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Dispersal and Harvest of Sage Grouse Utilizing the Test Reactor Area of the Idaho National Engineering Laboratory

Howard W. Browers, Jr.

DISPERSAL AND HARVEST OF SAGE GROUSE UTILIZING THE TEST REACTOR AREA ON THE IDAHO NATIONAL ENGINEERING LABORATORY

BY

HOWARD W. BROWERS, JR.

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DISPERSAL AND HARVEST OF SAGE GROUSE UTILIZING

THE TEST REACTOR AREA ON THE IDAHO

NATIONAL ENGINEERING LABORATORY

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.

Lester D. Flake Thesis Adviser	Date
Charles G. Scalet, Head Wildlife and Fisheries Sciences	Date

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DISPERSAL AND HARVEST OF SAGE GROUSE UTILIZING THE TEST REACTOR AREA ON THE IDAHO NATIONAL ENGINEERING LABORATORY

Abstract

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A radio telemetry study of sage grouse (Centrocercus urophasianus) summering at the Test Reactor Area (TRA) on the Idaho National Engineering Laboratory (INEL) in southeastern Idaho was initiated in July 1980. Objectives included determination of habitat use, home range, brood breakup, fall movements, and harvest of sage grouse using the TRA. Supplemental habitat data and fall movement data were collected from sage grouse summering at the Central Facilities Area (CFA) on the INEL in 1982.

Seasonal precipitation appeared to influence the period of use of the TRA by sage grouse. Grouse arrived later and left earlier in the wet year of 1980 than in the drier year of 1981. Grouse did not use the TRA in 1982. Sage grouse fed at the TRA primarily in the early morning and late afternoon and evening periods. Home range estimates averaged 109 ha for adults using the TRA in 1981 compared to 74 ha for juveniles. No differences in shrub cover and shrub height between adult and juvenile loafing sites were found. Shrub coverage at all loafing sites averaged 22.8%.

The timing of brood breakup and individual dispersal movements was determined for members of 2 broods. Brood breakup and dispersal were two distinct occurrences. Radio-marked brood members did not exhibit synchronized dispersal and did not associate during dispersal.

Movements from TRA averaged 10.7 km for juveniles and 9.4 km for adults. Movements of radio-marked grouse from CFA in 1982 averaged 5.7, 4.0, and 3.7 km for juveniles, adult females, and adult males, respectively. During the 3 hunting seasons that occurred during this study, only 1 radio-marked grouse was beyond INEL boundaries immediately following a summer spent at the TRA.

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INTRODUCTION

Several authors have reported on the duration of brood bonds among juvenile sage grouse (Patterson 1952, Dalke et al. 1963, Oakleaf 1971). Wallestad (1971) described movements of broods before brood breakup. General fall movements of juvenile sage grouse from brood rearing areas have also been described (Dalke et al. 1963, Connelly 1982). However, specific information on the activities and movements of individual brood members and other juveniles after brood breakup is lacking.

Forbs are an important part of the diet of sage grouse (Centrocercus urophasianus), particularly juveniles, during the summer months (Patterson 1952, Klebenow and Gray 1967, Peterson 1970, Wallestad et al. 1975). Movements of sage grouse during summer to moister areas which support growths of forbs have been well documented (Patterson 1952, Dalke et al. 1963, Klebenow 1969, Oakleaf 1971). These movements are often to natural upland meadows or alfalfa fields (Dalke et al. 1963, Klebenow 1969, Oakleaf 1971). Irrigated lawns near facilities on the Idaho National Engineering Laboratory (INEL) support growths of dandelion (Taraxacum officinale) and clover (Trifolium spp.) and offer another type of feeding environment for sage grouse. At one facility, the Test Reactor Area (TRA), the potential exists for radionuclide contamination of sage grouse through the food chain.

Connelly and Markham (1983) have documented the presence of radionuclide concentrations in sage grouse that had used the TRA as a

summer area. These concentrations were significantly higher than radionuclide concentrations of sage grouse using non-nuclear areas on and around the INEL. The authors reported, however, that these concentrations did not present a health hazard to humans unless a sizeable number of birds were consumed by one individual. Although the TRA as well as the entire INEL are closed to sport hunting, the possibility of harvesting contaminated sage grouse off-site does exist (Connelly and Markham 1983). Therefore, knowledge of sage grouse using the TRA and their movements during the fall hunting season are especially important.

This study was designed to describe sage grouse use of the TRA as a summer area and to investigate movements of brood members, other juveniles, and adults from the TRA. Specific objectives of this study were to (1) determine the portion of sage grouse summering near the TRA that are available to off-site hunters and document the percentage of these birds harvested, (2) document the permanence of sage grouse brood bonds during late summer or fall dispersal, (3) examine dispersal patterns of adult and juvenile sage grouse from the TRA, (4) determine home range and general activity patterns of sage grouse using the TRA, and (5) compare habitat use of juvenile and adult sage grouse using the TRA.

STUDY AREA

The INEL is administered by the U.S. Department of Energy for the purpose of nuclear research and consists of several facilities containing test nuclear reactors and support buildings, a facility for reprocessing spent fuel rods, and a radioactive waste disposal facility. The boundaries of the INEL encompass a 231,600 ha area located on the upper Snake River Plain in southeastern Idaho (Fig. 1). Bordering the INEL on the west and north are the Lost River, Lemhi, and Bitterroot mountain ranges (Fig. 1). Topography of the INEL is flat to rolling with an average elevation of 1470 m.

The climate is characterized by hot summers and cold winters with low precipitation. Average annual temperature is 5.6 C with extremes of 39 C and -42 C. Average annual precipitation is 22 cm with maximum amounts occurring in May and June.

Vegetation is dominated by shrub-grass communities with big sagebrush (*Artemisia tridentata*) being the dominant shrub (Anderson and Holt 1981). Other shrubs include three-tip sagebrush (*Artemisia tripartita*) and rabbitbrush (*Chrysothamnus* spp.). Grasses include blue-bunch wheatgrass (*Agropyron spicatum*), bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), and needle-and-thread grass (*Stipa comata*). More detailed descriptions of INEL vegetation are provided in Atwood (1970) and McBride et al. (1978).

The TRA facility is located in the south central portion of the INEL (Fig. 1) and consists of 2 nuclear reactors and support

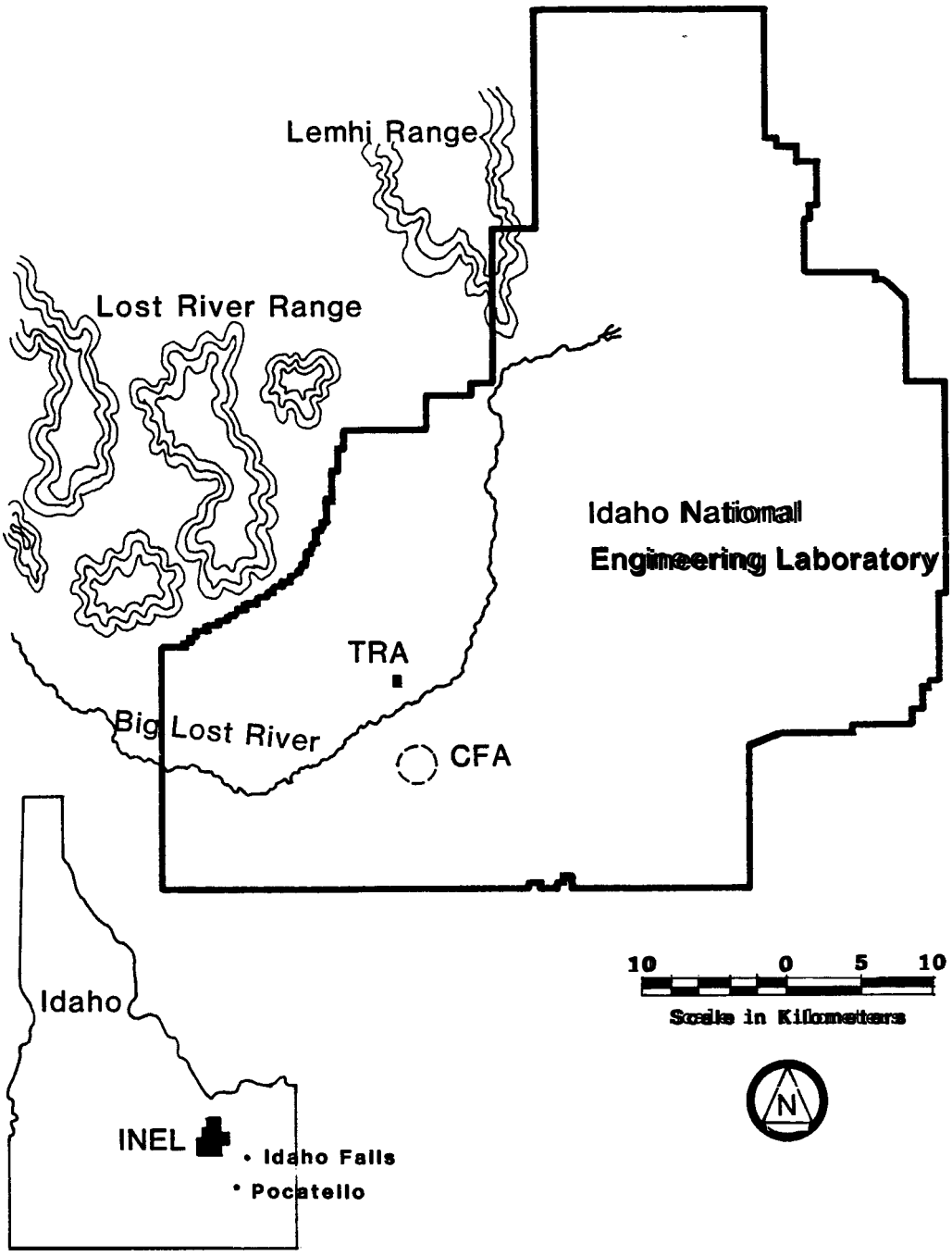


Fig. 1. Location of the Test Reactor Area (TRA) and Central Facilities Area (CFA) on the Idaho National Engineering Laboratory (INEL) in southeastern Idaho.

buildings. Irrigated lawns around the buildings support growths of forbs which attract feeding grouse. A low-level radioactive waste disposal pond is located on the east side of the TRA and is also a source of forbs and water for sage grouse. Both areas are enclosed by continuous chain link or barbed wire fences.

Because sage grouse did not use the TRA in the summer of 1982, supplemental habitat and fall movement data were collected from grouse using the Central Facilities Area (CFA) located 6 km south of the TRA (Fig. 1). The CFA is similar to the TRA except that no nuclear testing is done at CFA.

METHODS

The study was conducted from July through December 1980-82. Sage grouse using the TRA and CFA lawns during the summers were captured using mist nets and drive traps (Gill 1965). Age and sex of captured grouse were determined using wing measurements and plumage characteristics described by Petrides (1942), Crunden (1963), and Pyrah (1963).

All captured birds were fitted with $5 reward leg bands. Most birds were fitted with either a poncho-mounted solar powered radio transmitter (Amstrup 1980) or a back-mounted battery powered transmitter (Brander 1968). Juveniles too small to carry transmitters and some adults were color marked: females were fitted with numbered poncho markers (Pyrah 1970) and males were fitted with numbered patagial tags.

Radio-marked birds were located 1-4 times daily with a hand-held antenna and a portable receiver while summering on the TRA. On most location attempts each grouse was approached close enough to obtain a visual observation (approximately 4-6 m) without causing the bird to fly. If a grouse was inadvertently flushed, any further locations for that day were not included in home range calculations. Occasional continuous monitoring of an individual bird for a 10-14 hour period was undertaken using a mobile null-peak system; locations were determined by triangulation. The minimum area method (Mohr 1947) was used to estimate individual home ranges. Birds that were radio-located less than 15 times were not considered in home range calculations. In

addition, grouse using the TRA lawns were censused several times per week during morning or evening feeding periods.

During fall dispersal (prior to 15 December) radio-marked birds were located from a light airplane. Equipment and techniques were similar to those described by Gilmer et al. (1981). Radio-marked grouse were located at least twice per month from initiation of fall movements through December in 1980-82 and on an irregular basis from January through March in 1981.

Vegetative characteristics of sage grouse loafing sites in the sagebrush habitat surrounding the TRA and CFA were determined after locating and flushing a radio-marked bird. A 1 m^2 point-frame (Floyd and Anderson 1982) was used to measure vegetative characteristics. The first frame was centered over the flush site. The remaining frames were located adjacent to one another in a clock-wise fashion around the first frame until an area of 9 m^2 was sampled. Random sites were located and sampled for comparison with actual sites. Characteristics measured included percent cover of shrubs, grasses, forbs, litter, bare soil, and large rock. The height of the tallest shrub in each 1 m^2 frame was measured.

An analysis of variance was used to determine differences in vegetative characteristics between loafing sites of different age classes and random sites.

RESULTS

Residence Times, Home Ranges, and Habitat Use

Sage grouse were first observed using the TRA on 26 July in 1980 (Table 1). Peak numbers were attained by the second week of August (Fig. 2) and use of the TRA ceased by 6 September (Table 1). In 1981 grouse were first observed on 9 July and had departed by 3 October (Table 1). Again, peak numbers were recorded during the second week of August (Fig. 2). No grouse were observed using the TRA in 1982.

Rainfall for June through August in 1980 was 4.5 times greater than rainfall for the same period in 1981 when grouse arrived over two weeks earlier (Table 1). Fifty-seven percent (3.2 cm) of summer (June, July, and August) precipitation in 1980 occurred in June while 27% (1.5 cm) and 16% (0.9 cm) occurred in July and August, respectively. Precipitation for all 3 summer months was below normal in 1981 and amounted to 0.6 cm (50%) in June, 0.4 cm (33%) in July and 0.2 cm (17%) in August. The summer of 1982 was also wet with 5.0 cm of precipitation recorded (Table 1). However, the precipitation was more evenly distributed over the 3 months with 1.8 cm (35%) occurring in June, 1.2 cm (26%) in July, and 1.9 cm (38%) in August. Precipitation for all 3 months was above normal, and forbs were observed in the sagebrush habitat throughout the summer. September is one of the driest months on the INEL averaging 0.9 cm of precipitation, however; September precipitation totaled 3.9 cm in 1980 when grouse departed from the TRA in early September compared to 0.4 cm in 1981 when grouse remained on the TRA until early October.

Table 1. Summer and fall precipitation and dates of first and last observations of sage grouse using the Test Reactor Area (TRA) on the Idaho National Engineering Laboratory, 1980-1982.

Year	Date of First Observation	Summer Precipitation (cm) [a]	Date of Last Observation	Fall Precipitation (cm) [b]
1980	July 26	5.6	September 6	5.2
1981	July 9	1.2	October 3	2.7
1982 [c]		5.0		4.7

[a] June, July, and August.

[b] September and October.

[c] Grouse did not use the TRA in 1982.

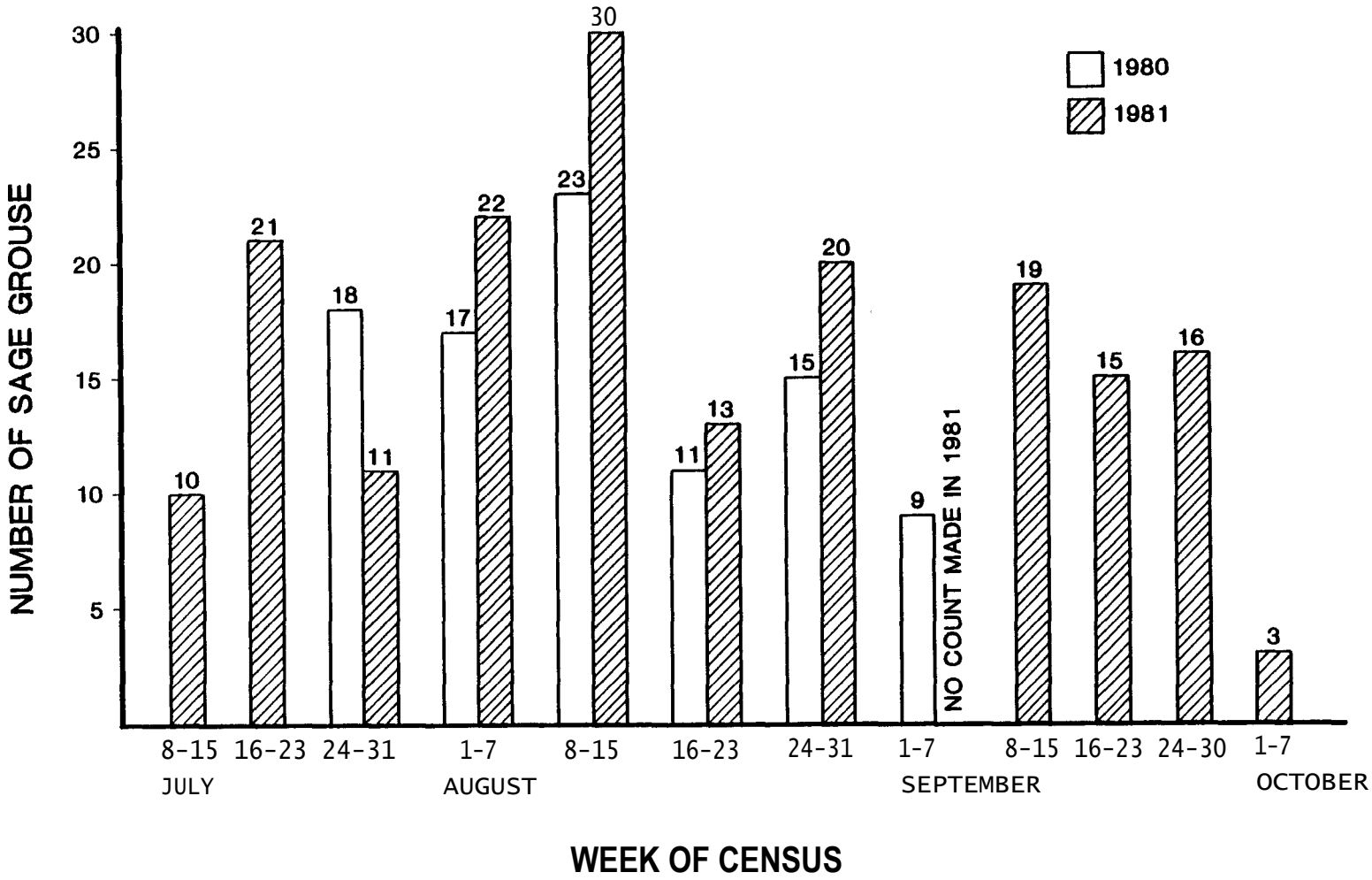


Fig. 2. Sage grouse use of the Test Reactor Area in 1980-81. Data are based on the highest daily count per week.

Forty-three sage grouse were captured at TRA during the summers of 1980-81 of which 31 (16 adult females, 15 juveniles) were radio marked. Six grouse (2 adult males, 2 adult females, 2 juveniles) were captured and radio marked at CFA in 1982.

Sage grouse generally fed at the TRA in the early morning and late afternoon and evenings (Fig. 3). These periods tended to coincide with periods of reduced employee activity at TRA. The majority of the work force arrived at 0800 and departed at 1630. Fifty-three percent of locations recorded during the evening period were inside the TRA (Fig. 3). A breakdown by years reveals that only 27% of 121 locations were recorded inside the TRA in the wet summer of 1980 while 73% of 156 locations were recorded at the TRA in 1981. Home range estimates averaged 109 ha for adults using the TRA in 1981 compared to 74 ha for juveniles (Table 2).

No differences in vegetative characteristics between loafing sites of adults and juveniles summering near the TRA in 1981 (Table 3) were noted ($P>0.05$). No differences were found between summer and fall loafing sites for juveniles in 1981 ($P>0.05$). Random sites were not different from loafing sites used by sage grouse near the TRA in 1981 ($P>0.05$). Vegetative characteristics of loafing sites near CFA in 1982 for juveniles and adults were not different ($P>0.05$). However, differences were documented between juvenile and random sites for total shrub cover ($P<0.05$). Shrub heights at random sites averaged less than at juvenile and adult sites near CFA ($P<0.05$). Total shrub coverage of loafing sites was not different between years and averaged 22.8% ($P<0.05$, $N=69$).

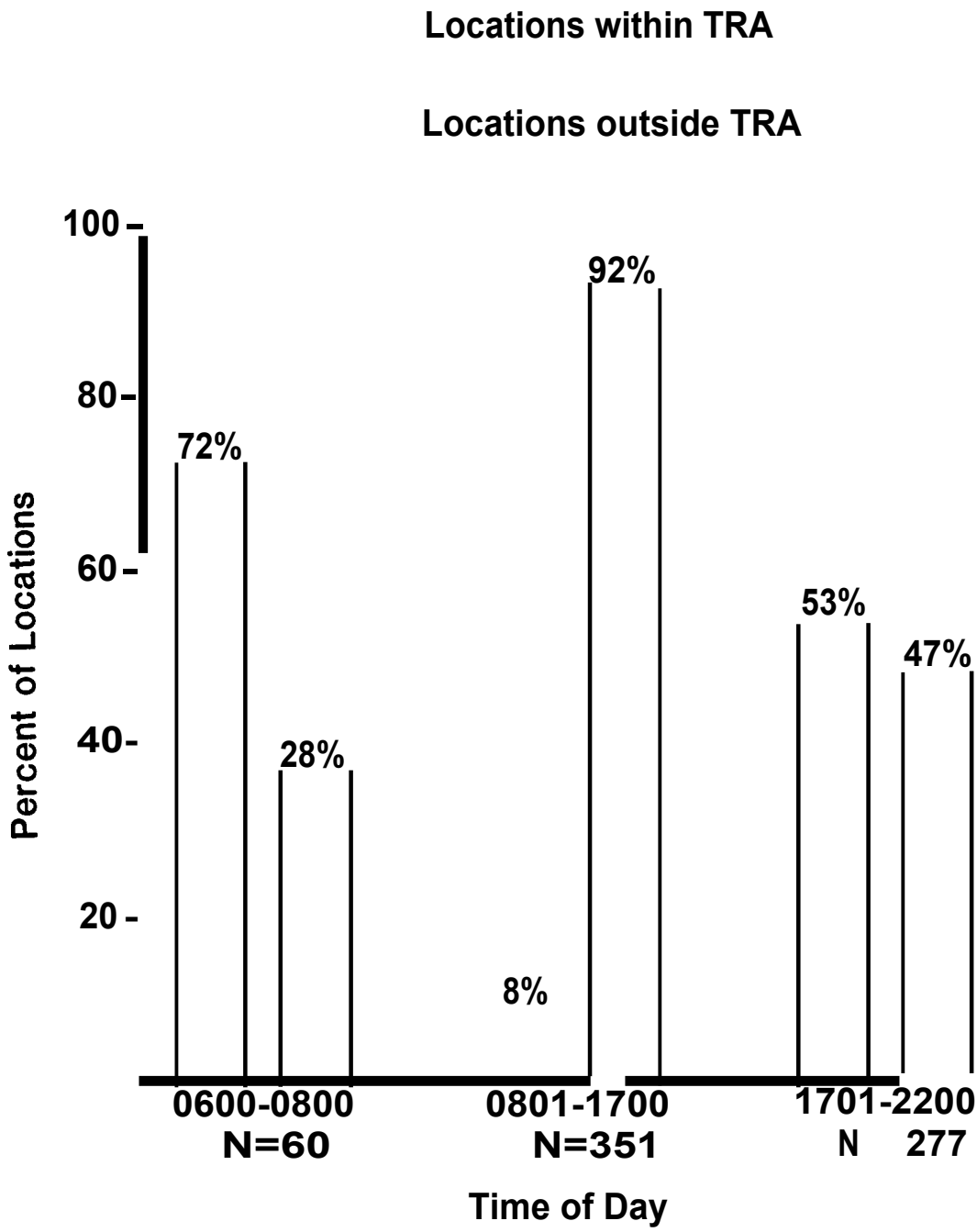


Fig. 3. Frequency of use of the Test Reactor Area (TRA) by radio-marked sage grouse compared with time of day during 1980-81.

Table 2. Home range estimates of sage grouse using the Test Reactor Area on the Idaho National Engineering Laboratory during 1981.

Age/Sex	Sample Size	x Home Range (ha)	Range (ha)
Juvenile female	8	80	40 - 121
Juvenile male	2	50	47 - 53
All juveniles	10	74	40 - 121
Adult female	4	109	81 - 149

Table 3. Vegetative characteristics of sage grouse loafing sites near the Test Reactor Area in 1981 and the Central Facilities Area in 1982 on the Idaho National Engineering Laboratory.

		Total Plant Cover (%)		Total Shrub Cover (%)		Grass Cover (%)		Shrub Height (cm)	
	Sample Size	x	SD	x	SD	x	SD	x	SD
1981									
Adult (Summer)	12	33.2	7.2	23.9	8.8	8.5	5.3	58.2	12.0
Juvenile (Summer)	11	36.0	8.5	21.3	10.6	14.2	5.9	50.6	15.9
Juvenile (Fall)	19	39.8	8.1	23.0	9.7	15.6	5.7	47.4	11.1
Random	21	39.3	11.4	25.1	9.8	13.7	7.4	54.7	11.1
1982									
Adult (Summer)	17	44.2	14.9	21.1	8.5	21.2	14.0	47.4[a]	11.8
Juvenile (Summer)	10	44.5	4.2	26.3[b]	9.3	15.3	9.5	53.9[a]	12.8
Random	9	34.6	5.4	14.1	11.7	18.4	12.1	30.9	11.3

[a]Significant difference between actual loafing sites and random sites ($P < 0.01$).

[b]Significant difference between actual loafing sites and random sites ($P < 0.05$).

Brood Breakup, Dispersal and Seasonal Movements

On 19 July 1981 a hen and 4 chicks (3 females, 1 male) estimated to be 10 weeks old were captured and radio marked. The hen and brood (brood 1) remained together until 23 July when the hen deserted the brood. Approximately 2 days later the brood breakup process began when the juvenile male (#208) moved to a sagebrush area near the Big Lost River 18 km southwest of the TRA (Fig. 4). The brood hen was monitored until 3 August when she lost her radio. She was found dead, however, on 22 October 1981 after having flown into a fence near the TRA. The juvenile females remained at the TRA for the rest of the summer and much of the fall. The radio of juvenile female #16 malfunctioned in mid-September. However, a bird was observed with a non-functioning radio on 3 October and it was believed that it was #16. She was in the company of 2 other juvenile females including a sibling (#22). Juvenile female #22 left the study area on approximately 8 October and was last located on 8 December 5.3 km northeast of TRA (Fig. 4). Juvenile hen *#17* stopped feeding at the TRA during the first week of October, but remained in the vicinity until late November when she was lost. The total range occupied by the brood members before dispersal was 121 ha (Fig. 5).

On 12 August 1981, 2 female brood members (brood 2) estimated to be 10 weeks old were radio marked. Hen desertion of the brood could not be determined since she eluded capture; however, the brood disbanded 2 days later. The total range of brood 2 before dispersal was 125 ha (Fig. 6). Juvenile female #27 departed from the TRA on approximately 2

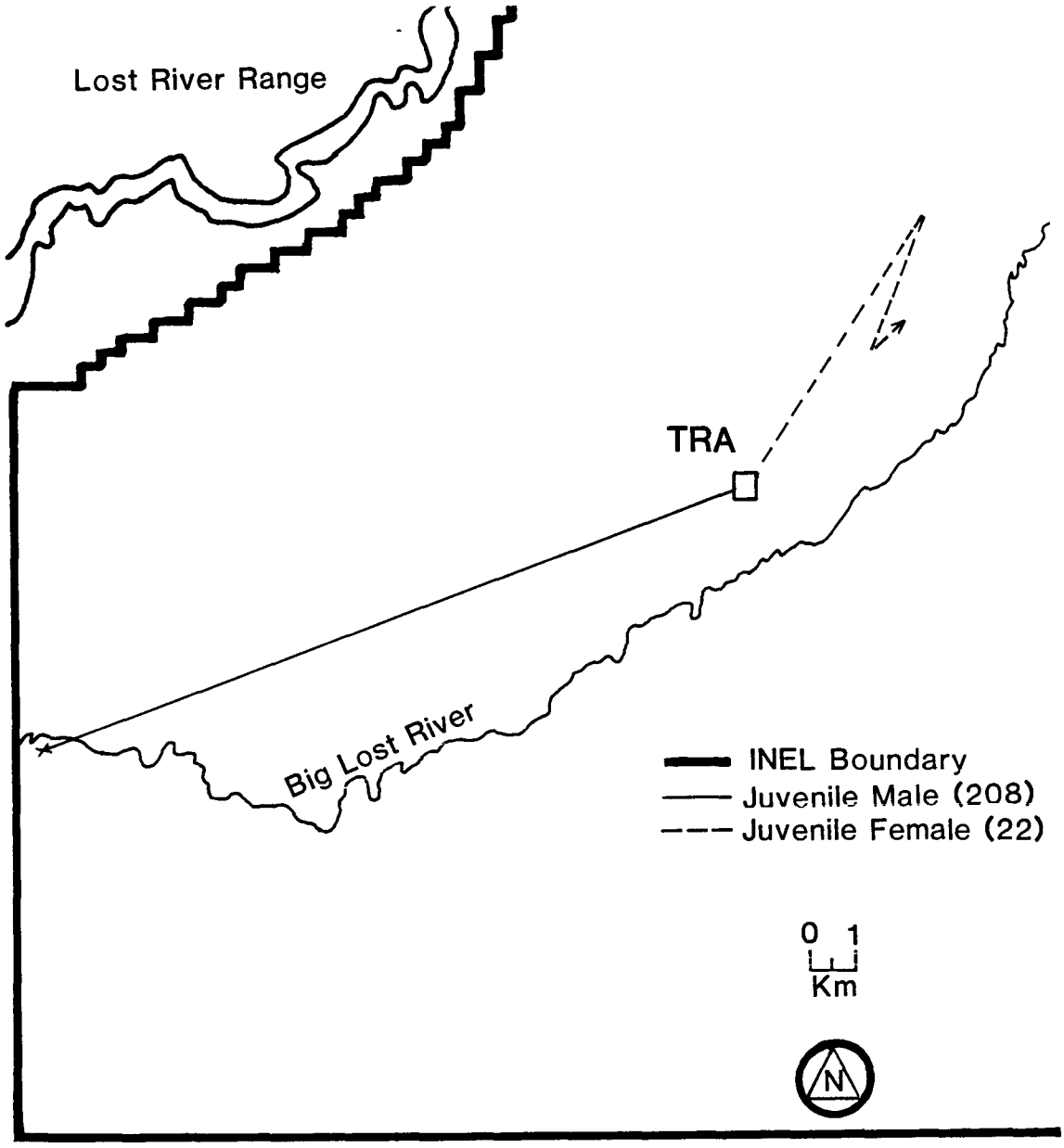
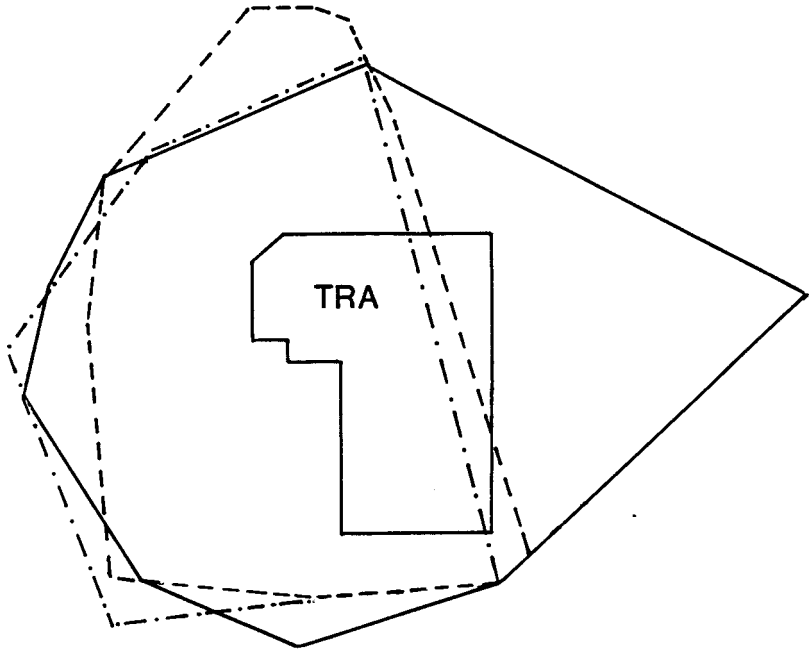


Fig. 4. Routes of dispersal from the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) and last location of members of brood 1 during 1981.



— - Juvenile Female (16) 67ha **25** Locations

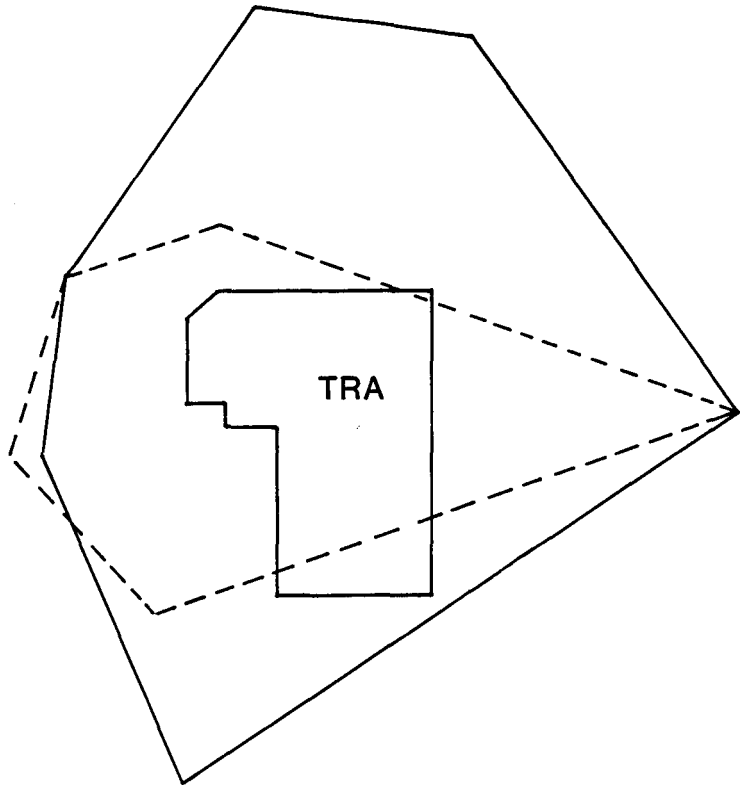
- -- Juvenile Female (17) 79ha **52** . Locations

Juvenile Female (22) 103ha 47 Locations

0 0.25 0.5

Km

Fig. 5. Individual home ranges of members of brood 1 at the Test Reactor Area (TRA) in 1981.



Juvenile Female **(27)** 121 ha 18 Locations

--- **Juvenile Female (28)** **47ha** 34 Locations

0 0.25 0.5

Km

Fig. 6. Individual home ranges of members of brood 2 at the Test Reactor Area (TRA) in 1981.

September and moved 8 km north (Fig. 7) to another INEL facility, the Naval Reactor Facility (NRF). This bird remained near the NRF until early October and was last located on 21 October, 22 km south of the NRF (Fig. 7). Juvenile hen #28 departed the TRA on approximately 4 October and was last located on 21 October, 1.8 km northwest of the TRA (Fig. 7).

Fall movement data were collected on 10 radio-marked juveniles (Fig. 8) and 10 radio-marked adult females (Fig. 9) from the TRA during 1980-81. In addition, fall movement data were obtained on 6 radio-marked grouse (2 adult females, 2 adult males, 2 juveniles) from CFA in 1982 (Fig. 10). Movements from TRA ranged from 1.2 to 20.3 km (x=10.7) for juveniles and 1.3 to 34.1 km (x=9.4) for adults (Table 5). Movements of radio-marked grouse from CFA averaged 5.7, 4.0, and 3.7 km for juveniles, adult females, and adult males, respectively. These distances, however, can only be considered minimum since some birds were lost or were found dead before the fall period ended.

Movements of radio-marked adult females from TRA appeared random (Fig. 9) while movements of radio-marked juveniles were more northerly in direction (Fig. 8). Radio-marked juveniles and adult females tended to move in a southerly direction from CFA in 1982 and adult males moved to the north (Fig. 10).

Departure dates for juveniles and adults from TRA were similar in 1980 (Table 4). Though 2 juveniles left in July in 1981, 6 Of 11 radio-marked juveniles were still at the TRA after 1 October. However, 5 of 6 adult females had made initial movements from TRA by 16

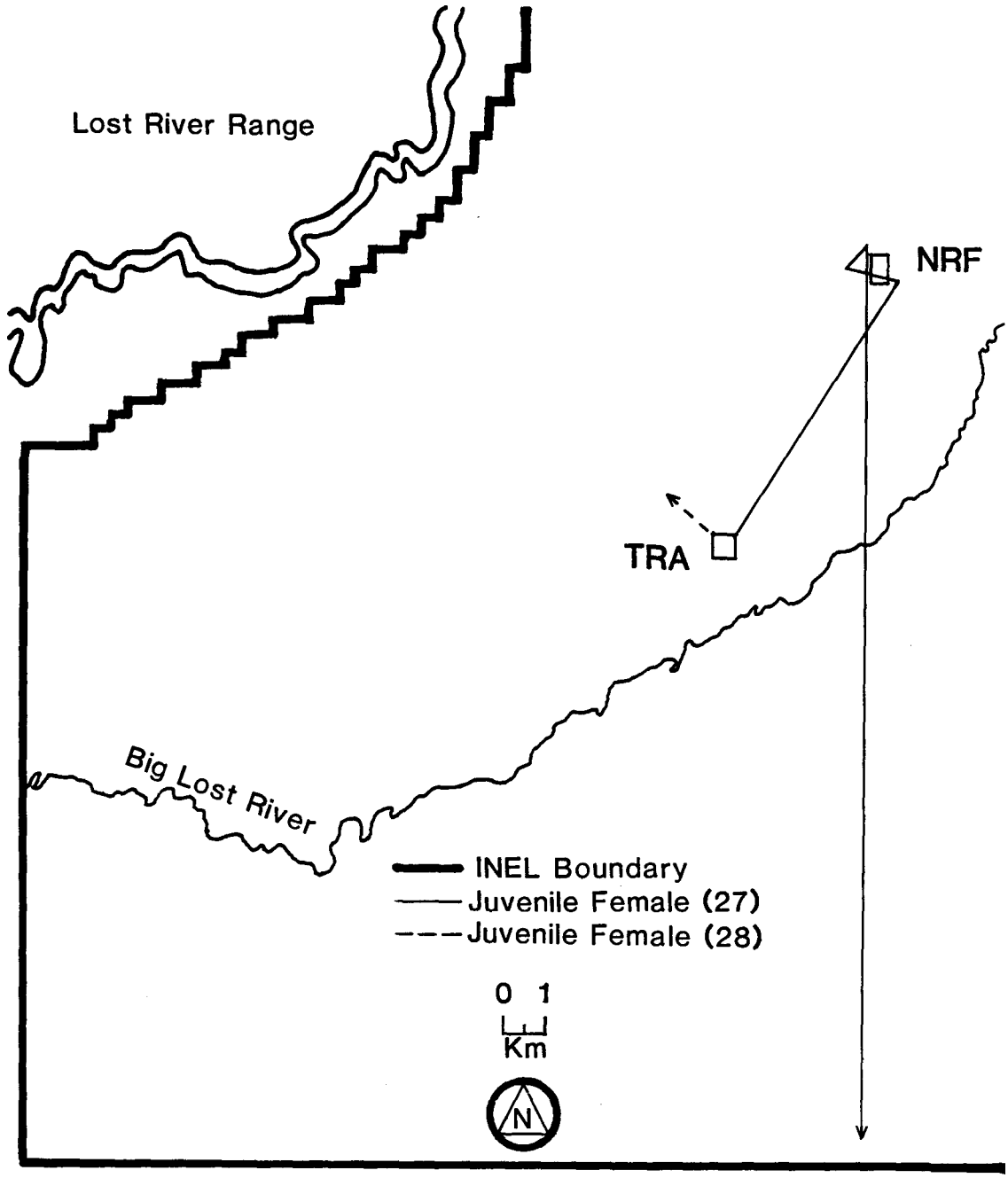


Fig. 7. Routes of dispersal from the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) and last location of members of brood 2 during 1981.

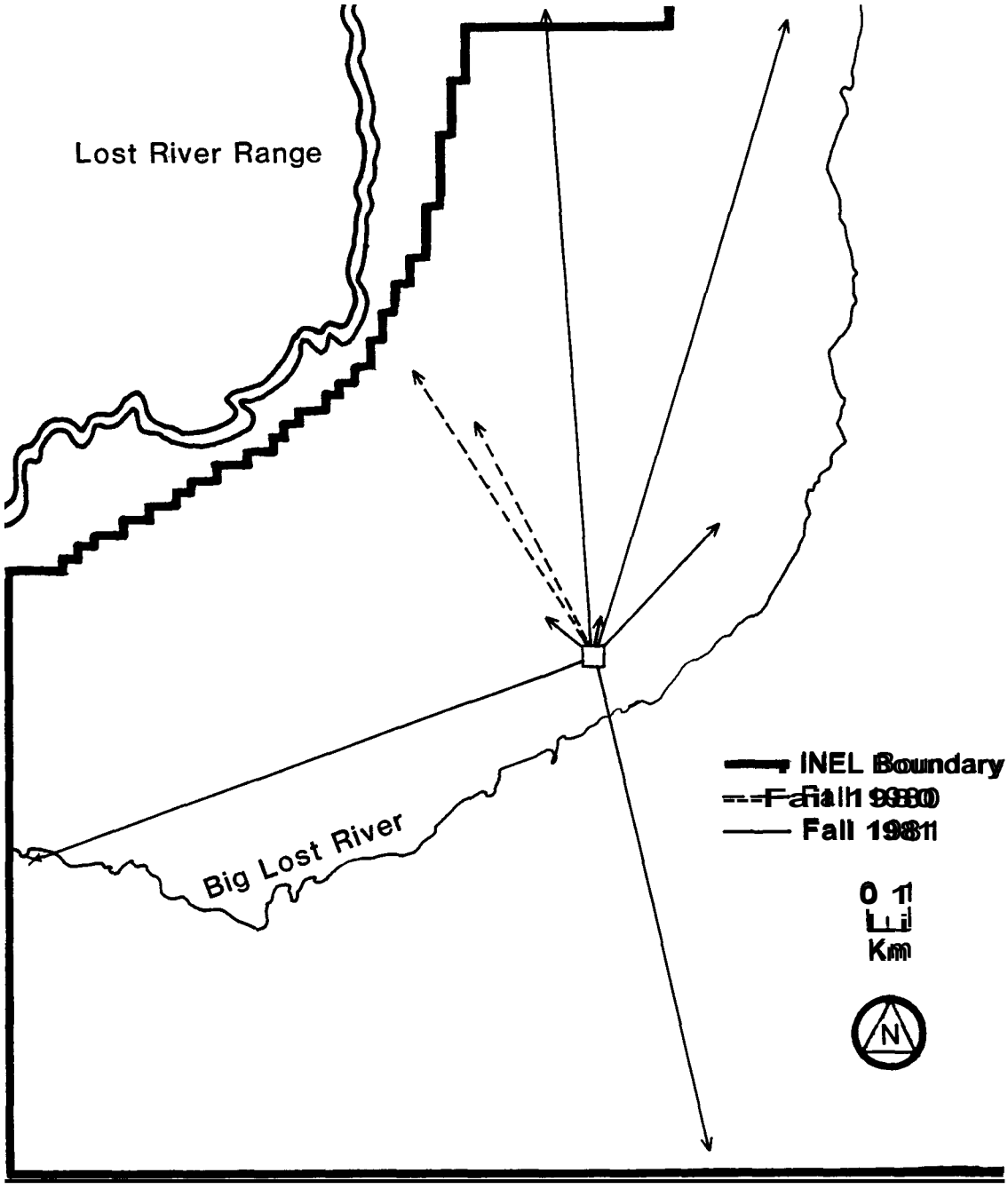


Fig. 8. Fall dispersal (prior to 15 December) of radio-marked juvenile sage grouse from the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) during 1980-81. An arrow indicates that a bird was still alive and probably still dispersing, while an X indicates that a bird was found dead.

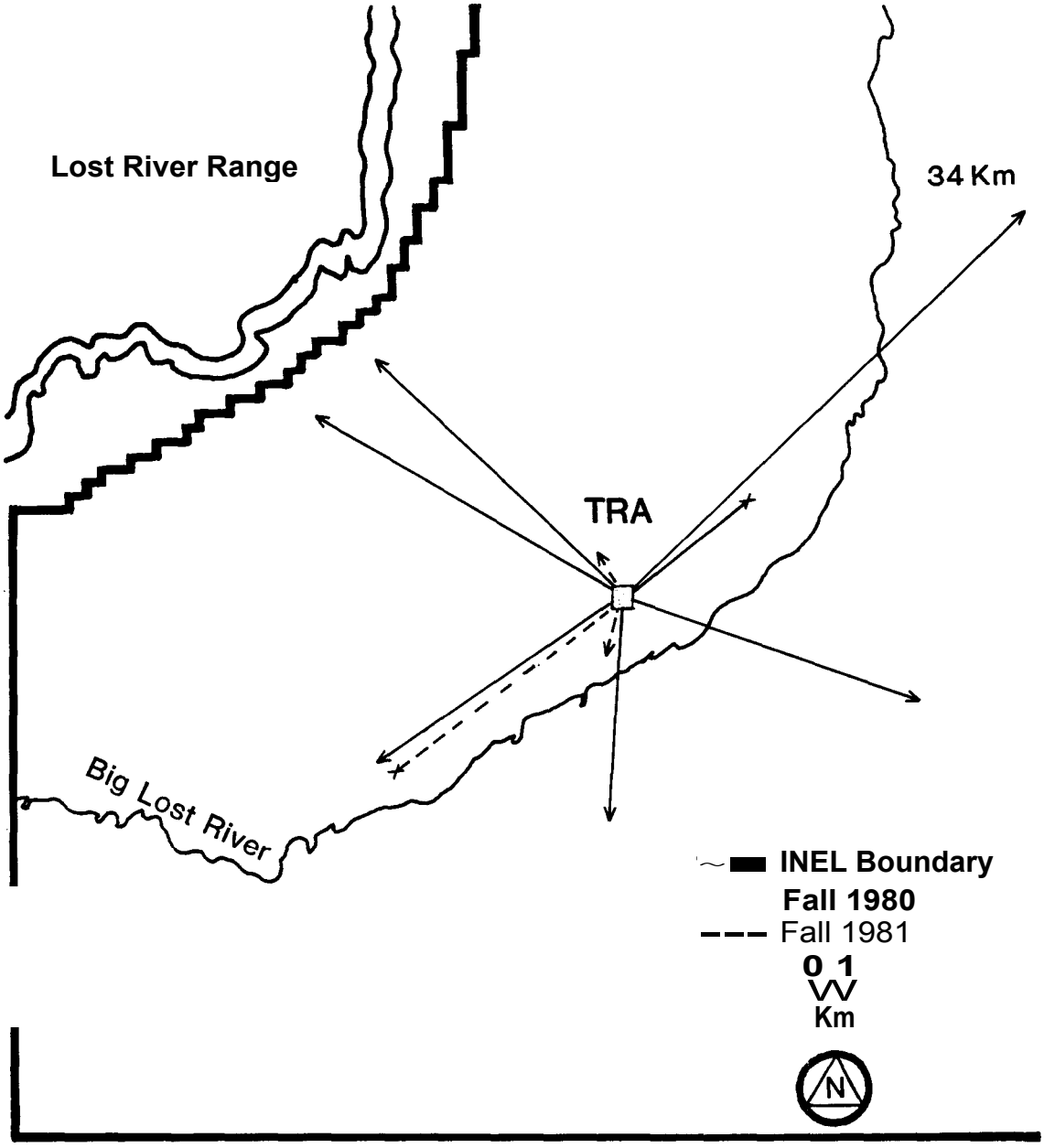


Fig. 9. Fall movements (prior to 15 December) of radio-marked adult sage grouse from the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) during 1980-81. An arrow indicates that a bird was still alive while an X indicates that a bird was found dead. Distances are indicated for movements greater than 30 km; other movements are drawn to scale.

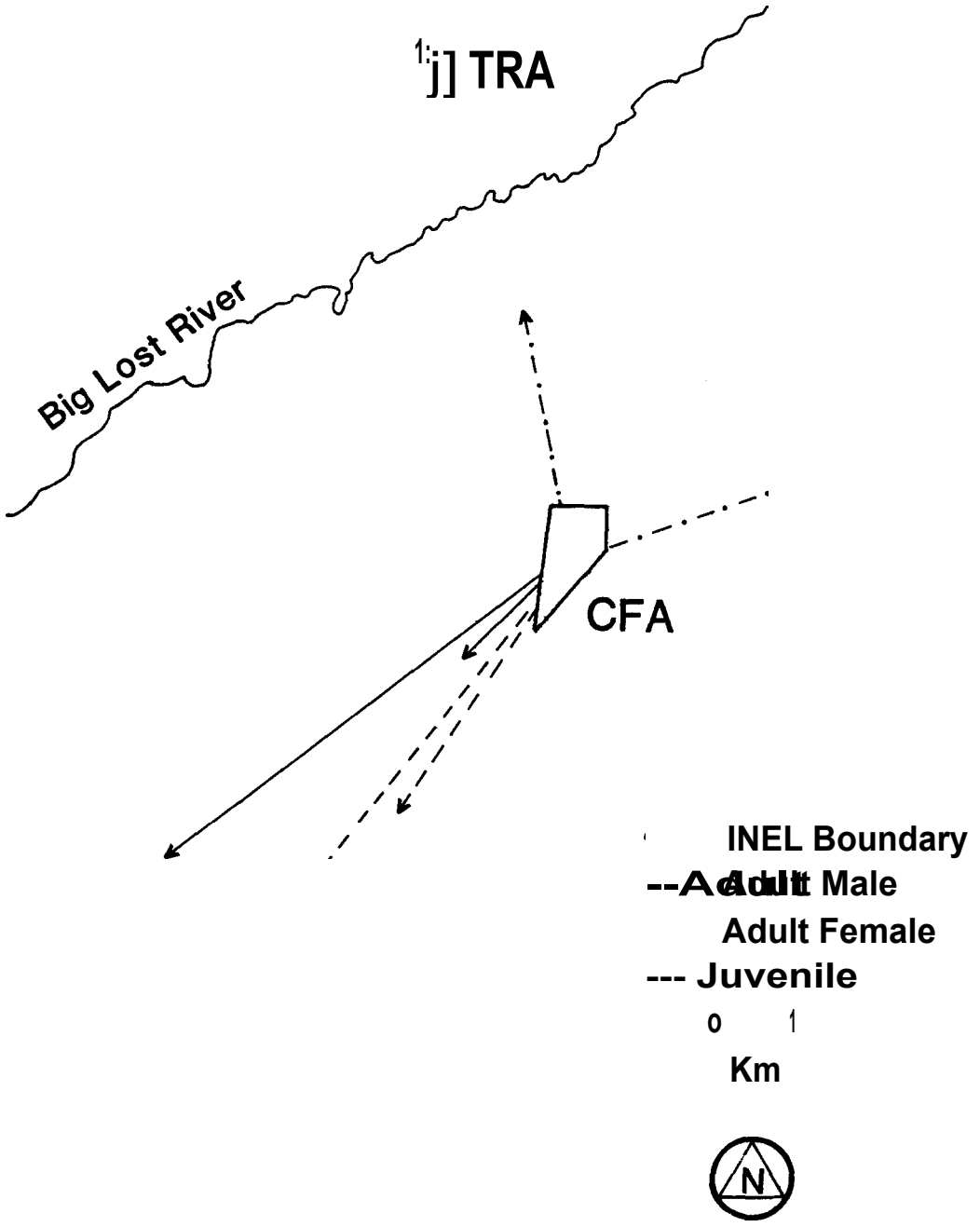


Fig. 10. Fall movements (prior to 15 December) of radio-marked sage grouse from the Central Facilities Area (CFA) of the Idaho National Engineering Laboratory (INEL) during 1982.

Table 4. Movement distances and dates of departure of sage grouse from the Test Reactor Area (TRA) on the Idaho National Engineering Laboratory, 1980-81. Distances are based on the last location prior to 15 December for each year.

	Sample Size	Distance From TRA (km)			Departure From TRA	
		Range	x	SD	Range	x
Adults (1980)	7	4.5 - 34.1	11.8	10.0	Sept. 3 - 18	Sept. 9
Adults (1981)	5	1.3 - 8.3	3.8	3.9	Aug. 13 - Sept. 16	Aug. 31
Juveniles (1980)	2	8.0 - 10.3	9.1	1.6	Sept. 4 - 14	Sept. 9
Juveniles (1981)	8	1.2 - 20.3	11.1	8.0	July 26 - Oct. 14	Sept. 9

September. Two of the adults left during the first week of September and returned 2-3 weeks later and were subsequently killed by predators. All radio-marked grouse had left the TRA before the hunting season began in 1980, but only 1 (Fig. 11a) was known to have been off-site during the season and was not harvested. Nine of 13 radio-marked grouse had departed the TRA during the hunting season of 1981, but none moved beyond INEL boundaries. All 6 grouse radio marked at CFA in 1982 had departed before the hunting season began, however, none moved off-site during the season.

Five female sage grouse (4 adults, 1 juvenile) marked in 1980 were radio-tracked for over a year. All of the adult grouse spent part of the summer of 1981 on the INEL (Fig. 11), however, only 1 grouse summered at the TRA (Fig. 11a). Two other adults (Fig.11b and d) summered near alfalfa fields to the north and west of the INEL and 1 adult (Fig. llc) was not located again after June, 1981. The juvenile female radio marked in 1980 summered in alfalfa fields north of the INEL in 1981 (Fig. 12) but moved back on the INEL in the fall and then her radio malfunctioned. Discounting those grouse that died or lost radios, only 2 of 19 marked in 1980 returned to summer at the TRA in 1981 and none of 11 marked in 1981 returned in 1982. This represented an overall return rate of 6.7%.

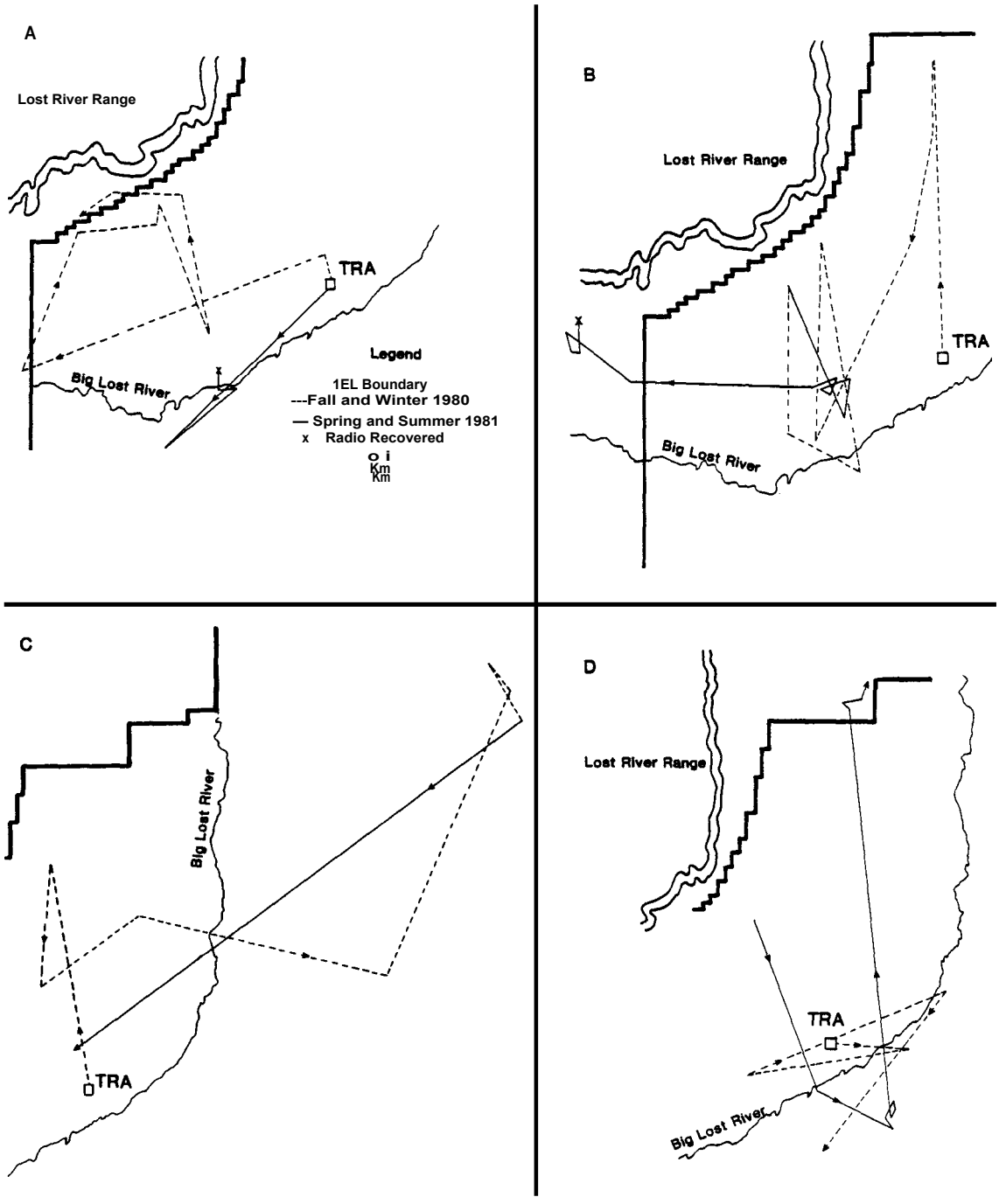


Fig. 11. Seasonal movements of 4 adult female sage grouse during 1980-81. All birds were radio marked in August, 1980 at the Test Reactor Area (TRA) on the Idaho National Engineering Laboratory (INEL). A gap between successive seasonal movements indicates that there was a period of time in which a bird was not located.

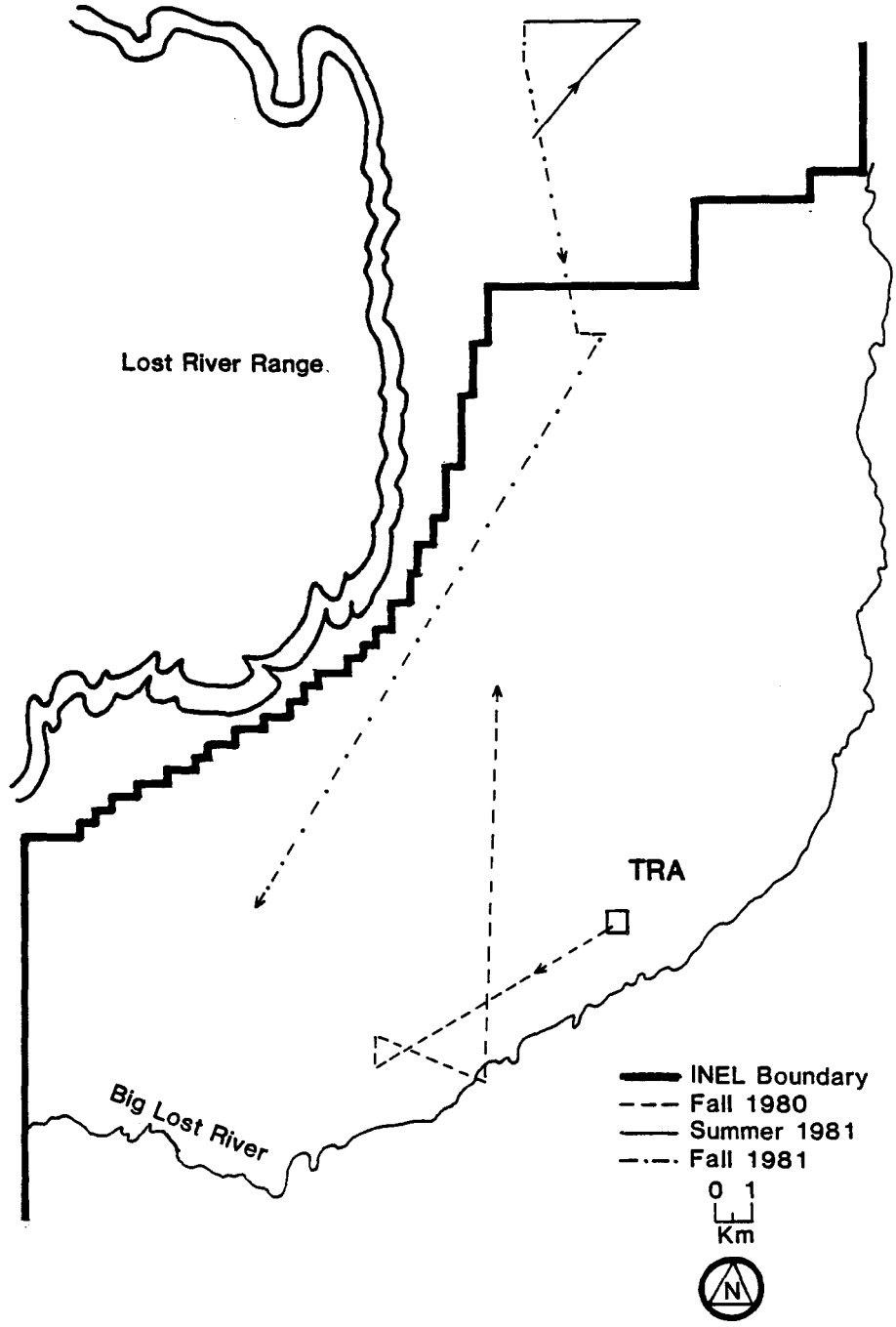


Fig. 12. Seasonal movements during 1980-81 of a female sage grouse radio marked as a juvenile at the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) in August, 1980. A gap between successive seasonal movements indicates that there was a period of time in which the bird was not located.

DISCUSSION

Sage grouse used the TRA in the summer and fall as a source of forbs and water. Arrival and departure dates appeared to be influenced by the amount of summer and fall rainfall. Grouse arrived later and left earlier in the wet year of 1980 than in the dry year of 1981. Oakleaf (1971) correlated forb phenology with rainfall and sage grouse meadow use in Nevada and reported that dessication of forbs and sage grouse use of meadows occurred earlier in years of lower rainfall. He concluded that movement to meadow habitat is stimulated by an insufficient food supply in sagebrush habitat.

Distribution of summer precipitation also had an effect on sage grouse use of the TRA. Both 1980 and 1982 were wet years. However, over half of the precipitation in 1980 occurred in June, which probably served to retard forb dessication in sagebrush habitats and delayed grouse movements to the TRA. Precipitation in 1982 when grouse did not use the TRA was more evenly distributed over the 3 summer months and forbs were probably available in sagebrush habitats on the INEL throughout the entire summer and use of the TRA was not necessary. Sage grouse production in southeastern Idaho was well below normal in 1982 (R. E. Autenrieth, pers. comm.) and could also have contributed to the nonuse of the TRA.

The maximum number of grouse observed at the TRA at any one time was 30. Connelly (1982) recorded a maximum of 31 grouse using the TRA during the 4 years of his study, which included years of good sage

grouse production and high numbers. He recorded as many as 55 grouse using the CFA at one time. In comparison, Connelly recorded as many as 206 grouse using alfalfa fields north of the INEL as summering areas.

Connelly and Markham (1983) reported slightly larger home range estimates for juveniles at TRA during 1978-79 compared to estimates determined in this study. Although they had no data for adult females at TRA, Connelly and Markham reported an average home range 3 times greater for adult females at CFA during 1979 and 1980 than data here indicates for adults at TRA. Connelly and Markham suggested that the larger home ranges of CFA grouse might be attributed to the greater amount of rainfall in 1980. Forbs and water may have been more available in sagebrush habitats in 1980 causing a reduced dependence on the CFA by grouse. The smaller ranges in 1981 were in a dry year when grouse were more dependent on the TRA for forbs. Further evidence is offered by the fact that more grouse locations were recorded outside the TRA during the evening period in 1980 while most locations for the same period in 1981 were inside the TRA.

Summer feeding periods of sage grouse in Wyoming have been documented to be from 0600-1000 and 1600-2000 (Girard 1937). Grouse feeding periods at the TRA were similar, though shorter. Grouse usually flew to sagebrush habitat by 0800 when workers began arriving. Movements to TRA for evening feeding periods usually began around 1700 after most employees left. On very hot days, it appeared that most grouse did not begin moving towards the TRA until after 1800. Evening feeding periods lasted until near dusk. Use of the TRA between 0800 and 1700 was noted on a few occasions.

Vegetative characteristics of sage grouse loafing sites were not different between age groups suggesting that both juveniles and adults select similar loafing sites. Loafing sites in fall were similar to summer loafing sites. Total shrub coverage for all loafing sites averaged 22.8%. It appeared that during summer, grouse used taller sagebrush on hot afternoons than on cooler mornings, however, data is insufficient to draw a firm conclusion.

Brood breakup occurred during the 10th week of age for brood 2 and the 11th week for brood 1. Patterson (1952) in Wyoming determined that sage grouse juveniles became independent at 10-12 weeks of age. Oakleaf (1971) reported a breakdown in brood integrity when sage grouse chicks were about 11 weeks old. Bowman and Robel (1977) reported similar findings for greater prairie chickens (Tympanuchus cupido) in Kansas, but they suggested that brood breakup may be more related to time of year than to age of brood members.

There appeared to be a distinct brood breakup period followed by dispersal movements several weeks later for 5 of the 6 brood members in this study. In the period between brood breakup and dispersal, loosely organized feeding flocks of up to 21 grouse including both adults and juveniles were observed feeding on TRA lawns. However, individuals were solitary or in groups of 2 to 3 birds when loafing in the sagebrush habitat during the day. Dalke et al. (1963) reported that aggregations of juvenile and adult sage grouse on feeding meadows after brood breakup were common. Godfrey and Marshall (1969) reported that brood breakup and dispersal were two distinct activities for ruffed

grouse (Bonasa umbellus) and that juveniles congregated after breakup without regard to sibling relation.

Dispersal of ruffed grouse brood members was rapid and synchronized with several individuals undertaking dispersal movements within hours of each other (Godfrey and Marshall 1969). The time between initial dispersal movements of sage grouse brood members in this study ranged from 1 to 2 months. However, brood movements in this study were documented only for the extremely dry year of 1981. Perhaps in a year of normal precipitation individual movements of brood members are not spaced as far apart. The sudden dispersal movements by ruffed grouse were attributed directly to climatological disturbances (Godfrey and Marshall 1969). It appeared that dispersal movements of 2 brood members in this study may have been influenced by passage of a cold front, however data are insufficient to attribute climatological phenomena as cause for initial dispersal movements. Movements of radio-marked juveniles from TRA appeared random. Radio-marked juveniles did not leave in groups and did not associate during dispersal. Connelly (1982) reported that juveniles dispersing from TRA in 1977-1979 tended to move in a westerly direction.

No difference in average departure dates from TRA between juveniles and adults in 1980 was noted, however juveniles tended to depart later in 1981. In another Idaho study, immature females were the first to leave for wintering areas, followed by mature females, then adult males, while immature males associated with both immature and mature females (Pyrah 1954).

Average movement distances were similar for adults and juveniles from TRA in 1980-1981 and for adults and juveniles from CFA in 1982. Connelly (1982) also reported no difference in distances moved between juveniles and adults. The maximum distance moved by an individual grouse in this study was 34.1 km. Dalke et al. (1963) reported that grouse traveled as far as 48 to 80 km to wintering areas. Connelly (1982) reported movements of up to 81 km to winter range.

The sage grouse hunting season in Idaho begins about 20 September and lasts until the first weekend in October. During the three hunting seasons that occurred during this study, only one radio-marked grouse was beyond INEL boundaries immediately following a summer spent at the TRA. Only 1 of 43 marked grouse was known to be harvested (Fig. 12b), but it was shot the second year after marking and had not summered at an INEL facility prior to being harvested. Connelly (1982) reported that only 5 (2%) of 245 grouse, marked at INEL facilities in the 4 years of his study, were harvested by hunters and 1 of these birds was taken illegally.

Of 5 radio-marked grouse tracked for over a year from 1980-81, only 1 returned to the TRA the second summer after marking, while 3 of these birds summered near alfalfa fields bordering the INEL in 1981. Two (6.7%) of a possible 30 grouse returned to the TRA in successive summers. The 2 that returned were an adult female and a juvenile male. Connelly (1982) reported an overall return rate of 14% of 177 birds marked at CFA and TRA during his study.

CONCLUSIONS

The Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) is a source of forbs and water for sage grouse in the summer. However, in years with above normal precipitation, the TRA may not be as important to grouse on the INEL. During wet years, grouse may be able to obtain necessary food and water without having to rely on the artificial habitats of the INEL facilities.

Connelly and Markham (1983) reported that a person would have to consume over 200 sage grouse from TRA in order to exceed the maximum permissable radionuclide whole-body dose committment of 500 mrem/year recommended by the International Commission on Radiological Protection (Int. Comm. Radiological Protection 1959). Data presented here strongly suggest that most grouse using the TRA during a summer do not venture beyond INEL boundaries during the subsequent hunting season. Since there are probably no more than 50 individual sage grouse using the TRA during a given summer, the potential for hunters harvesting sage grouse that have summered at the TRA is low as is the potential health hazard to humans.

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