

THE AUK

A QUARTERLY JOURNAL OF ORNITHOLOGY

VOL. 71

OCTOBER, 1954

No. 4

THE GAMBEL'S SPARROW AT MOUNTAIN VILLAGE, ALASKA

BY BARBARA BLANCHARD OAKESON

FIELD work for this paper was done at Mountain Village, Alaska (lat. 62° 07' N.), the settlement on the lower Yukon from which Mr. Henry C. Kyllingstad made explorations preparatory to the discovery of the nest of the Bristle-thighed Curlew (Allen and Kyllingstad, 1949). I chose this place for my work first, because arrival and departure dates for Gambel's Sparrows (*Zonotrichia leucophrys gambeli*) for a six-year period were available through the kindness of Mr. Kyllingstad; second, because meteorological data had been recorded there for several years; and third, because the lateness of the spring at Mountain Village, compared with that at stations of similar latitude farther inland, seemed likely to reveal the capacity of the Gambel's Sparrow to compress its breeding cycle. Mr. Kyllingstad had earlier estimated this species as second in abundance of all the migratory passerines breeding there. Unfortunately, the spring of 1950, when the field work was done, coincided with a low point in numbers. This fitted in with the many reports from southern California bird-banders of abnormally few immature Gambel's Sparrows trapped the previous winter. Beyond Mountain Village the Yukon fans out into broad flats unsuitable for this species, and the country back of the first row of hills above the village is also unsuitable. The sparse breeding population in 1950 was therefore not augmented by influx from adjacent land, nor could I extend my working area to include more nesting pairs. The low population level that year may account in part for the high percentage of young fledged.

MATERIAL AND METHODS

Three months were spent in Mountain Village, from late April through July, collecting, banding, and watching Gambel's Sparrows.

Plants were collected, and the vegetational changes were photographed weekly. Nine nesting pairs, most of which were marked recognizably with colored bands, were watched from the start of nesting until they fledged their young. The birds collected for anatomical analysis were taken on the day of, or within three days of, arrival, and were prepared as described in a previous paper (Oakeson, 1953). Five males were taken in late June and early July to find the approximate time of testis regression.

Data for the curves of daylight and hours of possible sunshine are extrapolated for latitude 62° N. from the figures for latitude 60° N. in the American Ephemeris for 1953. Data for the other climatic factors were taken from the U. S. Weather Bureau's Bulletin on Climatological Data for Alaska.

ENVIRONMENT

Topography.—Mountain Village occupies a narrow strip about three miles long on the north bank of the Yukon, 120 miles from its mouth, where the river bends north around a range of hills which come down to the water's edge. Most of the three-mile strip was incorporated into territories of Gambel's Sparrows. After the disappearance of snow and ice, a cross-section of the terrain, starting at the river, would pass through a narrow rocky beach, up the river bank, which is only a few feet high in most places, and over gently sloping hills, with flat or rounded tops. The "mountain," a hill 500 feet high behind the village, is steeper than the rest. Little streams, often not more than a few feet wide except at the mouth, run into the river every few hundred yards. On the more poorly drained hilltops are many small ponds.

Climate.—Meteorological data are graphed in figures 1 and 2. No adequate idea of the climate can be obtained without considering the wind velocity and the great proportion of the time the wind blows, but this has not been recorded systematically until recently. Except for three calm days, the wind blew every day of the three months I spent there, the highest velocity recorded being 43 miles per hour. Army observers had recorded winds of up to 100 miles per hour on top of the "mountain."

Vegetational Pattern.—Wherever White-crowned Sparrows nest, whether in central California, at the Canadian border, or in Alaska, the vegetational pattern is in broad outline the same: the essential elements are bare ground, grass or grass mixed with annual and small perennial flowering plants, and extensive clumps of dense shrubbery.

At Mountain Village, bare forage ground was not always incorporated into the nesting territory. For pairs living upland from the village, the nearest open ground lay a mile or so below at the river's edge, and in such cases the pairs flew back and forth between nesting and foraging grounds through the areas of other Gambel's Sparrows, which were never seen to protest.

At the upper edge of the beach grow flowering annuals and scrub alders. On the river bank and up the slopes just above are dense stands of grass mixed with other annuals, ferns, and dwarf perennials. The slopes adjacent to most of the houses are burned each spring, and these support almost pure stands of grass. Willow is the dominant shrub along the streams, giving way to alder on the steeper slopes, although both frequently occur together. The higher slopes and better drained hilltops support dense mats of dwarf perennials. In poorly drained areas on hilltops grow several species of sedge. No coniferous trees occur at Mountain Village.

Passerine Associates.—The commonest associate of the Gambel's Sparrow was the Savannah Sparrow (*Passerculus sandwichensis*). Nests of the Fox Sparrow (*Passerella iliaca*), the Tree Sparrow (*Spizella arborea*), and the Common Redpoll (*Acanthis flammea*), a permanent resident, were also found in territories of Gambel's Sparrows.

Natural Enemies.—Few potential natural enemies occurred at Mountain Village the spring I was there. No hawks of the genus *Accipiter* were seen. A pair of Canada Jays was seen once. Horned Owls were heard calling from the south bank of the Yukon, but none was seen or heard on the village side. Jaegers commonly flew over the upland tundra, but kept away from the village. Weasels were reduced to the minimum by trapping, and of course there were no snakes. The safety of the village for nesting Gambel's Sparrows, for that season at least, is borne out by the high percentage of young fledged.

ARRIVAL

Dates.—Gambel's Sparrows destined to breed at Mountain Village arrived there in 1950 over a period of at least 19 days. The first two males came May 9. One was color-banded and followed through the nesting cycle. From then until May 25, males filtered in gradually. The average arrival date for 17 males was May 15. The females arrived between May 17 and May 28, and the average arrival date for 11 birds was May 23. These data accord closely with those of Mr. Kyllingstad (personal communication) for six years between 1942 and 1948. I assume his records of early arrivals are for males.

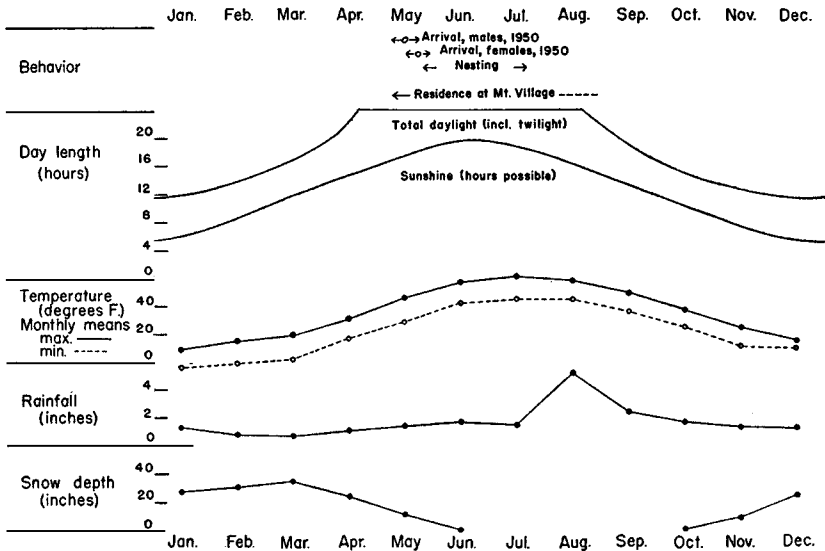


FIGURE 1. The relation of the residence period for Gambel's Sparrows at Mountain Village, Alaska, to the climate. Temperature and rainfall data are based upon averages of 4 to 6 years, and snow depth upon averages of 2 to 3 years.

His earliest record is for May 7, 1943, and his average date for "first Gambel's Sparrow seen" is May 10. His average date for when the species becomes common falls between May 14 and 15.

Correlation with departure from wintering grounds.—The nature of the influx at Mountain Village complements that of departure from the wintering grounds at Davis and Santa Barbara, California. As already stated (Blanchard and Erickson, 1949) it takes almost as long for one flock to disappear from the wintering grounds as it does the whole population. The thinning-out takes place over at least 14 days, which is close to the 19-day interval for the arrival at Mountain Village. Furthermore, just as the males arrived first at Mountain Village, so they get ready to leave the wintering grounds first. At both Davis and Santa Barbara, the earliest members of a given flock to get ready to leave (as judged by the accumulation of fat and progress of the molt) are males. In flocks not depleted by collecting, the last birds to be ready are predominantly females.

Approximate time spent in migration.—Table 1 shows the dates for 1950 for earliest and latest observed departure and arrival, and earliest, latest, and average dates for 21 years and 11 southern California and 3 far northern localities. Between the data for 1950 and the averages for all years and stations there is agreement too close to be accidental.



HABITAT OF GAMBEL'S SPARROW. The "Mountain": change in appearance of the country above Mountain Village, Alaska. (*Upper*) May 4. The earliest males came five days later. (*Lower*) The same spot on June 19, when nesting was in progress.



HABITAT OF GAMBEL'S SPARROW. Vegetation of the same spot. (*Upper*) May 7: the earliest males came two days later. (*Lower*) May 21: the earliest females had already arrived.

The time spent in migration by any one flock may well approximate thirty-five days. In the closely related race, *pugetensis*, there is evidence that populations wintering close to the southern limit of the wintering range breed close to the northern limit of the breeding range (Blanchard, 1942). If this is also true in *gambeli*, then it is at least a cogent possibility that birds wintering in southern California breed as far north as latitude 62° N. The air distance between Santa Barbara and Mountain Village is about 2700 miles, but the route taken by the birds is almost certainly longer. If we assume that birds wintering in southern California fly at least 2700 miles in not more than 35 days, then they would average over 75 miles per day.

TABLE 1
DEPARTURE AND ARRIVAL DATES, *Zonotrichia leucophrys gambeli*

| | <i>Earliest departure from so. Calif.</i> | <i>Earliest arrival on breeding grounds</i> | <i>Interval</i> | <i>Latest departure</i> | <i>Latest arrival</i> | <i>Interval</i> |
|---|---|---|-----------------|-----------------------------|---------------------------|-----------------|
| 1. Dates for 1950: three so. Calif. stations and Mt. Village | April 6 | May 9 | 35 days | April 21 | May 28 | 37 days |
| 2. Dates for all years and localities | | | | | | |
| a. earliest and latest | March 27 | May 1 | 35 days | May 14 | — | — |
| b. average dates | April 6 | May 10 | 36 days | April 26 | — | — |

Relation to the climate of the breeding grounds.—The average arrival date for males at Mountain Village falls within the period of most rapid amelioration of most climatic factors. Figure 1 illustrates this for the three- to six-year period for which data are available. By May 10 the total number of hours of daylight has recently reached twenty-four; the curves for temperature and hours of possible sunshine are rising sharply toward their maxima; precipitation is close to the minimum, and unmelted snow is rapidly decreasing. Table 2 relates the arrival dates for four years to the weekly means of daily minimum temperature.

This is not to imply that local weather conditions at time of arrival are critical, although there are numerous records of migrants arriving in the far north which were killed by late storms (Blanchard and Erickson, 1949, data from T. T. McCabe). What is probably of much greater importance is that the birds should arrive early enough

to start nesting as soon as the climate becomes suitable for raising young. The arrival of the males ahead of the females allows for the settlement of territorial matters, and permits the females to avoid some of the risks of late storms. On the more clement breeding-grounds at the Canadian border, females of the Puget Sound Sparrow arrived the same day as the males, but did not begin nesting until one to two weeks later. Females of the Gambel's Sparrow at Mountain Village arrived, on the average, eight days later than the males, but began nesting in two or three days.

TABLE 2
WEEKLY MEANS OF DAILY MINIMUM TEMPERATURES IN DEGREES F.,
AND ARRIVAL TIME OF GAMBEL'S SPARROWS

| Inclusive dates | Bethel | Mountain Village | | |
|-----------------|--------|------------------|--------|---------|
| | 1946 | 1947 | 1948 | 1950 |
| April 6-12 | 10.7 | 12.9 | 30.4 | 22.1 |
| April 13-19 | 8.4 | 11.7 | 10.1 | 15.9 |
| April 20-26 | 23.7 | 26.4 | 14.0 | 22.9 |
| April 27-May 3 | 20.6 | 20.6 | 19.1 | 19.1 |
| May 4-10 | } 26.6 | } 31.7 | 17.7 | { 26.1 |
| May 11-17 | } 29.9 | } 30.9 | { 29.1 | { 28.3; |
| May 18-24 | 36.0 | 30.0 | 32.7 | { 30.3; |
| May 25-31 | 39.3 | 39.3 | 35.7 | 31.6; |

Arrival periods (from date first bird seen to date when became common) are bracketed. Data for 1946-1948 from Mr. Henry Kyllingstad.

Dotted bracket for 1950: arrival of females.

Relation to progress of vegetation.—Plates 25 to 28 illustrate the changes in appearance of the country and the vegetation between early May and July. When nesting began, the only vegetation thick enough for concealment was either dead grass recently exposed by the melting snow or dense mats of upland dwarf perennials. That these afforded good protection is evidenced not only by the high percentage of young fledged, but also by the fact that, in spite of years of experience in finding White-crowned Sparrow nests, it took me many hours' intensive search to find each nest.

Physiological condition.—Of eight males known to be newly-arrived, five had mature sperm in the lumens of the seminiferous tubules and two others had mature sperm not yet free in the lumen. The mean testis volume for these eight (140.35 mm.³) was smaller than that of a breeding male collected a month later (251.4 mm.³), and it is probable that even the most advanced testes had not yet reached full breeding condition. The largest ovarian follicles in three newly-arrived females ranged from 1.3 to 2.1 mm. in diameter. Three of the females I watched must have been ready to breed almost as soon

as they arrived, for from five to seven days later they laid their first eggs.

The sharp contrasts in physiological condition between Gambel's Sparrows wintering at Santa Barbara taken on the eve of migration and the new arrivals at Mountain Village have been described (Oakeson, 1953). If we assume that the Mountain Village males began the flight north at about the same physiologic stage as did those wintering in Santa Barbara, and if we take 35 days as the interval spent in flight, then in this period the average body weight decreased by about 14 per cent, the mean liver weight decreased by about 30 per cent, and the mean spleen weight, by about 40 per cent. During the same period the mean testis volume increased over 100-fold. The changes in the females are less marked but are in the same direction.

At first I considered the marked decrease in body, liver, and spleen weights and in subcutaneous fat as evidence of nutritional depletion owing to the rigors of the flight north. Now I am inclined to look upon these changes rather as signs of the end of an endocrine rhythm, genetically based, which runs its course relatively independently of external environmental factors, and which may be partly responsible for the urge to migrate. Three considerations lend weight to such an idea. First, the observations of Laurence Irving and Simon Paneak on the nutritional state of 41 species of birds arriving at Anaktuvuk Pass in the Brooks Range indicate that in general "arriving migrants are fat and in excellent condition." "In some species the weight of the birds at the date of first arrival was greater than it was later during nesting . . . no detailed method of study has shown that first arrivals exhibit a deficit to denote depletion of their reserves in flight. There is no sign that the northward migration has imposed physiological stress because no strain is visible." (Irving, L. and S. Paneak, 1952). Second, a decrease in body and liver weights, occurs at the comparable stage of the gonad cycle in the permanently resident race, *nuttalli* (Oakeson, unpublished data). This decline cannot be due to any obvious physiological stress, since the birds never migrate, and the decrease occurs before they begin nesting. It could on the other hand be due to an endocrine rhythm basically similar to that in *gambeli*. Third, migrating Gambel's Sparrows in British Columbia, undoubtedly on the last lap of a long flight, may be even fatter than those on the eve of departure from California wintering-grounds (data from T. T. McCabe, in Blanchard and Erickson, 1949). The males arriving at Mountain Village, therefore, may be thin and have lower body, liver, and spleen weights than at any other time

of year, not because of any stress during the northward flight but because of a sudden change in nutritional economy, the timing of which may be influenced more by inherent endocrine rhythms and less by direct effects of environmental conditions met with *en route* than has been commonly supposed. We know that the histological condition of the thyroid, for example, is different in Gambel's Sparrows on the eve of migration than in birds newly arrived on the breeding grounds (unpublished data).

Behavior.—Although males arriving at Mountain Village had testes larger and more advanced, histologically, than those of Puget Sound Sparrows arriving at Friday Harbor, no loud singing or noisy conflicts between neighbors took place. The newly-arrived birds were so shy that to get within range of one often took hours of stalking. They flew distances of up to a mile without stopping. Their song was weak. Even after the males had established headquarters where they spent the greater part of each day, they sometimes left the areas for hours. Pursuits were seen, but so were cases of complete tolerance of one male by another. Several factors may have been involved in this weakness of territorial display as compared with the vigorous conflicts at Friday Harbor: the cold and inclement weather at Mountain Village compared with the much warmer and more sunny days at Friday Harbor, the low population density, and the lack of the stimulating effect of a mate. Whatever may have been the reasons, the facts illustrate that the vigor of territorial display is not alone a reliable criterion of testis size and histologic condition.

The few disputes over boundaries or mates that did take place later followed the pattern at Friday Harbor, and when incubation began, the Gambel's Sparrows behaved as do other breeding White-crowned Sparrows, with one exception, that of a male which tried for three days to steal the mate of a neighboring male while his own female was laying and starting to incubate. The facts were as follows.

On May 23, Male 1 acquired a mate. She built one nest, deserted it, and was finishing another when on May 28 copulation occurred. Female 1 must have begun incubation May 31, judging by the date her eggs hatched. Meanwhile the neighbor on the east, Male 7, had acquired a mate. She started her nest May 30. That same evening, Male 1 "attacked" her. (In Nuttall's Sparrows an "attack" occurs when either of a pair is not ready to mate.) Male 7, which until then had been singing regularly but not forcefully, chased Male 1, then began to sing loudly from conspicuous perches, patrolling his area as do males during incubation. The next evening, Female 7

was attacked again by Male 1. Then each time she flew, she was pursued by both males. Finally Male 7 began to chase the intruder, but could not drive him back to his own area. At 9:10 p.m., over one and one-half hours after the dispute had begun that evening, Male 7 began to patrol his territory, which now, owing to his intensified behavior, merited the term in all its connotations, and incorporated into his patrol a high aerial pole, from which he sang loudly. (Since there are no tall trees at Mountain Village the aerial poles near the Trading Post were favorite singing perches.) There followed a "singing contest" between the two males. This lasted until 9:45 p.m., some time after other birds had quieted down for the night. During the contest, Female 7 trilled and postured vigorously but her mate was too preoccupied to pay any attention to her. The next evening, June 1, the performance was repeated, and Male 1 flew at Pair 7 whenever they attempted copulation, preventing the mating not only psychologically but also physically, at least as long as I watched. By the next day the situation had returned to normal: each male sang from his respective territory. Pair 7 must have succeeded in copulating, for the female finished her nest June 1, laid her first egg June 3, and all eggs hatched June 19. This is the only case I have seen in White-crowned Sparrows where one male tried to steal a mate from another male while his own female was laying and incubating.

BREEDING

Relation to the climate.—Figure 1 shows the relation of the period that Gambel's Sparrows are resident at Mountain Village to the annual cycle of climate, based upon averages for several years. Figure 2 shows the timing of the events in the breeding cycle in 1950 and weekly climatological data for that season. Except for rain, the climate is least severe during nesting, yet the weather in 1950 was far from clement, and the year was not considered severe by old-timers. Between the day the first egg was laid and that when the young of Pair 1 were fledged, for example, there occurred a hailstorm with snow flurries, twelve days of rain, six of them consecutive, nine days with winds up to 35 miles per hour as recorded in a relatively protected part of the village, and four nights when the temperature fell to freezing or below. Yet, with the possible exception of one pair, which deserted their first nest, none that I watched lost eggs or young because of bad weather. At the end of the six-day storm, I found one setting female with drops of water on her back, but this was the only case I saw even of slight wetting, so effective in shedding water were the dead grass stems arching over the nests.

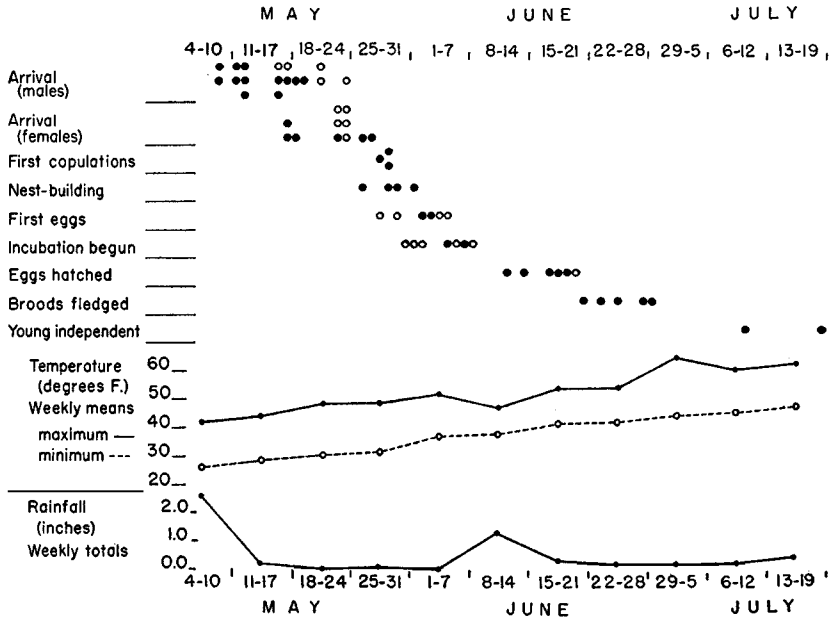


FIGURE 2. The breeding cycle of 1950 at Mountain Village, Alaska, and weekly means of temperature and total precipitation. Solid dot, data based on direct observations. Hollow dot, data calculated from subsequent observations.

Residence at Mountain Village.—The average period of residence for males is probably not less than 12 and not more than 16 weeks, of which less than seven weeks are spent in raising the single brood, and the rest either in preparing to nest or in molting and getting ready for fall migration. The average date of arrival of the earliest males, based on Kyllingstad's records for six years and mine for 1950, is May 10. Departure cannot be defined so narrowly. Kyllingstad (personal communication) says "a few stayed into the first week of September each year." From his banding records for four years, he states: "I believe most of the July (trapped) birds are those produced in the vicinity of Mountain Village. An influx, perhaps from farther north and west, occurs about the second week in August. These are mainly young of the year. Adults are very scarce in this group. Another influx strikes a week or two weeks later and many of the last birds in this wave are adults."

Breeding condition in the male.—The period from first observed copulation (May 28) to the first specimen with small testes (collected July 5) was 38 days in 1950. One male in full breeding condition was taken June 27, and others with small testes were taken July 13 and 19.

Raising the young.—Table 3 shows the duration of intervals within the breeding cycle. For one pair watched daily, the interval from first observed copulation to the day the young were first seen foraging independently was 43 days. For another pair, the interval between first observed nest-building and independence of the young was also 43 days. Pairs which fledged one brood made no attempt to raise a second. One female deserted her first nest, containing one newly hatched young and three eggs, on June 18. The pair moved their headquarters and fledged their young from the second nest July 19. The first egg must therefore have been laid in the second nest a week after the previous nest was deserted.

TABLE 3
DURATION OF BREEDING PHASES AT MOUNTAIN VILLAGE

| <i>Interval</i> | <i>Number</i> | <i>Range, in days</i> | <i>Average, in days</i> |
|-------------------------------------|---------------------|---------------------------|-----------------------------|
| First copulation—testis regression | whole population | | 38 |
| Arrival of female—nest begun | 3 | 3-4 | 3.3 |
| Nest finished—first egg laid | 5 | 0-3 | 1.2 |
| Earliest first egg—latest first egg | 5 | | 8 |
| Young hatched—young fledged | 13 | 8-10 | 9.0 |
| Fledging—independence of young | 3 | (minimum = 19) | |

Clutch size.—The average for six clutches was 4.66 eggs. Four or five eggs were laid in each clutch.

Nestling development.—The growth, progress in feathering, behavior, and general competence of the *gambeli* nestlings was so closely similar to that described for *nuttalli* nestlings (Blanchard, 1941) that it need not be reviewed here. In table 3, the figure of 9.0 days for the average nestling period was obtained by averaging the periods for individuals, rather than broods, since not all young in the same nest were hatched, or fledged, the same day. The brood I weighed daily is omitted from the average. They jumped out of the nest from fright when four were eight, and one only seven, days old. Of thirteen nestlings which left the nest without any obvious cause for fright, one left when eight days old, i.e., on the eighth day after the day hatched, eleven young left when nine days old, and one, when ten days old. Comparable treatment of data for Berkeley Nuttall's Sparrows and Friday Harbor Puget Sound Sparrows (table 4) indicates that the average nestling periods of the three races, while closely similar, are probably not identical. Karplus (1952) watched a brood of Robins at Umiat (lat. 69° 23' N.) which left the nest nine days after hatching. Data for 85 Robin broods in the "northern United States"

give a much longer average nestling period (13.2) although there is one possibly abnormal record for nine days. No such marked shortening of the average nestling period appears to occur in *Zonotrichia leucophrys* between latitudes 37° 48' N. and 62° 07' N., a latitudinal change not much less than that between the two regions involved in the comparison of Robin nestling periods.

TABLE 4
NESTLING PERIODS FOR THREE RACES of *Zonotrichia leucophrys*

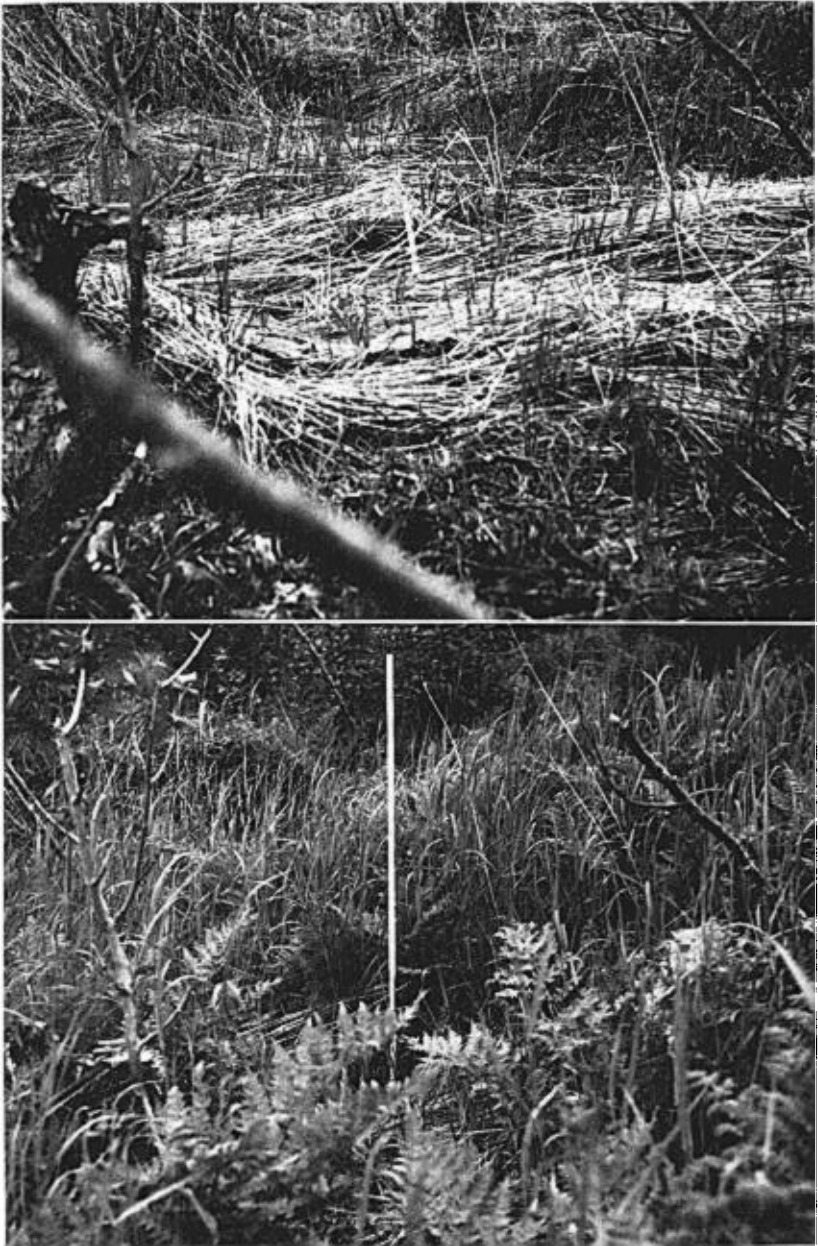
| Race | Population | Number of nestlings | Range of nestling period, days | Average nestling period, days |
|-------------------|--|---------------------|--------------------------------|-------------------------------|
| <i>nuttalli</i> | Berkeley, California (37° 48' N.) | 23 | 9-11 | 10.08 |
| <i>pugetensis</i> | Friday Harbor, Washington (48° 30' N.) | 26 | 8-11 | 9.61 |
| <i>gambeli</i> | Mountain Village, Alaska (62° 07' N.) | 13 | 8-10 | 9.00 |

Comparison with pugetensis.—The compression of the breeding cycle of Friday Harbor *pugetensis* as compared with Berkeley *nuttalli* has been analyzed in detail (Blanchard, 1941). The Gambel's Sparrow cycle at Mountain Village (38 days) was compressed to less than one-third that of Berkeley *nuttalli* (116 days) and to less than one-half that of Friday Harbor *pugetensis* (90 days). The greater part of the time saved lay in the fledging of only one brood, but compression of several other intervals was necessary in order to make fullest use of the short time between arrival and gonad regression. Males of the Gambel's Sparrow arrived with testes approaching full breeding condition, and, therefore, could presumably mate with the females as soon as the latter arrived. Before their mates came, they had established the rudiments of territories so no time was lost after the females' arrival either in establishing nesting areas or in achieving at least physiological readiness to mate. The females were ready to mate and begin work on the nest within a few days after arrival. Table 5 gives comparative data for *pugetensis* and *gambeli* for median dates of arrival, first copulations, and first eggs. The time spent in building the nest may also be shortened in *gambeli*. Four females spent between 2 and 4 days in building (average of 2.7 days) while one Puget Sound female at Friday Harbor spent 7 to 8 days on her first nest. Comparable figures for *nuttalli* are from 7 to 9 days for five nests found the day they were begun.

Percentage of young successfully fledged.—Of eight broods watched, six were successfully fledged, and at least one of the nestlings in each of the other two is known to have been fledged. The data of course



HABITAT OF GAMBEL'S SPARROW. Vegetation of the same spot as Plate 26 (*Upper*) June 19: nesting in progress. (*Lower*) July 2: most young had been fledged.



HABITAT OF GAMBEL'S SPARROW. Vegetational change at nest-site of female 7. (*Upper*) June 4: two eggs had been laid. (*Lower*) July 2: the young had been fledged four days before.

TABLE 5
DURATION OF INTERVALS IN NESTING CYCLE
Zonotrichia leucophrys pugetensis AND *Z. l. gambeli*

| Interval | <i>pugetensis</i> | | <i>gambeli</i> | |
|---|-------------------------|----------------|------------------|----------------|
| | Median dates | Duration, days | Median dates | Duration, days |
| From arrival of males to arrival of females | April 10 for both sexes | 0 | May 16–May 24 | 8 |
| From arrival of female to first copulation | April 10–21 | 11 | May 24–May 28–29 | 4–5 |
| From first copulation to first egg | April 21–29 | 8 | May 28–29–June 2 | 4–5 |
| From arrival of female to first egg laid | April 10–29 | 19 | May 24–June 2 | 9 |

represent only one season, and one of low numbers at that. Yet they do at least raise the question of whether Mountain Village may not be substantially safer for raising young than more southern localities. The percentage of Nuttall's Sparrow broods successfully fledged during the four years I watched the nesting cycle at Berkeley was only 12 out of 30, or 40 per cent. Comparable figures for Friday Harbor Puget Sound Sparrows for 1936 were 19 out of 32, or 59 per cent. Certainly the kinds and numbers of natural enemies are greater in the south. At Berkeley, jays, cats, and snakes are common. At Friday Harbor, crows appeared to be chiefly to blame for the destruction of the nests I watched. In both cases my daily trips to the nests undoubtedly increased the hazards from crows and jays. The scarcity of natural enemies at Mountain Village has already been mentioned.

ACKNOWLEDGMENTS

My thanks are due the American Association of University Women, who awarded me the Fellowship Crusade National Fellowship for 1949–1950, to do this work. Laboratory and field work at Santa Barbara were aided by two grants from the Committee on Research at Santa Barbara College. I am deeply indebted to Mr. Henry C. Kyllingstad, who suggested Mountain Village as a place to work and whose invaluable contributions are obvious throughout this paper. I am grateful to Dr. Laurence Irving, Biologist, Arctic Health Research Center at Anchorage, Alaska, for his help and encouragement in planning the field work, and to Dr. Jack C. Halderman, formerly Medical Officer in Charge of the U. S. Public Health Laboratory at Anchorage, for arranging my transportation in Alaska, lending me equipment, and placing at my disposal the facilities of the Arctic Research Laboratory.

I wish to thank Mr. George Sheppard, of Mountain Village, for allowing me to set up a laboratory at his trading-post, and sharing with me his great knowledge of the country. The native people of Mountain Village, with their intimate knowledge of the animals of the region, helped me in many ways. A wealth of material on departure dates for Gambel's Sparrows was contributed by Mrs. Harold Michener from her and her late husband's banding records. Dr. Elliott McClure, Miss Helen Pratt, Mrs. Edna Ferguson, Dr. Loye Miller, and Mr. and Mrs. F. H. Boynton also contributed valuable banding data.

My thanks are due Professor J. P. Anderson, of the Department of Botany and Plant Pathology at Iowa State College, who identified the plants from Mountain Village.

I am indebted to Nels Oakeson for drawing the graphs, and to Dr. Mary M. Erickson for criticism of the manuscript.

SUMMARY

Data for this paper include analysis of seasonal changes in climate and vegetation at Mountain Village, Alaska (lat. 62° 07' N.); anatomical analysis of Gambel's Sparrows collected on the day of, or shortly after, arrival at Mountain Village; daily observation of nine nesting pairs followed throughout the breeding season of 1950; and departure and arrival dates for a period covering 21 years from 11 southern California banding stations and 3 far northern localities.

Arrival of Gambel's Sparrows at Mountain Village in 1950 covered at least 19 days and coincided with the period of most rapid amelioration of most climatic factors. Males came 8 days earlier, on the average, than did females. Although their testes were close to breeding condition, territorial display was weak. Their body weight, liver and spleen weights, and subcutaneous fat averaged less than that of specimens taken at any other time of year. The time spent by far northern breeding populations in spring migration is estimated to be about 35 to 37 days.

The residence period at Mountain Village for males is between 12 and 16 weeks, of which about 6 weeks are spent in raising the single brood. For two pairs, 43 days elapsed between first observed copulation, or first observed nest-building, and the day the young were first seen foraging independently. Phases which were compressed even more in *gambeli* than in Friday Harbor *pugetensis* were the period from arrival of females to first copulation and that from first copulation to laying of the first egg. The average nestling period appears to decrease slightly with latitude (10.08 days for Berkeley *nuttalli*,

9.61 days for Friday Harbor *pugetensis*, and 9.00 days for Mountain Village *gambeli*).

The high percentage of broods fledged suggests that Mountain Village may be safer for White-crowned Sparrow young than Berkeley or Friday Harbor, but more data are needed to establish this. The scarcity of natural enemies at Mountain Village in 1950 was striking.

In the light of (a) the observations of Irving and Paneak on the nutritional state of 41 species of birds arriving at Anaktuvuk Pass, (b) those of McCabe on the large amount of fat possessed by migrating Gambel's Sparrows in British Columbia and (c) those of the author on seasonal cycles in liver and spleen weights in the non-migratory Nuttall's Sparrows, it is tentatively suggested that males arriving at Mountain Village with low liver and spleen weights and little fat may have undergone a sudden change in nutritional economy, the timing of which is influenced more by inherent endocrine rhythms and less by direct effects of environmental conditions met with during migration than has commonly been supposed.

LITERATURE CITED

- ALLEN, A. A., and H. KYLLINGSTAD. 1949. The eggs and young of the Bristle-thighed Curlew. *Auk*, 66: 343-350.
- BLANCHARD, B. D. 1941. The White-crowned Sparrows (*Zonotrichia leucophrys*) of the Pacific seaboard: environment and annual cycle. Univ. Calif. Publ. Zool., 46: 1-178.
- BLANCHARD, B. D. 1942. Migration in Pacific Coast White-crowned Sparrows. *Auk*, 59: 47-63.
- BLANCHARD, B. D., and M. M. ERICKSON. 1949. The cycle in the Gambel Sparrow. Univ. Calif. Publ. Zool., 47: 255-318.
- IRVING, L., and S. PANEAK. 1952. The weight and nutritional state of birds at the arctic terminus of migration. Report presented at the Third Alaska Science Conference, Mt. McKinley National Park, Alaska.
- KARPLUS, M. 1952. Bird activity in the continuous daylight of arctic summer. *Ecology* 33: 129-134.
- OAKESON, B. B. 1953. Cyclic changes in liver and spleen weights in migratory White-crowned Sparrows. *Condor*, 55: 3-16.

*University of California, Santa Barbara College, Goleta, California,
December 4, 1953.*