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ENVIRONMENTAL EFFECTS ON COMMON SNIPE WINNOWING AND CALLING (ACTIVITY)

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ABSTRACT.—Our objective was to clarify the effects of 10 identified variables on snipe activity (winnowing and calling) by demonstrating correlations between the variables and snipe activity. We monitored snipe at 2 study areas in southwestern Montana and northwestern Wyoming at all hours of the day and night during the 1996 and 1997 breeding seasons. We measured 10 variables at established points along transects that were situated through the middle of each study site (8 study sites total). A total of 1200 monitoring periods were conducted throughout the course of this study. Effects of each factor on snipe activity were considered by examining general trends in each factor's graphical representation. Our results identified 6 factors (season, time of day, lunar cycle, solar radiation, wind speed, and temperature) that are associated with snipe activity. Snipe were most active early in the breeding season during 2 twilight periods during the first and last quarters of the lunar cycle. Low solar radiation levels, wind speeds, and temperatures were also most ideal conditions for snipe activity. All 6 factors should be considered when attempting to detect, survey, or estimate snipe populations.

Key words: snipe, Gallinago gallinago delicata, *monitoring, temporal factors, meteorological factors, abundance, trends, surveys.*

Common Snipe (*Gallinago gallinago delicata*; AOU 1983, Tuck 1955) behavior patterns on breeding grounds are poorly understood. The snipe's mobility, elusiveness, and mythological characteristics such as capturing the bird with a bag and stick contribute to this lack of knowledge. After reviewing the literature on snipe, we identified 10 factors that might influence snipe winnowing and calling. Winnowing is an aerial flight pattern performed over a large area. Both male and female snipe winnow, but it is primarily done by males. Birds fly high into the air and drop rapidly toward the ground. Tail feathers are spread apart and air vibrates the feathers, producing a sound (winnowing). Calling is a form of vocalization usually produced by birds on the ground. Most observations of winnowing and calling are from 2 authors (Robbins 1952, 1954, Tuck 1955, 1972), but data regarding effects of variables on snipe winnowing and calling are conflicting. Quantifying the effects of environmental factors and using this knowledge (peak activity times, conspicuousness, etc.) can be helpful in planning fieldwork and selecting productive survey methods (Robbins 1981). However, this rarely has been done (Best 1981).

Consequently, our objective was to clarify the effects of 10 variables (season, time of day, lunar cycle, cloud cover, precipitation, wind speed, temperature, solar radiation, fog, and disturbances, which include cool temperatures, low wind, and clear sky) on snipe activity (winnowing and calling) by demonstrating general correlations between the factors and activity.

STUDY AREAS

We studied Common Snipe at Red Rock Lakes National Wildlife Refuge (RRLNWR), Montana, in 1996 and along the Green River north and west of Pinedale, Wyoming, in 1997 (Fig. 1). Pinedale and RRLNWR are considered study areas and habitat units. Low, bog, red, green, tosi, schwabachers, wagstaffs, and duck are study sites at the 2 areas. RRLNWR is located in southwestern Montana in Centennial Valley approximately 80 km west of Yellowstone National Park. The Gravelly and Centennial Mountain ranges border the refuge to the north and south, respectively (Fig. 1). Habitats range from high-elevation marsh at 2000 m to alpine at 3000 m above sea level.

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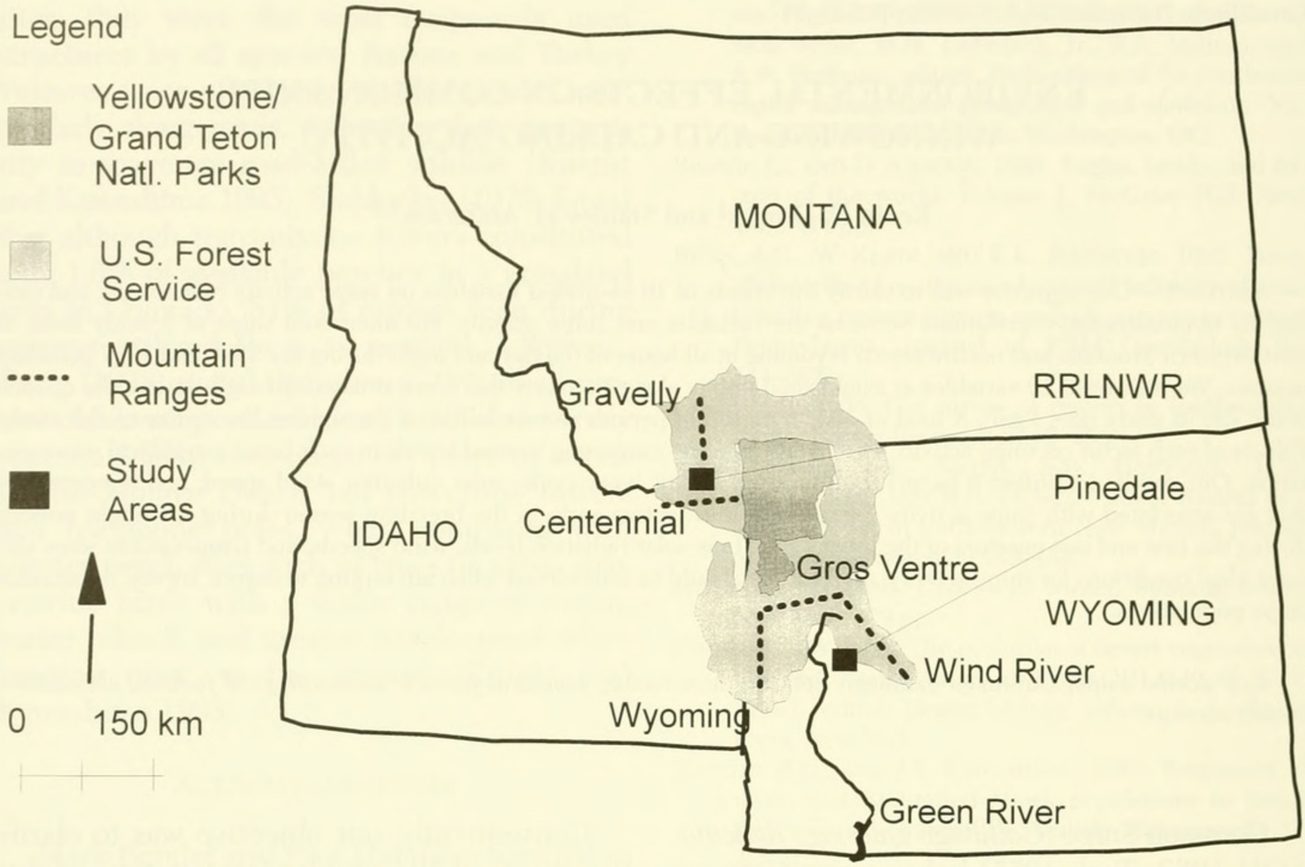


Fig. 1. Location of Red Rock Lakes National Wildlife Refuge and Pinedale study areas in Montana and Wyoming.

Two large lakes lie in the center of the 17,604-ha refuge and are fed by 17 creeks. Common Snipe are associated with fens, marshes, and sloughs located throughout the refuge. In particular, they prefer shallow-water areas averaging 30–40 mm in depth that are dominated by beaked sedge (*Carex rostrata*) and some shrub cover such as willow (*Salix* sp.), bog birch (*Betula glandulosa*), or shrubby cinquefoil (*Potentilla floribunda*; Nelson 1979).

RRLNWR headquarters is located in Lakeview, Montana, approximately 40 km east of I-15 exit 1 (Monida Pass) on a dirt road that follows the Montana-Idaho border. Montana study sites are described in relation to Lakeview. The low lake site (0.53 km^2) is approximately 2 km west of Lakeview along Red Rock Road and south of Lower Lake where a stand of willows is located in a sea of sedges and rush. The bog site (0.85 km^2) is located 12 km east of Lakeview on Red Rock road just south of Upper Lake. Red Rock Creek site (0.64 km^2), 21 km east of Lakeview along Red Rock road, is a willow riparian habitat on the north side of the road; it follows Red Rock Creek east to the refuge boundary.

Pinedale, in northwestern Wyoming, is approximately 215 km south of Yellowstone National Park along state highway 191. The town is surrounded by the Wyoming, Gros Ventre, and Wind River Mountain ranges to the west, north, and east, respectively (Fig. 1). Habitats range from grassy meadows and sagebrush (*Artemisia* sp.) for cattle grazing at 2200 m to alpine tundra and glaciers at 4200 m. Because the Green River is a major drainage for the Wind River Mountains, spring water coverage and depth vary with the amount of winter snow. Common Snipe use willow riparian areas and subirrigated meadows along the Green River, where dominant herbaceous plants consist of beaked sedge, water sedge (*Carex aquatilis*), and timothy (*Phleum* sp.).

Duck Creek site (1.63 km^2) is approximately 8 km west of Pinedale along state highway 191. Located on the north side of the road, it is a section of state land that allows fishing access to Duck Creek and has a parking area off the highway. Schwabacher ranch site (1.94 km^2) is approximately 12 km west of Pinedale on Quarter Circle 5 Ranch owned by Jackson Schwabacher. The site is on the south side of the highway along Faler Creek. Wagstaff Ranch site (1.88 km^2) is on county road 354, locally called Horse Creek Road. County road 354 is located at Daniel Junction 16 km west of Pinedale on state highway 191. Green River (1.56 km^2) and Tosi Creek sites (0.94 km^2) are approximately 40 km north of state highway 191 on county road 352. Green River site is approximately 16 km north of the Kendall guard station on the west side of the Green River, and Tosi Creek site is approximately 25 km northwest of Kendall just south of Moore Ranch (site butts up against the ranch boundary). Both sites are located off a forest service road that heads to Mosquito Lake.

METHODS

In 1996 we monitored snipe at 3 study sites (low, red, and bog) on RRLNWR between 0500 h and 1900 h MST. Each study site was located along the lake in willow sites 800–1000 ha in size. A straight-line transect was established through the middle of each study site with 10 sample points spaced 500 m apart. Points were spaced 500 m apart and on each side of the transect so we could adequately sample the relatively small area. Before nesting occurred (15 April–23 May), we measured 10 variables at each established point. While collecting these data, we also monitored snipe activity by counting the number of snipe heard. We determined that birds could be heard for approximately 500 m. Following nesting (24 May–15 July), we measured the 10 variables while monitoring previously radio-transmittered snipe (n =10). Nine of 10 transmittered snipe were located at the bog study site and were monitored twice daily (morning and afternoon). We then used data from marked and unmarked birds. To standardize snipe monitoring efforts, a 10-min time period was established. We also divided the 10 variables into categories (Table 1).

In 1997 we monitored snipe at 5 study sites near Pinedale, Wyoming. These sites were approximately 500 ha in size and located in willow communities. Transects were established through the middle of each site with points spaced 1 km apart. From 17 April to 30 June, we monitored snipe activity from points on the transect while measuring the 10 variables. We did not use radio telemetry in 1997. Also, monitoring in July 1997 was eliminated because snipe were inactive. In 1996 we rarely (<5% of the time) counted additional snipe during the last 4 min of monitoring; thus, in 1997 we decreased our listening time from 10 to 6 min. This did not affect the number of snipe heard/counted.

RESULTS

We conducted a total of 1200 monitoring periods, 6 or 10 min each, throughout the course of this study. Initially, the effects of each factor on snipe activity were considered by examining general trends apparent in each factor's graphical representation. Two variables (fog and disturbances) could not be evaluated as no data were available.

Temporal Variables

SEASON.—Snipe activity was most pronounced in May (Fig. 2). The peak in activity occurred early in the breeding season followed by a steady decline.

TIME OF DAY.—Snipe were slightly active throughout the day and night, but were most active during dusk (post-sunset) and late-night (predawn) periods (Figs. 2, 3).

Meteorological Variables

LUNAR CYCLE.—During the first and last quarters, we heard more snipe than we did when a full moon or no moon was present (Fig. 2). A few snipe were active throughout the night regardless of moon phase, but more activity occurred at dusk, especially during the first quarter.

CLOUDS.—We heard more snipe on very cloudy or overcast days. We heard fewer snipe on other days, although numbers were basically equivalent whether the days were clear or partly cloudy (Fig. 3).

PRECIPITATION.— We recorded more snipe activity during rain than during drizzle or no precipitation (Fig. 3). Rain did not seem to affect snipe activity adversely; in fact, we recorded a considerable amount of activity during some inclement weather. However, hail (2–10 mm in size) caused snipe to stop winnowing immediately. Rain probably affected our ability to hear more than it did snipe activity.

WIND SPEED.—We heard more activity when wind speed was <8 km/h (Fig. 4). Activity decreased with wind speeds of 8–13 km/h

TABLE 1. Ten variables that can affect snipe activity, with accompanying categories and collection methods.

Variable	Categories	Collection methods
Season	April, May, June, July	Calendar
Time of day (MST)	Morning (0500–1030 h) Late morning (1031–1330 h) Early afternoon (1331–1630 h) Late afternoon (1631–1900 h) Dusk (1901–2200 h) Early night (2201–2400 h) Midnight (0001–0300 h) Late night (0301–0500 h)	Watch
Lunar cycle	First quarter Last quarter Full moon No moon or less than a quarter	Calendar and field observation
Cloud cover	No clouds (0%) Partly cloudy (1–50%) Very cloudy (51–100%) Overcast (100%)	Field observation
Precipitation	None Rain Light snow (could see) Heavy snow (couldn't see)	Field observation
Wind speed (km/h)	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+	Dwyer® handheld wind meter[a]
Temperature (°C)	minus 13–0, 1–5, 6–10,11–15, 16–20, 21–23	Campbell Scientific Datalogger[b]
Solar radiation ($W \cdot m^2$)	0–1, 2–100, 101–200, 201–300, 301–400, 401–500, 501–600, 601–700, 701–1200	Campbell Scientific Datalogger[b]
Fog	Distance observer could see	Field observation
Disturbances	Any loud noise such as train whistles, backfires from car, or low-flying airplanes	Field observation

[a]Instrument purchased from Forestry Suppliers Inc., Jackson, MS.
[b]Instrument purchased from Campbell Scientific, Inc., Logan, UT.

(Fig. 4). At greater velocities we could not determine whether activity diminished or our ability to hear it was impaired.

TEMPERATURE.—Common Snipe were moderately active at temperatures of 6–10°C (Fig. 4). Snipe appeared to be most active when the temperature was below 6°C.

SOLAR RADIATION.—Snipe activity was greatest during the lowest level of solar radiation (0–1 Watt • m^2; Fig. 4). This threshold seemed very important to snipe.

DISCUSSION

From our evaluation of 10 variables identified from the literature, we subsequently identified 6 (season, time of day, lunar cycle, solar radiation, wind speed, and temperature) that appeared to influence snipe activity (Figs. 2, 4).

Season

Snipe are most active early during the breeding season (Tuck 1972, Smith 1981, Taylor 1978). We found snipe activity to be highest in May. This peak in activity is influenced by the arrival of females (Tuck 1972), latitude, and weather conditions (Tuck 1972). During this time snipe compete for mates, secure pair bonds, and defend territories.

Time of Day

Snipe activity varies by time of day, as with most birds. We found snipe to be most active during the 2 twilight periods. Similar results

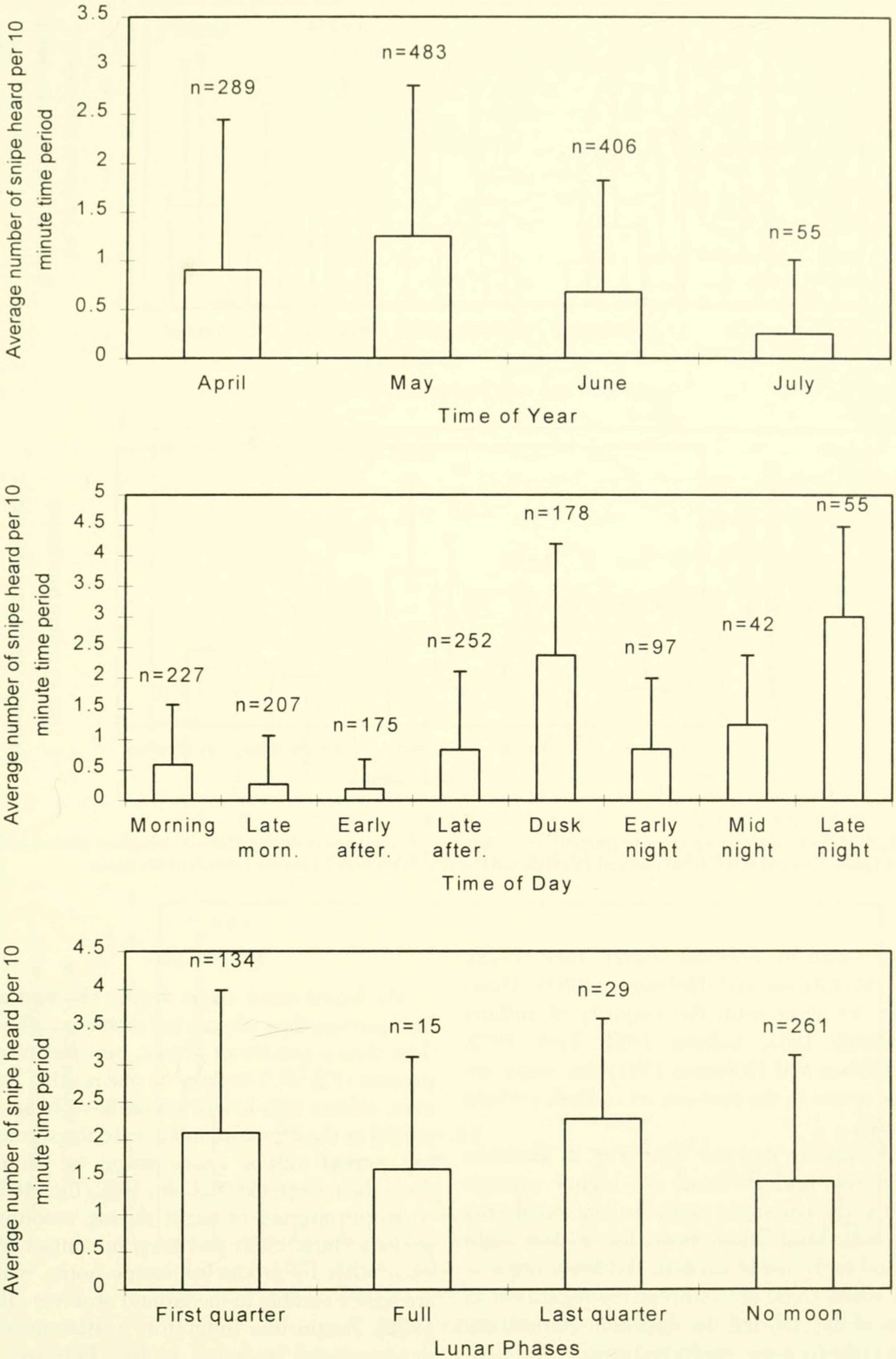
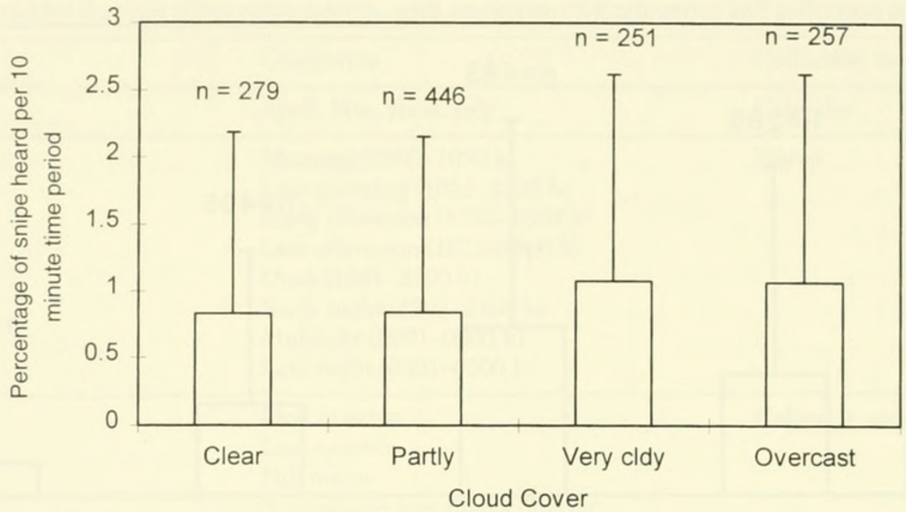


Fig. 2. Effects of season, time of day, and lunar phases on average number of snipe heard during 1996–97 breeding seasons at Red Rock Lakes National Wildlife Refuge and Pinedale study areas. Error bars represent 1 standard deviation. Data are based on 10-min counts in 1996 and 6-min counts in 1997.



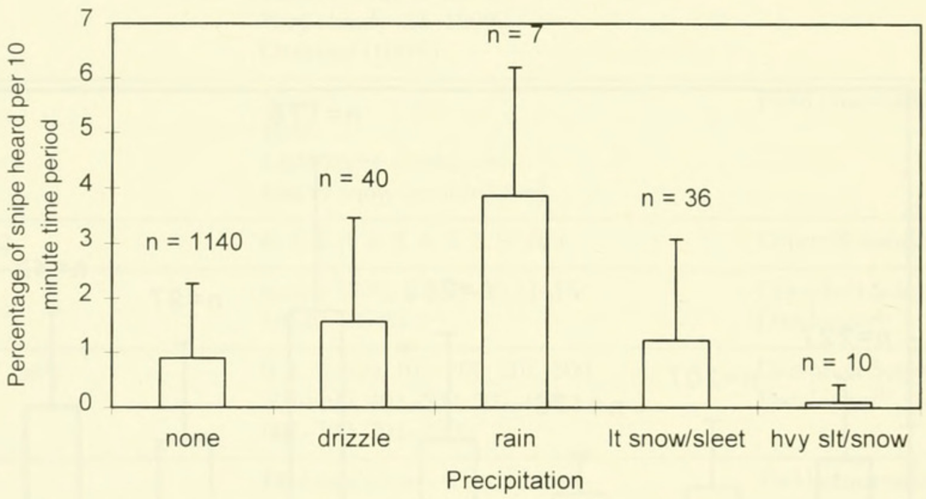


Fig. 3. Effects of cloud cover and precipitation on number of snipe heard during 1996–97 breeding seasons at Red Rock Lakes National Wildlife Refuge and Pinedale study areas. Error bars represent 1 standard deviation.

were found by Robbins (1952), Tuck (1972), and McKibben and Hofmann (1981). However, we agree with the majority of authors (Burleigh 1951, Solman 1954, Tuck 1972, McKibben and Hofmann 1981) that snipe are most active in the post-sunset or dusk twilight period.

We realize that our data (Fig. 2) illustrate otherwise and attribute the higher average during the late-night period to our monitoring protocol. Most observations for the late-night period were made early in the breeding season when snipe are more active regardless of time of day. During the dusk time period, our observations were conducted equally throughout the breeding season. Precipitation (Fig. 3) could also be misleading, as most rain and snow occurred early in the breeding season.

Lunar Cycle

We heard more snipe during the first and last quarters than when a full moon or no moon (less than a quarter or absent, new moon) was present (Fig. 2). Contrary to our results, however, effects of a bright moon have been reported in the literature to increase the winnowing period and/or cause snipe to winnow throughout the night (Robbins 1952, Tuck 1955).

Snipe migrate at night during moonlight periods (Tuck 1972) and keep in contact with each other by producing scaipe notes, which are barely audible to the ground observer (Tuck 1972). Zugunruhe (migratory restlessness) is demonstrated by snipe in late February or early March in Florida (Fogarty 1970). At this time snipe flush and wheel around in flocks and drop abruptly to the ground (Fogarty 1970).

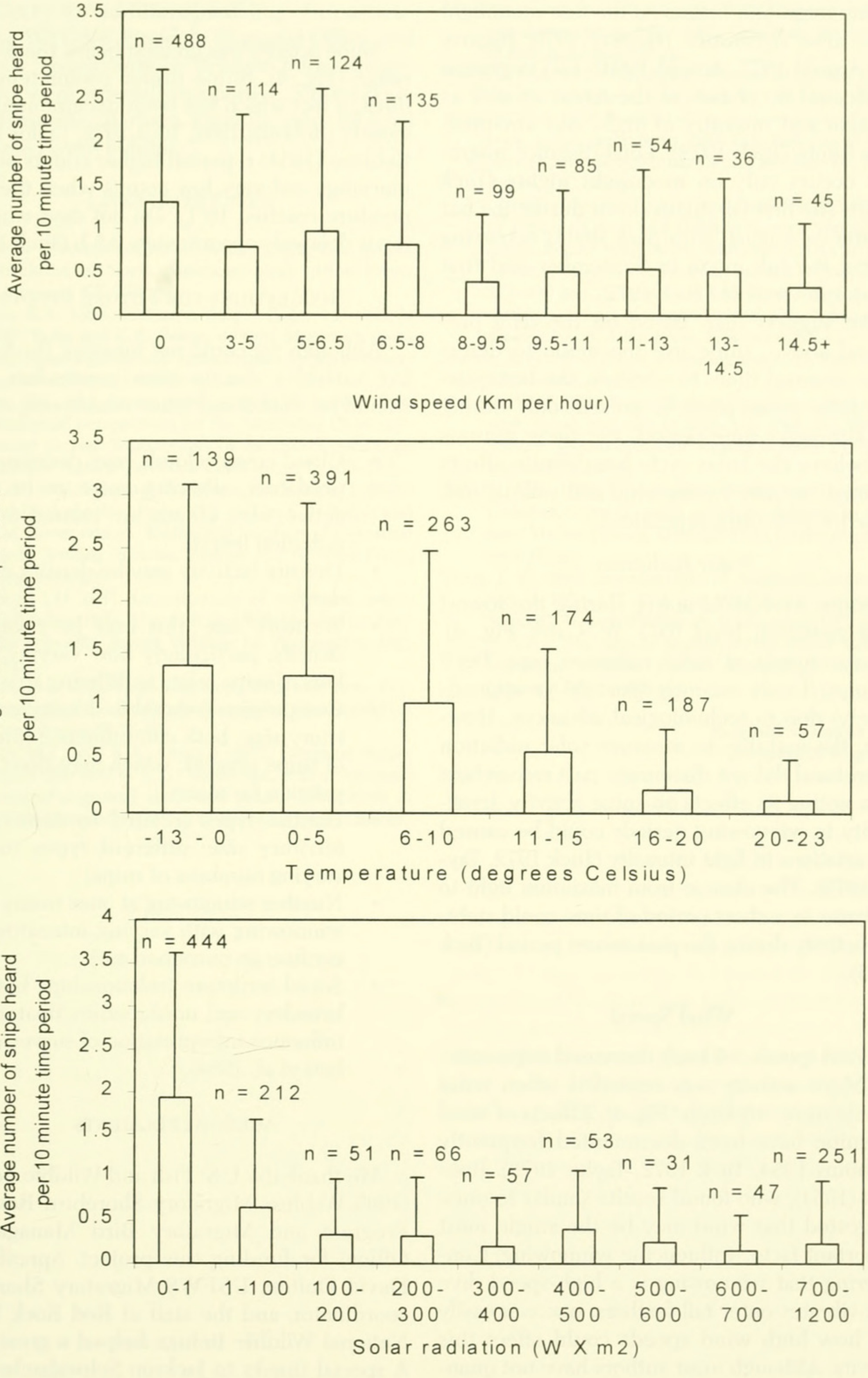


Fig. 4. Effects of wind speed, temperature, and solar radiation on average number of snipe heard during 1996–97 breeding seasons at Red Rock Lakes National Wildlife Refuge and Pinedale study areas. Error bars represent 1 standard deviation.

Spring migration begins on the first moonlight night after zugunruhe (Fogarty 1970, Fogarty and Arnold 1977, Arnold 1994). Fall migration is affected by phases of the moon as well as location and intensity of high- and low-pressure fronts (Tuck 1972). Long-distance migration occurs only on moonlight nights (Tuck 1972). The first fall flights occur during the last quarter in August, with peak flights occurring during the full moon in September and first quarter in October (Tuck 1972).

We suggest that, based on the data presented above, snipe use the moon to determine seasonal time. In addition, the last quarter of the moon phase is present only during the late-night time period. For these reasons we believe the lunar cycle has definite effects on snipe activity (winnowing and calling) and behavior (breeding, migration).

Solar Radiation

Snipe were most active during the lowest solar radiation level (0–1 W • m^2; Fig. 4). Measurements of solar radiation have been attempted only recently (past 20 yr approximately) due to technological advances. However, the inability to measure solar radiation beforehand did not discourage past researchers from noting its effects on snipe activity. Irregularity in winnowing periods could be caused by variations in light intensity (Tuck 1972, Taylor 1978). The change from maximum light to darkness in a short period of time could stabilize activity during the post-sunset period (Tuck 1955).

Wind Speed

Wind speeds >8 km/h decreased snipe activity. More activity was recorded when wind speeds were <8 km/h (Fig. 4). Effects of wind on snipe have been documented frequently (Robbins 1954, Tuck 1972, Taylor 1978). Robbins (1954), who found results similar to ours, suggested that wind may be the single most important factor influencing winnowing. Considering that winnowing is a high-speed dive that vibrates outer tail feathers, one can easily see how high wind speeds could affect this activity. Although most authors have not quantified their observations of wind on snipe activity, their previous research nevertheless supports our now-quantified data.

Temperature

Snipe activity was greatest below the 6–10°C range (Fig. 4). Snipe prefer cooler temperatures, a fact which has been documented previously (Robbins 1954, Tuck 1972, Taylor 1978). Robbins (1954) reported higher counts on cool mornings and very low counts when the temperature reached 10°C. On hot days winnowing is delayed approximately 0.5 h (Tuck 1972).

SUGGESTIONS FOR FUTURE STUDY

Although we could not measure the following variables due to time constraints, they should be considered when monitoring snipe:

- Cloud cover (clouds may decrease bird predators, allowing snipe to be more active; also, clouds are related to solar radiation levels)
- Density (activity may be density dependent)
- Territory size (this may be related to density, particularly how varying numbers of snipe relate to differing area sizes)
- Competition (related to density and territory size; both can influence numbers of snipe present, which may affect competition for mates)
- Habitat types (related to density and territory size; different types support varying numbers of snipe)
- Number winnowing at once (many snipe winnowing with varying intensities can confuse an untrained ear)
- Social structure (relationships between breeders and nonbreeders/floaters can influence interpretation of surveys; Baskett et al. 1984).

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