

- (*Buteo jamaicensis*) in the Gallatin Valley, Montana. Ph.D. diss., Montana State Univ., Bozeman, Montana.
- KUSSMAN, J. V. 1977. Post-fledging behavior of the Northern Bald Eagle, *Haliaeetus leucocephalus alascanus* Townsend, in the Chippewa National Forest, Minnesota, Ph.D. diss., Univ. Minnesota, St. Paul, Minnesota.
- MEINERTZHAGEN, R. 1964. The education of young Ospreys. *Ibis* 96:153–155.
- NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, South Dakota.
- PARKER, A. 1975. Young male peregrines passing vegetation to each other. *Br. Birds* 68: 242–243.
- ROWE, E. G. 1947. The breeding biology of *Aquila verreauxi*. *Ibis* 89:576–606.
- SCHNELL, J. H. 1958. Nesting behavior and food habits of Goshawks in the Sierra Nevada of California. *Condor* 60:377–403.
- SHERMAN, A. R. 1913. The nest life of the Sparrow Hawk. *Auk* 30:406–418.
- SHERROD, S. 1983. Behavior of fledgling peregrines. Pioneer Impressions, Fort Collins, Colorado.
- SOUTHERN, H. N., R. VAUGHAN, AND R. C. MUIR. 1954. The behaviour of young Tawny Owls after fledging. *Bird Study* 1:101–110.
- WHEELER, S. 1979. New Hampshire kestrels. *New Hampshire Audubon Annual*, Spring: 25–27.
- WILLOUGHBY, E. J. AND T. J. CADE. 1964. Breeding behavior of the American Kestrel (Sparrow Hawk). *Living Bird* 3:75–96.
- WILMERS, T. J. 1982. Kestrel use of nest boxes on reclaimed surface mines in West Virginia. M.Sc. thesis, West Virginia Univ., Morgantown, West Virginia.

DIANA W. LETT AND DAVID M. BIRD, *Macdonald Raptor Research Centre of McGill University, 21,111 Lakeshore Road, Ste-Anne-de-Bellevue, Quebec H9X 1C0, Canada.* (Present address of DWL: *Dept. Ecology and Evolutionary Biology, Univ. Arizona, Tucson, Arizona 85721*). Received 8 Mar. 1986, accepted 17 July 1986.

Wilson Bull., 99(1), 1987, pp. 82–86

Abundance, habitat use, and perch use of Loggerhead Shrikes in north-central Florida.—Although populations of Loggerhead Shrikes (*Lanius ludovicianus*) have declined severely in numbers in many parts of their range in the United States (Morrison 1981, Fraser and Luukkonen 1986), they remain common in Florida. I studied relative abundance, habitat use, and perch use of Loggerhead Shrikes in north-central Florida. These data should provide useful comparative information not only for future studies in this area, but for other regions where shrike populations are low.

I randomly established 24 16-km roadside transects on paved secondary roads in parts of nine counties surrounding Gainesville, Florida (see Bohall 1984 for details). Two observers censused each transect once every 2 weeks from 18 October 1981 to 30 October 1982, by driving 32 km/h and scanning both sides of the road for perched and flying shrikes. I recorded the habitat for each shrike observed, whether the bird was on the roadside or actually in the habitat, and the perch type.

I combined 26 recognized vegetation types on the basis of vegetation structure into 5 habitat types for data analyses: completely open areas (low herbaceous vegetation without trees), midsuccessional (overgrown areas with tall shrubs or small trees), woods, wetlands (marsh or lake edge), and pastures with scattered trees. The completely open areas included settled areas (suburbs, lawns, homes), improved pasture, overgrown pasture (herbaceous

TABLE 1
NUMBER OF LOGGERHEAD SHRIKES OBSERVED IN 5 HABITATS ALONG 24 16-KM ROADSIDE
TRANSECTS IN NORTH-CENTRAL FLORIDA

| Habitat | Ob- served | Ex- pected | \bar{P}_a | P_b | 95% Confidence interval ^c |
|-----------------|---------------|---------------|-------------|-------|--------------------------------------|
| Open | 1456 | 594 | 0.877 | 0.358 | $0.856 \leq P \leq 0.897$ |
| Midsuccessional | 43 | 78 | 0.026 | 0.047 | $0.016 \leq P < 0.036$ |
| Scattered trees | 112 | 99 | 0.067 | 0.060 | $0.052 \leq P < 0.083$ |
| Woods | 44 | 883 | 0.026 | 0.531 | $0.016 \leq P \leq 0.037$ |
| Wetlands | 6 | 7 | 0.004 | 0.004 | $-0.0002 \leq P \leq 0.007$ |
| Total | 1661 | 1661 | | | |

^a Proportion of shrikes observed in each habitat (for example: $0.877 = 1456/1661$).

^b Proportion of total habitat available (used to calculate expected values; for example: $594 = 0.358 \times 1661$).

^c 95% Confidence interval around proportion of observed shrikes. If P_i does not fall within this interval, observed use is significantly less than or greater than expected.

vegetation ≤ 1 m in height), and crop fields (planted and unplanted). I measured the linear distance of habitat types on either side of the road with an odometer and calculated the percentage availability of each.

I evaluated habitat use with Chi-square tests for goodness-of-fit and calculated a 95% confidence interval to determine if a given habitat was used significantly more or less than expected (Neu et al. 1974). Expected values were calculated using percentage habitat availability. Winter (18 October 1981 to 20 March 1982 and 19 September to 30 October 1982) and summer (21 March to 18 September 1982) habitat use was compared with a Chi-square contingency test. Perch use was evaluated with Chi-square tests for goodness-of-fit and contingency.

I observed 965 shrikes (68.9 per 2-week sampling period) in winter, and 697 (53.6 per sampling period) in summer. The winter population was significantly larger than the summer population ($\chi_1^2 = 25.7$, $P < 0.001$).

I found no significant difference in use of the 5 habitat types between winter and summer ($\chi_4^2 = 4.63$, $P > 0.30$), so I combined data from the 2 seasons. Habitat use of shrikes observed along the roadside was not significantly different from that of shrikes observed in habitats away from the roadside ($\chi_4^2 = 1.50$, $P > 0.80$), indicating that samples of shrikes along the roadside did not bias the overall results of habitat use. The observed use of the 5 habitat types was significantly different from expected based on availability ($\chi_4^2 = 2065$, $P < 0.001$) (Table 1). Shrikes used open areas significantly more than expected and mid-successional areas and woods significantly less than expected. Pastures with scattered trees and wetlands were used in proportion to their availability. Similarly, Bent (1950) has stated that shrikes are open country birds.

Use of the 4 open habitat vegetation types also was significantly different than expected ($\chi_3^2 = 99.02$, $P < 0.001$) (Table 2). Settled areas were used significantly less by shrikes than expected, possibly due to more human disturbance there. Improved pastures were used significantly more than expected. The very low vegetation there may facilitate sighting and capture of prey. I observed shrikes more than expected in overgrown pastures and as often as expected in crop fields. However, of the 171 shrikes in crop fields, 74% were observed along the roadside. Similarly, 66% of the 192 shrikes observed in overgrown pastures were associated with the roadside. In improved pastures, 54% ($N = 944$) of the shrikes observed

TABLE 2
NUMBER OF LOGGERHEAD SHRIKES OBSERVED IN 4 OPEN HABITAT VEGETATION TYPES
ALONG 24 16-KM ROADSIDE TRANSECTS IN NORTH-CENTRAL FLORIDA

| Open habitat vegetation types | Observed | Expected | \bar{P}_a | P_b | 95% Confidence interval |
|----------------------------------|----------|----------|-------------|-------|---------------------------|
| Settled | 149 | 299 | 0.102 | 0.205 | $0.082 \leq P \leq 0.122$ |
| Improved pasture | 944 | 854 | 0.648 | 0.587 | $0.617 \leq P \leq 0.680$ |
| Overgrown pasture | 192 | 149 | 0.132 | 0.103 | $0.110 \leq P \leq 0.154$ |
| Crop fields | 171 | 154 | 0.117 | 0.106 | $0.096 \leq P \leq 0.138$ |
| Total | 1456 | 1456 | | | |

^a Proportion of shrikes observed in each habitat.

^b Proportion of total habitat available (used to calculate expected values).

were along the roadside. In crop fields, prey may be less available than in improved pastures, and the tall vegetation of overgrown pastures may hinder sighting and capture of prey. In contrast, vegetation along the roadside was very similar to improved pastures. Mills (1979) reported that shrikes preferentially hunted in short vegetation. Siegel (1980) and Kridelbaugh (1983) reported on the importance of pastures within the breeding habitat of shrikes, and Porter et al. (1975) found shrikes using grasslands more than cultivated fields.

Most shrikes I observed were perched on powerline wires (Table 3). In Texas, 98% of the perched shrikes observed by Bildstein and Grubb (1980) were on powerlines. In general,

TABLE 3
NUMBER OF PERCHED AND FLYING LOGGERHEAD SHRIKES AND PERCH-SITE USE ALONG 24
16-KM ROADSIDE TRANSECTS IN NORTH-CENTRAL FLORIDA

| Location | N | % |
|-----------------------------|------|-------|
| Manmade perches | | |
| Powerline wire | 1027 | 61.8 |
| Utility pole | 19 | 1.1 |
| Fencewire | 101 | 6.1 |
| Fencepost | 221 | 13.3 |
| Subtotal | 1368 | 82.4 |
| Natural perches | | |
| Live tree | 41 | 2.5 |
| Dead top of live tree | 28 | 1.7 |
| Bare tree, snag | 76 | 4.6 |
| Shrub | 89 | 5.4 |
| Fallen tree, debris, ground | 28 | 1.7 |
| Subtotal | 262 | 15.8 |
| Flying | 31 | 1.9 |
| Total | 1661 | 100.0 |

manmade perches were used significantly more often than natural perches ($\chi_1^2 = 461.57$, $P < 0.001$), probably because fences and powerlines often were the only perches available in large open pastures.

High perches (powerlines, utility poles, live and dead standing trees) were used more often than low perches (fenceposts, fencewire, shrubs, fallen trees) in summer (81% vs 19% of observations, $N = 677$, $\chi_1^2 = 256.85$, $P < 0.001$) and winter (68% vs 32%, $N = 953$; $\chi_1^2 = 117.76$, $P < 0.001$). There was, however, a significant increase in use of high perches from winter to summer ($\chi_1^2 = 35.16$, $P < 0.001$). Shrikes may perch higher during the summer to be more conspicuous during the breeding season. Morrison (1980) reported that shrikes selected higher perches during the summer in response to the greater height and density of vegetation. In Florida, vegetation in improved pastures remains low in summer, and shrikes tended to perch low more frequently there. Mills (1979) suggested, based on optimal foraging models, that American Kestrels (*Falco sparverius*) perch high when hunting large prey and perch low when foraging for smaller prey. Perhaps shrikes use a similar strategy. Alternatively, shrikes may perch lower in winter for more efficient thermoregulation.

These data on the relative abundance, habitat use, and perch use of Loggerhead Shrikes in an area where their numbers are relatively high will establish important baseline data for subsequent studies. They may also be of use when compared to data collected by researchers conducting studies in other parts of the Loggerhead Shrike's range where they are less common or declining where habitat use may not represent the habitat potentially used by a healthy population.

Acknowledgments.—I thank K. Bildstein, F. Burnside, M. W. Collopy, J. D. Fraser, and M. L. Morrison for their helpful reviews of this manuscript. I also thank the many people who assisted with the roadside surveys. This is contribution No. 7400 of the Journal Series, Florida Agriculture Experiment Station, Gainesville, Florida 32611.

LITERATURE CITED

- BENT, A. C. 1950. Life histories of North American wagtails, shrikes, vireos, and their allies. U.S. Natl. Mus. Bull. 197.
- BOHALL, P. G. 1984. Habitat selection, seasonal abundance, and foraging ecology of American Kestrel subspecies in north Florida. M.Sc. thesis, Univ. Florida, Gainesville, Florida.
- BILDSTEIN, K. L. AND T. C. GRUBB, JR. 1980. Spatial distributions of American Kestrels and Loggerhead Shrikes wintering sympatrically in eastern Texas. Raptor Res. 14:90–91.
- FRASER, J. D. AND D. R. LUUKKONEN. 1986. The Loggerhead Shrike. Pp. 933–941 in Audubon Wildlife Report 1986 (R. L. Di Silvestro, ed.). Nat. Aud. Soc., New York, New York.
- KRIDELBAUGH, A. 1983. Nesting ecology of the Loggerhead Shrike in central Missouri. Wilson Bull. 95:303–308.
- MILLS, G. S. 1979. Foraging patterns of kestrels and shrikes and their relation to an optimal foraging model. Ph.D. diss., Univ. Arizona, Tucson, Arizona.
- MORRISON, M. L. 1980. Seasonal aspects of the predatory behavior of Loggerhead Shrikes. Condor 82:296–300.
- . 1981. Population trends of the Loggerhead Shrike in the United States. Am. Birds 35:754–757.
- NEU, C. W., C. R. BYERS, AND J. M. PEEK. 1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38:541–545.
- PORTER, D. K., M. A. STRONG, J. B. GIEZENTANNER, AND R. A. RYDER. 1975. Nest ecology, productivity, and growth of the Loggerhead Shrike on the shortgrass prairie. Southwest. Nat. 19:429–436.

SIEGEL, M. S. 1980. The nesting ecology and population dynamics of the Loggerhead Shrike in the Blackbelt of Alabama. M. Sc. thesis, Univ. Alabama, Birmingham, Alabama.

PETRA BOHALL-WOOD, Dept. Wildlife and Range Sciences, 118 Newins-Ziegler Hall, Univ. Florida, Gainesville, Florida 32611. Received 19 Feb. 1986, accepted 9 July 1986.

Wilson Bull., 99(1), 1987, pp. 86–91

Testosterone, aggression, and dominance in Gambel's White-crowned Sparrows.—The effects of testosterone on dominance hierarchies differ among avian species, and it is difficult to predict how particular species will respond. Selinger (1967) found that androgen injections increased the number of head grabs and pecks in Japanese Quail (*Coturnix coturnix japonica*), in some cases leading to a reversal in dominance. Androgen injections also led to a reestablishment of original dominance relationships in quail that had previously lost their dominance due to castration. Gottier (1968) reported that chickens (*Gallus gallus*) injected with androgens moved up in their hierarchy. In the polymorphic Harris Sparrow (*Zonotrichia querula*) darker birds are dominant to lighter colored birds (Rohwer, 1978). Low-ranking birds disguised to resemble high-ranking individuals by painting did not move up in the hierarchy, unless they were also treated with testosterone (Rohwer and Rohwer 1978). Testosterone injections, however, had no effect on low-ranking Red-billed Queleas (*Quelea quelea*), European Starlings (*Sturnus vulgaris*), or domestic Rock Doves (*Columba livia*) (Mathewson 1961, Crook and Butterfield 1968, Lumia 1972).

Here we report on post-testosterone treatment hierarchies in migratory Gambel's White-crowned Sparrows (*Zonotrichia leucophrys gambelii*).

Methods.—In the fall of 1979, hatching-year Gambel's White-crowned Sparrows (aged by crown color) were captured in the Los Angeles, California area, sexed by laparotomy, and held for several weeks in outdoor aviaries. On 9 January 1980, control and experimental groups of six males each were color-banded for individual recognition and put in separate rooms in 1.2 × 0.9 × 0.5 m cages. Photoperiod was held at 10L:14D and room temperature at 20 ± 1°C. Birds were fed seeds, pheasant starter, grit, greens, and vitamins. From 13 January through 28 January (Period 1) each of us independently observed the two captive flocks. For 1 h each observation morning we counted displacements as described by Parsons and Baptista (1980). We then compared our tabulations. Because we found that we agreed on the positions of the birds in the two hierarchies, we pooled our data throughout the experiment. On 28 January the two lowest ranking birds in one hierarchy (birds 5e and 6e in the experimental group) were given intramuscular injections of testosterone (Searle SC-16148, 0.15 cc at 50 mg/cc). Previously, this dosage was found to be effective in inducing song (Baptista 1974) (see below). Birds 5c and 6c in the control group were injected with placebo (the peanut oil vehicle). Four days later birds 5 and 6 in the experimental group were given a second injection (0.10 cc), and their counterparts in the control group were injected with placebo. We observed the birds for 45 days, during which time 4819 aggressive interactions were recorded (2181 in the control group and 2638 in the experimental group).

Observations were made between 13 and 28 January. Before injections, straight-line hierarchies were established in both groups (Period 1) (Fig. 1). The ratio of wins to losses between any two birds indicates which of the two is dominant, although subordinate birds occasionally won encounters with dominants.

Behavior following injections.—In the control group, no changes in behavior occurred after placebo injections of the two lowest ranking birds (5c and 6c). In the experimental group, three types of changes were observed. First, the injected birds, 5e and 6e, initiated