on statistical methodology, D. A. Davenport assisted with data processing, and the Cedar Creek Bioelectronics Laboratory of the Univ. Minnesota constructed and maintained our biotelemetry equipment. We especially thank our coworkers I. J. Ball and D. S. Gilmer for advice regarding conduct of this study and for comments on early drafts of the manuscript. W. H. Dryer, D. H. Johnson, J. T. Lokemoen, R. D. Titman, and an anonymous referee provided additional manuscript review.—RONALD E. KIRBY AND JOHN H. RIECHMANN, *Dept. Ecology and Behavioral Biology, Univ. Minnesota, Minneapolis, Minnesota 55455*; AND LEWIS M. COWARDIN, *U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Jamestown, North Dakota 58401.* (Present address of REK: *U.S. Fish and Wildlife Service, Office of Information Transfer, 2629 Redwing Rd., Ft. Collins, Colorado 80526;* present address of JHR: *RR #2, Box 163, Valmeyer, Illinois 62295.* Address reprint requests to LMC.) *Accepted 10 Jan. 1985.*

Wilson Bull., 97(2), 1985, pp. 219–221

Observations of the formation of a Sage Grouse lek.—Sage Grouse (*Centrocercus urophasianus*) commonly use disturbed areas as breeding arenas (Dalke et al., J. Wildl. Manage. 27:811–840, 1963; Connelly et al., J. Range Manage. 34:153–154, 1981); however, few data are available on the establishment of leks by Sage Grouse. During a study of Sage Grouse use of a prescribed burn site, observations of three wing-tagged male and three radio-collared female grouse on a recently burned area provided some insight into the establishment of an arena.

My study was conducted on a 300 km² segment of the Idaho National Engineering Laboratory (INEL) in southeast Idaho. The area surrounding the burn site is dominated by big sagebrush (*Artemisia tridentata*), green rabbitbrush (*Chrysothamnus viscidiflorus*), and perennial grasses (mostly *Pseudoroegnaria spicata* and *Elymus elymoides*, McBride et al., Natl. Tech. Inf. Serv. IDO–12084, 1978). Mean elevation of the burn site is 1515 m. A more detailed description of the physical and biotic environments of the study area is given in Gates (M.S. thesis, Montana State Univ., Bozeman, Montana, 1983).

Four hundred ha of the study area were control-burned in Aug. and Oct. 1981. Prior to burning, arenas occurred on (Arena A) and adjacent to (Arena B) the burn site. Ten male grouse were captured (Giesen et al., Wildl. Soc. Bull. 10:224–231, 1982) on Arena B in 1981; 10 males and five females were marked there in 1982. Five males and one female were marked on Arena A in 1982. Seventy grouse were captured and marked on three other arenas within 6.5 km of the burn site. In addition, 113 grouse were marked in irrigated cropland 6.4 km north of the burn site. Captured grouse were marked with numbered patagial tags (males), poncho tags (females; Pyrah, J. Wildl. Manage. 34:466–467, 1974), or radio-collars (both sexes; Amstrup, J. Wildl. Manage. 44:214–217, 1980).

Five arenas within 6.5 km of the burn site were censused in the springs of 1981–1983. The maximum number of males attending Arena B declined from 45 in 1981, to 25 in 1982, and 18 in 1983. Arena A, which was used by grouse in 1981 but not censused, declined from 12 males in 1982 to three in 1983. A similar decline of males from 39 to 20 to 16 occurred between 1981 and 1983 on an arena 6.5 km east of the burn site. No grouse were observed in 1982 and 1983 on an arena 3.5 km southeast of the burn site that had 18 males in 1981. The apparent cause of the downward population trend between 1981 and 1983 was poor production resulting from abnormally cold, wet weather during the springs of 1980 and 1981 (Gates 1983).

A new arena (Arena C) was discovered on the burn site on 10 Apr. 1982, 1.5 and 2.0 km south of Arenas A and B. Arena C was observed on six mornings between 10 and 29 Apr.

1982. Grouse were present on four mornings through 23 Apr. Three males and 7–11 females were observed on three mornings from 10 through 16 Apr. A fourth male appeared on the periphery of Arena C on 23 Apr.; however, no females were present. No grouse were observed on two subsequent visits to Arena C on 24 and 29 Apr.

One of the males (M510) initially observed on the new arena was wing-tagged as a juvenile in irrigated cropland 8 km to the north in July 1980. He was recaptured on Arena B, adjacent to the burn site, on 28 Mar. 1981 and was seen again on the same arena on 27 Mar. 1982. In 1982, this bird did not occupy even a peripheral territory on the arena, which was attended by 20–25 males. He was unable to defend a breeding territory and was displaced continually by other males as described by Wiley (Anim. Behav. Monogr. 6:85–169, 1973:135).

Fourteen days after being seen on Arena B in 1982, M510 was observed occupying a central territory on Arena C, which he defended against two other males. Seven females present on 10 Apr. 1982 remained mostly within the area that M510 defended. On 16 Apr., M510 was observed copulating with one of 8 females in attendance. None of the other three displaying males was observed to copulate during three mornings of observation when hens were present.

Both males captured on the new arena on 12 Apr. 1982 were adults (>1 year), based on the condition and shape of their 9th and 10th primaries (Dalke et al. 1963). Both males were observed displaying with M510 on 16 and 23 Apr. 1982. They may have been the same individuals observed with M510 on 10 Apr. Three females captured on the new arena on 17 and 18 Apr. were yearlings, based on the appearance of their outer two primaries.

In Apr. 1983, the new arena could be censused only by flushing the birds from small burned openings in the sagebrush 30–75 m from the area that was used in 1982. The reason for this shift from the more open area used in 1982 to a smaller burned area in 1983 was unknown. Vegetation regrowth was minimal one year after burning. A maximum of five males and three females was observed on the new arena in April 1983. One or two wing-tagged males were observed each morning that the arena was visited; however, their identities were not determined.

Connelly et al. (1981) documented Sage Grouse displaying on recently disturbed sites elsewhere on the INEL during 1978 and 1979, a period of increase in the grouse population. I observed grouse displaying and mating on a burned area during the first two breeding seasons following a burn and during a population decline. At least three of four males attending the arena in its initial year were adults and three captured females were yearlings. Up to 11 females were observed in attendance daily in 1982, so some adults could have been present.

Eng et al. (pp. 464–468 *in* The Mitigation Symposium, Colorado State Univ., Fort Collins, Colorado, 1979) reported that most of the first females to attend a new arena were yearlings. Adult females show a certain degree of fidelity to arenas that they attended in previous years (Dalke et al., Trans. N. Am. Wildl. Nat. Resour. Conf. 24:396–407, 1960), although movements between arenas within and among years is common (Wallestad, Life History and Habitat Requirements of Sage Grouse in Central Montana, Montana Dept. Fish and Game, Helena, Montana, 1975; Petersen, M.S. thesis Colorado State Univ., Fort Collins, Colorado, 1980).

Adult males show greater fidelity to arenas than do females (Dalke et al. 1960; Emmons, J. Wildl. Manage. 48:1023–1028, 1984). Although young males are physiologically capable of breeding (Eng. J. Wildl. Manage. 27:841–849, 1963), their subordinate position on previously established arenas affords them a low probability of mating (Wiley 1973). I observed a 2-year-old male that colonized and copulated on a new arena. By colonizing new openings and attracting females, some young males may enhance their opportunities for breeding in the short- and long-term. The first males to colonize new arenas may be young adults not firmly established as members of other breeding populations. Yearling males, however,

appear to be attracted to arenas by the presence of grouse of both sexes (see Wiley 1973). Eng et al. (1979) reported that yearling males were the first to be attracted to an artificial arena on which decoys were placed and recorded sounds of displaying grouse were played.

Females were captured on the new arena at a time of year when yearling hens normally predominate on INEL leks; however, breeding phenology was delayed 2–3 weeks in 1982 by adverse weather. Adult females were captured on nearby arenas as late as 18 Apr. and yearlings were first captured on 10 Apr. The delayed breeding season may have caused more overlap in the appearance of yearling and adult hens on arenas and may, in part, explain the success of the new arena in attracting females in 1982. Hannon et al. (Auk 99:687–694, 1982) implicated aggressive behavior of adults as the cause for delayed breeding and greater distances traveled to nest by yearling Blue Grouse (*Dendragapus obscurus*). With reduced competition from adults on new leks, yearling female Sage Grouse could establish more easily a tradition of breeding on new arenas.

The appearance of displaying grouse on recently disturbed sites suggests that natural openings suitable for arenas are limited on some areas of the INEL. Sagebrush-dominated vegetation types cover most of the western INEL but openings occur in playas, shallow basins, and disturbed areas. Of nine arenas within 12 km of the burn site, four occur in playas or basins and five are on burned areas. Eng et al. (1979) stressed the importance of juxtaposition of arenas with winter, nesting, and early brood-rearing habitat. In areas such as the western INEL where sagebrush cover is continuous over large areas and openings are widely spaced, suitable nesting and early brood-rearing habitat may be underused due to isolation from arenas; however, this needs to be demonstrated.

Acknowledgments.—R. S. Gates, J. E. Toepfer, J. Ensign, and R. Crete provided field assistance. O. D. Markham and R. L. Eng provided administrative assistance and guidance. This work was performed under a grant from the Office of Health and Environmental Research, U.S.D.E. and was published as Journal Series No. 1583, Montana Agricultural Experimental Station. This paper is a contribution of the INEL Radioecology and Ecology Program. R. L. Eng, O. D. Markham, and J. E. Swenson provided valuable suggestions on earlier drafts of the manuscript. I thank R. H. Wiley and F. N. Hamerstrom for their review of final drafts of the manuscript.—ROBERT J. GATES, *Fish and Wildlife Program, Biology Dept., Montana State Univ., Bozeman, Montana 59717.* (Present address: *Cooperative Wildlife Research Lab., Southern Illinois Univ., Carbondale, Illinois 62901.*) *Accepted 5 Jan. 1985.*

Wilson Bull., 97(2), 1985, pp. 221–224

Nest usurpation and female competition for breeding opportunities by Tree Swallows.—Tree Swallows (*Tachycineta bicolor*) are hole nesters that are often limited by nest site availability (Holroyd, Can. Field-Nat. 89:60–64, 1975). Populations generally increase following the erection of nest boxes (Low, Bird-Banding 3:76–87, 1933; Chapman, Bird-Banding 6:45–57, 1935; Holroyd 1975), and competition for nest-sites occurs early in the breeding season (Kuerzi, Proc. Linn. Soc. N.Y. 52–53:1–52, 1941). Territorial defence of the area surrounding the nest-site may further limit the availability of breeding opportunities if more than one nest-site is defended by a single pair of birds. Harris (Can. J. Zool. 57: 2072–2078, 1979) argued that the defense of unnecessary resources (extra boxes) was an example of superterritoriality (Verner, Am. Nat. 111:769–775, 1977). Robertson and Gibbs (Condor 84:313–316, 1982), however, found that territorial defense was not focused on