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PRAIRIE CHICKEN RESPONSES TO CHANGING BOOMING-GROUND COVER TYPE AND HEIGHT¹

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Abstract: Prairie chicken (*Tympanuchus cupido*) responses to experimental and natural changes in booming-ground cover were observed in central Wisconsin. Natural changes included cultivation, wild-fire, snow, and natural succession and growth of vegetation. Experimental changes included burning, mowing, and installation of a conifer windbreak. No consistent pattern of use or preference for cover types was evident. Cocks preferred cover heights that were 6 inches or less. The presence of an artificial windbreak disrupted booming grounds.

Several researchers have reported that prairie chicken cocks are sensitive to density and height of booming-ground cover, and that cocks prefer sites with lower cover (Hamerstrom 1939, Lehmann 1941, Yeatter 1943, Schwartz 1945, Grange 1948, Baker 1953, Ammann 1957, Hamerstrom et al. 1957, Jones 1963, Kobriger 1965). Preference for cover type is not so obvious, for prairie chicken cocks have been observed to boom on a variety of types. However, changes in type have been associated with changes in location of booming grounds

(Schwartz 1945). Trees, through natural succession or planting, have been responsible for major changes in booming-ground locations (Hamerstrom et al. 1957).

I intensively studied 23 booming grounds in Portage and Wood Counties, Wisconsin, during the spring booming seasons of 1962, 1963, and 1964, and to a lesser degree from 1965 through 1967. Fourteen of the booming grounds were located in the Portage County Management Area of Hamerstrom, Mattson, and Hamerstrom (1957:26) and nine were located approximately 20 miles northwest of that study area in Carson and Linwood Townships, Portage County, and in Sherry and Sigel Townships, Wood County. Several of these booming grounds underwent uncontrolled changes in cover

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between and during booming seasons; others were experimentally subjected to change. This paper reports the reactions of booming-ground populations and those of individual prairie chicken cocks to such changes.

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METHODS

General

This study was conducted, for the most part, during spring booming seasons, with observations being confined largely to the morning display period. Booming grounds were under observation daily between April 1 and June 10 of each booming season for the years 1962, 1963, and 1964. The use of volunteer manpower made it possible to have several booming grounds under observation each morning. Most observations were made from blinds located on the edges of booming grounds. Individual cocks were identified by colored leg bands (Hamerstrom and Mattson 1964) or by distinctive variation in plumage, usually the pattern of undertail coverts. Territorial boundaries of cocks were mapped by noting points of contact between adjacent cocks and orienting those points to naturally occurring topographic features and/or inconspicuous markers placed on the booming ground in a 25-ft grid. Changes in size, shape, or location of individual territories were obvious when chronological maps of territories were compared.

Booming-ground cover was experimentally modified by mowing, burning, and by the installation of a temporary coniferous windbreak. Uncontrolled changes included mowing, wildfire, snow, and cultivation.

Mowing

To test the attractiveness of short vs. tall grass as display cover, three booming grounds, with cover of varying height and density, were mowed in various patterns to determine cock preference. Strips and rectangles were outlined with small markers in the existing cover on the booming grounds. Extent of use before treatment was determined by recording the number of prairie chicken cocks present in the marked areas once every minute during a morning display period. The marked areas were mowed after the birds had left. We used a rotary power-mower which cut the vegetation to a height of 2 inches. Use of mowed areas was determined on the following day in the same manner as described for the pre-mow period.

On booming ground A, a strip (4×100 ft) and a square (10×10 ft) was mowed in new grass growth that appeared late in the booming season of 1962. This booming ground was mowed with a conventional hay mower in the fall of that year leaving a 4- to 6-inch stubble. Three strips (4×130 ft) were mowed in this stubble with a rotary mower in the spring of 1963. Grass-forb growth of the previous year exceeded 12 inches in height on booming grounds B and C. Two strips (4×130 ft) on booming ground B, and one strip (4×130 ft) and two squares (12×12 ft) on booming ground C were mowed after pre-mow use had been established.

Burning

In 1963, cover on booming ground D consisted of a rank growth of grass and

forbs (*Poa* spp., *Aster* spp., *Solidago* spp., *Urtica* spp.). To test the hypothesis that cocks are not dependent upon obvious objects and naturally occurring topographic features for territorial landmarks, and to evaluate the effect of a sudden change in cover type and height, booming ground D was burned on April 11, after seven cocks had become well established. Cock territories were mapped before and after the burn to discern any changes in boundaries.

Windbreak

Booming ground G, which had been active in its present location since at least 1951, was selected for this study. It is characterized by the necessary "wide horizons" (Hamerstrom et al. 1957). The nearest tree line is 0.5 mile to the north, with distances to other tree lines being 0.75 and 1.25 miles to the west and east, respectively; it is open to the horizon to the south.

In order to study the effect of a space-destroying windbreak on this booming ground, a row of 13-ft jack pine (*Pinus Banksiana*), 140 ft long, was erected during the mating seasons of 1962 and 1963. The trees were stabilized by planting the butt-end 2 ft in the ground and securing each stem to a horizontal wire attached to steel fence posts. This "instant" windbreak was placed at decreasing distances from and finally onto the booming ground in successive moves. In 1962, the tree-line was first established 300 ft from the ground. It was later moved to a distance of 170 ft, and then to the edge of the booming ground. In 1963, it was initially positioned 150 ft from the edge and then moved onto the booming ground. A minimum of 3 days was allowed between moves to permit the birds adequate time to react to the presence of the trees. The trees were finally removed from the booming ground. Cock response to the

Table 1. Use of booming-ground cover by prairie chicken cocks before and after mowing. Number of observations in parentheses.

BOOM- ING GROUND	EXPERI- MENTAL UNIT	COVER TYPE AND HEIGHT BEFORE MOWING	COCK USE ^a	
			Before Mow	After Mow
A-1962	Strip	Grass		
	4 × 100 ft	0-3 inches	45(100)	40(100)
	Square	Grass		
	10 × 10 ft	6-8 inches	4(100)	8(100)**
A-1963	Strip A	Grass-stub- ble		
	4 × 130 ft	4-6 inches	15(38)	69(217)
	Strip B	Grass-stub- ble		
	4 × 130 ft	4-6 inches	36(114)	50(217)
	Strip C	Grass-stub- ble		
	4 × 130 ft	4-6 inches	21(114)	30(217)
	B	Strip A	Dense grass- forbs	
	4 × 130 ft	6-24 inches	31(100)	72(128)*
	Strip B	Sparse grass- forbs		
	4 × 130 ft	6 inches	7(100)	12(128)
	C	Strip A	Medium dense grass	
	4 × 130 ft	12-16 inches	25(76)	85(122)**
	Square A	Medium dense grass-forbs		
	12 × 12 ft	12-24 inches	5(76)	23(122)*
	Square B	Dense grass- forbs		
	12 × 12 ft	12-16 inches	7(73)	39(98)**

^a Total number of times that cocks were present on the experimental unit.

* $P < 0.05$.

** $P < 0.01$.

presence of the trees, including changes in the location of territorial boundaries, was recorded daily.

RESULTS AND DISCUSSION

Mowing

A summary of cock responses to mowing is presented in Table 1. On booming ground A, new growth of grass was uneven

in height on different parts of the ground in the spring of 1962. Where the grass was taller than 6 inches, there was a significant difference ($P < 0.01$) in use after mowing; cocks preferred the mowed, shorter cover. There was no significant difference ($P > 0.05$) in use of a mowed strip where cover height was 3 inches or less before mowing. There was no significant difference ($P > 0.05$) in use of three mowed strips of 4- to 6-inch grass stubble on booming ground A in 1963.

There was a significant difference ($P < 0.05$) in use of mowed strips and squares on booming grounds B and C where cover height exceeded 12 inches before mowing. Mowing a strip of 6-inch grass cover on booming ground B did not influence its use, while a second strip on that same booming ground and a strip and two squares on booming ground C, where cover had been taller, were preferentially used after mowing. A further indication of cover-height preference was demonstrated when cocks on booming ground C moved approximately 0.25 mile to the west during the 1963 booming season to a site where the vegetation was less than 6 inches high.

Thus, prairie chicken cocks demonstrated a preference for mowed areas when original unmowed cover was over 6 inches high. There was no indication of preference for a mowed area when pre-mowed cover height was 6 inches or less. These experimental data support general observations that prairie chicken cocks prefer short cover for display purposes. Jones (1963:771 in Oklahoma), reports the "Mean height of the vegetation used for booming by the greater prairie chicken was 15.1 cm. . . ." There is value in having taller escape cover in close proximity to or even on the booming ground. I observed cocks to consistently use the unmowed grass areas when disturbed by a

passing hawk or car. They would run from the mowed areas and squat in the taller cover. A small amount of such cover, scattered on the booming ground, may add stability to the grounds; cocks could utilize such nearby cover for escape purposes at a time when they are most vulnerable.

Burning

Seven cocks had established territories on booming ground D prior to burning on April 11. They were briefly hesitant about entering the booming ground the morning following the burn, remaining on the edge for 8 minutes before coming on and booming. That landmarks denoting territorial boundaries had been destroyed by fire was evidenced by an unusually high number of vigorous combats; however, cocks established new boundaries in essentially the same locations as before the burn. Light-colored stems of nettle (*Urtica* spp.) that had resisted the burn, were very conspicuous on the booming ground after the fire. Cocks began "riding" them down the day after the burn and by the end of the booming season, all nettle stems had been snapped off at ground level. It is not known why such stems were broken down; presumably cocks attempted to perch on them for a higher vantage point during their display. I have observed cocks to frequently use points of higher elevation (blinds, fenceposts, small knolls) for display, especially when hens are present.

After the burn, the maximum number of cocks present on the booming ground increased from 7 to 13 present 4 days after the burn. This could be a normal increase sometimes occurring on booming grounds at the peak of the booming season. The maximum number of cocks present on five other booming grounds also increased during this same time but by only one cock

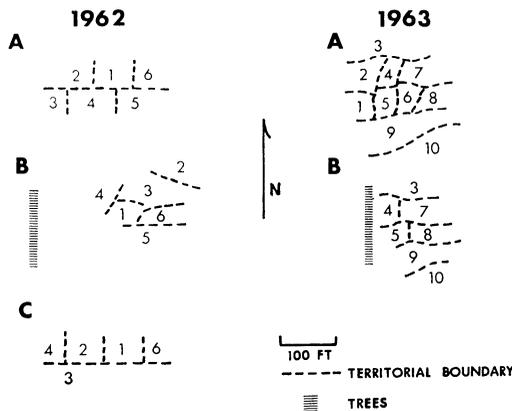


Fig. 1. Booming ground G—1962 and 1963. Territories of prairie chicken cocks as they existed prior to (A), during (B), and after (C) the presence of a row of 13-ft conifers. The straight-line boundaries in 1962 are the result of the orientation of cocks to a fence line.

each. Cock numbers did not change on three booming grounds, and on three others they decreased by one cock each.

The burned cover did not appear to have an influence on hen attendance. There were 5 and 3 hens present, respectively, on the 2 days prior to the burn, and 3 and 7 present, respectively, on the 2 days following the burn. The peak of hen attendance (10 hens) on this booming ground occurred 4 days after the burn (April 14), the same date that the peak of mating occurred on other booming grounds in 1963 (Hammerstrom, personal communication).

In 1964, booming ground D again was covered with a rank growth of grass and forbs. Cocks commenced booming on the 1963 site early (March 11) but by March 20 they had moved approximately 100 yards southeast and across a drainage ditch to an area that had been mowed the previous fall. The 1963 site was burned on April 11, but the main body of cocks remained on the new site to the south. Two cocks from the 1963 booming ground (identified by leg bands) used both sites throughout the 1964 season.

An uncontrolled fire burned 760 acres of prairie-chicken range, including booming ground E, on April 18, 1964. The booming ground cover had been mowed with a hay mower the preceding fall, but there was sufficient fuel to facilitate a severe burn. Here, as at D in 1963, the booming-ground cover was reduced to a black, homogeneous, and essentially featureless condition. Cocks again occupied essentially the same territories that they had held before the burn. Hen counts remained high after the burn; there were 17 and 26 hens present on this booming ground during the 2 days immediately preceding the burn, and 22 were present the second day after the burn.

Snow

On April 23, 1963, a snowfall created booming-ground cover conditions similar to that of a fire, that is, it obliterated micro-features and changed the color and texture of the booming ground. Observations from a blind on booming ground F with 5 inches of snow on that date, and examination of sign on two others (G: 4 inches, H: 1.5 inches) revealed little or no changes in size or location of individual cock territories.

Windbreak

1962.—Boundaries of individual cock territories relative to the location of the windbreak on different dates are presented in Fig. 1. The windbreak was initially erected 300 ft from the west edge of the display ground on April 19; it remained there for 6 days. No reaction by the cocks could be detected with the trees at this distance. The trees were then moved to a position 170 ft from the edge of the booming ground. At this distance, the cocks left the ground singly, or in groups, and returned after varying lengths of time. In most cases they were observed to alight in an area about 0.5 mile to the east, where another booming

ground of uncertain status was located. Further reaction to the trees was demonstrated by wary behavior and listless, sporadic booming. This behavior continued for 4 days, when the trees were moved to the edge of the booming ground. Departures to the area 0.5 mile to the east, by some or all of the cocks present, continued. Within 3 days, three of the six cocks established new territories on the northeast edge of the booming ground. On May 7, the trees were taken down and laid horizontal in the same location, thereby creating a hedge that was 3 ft high. No further changes occurred while the trees were in the hedge formation. Four days later, May 11, the trees were removed. By May 16, the territories to the northeast of the booming ground were abandoned, and the territories on the west edge of the booming ground were reoccupied. One bird (Cock-4) changed the location of his territory. Cock-5 abandoned the booming ground after May 11, but this could have been normal late-season behavior.

1963.—This year the booming ground was located 50 yards to the northeast of the 1962 site. There did not appear to be any hesitancy about setting up territories as cocks were fairly well-established by April 8 (Fig. 1-A). On April 16, the 140-ft row of 13-ft jack pine trees was erected 150 ft from the west edge of the booming ground. Within 4 days, Cocks 1, 2, and 3 had noticeably reacted to the presence of the trees. Cocks 1 and 2 left the booming ground to boom in a plowed field 0.25 mile to the east. Cock 3 remained at least 210 ft away from the trees, whereas he previously had spent much of his time north of Cock 2 territory, 150 ft from the trees. At the end of 4 days, the trees were moved onto the booming ground to the edge of Cocks 4 and 5 territories. On the next day, Cock 6's ter-

ritory was vacated and divided between Cocks 5, 8, and 9. Cock 6 was now booming 0.25 mile to the east. The trees remained in this position for 10 days and then were removed. During the 10 days that trees were present on the booming ground, there were several departures by all cocks present to an area 0.25 mile to the east where Cocks 1, 2, and 6 were now booming. Cocks 3, 4, and 5 remained on the booming ground most of the time but occupied the far sides of their territories away from the trees. Within 3 days after the trees were removed, Cock 2 had returned to his original territory, but Cocks 1 and 6 did not return for the rest of the season. Thirteen days after the removal of the trees (May 13), only Cocks 3, 5, 7, 8, and 9 were present on the booming ground; the rest were booming 0.25 mile to the east. On May 26, the final observation date, there were 12 cocks boom on the field to the east and none on the original booming ground. In 1964, birds were again booming on the 1963 site; however, they were late in becoming established, not stabilizing until April 10.

Booming ground I, located on bare peat soil and ringed by willows (*Salix* spp.) approximately 30 ft high, disappeared after 1 year of observation. Hamerstrom et al. (1957:11) report the abandonment of a booming ground that was hemmed in by a pine windbreak. The loss of a "space factor," such as by being crowded by windbreaks, is highly disruptive even when the booming ground itself is not encroached upon.

Changes in Cover Type

During this study ten booming grounds underwent uncontrolled changes in cover type and density between and during the booming seasons. These were largely the result of agricultural practices (cultivation)

but in some instances were due to natural growth of vegetation. Prairie chicken reactions to these changes were varied and inconsistent. One booming ground was located on a strip-cropped field with four parallel strips, each 200 ft wide. The strips were separated by a shallow, 10-ft-wide grass waterway. In 1962 and 1963, the booming ground was located on a bare strip that had been plowed the previous fall. In 1964, it shifted 200 ft west to plowed ground when the 1962 and 1963 site was left in grain stubble and clover (*Trifolium pratense*). In 1965, cocks remained on the 1964 site although it was in grain stubble. Cocks used this same site in the fall of 1965 but, when all strips were in grain stubble by the spring of 1966, they shifted approximately 0.25 mile northwest to bare ground with short corn stubble. The booming ground was located on this same site with the same cover in 1967. Apparent affinity for bare ground was evident here during four of the five springs of observation.

By contrast, cocks on another booming ground appeared to have an affinity for sod. In 1963, this booming ground was located on sod which was plowed midway through the booming season (April 20). By May 15 all six cocks on this booming ground had moved to a grazed sod area approximately 0.25 mile to the east. This site was, in turn, plowed during the fall of 1963. In the spring of 1964, the booming ground was located on sod again approximately 0.25 mile south-southeast. By the spring of 1965, the 1964 site was plowed, but the cocks returned to it. In 1966, the cocks moved to a 12-inch corn-stubble field, ignoring a sod area immediately adjacent to it. In 1967, they moved again, this time to a grain-stubble field. Except for 1965 and 1966, there was an apparent affinity for sod.

Between-season changes in booming-

ground cover on other booming grounds had no apparent effect on the status of the birds. One booming ground has persisted on the same site for at least 17 years in spite of cover changes resulting from an irregular rotation of grain and pasture. The cover sometimes consisted of bare ground (when fall plowed), grain stubble, or grazed sod. Cover on another booming ground has changed from bare peat to wet-site vegetation consisting of smartweed (*Polygonum* spp.) and grass (*Agrostis* spp.) without affecting the general location of the booming ground. Its specific location, however, moved a few feet each year as a dense growth of sedge (*Scirpus* spp.) advanced from the east. Schwartz (1945:40) mentions two booming grounds in Missouri that were present on the same sites for 40 and 20 years, respectively, in spite of their being cultivated, sown to tame hay, pasture^d, and mowed.

Midseason changes in cover also had an inconsistent effect. Cocks on one booming ground moved 0.25 mile east when it was plowed on April 20, 1963. Cocks on another booming ground did not move, although territorial boundaries shifted, when the sod there was plowed on April 25, 1963. Dragging, disking, grading, and seeding operations on a third booming ground caused minor shifts in territorial boundaries but had no effect on location of the booming ground proper.

The location of other booming grounds did change, however, presumably due to increased cover height. Cocks on booming ground M shifted to mowed sod approximately 0.25 mile east of the 1961 site, which was 16- to 18-inch corn stubble, in the spring of 1962. Booming grounds C and D (see above) moved to sites with shorter vegetation when the traditional sites became a rank growth of grass and forbs.

From these experimental data and general observations, prairie chicken cocks do not appear to exhibit any consistent pattern of use or preference for booming ground cover types. Short cover and wide horizons, however, are physiognomic characteristics that were consistently preferred and presumably necessary, probably satisfying cock needs to see and be seen during the display period.

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A METHOD FOR EVALUATING GREATER PRAIRIE CHICKENS HABITAT IN COLORADO¹

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Abstract: Important habitat components associated with greater prairie chicken (*Tympanuchus cupido pinnatus*) abundance in the sandhill region of northeast Colorado include grainfields for winter food and an abundance of tall-grass species for suitable nesting cover. A form was designed to aid the game manager in systematically assigning a numerical value to individual habitat components. In aggregate, these individual ratings indicate the potential value of a specific range for greater prairie chickens. Separately, they indicate habitat components that are lacking or inadequate and need improving.

Greater prairie chickens are native to the tall-grass prairies and apparently were not found in Colorado prior to settlement. Determination of their past distribution is com-

plicated because no distinction was made between the prairie chicken and the sharp-tailed grouse *Pedioecetes phasianellus* in early records. It seems that before settlement by white men, the greater prairie chicken did not occur farther west than the middle of Kansas (Baker 1953:10, Beck 1957, and Cooke 1888:104). Greater prairie chicken range gradually extended westward as homesteaders provided winter food by planting cereal crops (Sclater

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