MOVEMENT PATTERNS AND POPULATION DYNAMICS OF GREATER SAGE-GROUSE IN MONO COUNTY, CALIFORNIA

ANNUAL REPORT
SUBMITTED
TO
CALIFORNIA DEPARTMENT OF FISH & GAME

Prepared by

Lief Wiechman
Graduate Research Assistant
and
Kerry P. Reese, Ph.D.
Department of Fish and Wildlife Resources

January 2008

Department of Fish and Wildlife Resources
College of Natural Resources
University of Idaho
P.O. Box 441136
Moscow, Idaho 83844-1136
liefwiechman@vandals.uidaho.edu

INTRODUCTION

Greater sage-grouse (*Centrocercus urophasianus;* hereafter sage-grouse) populations in California occupy the western periphery of their range. Populations on the fringe of their range have distributions that are becoming increasingly separated from core regions of the range [e.g., Mono County, California; eastern Washington; southern Utah] (Schroeder et al. 1999). We began this study in Mono County in March of 2007 to investigate the annual cycle, population dynamics, and demographic rates of sage-grouse. Several subpopulations of sage-grouse exist in Mono County and we will investigate dispersal and movement patterns of the subpopulations. Objectives of this study are to:

- Estimate sex- and age-specific survival of radio-marked sage-grouse,
- Estimate nest success, brood success and brood survival of radio-marked sage-grouse,
- Determine sex- and age-specific movement patterns and home ranges of radio-marked sage-grouse,
- Determine seasonal habitat use between subpopulations of greater sage-grouse in Mono County, and
- Map movement of birds throughout the year between seasonal habitats to determine movement patterns and corridors used.

METHODS

Capture and Marking

We began trapping in March using spotlighting techniques (Giesen et al. 1982, Wakkinen et al. 1992). We trapped hens opportunistically on and near lek areas in the

Long Valley (n=15), the Bodie Hills (n=13), and Wheeler Flat (n=1). We fitted each hen with a necklace-style radio-transmitter weighing ≤22 grams transmitting 40-50 pulses/minute (Connelly et al. 2003), and an aluminum leg band. We slightly over-clipped the hind toenail to collect a blood sample, which was stored in lysis buffer for genetic analysis at a later date. Mass of the grouse was also recorded.

All radio-marked grouse were monitored 1-3 times a week from the ground upon capture with a portable receiver and hand-held yagi antenna when conditions allowed. Females are monitored to nest initiation, and are monitored during incubation until nest fate is determined.

Brood Capture (1st)

Broods of young chicks were located by using radio telemetry to find the maternal hen at sunrise, and then capturing the chicks by hand. All broods were captured at sunrise to minimize the effects of exposure once released. We captured 27 chicks within 3 days of hatch. Chicks were weighed and marked with a passive integrated transponder tag (hereafter "PIT tag") mid-dorsally just above the wings via a 16-gauge syringe (Carver et al. 1999). Injection sites were sealed with surgical glue to reduce tag loss (Becker and Wendeln 1997). A secondary feather was taken for a genetic sample to determine the gender of each bird.

Brood Capture (2nd)

Beginning in late June, we began to recapture chicks from previously PIT-tagged broods. We used spotlighting techniques similar to capturing sage-grouse on leks (Giesen et al. 1982, Wakkinen et al. 1992). Chicks recaptured were sutured with a juvenile chick transmitter weighing 3.9 grams (Burkepile et al. 2002). Chicks were then

monitored along with the maternal hen to estimate chick survival. Of the 27 chicks initially captured, 3 were recaptured.

In late July, 6 chicks were captured from 2 random broods. Each chick was weighed and a juvenile chick transmitter sutured to its back. The brood hen was also trapped and fitted with a necklace style radio-transmitter to aid in monitoring movement and survival.

Fall Capture (3rd)

During September, remaining juveniles were recaptured using spotlighting techniques similar to capturing sage-grouse on leks (Giesen et al. 1982, Wakkinen et al. 1992). Two juveniles were recaptured and fitted with a necklace-style radio-transmitter as previously described for hens and a blood sample was collected from the hind toe, which was stored in lysis buffer for genetic analysis at a later date. Mass of the grouse was also recorded.

Habitat Sampling

Habitat variables at nests and brood locations (nocturnal and diurnal) were measured along two, 10 m perpendicular transects intersecting at the nest, hen location or center of use. Both transects ran in the cardinal directions. Live and dead shrub cover was quantified using the line intercept method (Canfield 1941). We estimated % cover of forbs, grasses, litter, and bare ground, and measured the height of nearest grass and shrub at 5, 50x50 cm quadrats spaced equidistantly along each transect (Daubenmire 1959). Plants were identified to smallest taxonomic unit. Cover type, visual obstruction at 5 meters using a Robel pole (Robel et al. 1970), and size of the areas used by broods at night were measured, as well as the distances to the edge to determine nearest change in

cover. For every nest and brood use site (nocturnal and diurnal), a vegetation survey were conducted at a paired random site within 1 km of a nest or brood location. While all nests were surveyed, a random number of diurnal brood locations were sampled as well as randomly selected nocturnal brood locations. At all locations, cover type, elevation, aspect, and slope were recorded.

RESULTS

Twenty-nine females were radio-marked (6 adults and 23 yearlings) during the spring from 21 March to 30 April. Average hen weight for individuals caught in the spring was 1230 grams (n=27, range 1069-1520; Table 1).

Seventeen grouse were radio-marked during the late summer and fall from 22 July to 20 November (9 adults, 5 yearlings, 3 juveniles). This included 2 juvenile chicks from M-30-07's brood, one of which was a male. Average hen weight for individuals caught during the late summer and fall was 1225 grams (n=14, range 1044-1339; Table 1).

Production

Ten of 27 (37%) hens initiated nests. One adult was captured on the lek with a brood patch. No information about her initial nest was available. All 4 adults initiated a nest as did 6 of the 23 yearlings. We may have missed some nest initiations in the 2-4 day period between ground locations. However, many of the grouse were not observed outside of a flock of birds, and many did not localize, suggesting that they did not attempt to nest. None of the unsuccessful hens attempted to renest.

Nest success of adult hens was 25%, and that of yearlings was 67%. Overall, nest success was 50% (Table 2). Hen success was 18% (5/27) across the study area.

There was a minimum of 49 eggs laid in 10 nests. However, one nest was initiated and lost before the hen was captured and another nest was depredated and all eggs and remains were absent from the nest bowl and surrounding area. Thirty-one eggs hatched of the 49 laid (31/49; 63%). One nest had an egg that did not hatch, and when the egg was opened appeared to be unfertilized no development.

In 8 nests where eggs or shells were present, average clutch size was 6 eggs (range 5-7). The average weight of 26 chicks at hatching was 29 g (range 25-32; Table 3). There were 1.2 chicks per hen (32/27) upon hatch of successful nests (Table 4). At 35 days post-hatch (1 July) for the youngest brood, there were 0.26 (7/27) chicks per hen.

MOVEMENT

Movement analysis will begin in 2008. To date, over 1900 locations have been recorded while monitoring 53 individuals, including 9 chicks. Beginning after capture, 427 locations were recorded during the spring (March-May), 761 during the summer (June-August), 700 during the fall (September-November), and over 40 to date in the winter. Analysis will include determination of home ranges, seasonal ranges, and movement corridors of all the birds.

SURVIVAL

The following are apparent survival estimates from 19 March through 31 December. Adult survival was 71% (10/14), although the majority of the adults (n=10) were captured after 15 July. Yearling survival was 65% (19/29). The majority (n=23) of the yearlings were captured in March and April.

Survival for both age classes was 93% (27/29) during the pre-nesting period. The pre-nesting period is defined as the period between capture and mid-June, 2 weeks after the last initiated nest was scheduled to hatch. Survival for all nesting birds (n=10) was 100%. No individuals were lost during incubation.

Survival for all broodless hens was 74% (17/23). Broodless hens are defined as hens that did not initiate a nest nor had their nests depredated during incubation. One of the 6 mortalities that occurred was due to hunter harvest. Survival of hens during the early brood period (defined as the first 7 weeks post hatch) was 75% (3/4). Survival of hens during the late brood period (defined as 8-12 weeks post hatch) was 80% (4/5). Two hens were added to this analysis after they were trapped (along with their broods) in late July. One maternal hen was killed in late September. Fall survival, which is defined as survival after 1 October, was 88% (28/32). This survival estimate includes the survival of all new hens captured during the fall (September – November). Twelve females were newly captured during this time period. A Kaplan-Meier survival estimate will be conducted in 2008.

Brood Survival

We marked broods from 4 of 5 successful nests. One brood was lost prior to capture. We marked 26 chicks in the 4 broods. No mortalities were recorded due to the procedure, exposure, or abandonment. Each capture site was thoroughly examined the following morning to search for chick fatalities. A missing chick may not be dead. Brood mixing can occur and we have no way to monitor the movements of the chicks prior to radio marking.

Of the 26 chicks marked initially, 3 were recaptured and sutured with a juvenile

transmitter along with 6 chicks from 2 random broods. Of the 26 chick captured, none survived past 5 August. Of the 6 chicks added, 2 survived to September and were fitted with a necklace-style radio- transmitter.

HABITAT SAMPLING

Habitat surveys were conducted at each nest and at a paired random point within 1 km of the nest location. Nine nest sites were surveyed along with 8 paired random locations. Twenty-nine (29) diurnal brood locations were sample along with 27 paired random locations. Due to the low number of successful nests, only 27 nocturnal brood locations were sampled across 4 broods, along with 25 paired random locations.

To date, no analysis has been conducted on the habitat data. Habitat surveys will be conducted again during the 2008 field season. Nests sites, randomly selected diurnal and nocturnal brood sites will be surveyed along with paired random sites for each. After the field season is completed, all habitat data will be analyzed.

DISCUSSION

There were a low number of nests initiated during the breeding season. This could be a response to several factors. The majority of the radio-marked females were yearlings. This may influence the number of nests as yearling may initiate less than adults. We may have a better idea of this after the second year. We do not believe our sample age ratio is representative of the population. Due to trapping conditions and several snow storms, we believe we trapped after hen peak in the Bode Hills, which limits the number of adult hens for capture.

Winter precipitation in 2007 was low which lead to a dry spring. This may have affected habitat quality and forb production, directly influencing prenesting body condition of females (Barnett and Crawford 1994). The lack of precipitation may also have lead to a lower abundance of invertebrates for the chicks to consume. This may have resulted in the low survival of our marked chicks.

Sage-grouse capture in 2008 will begin in March. We anticipate radio-marking 20-30 hens dependent on winter survival. These hens will be monitored throughout the year for production, movements, survival and habitat use data.

LITERATURE CITED

Barnett, J. K., and J. A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. Journal of Range Management 47:114-118.

Becker, P. H., and H. Wendeln. 1997. A new application for transponders in population ecology of the common tern. The Condor 99:538-543.

Burkepile, N. A., J. W. Connelly, D. W. Stanley, K. P. Reese. 2002. Attachment of Radiotransmitters to One-Day-Old Sage Grouse Chicks. Wildlife Society Bulletin 30:93-96.

Canfield, R. H. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry 39:388-394.

Carver, A. V., L. W. Burger, and L. A. Brennan. 1999. Passive integrated transponders and patagial tag markers for northern bobwhite chicks. Journal of Wildlife Management 63:162-166.

Connelly, J. W., K. P. Reese, and M. A. Schroeder. 2003. Monitoring of greater sage-grouse habitats and populations. University of Idaho, College of Natural Resources Experimental Station, Station Bulletin. 80.

Daubenmire, R. F. 1959. A canopy coverage method of vegetation analysis. Northwest Science 33:224-227.

Giesen, K. M., T. J. Schoenberg, and C. E. Braun. 1982. Methods for trapping sage grouse in Colorado. Wildlife Society Bulletin 10:224-231.

Robel, R. J., J. N. Briggs, A.D. Dayton, and L. C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23:295-297

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage grouse (*Centrocercus urophasianus*). In the Birds of North America, No. 425 (A. Poole, and F. Gill, editors). The Birds of North America, Incorporated, Philadelphia, Pennsylvania, USA.

Wakkinen, W. L., K. P. Reese, J. W. Connelly, and R. A Fischer. 1992. An improved spotlighting technique for capturing sage grouse. Wildlife Society Bulletin 20: 425-426.

Table 1. Date of capture, sex, age and weight of greater sage-grouse captured in Mono County, California in 2007.

Bird Number	Capture Date	Sex[1]	Age[2]	Weight (g)
1	3/21	F	Y	NA
2	3/21	F	A	1245
3	3/23	F	A	1395
4	3/23	F	Y	1245
5	3/25	F	A	1445
6	3/31	F	Y	1269
7	3/31	F	Y	1169
8	4/5	F	Y	1169
9	4/6	F	Y	1069
10	4/7	F	Y	1219
11	4/7	F	A	1193
12	4/8	F	Y	1069
13	4/8	F	Y	1369
14	4/9	F	Y	NA
15	4/10	F	Y	1092
16	4/13	F	Y	1140
17	4/13	F	Y	1190
18	4/13	F	Y	1160
19	4/13	F	Y	1232
20	4/14	F	Y	1520
21	4/16	F	Y	1276
22	4/18	F	Y	1276
23	4/18	F	Y	1136
24	4/21	F	Y	1376
25	4/22	F	Y	1076
26	4/22	F	A	1316
27	2/28	F	Y	1156
28	4/25	F	Y	1196
29	4/30	F	Y	1206
30	7/22	F	A	1181
31	7/28	F	Y	1099
32[a]	9/17	M	J	1160
33[a]	9/18	F	J	969
34	10/2	F	J	882
35	10/8	F	A	1201
36	10/10	F	Y	1044
37	10/29	F	Y	1278
38	10/29	F	A	1251
39	10/30	F	A	1326
40	10/30	F	A	1361
41	10/30	F	A	1180
42	10/30	F	A	1261
43	11/1	F	A	1191
44	11/14	F	Y	1339
45	11/14	F	A	1207
46	11/20	F	Y	1231

[1] F = female, M = male;

[2] A = adult, Y = yearling, J = juvenile;

[a] M-32-07 and M-33-07 were chicks from M-30-07's brood

Table 2. Productivity data of 10 greater sage-grouse that nested in Mono County, California in 2007.

Bird Number	Age[1]	Incubation Date	Estimated Hatch Date	Fate[2]	Clutch Size	Nest Plant Species
6	Y	13-Apr	10-May	S	7	Antelope Bitterbrush
13	A	13-Apr	10-May	S	7	Mountain Big Sage
2	A	18-Apr	15-May	U	5	Antelope Bitterbrush
3	A	21-Apr	18-May	U	5	Mountain Big Sage
26	A	Unk	NA	U	Unk	Unk
9	Y	24-Apr	21-May	S	5	Mountain Big Sage
14	Y	26-Apr	23-May	U	6	Antelope Bitterbrush
20	Y	28-Apr	25-May	S	7	Mountain Big Sage
19	Y	3-May	30-May	S	6	Mt. Big Sage/ Gooseberry
10	Y	6-May	2-Jun	U	Unk	Mountain Big Sage

[1] A = adult, Y = yearling, J = juvenile;
[2] S = successful, U = unsuccessful

Table 3. Greater sage-grouse chick and brood data from 4 broods in Mono County, California in 2007.

Female #	Lek of Capture	Total No. Eggs	Total No. Hatched	PIT Chicks	Hatch Date	28-day date	100-day date	Chick #	Chick Weight at Hatch	PIT ID #
M-6-07	LV-2	7	7	6	10-May	6-Jun	17-Aug	800	28	96893807
								801	28	97005794
								802	28	97014626
								803	28	96879054
								804	29	97016075
								805	28	97042561
								806	NA	NA
M-13-07	LV-1	7	7	7	10-May	6-Jun	17-Aug	807	30	96873601
								808	29	97034012
								809	30	97044363
								810	31	96865105
								811	31	97021061
								812	30	96880078
								813	31	97039111
M-9-07	LV-2	5	5	0	21-May	17-Jun	NA	NA	NA	NA
								NA	NA	NA
								NA	NA	NA
								NA	NA	NA
								NA	NA	NA
M-20-07	F-3	7?	6	7	25-May 5/24??	21-Jun	1-Sep	814	28	96880353
								815	29	97015292
								816	29	97043061
								817	32	96885781
								818	31	97004792
								819	29	97034366
								820	31	96891362
M-19-07	BH-5/6	6	6	6	30-May	26-Jun	6-Sep	821	28	96878561
								822	25	97013873
								823	28	96892615
								824	30	96878532
								825	30	97032370
								826	29	96891025

Table 4. Greater sage-grouse chicks recaptured and radio-marked in Mono County, California in 2007.

Chick Number	Study Area	Brood	Weight	Days Old
700	Bodie Hills	M-30-07	585 g	>30
701	Bodie Hills	M-30-07	NA	>30
702	Bodie Hills	M-31-07	373 g	>30
703	Bodie Hills	M-31-07	304 g	>30
704	Bodie Hills	M-31-07	501 g	>30
705	Bodie Hills	M-30-07	500 g	>30
811	Long Valley	M-13-07	279 g	44
813	Long Valley	M-13-07	307 g	45
820	Fales	M-20-07	274 g	34