electronically tracing boundaries of grassland, woodland, bottomland, cultivated land, farmstead, and permanent water boundaries from topographic maps and aerial photographs. A separate map of northern versus southern aspect boundaries was created in the same manner. Both maps were converted to a cellular (Raster) grid system with 0.0550 ha (0.136 acre) cells by the computer. The computer created the final cover map by overlaying the boundaries map on the aspect map and plotting the 8 desired combinations: north-facing grasslands; south-facing grasslands; north-facing woodlands; south-facing woodlands; bottomlands; cultivated lands; farmsteads; and permanent water.

Telemetry locations, by individual bird, were plotted using the computer program TELEM (Koeln 1980) in conjunction with a Model 8 IBM

3031 computer and a CALCOMP 1051 line-printer. The CALCOMP plots, at the same scale as the final cover map, were overlaid manually on the final cover map using a light table, and the respective placement of turkey locations were recorded.

Telemetry data were combined for both years, and analyses were conducted on (1) hens with broods and (2) hens without broods. Home range size information and cover analyses were examined during periods before and after 4 weeks posthatching because of potential changes in brood-movement patterns (Williams et al. 1973, Porter 1980) and brood diet composition (Nenno and Lindzey 1979) evident after 4 weeks.

Home range size and composition were derived from TELEM and the RSI AREAS (Area REsource Analysis System) program, respectively. TELEM was used to calculate home range size and plot the range using the convex polygon method (Mohr 1947). The range boundary was digitized and overlaid on the final cover map. The AREAS program determined the total hectares and proportion of each land use and cover type within the home range.

Data analysis

Statistical analyses included chi-square tests for temporal changes of cover use, proportionality of cover use to cover area available, and selection/avoidance criteria (Neu et al. 1974). Neu et al. (1974) used the term "preference" pertaining to a statistically evident, positive choice toward a cover or land use type. But due to confusion over the biological meaning of that expression, I have substituted the term "selection."

RESULTS

North-facing grasslands (NFGL)

NFGL had more grass and forb cover than did SFGL. Plants that were present at a frequency ≥10% included sedges (Carex spp.) (72%), western wheatgrass (Agropyron smithii) (46%), green needlegrass (Stipa viridula) (45%), blue/hairy grama (Bouteloua gracilis/ Bouteloua hirsuta) (43%), sand dropseed (Sporobolus cryptandrus) (39%), moss (30%), big bluestem (Andropogon gerardi) (15%), and leadplant (Amorpha canescens) (10%).

South-facing grasslands (SFGL)

SFGL had less grass and forb cover than did NFGL by 27% and 65%, respectively. Plants frequent at ≥10% included sedges (88%), sideoats grama (B. curtipendula) (61%), blue/hairy grama (61%), big bluestem (50%), needle and thread (S. comata) (27%), sand dropseed (22%), and leadplant (14%).

North-facing woodlands (NFWD)

NFWD were dominated by bur oak (Quercus macrocarpa) at 858 trees/ha, interspersed with small American elm (Ulmus americana), juniper (Juniperus virginiana), box elder (Acer negundo), green ash (Fraxinus pennsylvanica), and basswood (Tilia americana). Canopy cover averaged 93% and there were 16.4 m^2/ha of trees. Understory ground cover had fewer grasses than did SFWD and BOTT, but more shrubs (including shrub stem number) and tree seedlings. Forb cover was similar among wooded cover types. Horizontal visibility below 2 m averaged 39%. Understory plants present at a frequency ≥10% included American elm seedlings (83%), wild stawberry (Fragaria virginiana)

(57%), sedges (56%), moss (22%), juniper seedlings (18%), chokecherry (Prunus virginiana) (16%), Virginia creeper (Parthenocissus quinquefolia) (16%), littleseed ricegrass (Oryzopsis micrantha) (13%), riverbank grape (Vitis riparia) (12%), C. blanda (11%), and bur oak seedlings (10%). NFWD were considered forest.

South-facing woodlands (SFWD)

SFWD also were dominated by bur oaks, but at 46% of the density of NFWD. Junipers were present as well. Canopy cover averaged 48% and there were 4.5 m^2/ha of trees. Grasses and forbs along with some tree seedlings dominated the understory; horizontal visibility averaged 48%. Frequently encountered plants included sedges (94%), sideoats grama (64%), big bluestem (42%), Kentucky bluegrass (Poa pratensis) (30%), western wheatgrass (14%), littleseed ricegrass (10%), and little bluestem (Andropogon scoparius) (10%). This cover type had the characteristics of savannah (Hayden 1979).

Bottomland (BOTT)

BOTT was a dominantly green ash forest interspersed with bur oak, box elder, American elm, basswood, and juniper. Also present were small numbers of large cottonwood (Populus deltoides), hackberry (Celtis occidentalis), and willows (Salix spp.), comprising 26.6 m^2/ha of trees. Canopy cover averaged 78%; horizontal visibility below 2 m averaged 47%. Understory ground cover values were similar to that of SFWD. Frequently encountered plants included sedges (88%), Canadian wildrye (Elymus canadensis) (60%), Kentucky bluegrass (38%), Sanicula canadensis (18%), Japanese brome (Bromus japonicus) (18%), wild strawberry (12%), C. blanda (12%), and American elm seedlings (11%).

Capture and telemetry

Nineteen juvenile wild turkey hens and 69 adult hens were captured and marked during the 2 field seasons, including some off-site trapping in similar nearby habitat. In the initial year of the study, 1982, the juvenile-to-adult trapping ratio was 0.5:1 (N=12). The 1983 ratio was 0.23:1 (N=85). In 1984, the ratio was 1.7:1 (N=27). Telemetry data were collected and analyzed on 3 of 7 radioed hens in 1982 (373 locations), and 11 of 21 hens in 1983 (569 locations). Other radioed hens either died, were lost to unknown causes, or moved from the study area. Known causes of mortality included legal hunting, poaching, and predators, plus what appeared to be transmitter-induced trauma. One WB transmitter failed after 1 week in the field, and 1 hen was found diseased upon capture (see Appendix 3). Nests of 2 radioed hens were located in 1983. One of those nests was lost when a predator killed the hen, and the other was washed away in a rainstorm.

Of 3 broods known to have been hatched by radioed hens, all in 1983, 1 brood was observed at 1 week of age but was not with the hen 1 week later. The other 2 broods were reared to at least 6 weeks posthatching. The 2 hens with surviving broods were separate initially, but were observed to travel together 3 weeks after their broods hatched. Estimated hatching dates were 5 July 1983 and 7 July 1983, based on characteristics of the poults at first observation (Nixon 1962). Two posthatching intervals from 5 July through 2 August and 3 August through 17 August were chosen for home range size and cover analyses.

Average home range size of hens with broods during the 2 posthatching periods, respectively, were 7 ha ± 1 (mean ± S.E., N=2) and 8 ha ± 0 (N=2). Averages for hens without broods were 51 ha ± 21 (N=9) and 53 ha ± 13 (N=12). Home range sizes for hens without broods (Appendix 4) showed wide variation over both time periods (SD=64 and 46, respectively).

Cover use

Cover-use analyses, using goodness of fit tests within both posthatching time periods for hens with broods and those without, indicated that cover use was not in proportion to cover area available (Table 2). Also, contingency tables showed significant ($P < 0.001$) change in cover use between posthatching time periods (Table 2).

Selectivity, avoidance, and proportionality of use of cover and land-use types by hens with broods and those without, varied over time (Table 3). NFGL were avoided ($P < 0.05$) by broodless hens, and used proportionally by hens with broods during both time periods. SFGL were avoided ($P < 0.05$) except between 5 July and 2 August by hens without broods. Between 3 August and 17 August, NFWD were selected ($P < 0.05$) by all hens. Broodless hens used SFWD proportionally during the first 4 weeks (5 July-3 August), but showed selection ($P < 0.05$) later; hens with broods showed the opposite choice pattern. CULT, BOTT, and FARM were used proportionally or not at all in every case.

Table 2. Chi-square analyses of cover use by radio-tagged wild turkey hens with broods and those without on the study area in Gregory County, South Dakota, over combined posthatching time periods (5 July through 2 August and 3 August through 17 August) in 1982 and 1983.

	HENS WITH BROODS		HENS WITHOUT BROODS	
Cover or land-use type	1st time period	2nd time period	1st time period	2nd time period
North-facing grasslands	39	64	75	73
South-facing grasslands	19	1	97	72
North-facing woodlands	18	70	62	152
South-facing woodlands	35	10	28	71
Cultivated land	*	*	22	25
Bottomland	*	*	*	*
Farmsteads	*	*	6	*
Within period χ^2:	58.08** (d.f.=3)	148.48** (d.f.=3)	36.71** (d.f.=5)	216.68** (d.f.=4)
Between period χ^2:	63.49** (d.f.=3)		50.85** (d.f.=4)	

* value < 5, categories with * not included in χ^2 analyses;
** P < 0.001.

Table 3. Tests for cover selection or avoidance (95% confidence interval [CI]) by radio-tagged wild turkey hens during the first (5 July through 2 August) and second (3 August through 17 August) posthatching periods, using combined data for 1982-1983 on the study area in Gregory County, South Dakota.

Cover*	Actual Proportion	Posthatching Period	Proportion observed**	95% CI on proportion observed
HENS WITH BROODS				
NFGL	0.36	1st	0.35	$0.24 < P_1 < 0.47$
		2nd	0.44	$0.34 < P_2 < 0.54$
SFGL	0.29	1st	0.17a	$0.08 < P_1 < 0.26$
		2nd	0.01a	$-0.01 < P_2 < 0.02$
NFWD	0.15	1st	0.16	$0.08 < P_1 < 0.25$
		2nd	0.48b	$0.38 < P_2 < 0.59$
SFWD	0.10	1st	0.32b	$0.21 < P_1 < 0.43$
		2nd	0.07	$0.02 < P_2 < 0.12$
HENS WITHOUT BROODS				
NFGL	0.36	1st	0.26a	$0.19 < P_1 < 0.33$
		2nd	0.18a	$0.13 < P_2 < 0.24$
SFGL	0.29	1st	0.33	$0.26 < P_1 < 0.41$
		2nd	0.18a	$0.13 < P_2 < 0.23$
NFWD	0.15	1st	0.21	$0.15 < P_1 < 0.28$
		2nd	0.38b	$0.32 < P_2 < 0.45$
SFWD	0.10	1st	0.10	$0.05 < P_1 < 0.14$
		2nd	0.18b	$0.13 < P_2 < 0.23$
CULT	0.08	1st	0.08	$0.04 < P_1 < 0.12$
		2nd	0.06	$0.03 < P_2 < 0.10$
BOTT	0.01	2nd	<0.01	$-0.01 < P_2 < 0.02$
FARM	<0.01	1st	0.02	$0.00 < P_1 < 0.04$
		2nd	<0.01	$0.00 < P_2 < 0.01$

* NFGL=North-facing grasslands; SFGL=South-facing grasslands; NFWD=North-facing woodlands; SFWD=South-facing woodlands; CULT=Cultivated lands; BOTT=Bottomland; FARM=Farmsteads.

** a=avoidance (actual proportion > upper confidence limit); b=selection (actual proportion < lower confidence limit).

DISCUSSION

Success rate for radioed hens nesting, hatching, and rearing broods to ≥6 weeks of age was 14% (2 of 14). Limited telemetry readings and direct observations of 6 additional hens indicated overall success in radioed hens may have been even lower (10%; 2 of 20). This success rate is below the suggested sustaining level (20%) for a wild turkey population in western New York (Glidden and Austin 1975). Juvenile-to-adult trapping ratios in winter and spring also indicate extremely low (0.23:1) to mediocre (1.7:1) reproductive success in the preceeding reproductive seasons (cf DeArment 1959, Mosby 1967, Porter 1979).

Adverse weather may have been a factor in the low recruitment. During both years of the study early warm spells may have initiated early breeding and nesting by the hens, and followed by late snowfall that may have caused poor initial nesting success because of abandonment (Markley 1967). Also, prolonged rains and cool weather occurred in June of both years, when any initial hatch of poults was most vulnerable to adverse conditions. Extended periods of chilling often cause death in young poults (Mosby and Handley 1943, Ligon 1946, Wheeler 1948, Latham 1956, Schorger 1962, Holbrook and Lewis 1967).

The 2 hens that reared broods successfully had similar home range sizes and used the same habitat; they and their broods were observed to travel together for most of the study period. Their home range sizes were small (about 8 ha) in comparison with broods from Minnesota (Porter 1980), for which home range size during 2, 4-week

posthatching periods was 34 ha ± 5 (N=9) and 72 ha ± 11 (N=9). However, Grettenberger (1979) found a brood home range in northern Michigan was 14 ha during the poults' first 2 weeks. The modified minimum area method (Harvey and Barbour 1965) used in home range estimation by the latter 2 researchers is more conservative than the convex polygon method used here; size differences may be even greater than apparent from the numbers indicated. Home range sizes averaged >6 times larger for broodless hens than for those of hens with broods during the same time periods. This difference suggests that broods may be using more specific habitat to provide the necessary requirements for survival in a small area.

Poult survival is dependent on an adequate food source and shelter from adverse weather and predators. Most poult mortality occurs within 2 weeks posthatching (Wheeler 1948, Spicer 1959, Glidden and Austin 1975, Everett et al. 1980). Chilling from moist, cool weather is an oft-cited cause. Also, high protein needs of turkey poults <5 weeks old are supplied by consumption of insects. Hurst and Stringer (1975) found that 1-week-old poults ingest 79% animal foods on average. Adults normally ingest <11% animal foods (Korschgen 1967, 1973; Scott and Boeker 1973). Most food habit studies of turkeys have been conducted in forest/forest-opening ecosystems. Forested areas tend to be lower in insect availability than are forest-openings such as clearings, pastures, and fields (Blackburn et al. 1975, Hurst and Stringer 1975, Martin and McGinnes 1975, Speake et al. 1975). However, trees can protect poults from rainfall and can relatively minimize observation of poults by aerial predators. Consequently, most researchers have found

open areas to be important to turkey broods, particularly small fields with readily accessible escape cover (Wheeler 1948, Lewis 1967, Hillestad and Speake 1970, Blackburn et al. 1975, Grettenberger 1975, Speake et al. 1975, Porter 1977, Pack et al. 1980).

Turkey habitat in southcentral South Dakota has forest, open areas, and also savannah (as defined by Hayden [1979]). Wild turkeys will concentrate in areas of habitat that offer the best balance of food and cover resources. From the findings of this study, I suggest that savannah provides the best food/shelter balance for turkey broods <5 weeks old and that open fields are utilized only when adequate food cannot be found in areas with cover. During the first 4 weeks of life, when nutritional and cover needs are highest, broods in southcentral South Dakota favored south-facing savannah woodlands. Wild turkeys are opportunistic feeders (Bailey and Rinell 1967) and insects apparently were plentiful on south-facing slopes (an abundance of grasshoppers was observed during this period), as were grasses and forbs. South-facing slopes also provide the benefit of early morning sunlight, useful in burning off dew quickly, which reduces the hazard of poults being dampened and chilled. South-facing woodlands were selected over south-facing grasslands probably because the 48% canopy cover provided protection from aerial predators, shelter against rain and wind while giving ready access to open drying areas wherever trees are sparse, and shade from heat (which also may concentrate insects [Anderson and Samuel 1980]). These benefits probably occur without reducing the food base. Use of savannah communities by broods has been noted by a number of investigators, including Williams et al. (1973, 1974), Scott and Boeker

(1973), Pybus (1977), Burkert (1979), Hayden (1979, 1980), Nenno and Lindzey (1979), Baker et al. (1980), and Pack et al. (1980).

After poults were 4 weeks of age, cover selection by Gregory County turkey broods shifted to north-facing woodlands, similar to selection by broods studied by Pack et al. (1980) in West Virginia. Open areas continued to be avoided or used proportionally. Savannah use decreased, probably because protein needs of poults decreased to a level similar to that of adult turkeys (Hurst and Stringer 1975), and north-facing woodlands were able to provide the best balance between the food and shelter needs of older poults. This is consistent with information from Scott and Boeker (1973), who found that during summer months, wild turkeys consume about 36% mast and soft fruit by volume, with forbs constituting about 30% and grasses <20%. Of all cover types, north-facing woodlands on the study area had the greatest abundance of mast-producing bur oaks and soft fruit-producing shrubs, such as gooseberry (Ribes missouriense), smooth sumac (Rhus glabra), black and red raspberry (Rubus sp.), buffaloberry (Sheperdia argentea), and snowberry (Symphoricarpos albus). Forb cover was as abundant in north-facing woodlands as in savannah and the understory generally was as dense as in other woodland cover types. Canopy cover averaged over 90%, which created shade, retension moisture beneficial to herbaceous food plants, and concealment from aerial predators.

Bottomland also is a forest cover type and might provide the best food sources for wild turkeys of the region, given its quantitative advantages in forb and grass cover over north-facing woodlands. However, bottomland was not shown to be utilized by hens with broods,

and hens without broods appeared to use bottomland only for roosting or as travelling lanes. It seems likely that bottomland is avoided because it is quanitatively lacking in soft fruit and mast, having the lowest densities of shrubs and oaks of the wooded cover types. Vegetation is thick (total basal area is greatest of the cover types, and the average horizontal visibility below 1 m is least), making travel difficult for poults. Also, predators are more easily concealed. Adult turkeys cannot use a downhill gliding escape flight from the valley floor. Pybus (1977) also noted a lack of bottomland use by broods in West Virginia.

Cultivated land was not selected probably because most fields were planted in corn, which are low in food production in spring and summer (Porter 1977). However, based on personal observations of non-radioed birds, 2 small alfalfa fields on the study area did appear to be desirable to turkeys. Since crops within the designation of cultivated fields were not examined separately, no conclusion on the specific value of alfalfa can be drawn, but Porter (1980) listed alfalfa as valuable to broods. Farmsteads probably were not selected due to human and canine activity in these areas.

Since hens without broods are not constrained by brood mobility, shifts in activity patterns would be expected to correspond with dietary needs and food and cover resource changes. All but 1 broodless hen in this study did not attempt to nest during the time periods studied, based on movement data and personal observations. Consequently, behavioral influences of nesting or incubating probably were not an effect on these hens or a cause for the shift from proportional use of

most cover to selection for woodlands and avoidance of grasslands. The explanation for the observed shift may be a change in the food resource as a result of the drying of range vegetation over summer. Succulent plant matter and insects probably decrease in abundance as summer progresses. This could cause a gradual cover-selection change to the cooler and moister wooded lands where green plant food would be more plentiful, a situation noted by Burkert (1978) and Baker et al. (1980). Another possibility is that 1 or more woodland food items may become available in early August.

Management implications

This study showed the utility of diverse cover to wild turkey broods. Diversity of woodland types in regard to canopy cover, insect populations, and forbs seems to be particularly important. Land-use practices that alter the nature of woodlands in the region could have negative impacts on brood production and general habitat. Management in southcentral South Dakota ought to be directed toward habitat maintenance because wild turkey habitat does not appear to be deteriorating. The human population level is not increasing and current land-use practices are stable, with most land used for moderate grazing by cattle. Rugged topography likely will prevent extensive conversion of turkey range for cropland. Overgrazing, which could effect insect and forb populations, is a problem in localized areas, but currently is not of serious impact. It could become more prevalent if economic difficulties continue in the region. Effort should be made to encourage moderate grazing practices and to inform landowners of the financial

benefits of proper range management (cf Callendar 1947, Blakey 1944, Merrill 1959, Korschgen 1967). Moderate grazing can be beneficial to turkeys by increasing plant diversity without reducing carrying capacity (Walker 1951, Stoddard 1963, Hillestad and Speake 1970, Merrill 1975, Porter 1980) and cattle ranching generally has been compatible with wild turkeys in Gregory County, as exhibited by their establishment and proliferation.

Habitat improvement for wild turkeys is possible in the area. Specifically, I would suggest landowners be encouraged to employ deferred-rotation grazing, possibly following the guidelines set by Merrill (1975). This has been shown to be advantageous to both livestock and wildlife by increasing rangeland productivity.

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Appendix 1. Cover-type vegetation statistics for the study area in Gregory County, South Dakota.

GRASSLANDS Variable	NFGL (N=80) Mean (S.E.)	SFGL (N=120) Mean
Frequency of		
Agropyron smithii	46 (6)	0 (0)
Amorpha canescens	10 (3)	14 (3)
Andropogon gerardi	15 (4)	50 (4)
Bouteloua curtipendula	0 (0)	61 (5)
Bouteloua gracilis/ Bouteloua hirsuta	43 (5)	61 (4)
Carex spp.	72 (5)	88 (3)
Moss	30 (5)	8 (2)
Sporobolus cryptandrus	39 (5)	22 (4)
Stipa comata	0 (0)	27 (4)
Stipa viridula	45 (6)	1 (1)
Ground cover (cm^2) by		
grasses	1006 (69)	736 (37)
forbs	140 (24)	49 (6)

WOODED LANDS Per sampling frame variables (N=200)	NFWD Mean	SFWD Mean	BOTT Mean
Frequency of			
Juniperus virginiana	18 (3)	1 (1)	1 (1)
Prunus virginiana	16 (3)	2 (1)	1 (1)
Quercus macrocarpa	10 (2)	7 (2)	4 (1)
Ulmus americana	83 (3)	1 (1)	11 (2)
Agropyron smithii	0 (0)	14 (2)	0 (0)
Andropogon gerardi	0 (0)	42 (3)	0 (0)
Andropogon scoparius	0 (0)	10 (2)	0 (0)
Bouteloua curtipendula	0 (0)	64 (3)	0 (0)
Bromus japonicus	0 (0)	0 (0)	18 (3)
Carex blanda	11 (2)	2 (1)	12 (2)
Carex spp. (other)	56 (4)	94 (2)	88 (2)
Elymus canadensis	6 (2)	4 (1)	60 (3)
Oryzopsis micrantha	13 (2)	10 (2)	0 (0)
Poa pratensis	6 (2)	30 (3)	38 (3)
Moss	22 (4)	1 (1)	0 (0)
Fragaria virginiana	57 (4)	1 (1)	12 (2)
Parthenocissus quinquefolia	16 (2)	0 (0)	6 (2)
Sanicula canadensis	8 (2)	0 (0)	18 (3)
Vitis riparia	12 (2)	2 (1)	4 (1)
Ground cover (cm^2) by			
trees	13 (6)*	18 (9)	6 (3)
shrubs	141 (21)	86 (19)	34 (12)
grasses	63 (12)	397 (23)	451 (30)
forbs	139 (14)	112 (52)	170 (23)
seedlings	190 (14)*	57 (40)	49 (30)

Per plot variables (N=50)	**NFWD**	**SFWD**	**BOTT**
Number of shrub stems	26 (2)	11 (1)	10 (1)
Canopy opening (%)	7 (1)	52 (2)	22 (1)
Horizontal visibility (% open)			
0.0 to 0.5 m	25 (2)	33 (2)	15 (2)
0.5 to 1.0 m	44 (2)	55 (2)	43 (2)
1.0 to 1.5 m	45 (2)	56 (3)	59 (2)
1.5 to 2.0 m	42 (2)	48 (3)	71 (2)
Per site variables (Point-centered quarter method calculations) (N=5)			
Frequency of			
Acer negundo	6	0	18
Celtis occidentalis	0	0	1
Fraxinus pennsylvanica	2	<1	29
Juniperus virginiana	6	8	2
Populus deltiodes	0	0	5
Quercus macrocarpa	63	92	23
Salix spp.	0	0	3
Tilia americana	1	0	6
Ulmus americana	20	0	13
Density (trees/ha) of			
Acer negundo	59	0	51
Celtis occidentalis	0	0	2
Fraxinus pennsylvanica	40	2	121
Juniperus virginiana	79	19	9
Populus deltoides	0	0	17
Quercus macrocarpa	858	393	65
Salix spp.	0	0	7
Tilia americana	9	0	17
Ulmus americana	229	0	48
Ave. basal area (m^2/tree) of			
Acer negundo	0.024		0.062
Celtis occidentalis			0.101
Fraxinus pennsylvanica	0.011	0.002	0.049
Juniperus virginiana	0.016	0.006	0.006
Populus deltoides			0.744
Quercus macrocarpa	0.014	0.011	0.019
Salix spp.			0.095
Tilia americana	0.024		0.051
Ulmus americana	0.005		0.040
Total m^2/ha	**16.4**	**4.5**	**26.6**

* N=160

Appendix 2. Plant species acquired in a collection on the Gregory County, South Dakota, study area (1983).

FAMILY (F.) CUPRESSACEAE	
Juniperus virginiana L.	Eastern red cedar
F. COMMELINACEAE	
Tradescantia occidentalis (Britt.) Smyth.	
F. LILIACEAE	
Allium textile Nels. & Mac Br.	
Yucca glauca Nutt.	Soapweed
F. SALICACEAE	
Populus deltoides Marsh.	Cottonwood
F. FAGACEAE	
Quercus macrocarpa Michx.	Bur oak
F. ULMACEAE	
Ulmus americana L.	American elm
F. MORACEAE	
Cannabis sativa L.	Marijuana
F. SANTALACEAE	
Comandra umbellata (L.) Nutt.	Bastard toadflax
F. NYCTAGINACEAE	
Mirabilis linearis (Pursh) Hiemerl.	
F. PORTULACACEAE	
Talinum parviflorum Nutt.	Fameflower
F. RANUNCULACEAE	
Delphinium virescens Nutt.	Prairie larkspur
F. BRASSICACEAE	
Capsella bursa-pastoris (L.) Medic.	Shepherd's purse
Descurainia pinnata (Walt) Britt.	Tansy mustard
Erysimum asperum (Nutt.) DC.	Western wallflower
F. CAPPARIDACEAE	
Thlaspi arvense L.	Pennycress
F. ROSACEAE	
Geum canadense Jacq.	White avens
Prunus besseyi Bailey	Sand cherry
Prunus virginiana L.	Chokecherry
Rosa arkansana Porter	

F. FABACEAE	
Amorpha canescens Pursh.	Leadplant
Astragalus missouriensis Nutt.	
Desmodium glutinosum (Muhl.) Wood	
Medicago lupulina L.	Black medic
Medicago sativa L.	Alfalfa
Melilotus officinalis (L.) Lam.	Yellow sweet clover
Petalostemon candidum Michx.	White prairie clover
Petalostemon purpureum (Vent.) Rydb.	Purple prairie clover
Petalostemon villosum Nutt.	
Psoralea digitata Nutt.	
Psoralea argophylla Pursh.	
Schrankia nuttallii (DC) Standl.	Sensitive briar
Trifolium pratense L.	Red clover
Trifolium repens L.	White clover
F. OXALIDACEAE	
Oxalis violacea L.	
F. POLYGALAACEAE	
Polygala verticillata L.	
F. RUTACEAE	
Zanthoxylum americanum Mill.	Prickly ash
F. EUPHORBIACEAE	
Euphorbia missurica Raf.	
Euphorbia marginata Pursh.	Snow-on-the-mountain
Euphorbia strictospora Engelm.	
F. ANACARDIACEAE	
Rhus glabra L.	Smooth sumac
F. ACERACEAE	
Acer negundo L.	Boxelder
F. VITACEAE	
Parthenocissus vitacea (Knerr.) A. S. Hitchc.	Woodbine
F. MALVACEAE	
Sphaeralcea coccinea (Pursh) Rydb.	Scarlet mallow
F. VIOLACEAE	
Viola pratincola Greene	Meadow violet
F. LOASACEAE	
Mentzelia decapetala (Pursh) Urb. & Gilg.	Sand lily
F. CACTACEAE	
Coryphantha vivipara (Nutt.) Britt. and Br.	Pincushion cactus
Opuntia polycantha Haw.	

F. ONAGRACEAE	
Calylophus serrulatus (Nutt.) Raven	
Gaura coccinea (Nutt.) Pursh	
Oenothera strigosa (Rydb.) Mack. & Bush.	
Oenothera nuttallii Sweet.	
F. APIACEAE	
Musineon divaricatum (Pursh) Nutt.	
Sanicula canadensis L.	
F. PRIMULACEAE	
Androsace occidentalis Pursh	Rock jasmine
F. OLEACEAE	
Fraxinus pennsylvanica Marsh.	Green ash
F. CONVULVULACEAE	
Convolvulus arvensis L.	Field bindweed
Ipomoea leptophylla Torr.	Bush morning glory
F. BORAGINACEAE	
Lithospermum carolinense (Walt.) MacMill.	
Lithospermum incisum Lehm.	Fringed puccoon
Verbena bipinnatifida Nutt.	
Verbena stricta Vent.	Hoary vervain
F. LAMIACEAE	
Mentha arvensis L.	Field mint
Salvia reflexa Hornem.	Sage
F. SOLANACEAE	
Physalis virginiana Mill.	
Solanum rostratum Dunal.	Buffalo bur
F. SCROPHULARIACEAE	
Penstemon grandiflorus Nutt.	Large beardtongue
Penstemon angustifolius Pursh	Narrow beardtongue
F. CAPRIFOLIACEAE	
Symphoricarpos occidentalis Hook.	Wolfberry
F. LOBELIACEAE	
Lobelia siphilitica L.	Blue cardinal flower
F. ASTERACEAE	
Ambrosia artemissifolia L.	Small ragweed
Aster ericoides L.	White aster
Aster hesperius Gray	Lilac aster
Bidens cernua L.	
Bidens vulgata Greene	

Chrysopsis villosa (Pursh) Nutt.	Gold aster
Cirsium undulatum (Nutt.) Spreng.	Wavy-leaved thistle
Cirsium altissimum (L.) Spreng.	
Dyssodia papposa (Vent.) Hitchc.	Fetid marigold
Echinacea angustifolia DC.	Purple cone-flower
Erigeron strigosus Muhl.	Daisy fleabane
Grindelia squarrosa (Pursh) Dunal.	Curlycup gumweed
Haplopappus spinulosus (Pursh) DC.	Iron plant
Helianthus petiolaris Nutt.	
Helianthus rigidus (Cass.) Desf.	
Helianthus maximiliana Schrad.	Maximilian's sunflower
Iva xanthifolia Nutt.	Marshelder
Kuhnia eupatorioides L.	False boneset
Liatris aspera Michx.	
Liatris punctata Hook.	
Machaeranthera canescens Pursh.	Hoary aster
Ratibida columnifera (Nutt.) Woot. & Standl.	Coneflower
Senecio plattensis Nutt.	Prairie ragwort
Solidago rigida L.	Rigid goldenrod
Solidago canadensis L.	Canada goldenrod
Taraxacum officinale Weber	Gray-seeded dandelion
Veronia fasciculata Michx.	Ironweed
Xanthium strumarium L.	Cockelbur

Appendix 3. A chemical burn of unknown origin on the head of a wild turkey hen.

On 25 June 1982, I captured an afflicted female wild turkey (Meleagris gallopavo) in Gregory County, South Dakota, on private land north of the town of St. Charles (T96N, R69W, Sec 7). The bird entered a corn-baited, walk-in funnel trap (Petersen and Richardson 1975) with two other hens and had an apparent skin disease of the head and neck.

The effected hen was observed to remain motionless in 1 corner of the trap with her head lowered for an extended period of time. When approached, the other female turkeys became agitated, while the afflicted hen stayed relatively still.

Field examination found that the normally fleshy head and neck regions were darkened, dried, and cracked. Exudate from the eyes was conspicuous, causing 1 eye to be blocked partially and the other entirely. Rapid blinking was evident and vision appeared to be impared except to fast or very close movements. Because of concern over the possibility of an outbreak of the contagious turkey blackhead disease (Schorger 1966), the hen was sent to the South Dakota State University Animal Disease Research and Diagnostic Laboratory for analysis.

Necropsy revealed the following symptoms: (1) emaciation; (2) dry erosion of the head and neck; (3) skin from the head had necrosis of the epidermis with a sharp line of infection in the dermis; and (4) eyes closed due to adherence of the eyelids by exudate. No evidence of unusual bacteria or infectious process was noted.

The specific cause of the problem could not be determined, but

necropsy results indicated a probable chemical burn. Discussion among researchers and local landowners yielded no suggestions as to the source of any such chemical agent. Aerial crop spraying was considered an unlikely source, due to the extensive nature of the injury.

On 27 June 1982, another turkey with the same apparent condition was observed in a flock within a mile of the previous bird's capture (T96N, R70W, Sec 12). This hen was not captured nor was it seen for the rest of the summer.

Appendix 4. Home range data summary by posthatching time period per individual bird showing the number of days readings were taken, the number of locations, the size by the the convex polygon method, and the percentages of each cover type incorporated within the convex polygon delineating the area.

5 July-2 August (1st 4 weeks)

Bird #	Yr	# of Days	# of Locations	Size (ha)	Percentages							
					NFGL	SFGL	NFWD	SFWD	BOTT	CULT	FARM	WATR
200	82	7	34	140.0	15	21	25	27	1	11	0	<1
203	82	7	73	78.3	29	43	15	12	0	0	0	<1
207	82	9	130	167.9	16	32	27	21	5	0	0	<1
440	83	2	12	7.5	34	18	40	8	0	0	0	0
452	83	2	5	36.9	19	11	54	15	0	0	0	0
456	83	1	11	22.6	34	31	27	5	0	2	0	0
463	83	1	7	0.3	84	15	0	0	0	0	0	0
480	83	2	5	3.1	48	12	38	2	0	0	0	0
489	83	1	9	1.5	56	32	12	0	0	0	0	0
445	83	3	54	6.0	21	34	14	31	0	0	0	0
460	83	3	57	8.7	21	15	52	12	0	0	0	0

3 August-17 August (5th & 6th weeks)

Bird #	Yr	# of Days	# of Locations	Size (ha)	Percentages							
					NFGL	SFGL	NFWD	SFWD	BOTT	CULT	FARM	WATR
200	82	7	48	29.4	29	7	31	10	0	24	0	0
200	83	2	20	19.8	16	33	14	15	0	5	18	0
203	82	6	24	16.7	33	38	23	4	0	0	0	1
207	82	7	64	157.7	15	29	28	23	5	<1	0	<1
411	83	3	19	9.2	42	7	38	2	0	10	0	0
422	83	2	19	29.0	21	24	40	15	0	0	0	0
440	83	3	47	83.2	25	13	48	14	0	0	0	0
452	83	1	11	10.8	23	8	63	7	0	0	0	0
456	83	4	25	66.9	21	23	32	12	0	6	5	0
463	83	3	40	113.9	25	13	46	16	0	0	0	0
480	83	3	37	44.7	34	13	42	11	0	0	0	0
489	83	3	43	59.5	21	10	56	12	0	0	0	0
445	83	4	72	8.5	42	2	50	6	0	0	0	0
460	83	4	73	8.5	44	2	49	5	0	0	0	0