MOUNTAIN WHITE-CROWNED SPARROWS IN CALIFORNIA

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In the summer of 1960 we travelled through the high Sierra Nevada and the southern Cascades Range to observe White-crowned Sparrows of the mountain race, *Zonotrichia leucophrys oriantha*, on their nesting grounds and to check their presence in certain localities in northern California and southern Oregon. In the course of this trip and in our review of the literature, we found data relating to the breeding cycle which help to round out the picture of physiological variation in the races of this species.

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ROUTE

We started our field work on June 14 at Horse Meadow, Tulare County, California, (latitude 35° 50′N) and covered about seven degrees of latitude in two weeks, ending our search for nesting pairs at Diamond Lake, Oregon (latitude 43° 08′N), on June 28. We found a nest with four eggs about two-thirds incubated at Horse Meadow. This is, so far as we know, the southernmost locality in the Sierra Nevada for which a nest has been reported (Grinnell and Miller, 1944). It is not the southernmost record for the state, since Goodman (*in* Small, 1956:411) recently found a colony of breeding *oriantha* some 120 miles south of Horse Meadow in the San Bernardino Mountains. On June 19 and 20, we searched the Tuolumne Meadows and vicinity and found two nests, one of which provides the earliest date of which we are aware for a clutch laid at this altitude (8600 feet). June 1 is the calculated date for the first egg laid. On June 21 we searched the shores of Donner Lake and found only one pair, which had a nest with two young and one egg. On June 23 we hiked up the Tamarack Trail from Fallen Leaf Lake to the Desolation Valley Wilderness Area, where we heard several male White-crowned Sparrows singing loudly, and where, at Haypress Meadow, we saw a pair which behaved as if they had a nest. In our efforts to reach each locality as soon as possible after the start of nesting, we overshot the mark at Lassen National Park. There at King's Creek Meadows on June 26 we found only males, which were spaced out, singing regularly, and pursuing one another, as do males of other races of this species in the early phases of territory establishment. This was the northernmost point on our trip where we found White-crowned Sparrows.

From June 26 through 28 we searched the Mount Shasta area, and in Oregon we visited Fort Klamath, Crater Lake National Park, and Diamond Lake, but found no White-crowned Sparrows. There are reports of breeding birds for most of these localities in the ornithological literature of the latter half of the nineteenth century, but at least

two other observers have failed in recent years to find nesting birds (Farner, 1952; and Banks, personal communication). Except for King's Creek Meadows, which still had deep snow at the edges, all the places we visited were nearly or completely free of snow, so our failure to find birds in the northern localities was probably not due to our being too early. The discrepancies between early reports and recent observations are discussed more fully later.

Fig. 1. Above: Horse Meadow, June 15, 1960. Shows grass, bare ground, shrubbery, and tall conifers—habitat elements common to nesting sites of *Z. l. oriantha* in California. Nesting pair found here.

Below: Same place and date. Shows additional common habitat element of running water.

FIELD DATA

The purpose of this section is to present certain details of our field observations, and to compare the terrain and vegetation of meadows where we found nesting pairs of White-crowned Sparrows with that of adjacent meadows where we found none. The comparison reveals subtle differences which suggest the nature of the optimum habitat

not only for this race but for the other Pacific coast races as well. As will be shown later, the characteristics common to all nesting habitats involve similar vegetational patterns rather than identical plant species. Therefore we use only the common or the generic names of plants.

Localities Where White-crowned Sparrows Were Present

Horse Meadow, Tulare County, California.—Latitude 35° 50′N, elevation 7350 ft. Observations were made here from June 14 to 17. The snow had melted by mid-May. The meadow is about three-quarters of a mile long and one-third of a mile wide. It lies in a forest of Jeffrey and lodgepole pines. It is criss-crossed by small meandering streams which divide the grass, sedges and flowering annuals into patches a few yards in extent. The meadow was soggy in the center. At the periphery, low *Artemisia* bushes and scrub willow grow on sand and gravel bars. Surrounding the meadow are tall lodgepole pines which the sparrows used for singing posts (fig. 1).

We counted four singing males in the meadow, one of which was unmated. Two pairs had nests. On June 17 we found a nest containing four eggs. We opened one and found a large embryo with egg tooth visible to the naked eye. The second pair of sparrows behaved like the ones whose nest we found. The female flew to and fro between the meadow and a clump of *Artemisia* bushes and uttered the *eep* note characteristic of incubating birds. When we tried unsuccessfully to find this nest, the male showed awareness of our presence but did not utter the warning *tit* note used by parents with young. Therefore we assume that this pair was also in the incubation phase.

In all calculations, we assume that the incubation period for *Z. l. oriantha* is the same as that for *Z. l. nuttalli*, that is, twelve days (Blanchard, 1941), and that it starts the day before the last egg of the clutch is laid. The egg we opened appeared to have been incubated at least eight days. Therefore the first egg of the clutch was probably laid at least by June 6.

Tuolumne Meadows and vicinity, Tuolumne County, California.—Latitude 37° 53′N, elevation 8600 ft. Observations were made here from June 19 to 21. The snow had melted about a month before. The meadows (fig. 2) are about 0.7 square miles in area, at the edges of which are groves of tall lodgepole pines. The meandering streams create little islands of grass and flowering annuals, scrub lodgepole pine and bare ground. We saw no willow.

On June 19 we found a nest with four young with eye slits but eyes not yet open. By comparison with the description of nestlings of *Z. l. nuttalli* of known age (Blanchard, 1941), the young were judged to be about four days old. On June 20 we found a nest with five eggs, one of which we opened and found a tiny embryo not more than two or three days incubated. On this date we also heard males singing regularly at Tenaya Lake, in meadows between Tuolumne and Dana meadows, and at the southeast edge of Dana Meadows.

The first egg of the nest with four young was probably laid June 1. The first egg of the second nest was probably laid June 14 at the earliest.

Snow Flat, Tuolumne County, California.—Latitude 37° 53′N, elevation about 8400 ft. Observations were made here on June 20. There was no snow present. We heard one male singing regularly beside the new road from Tuolumne Meadows to Yosemite Valley. We saw no female. The location appeared to us to be the driest, and in every way the most marginal, of any of the places on this trip where we heard White-crowns singing. There was a small clearing with sparse bunch grass mixed with gravel, low manzanita clinging to crevices in granite boulders, and dwarf lodgepole pines scattered among the rocks. A few yards farther in from the road we found little pools of melted snow amid red fir. It would be worth checking again for the presence of *Z. l. oriantha* at this locality to see whether *oriantha* becomes more numerous here as the road becomes well-travelled and the changes inevitably attendant upon the presence of large numbers of human beings occur.

Trail from Tioga Pass Ranger Station to Gaylor Lakes, Tuolumne County, California.—Latitude 37° 53′N, elevation about 10,300 ft. Observations were made here on June 21 .There was no snow at this altitude, but there were snow banks at 10,600 ft. The habitat here consisted of a steep slope above Dana Meadows, with a stream overgrown with willows and patches of sparse grass and bare ground bordering the trail. Sizable conifers grew on the slope.

We found one pair of White-crowns, which behaved as if it had young. The female was gathering insects. The male uttered the warning note used by parents with nestlings.

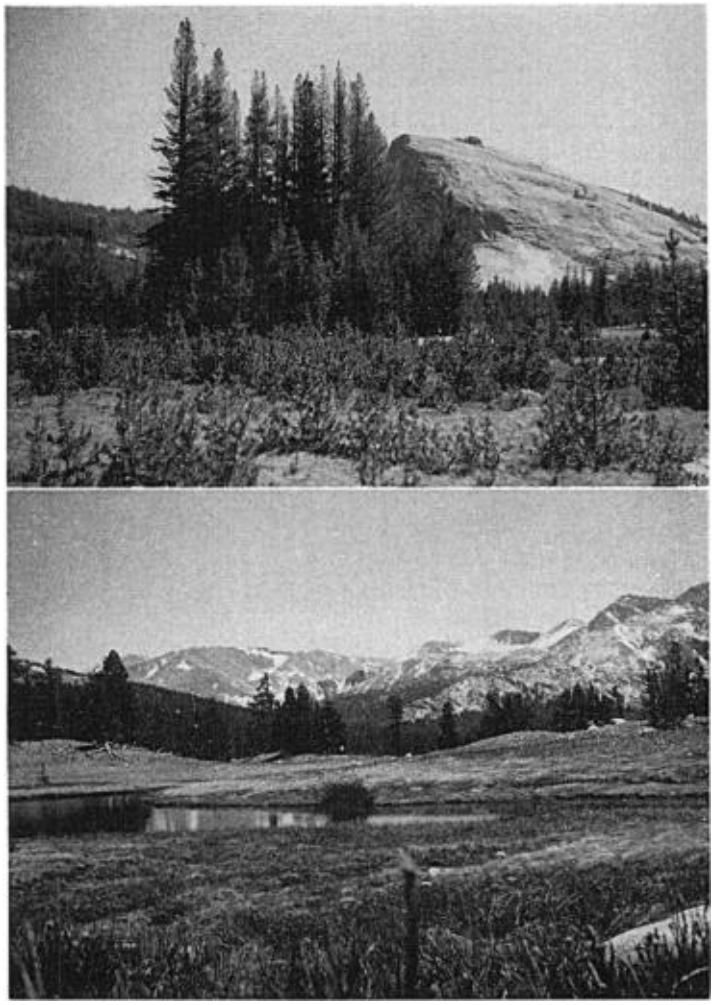

Fig. 2. Above: Tuolumne Meadows, June 21, 1960. Shows three of the five common habitat elements: grass, scrub pine and tall conifers. A nest of four-day-old young of *Z. l. oriantha* was found under scrub pine in center of photograph.

Below: Upper edge of Dana Meadows, same date. No *Z. l. oriantha* seen here. Note presence of all common habitat elements except clumps of scrub pine.

Desolation Valley Wilderness Area, Eldorado County, California.—Latitude 38° 52'N, elevation 8116 ft. (Lake Aloha). Observations were made here on June 23. The snow still lay deep in spots, obscuring the trail. The meadows were open, with snow on the ridges above. We heard birds singing in the meadows above the upper end of Tamarack Trail, along the shore of Desolation Lake, and on the slopes above the lower lakes (Heather and Susie) which were fed by melting snow. At Haypress Meadow the snow still lay on ridges above the meadow, which contained willow and scrub lodgepole pine and which was bordered by hemlocks. Desolation Lake is surrounded by mountains on which much snow still lay. The shores of the lake are bordered by granite boulders, between which grow dwarf pines and wind-wracked junipers. The grass was sparse and the bare ground consisted of patches

of trail recently uncovered by melting snow. There was still much snow close to the lake shore. On the slope above Heather Lake was loose rock traversed by streams of melting snow. Along the streams there was alder, small lodgepole pines and hellebore (*Veratrum californicum*). Susie Lake was similar to Heather Lake, but with less snow.

At Haypress Meadow we found a singing male mated to a female which behaved as if she had a nest. Along the shore of Desolation Lake we heard six males singing. On the slope above Heather Lake we heard a female utter *eep*'s as if leaving a nest. We heard one male singing at Susie Lake.

Donner Lake, Nevada County, California.—Latitude 39° 19′N, elevation 5937 ft. Observations were made here on June 21. There was no snow. The peninsula at the south side of the lake consists of a sandy beach bordered with sedges and a central strip with dense clumps of willow, alder, and young lodgepole pines more luxuriant in growth habit than at Tuolumne Meadows. The forest adjoining the peninsula is composed of Jeffrey and lodgepole pines.

On the peninsula we found one nesting pair. We searched the south shore of the lake without finding any others. The nest contained two young, which we judged to be three days old, and one unhatched egg. We calculated the first egg was laid by June 4.

King's Creek Meadows, Lassen National Park, Shasta County, California.—Latitude 40° 30′N, elevation 7400 ft. Observations were made here from June 25 to 26. The snow was still deep at edges of the meadows, although this season was an early one. The snow usually stays on or at the edges of these meadows until mid-July. These meadows (fig. 3) are about 80 acres in extent, with thickets of willow and sparsely scattered scrub lodgepole pines extending from the edges of the meadows toward the centers. At the upper edges the grass was already green and was sprouting in the moister parts, but the willow had not yet started to leaf out. Swamp laurel and fawn lily were in bloom. On the periphery were hemlocks in deep snow.

We found only males, which sang regularly from the willow thickets, hemlocks, and scrub pines. One male, found June 25, whispered his song and did not always finish it. The next day he was singing loudly, alternating with another male. The birds were shy, flew long distances and did not seem attached to any particular area. On June 26 we saw one male pursue another. On July 4, Park Superintendent and Mrs. Dixon Freeland (personal communication) reported that the meadows "were alive with song" and that pairs of White-crowned Sparrows were common.

We assume that on June 26 the males were in the early stages of territory establishment. If the earliest females arrived June 27, the day after we left, and if the interval between arrival and first egg laid is at least five days (the shortest interval for this phase in *Z. l. gambelii,* lat. 62°N; Oakeson, 1954) then the earliest date for the first egg laid would be July 2.

Localities Where White-crowned Sparrows Were Absent

We visited several localities where *Z. l. oriantha* has previously been found nesting, or where specimens in breeding condition have been collected, but where we neither saw nor heard any birds in 1960. Also, we found meadows which lacked White-crowned Sparrows but which were superficially similar in aspect to nearby meadows where we found nesting birds. We describe both types of localities, and offer possible reasons why these places were either marginal or unsuitable for nesting White-crowned Sparrows in 1960.

Big Meadow, Tulare County, California.—Latitude 35° 53′N, elevation 7800 ft. Observations were made here on June 15. There was no snow.

A specimen of Mountain White-crowned Sparrow with testes 13 mm. in length was collected here on June 29, 1938, by Joe T. Marshall, Jr. We searched the north and east ends of the meadow on June 15, 1960, but neither saw nor heard any sparrows. Since we spent over two hours at the meadow, there is little likelihood that we overlooked the species. Dr. G. T. Pengelley (personal communication) spent several days at this locality in middle and late August of the same year and did not see any White-crowned Sparrows.

This meadow lies three miles southeast of Horse Meadow. It is about two miles long and a mile wide, and consists of unbroken grassland, at the edge of which are extensive areas of dense low composite shrubs. The interface between grass and shrubs is abrupt. Surrounding the meadow are solid

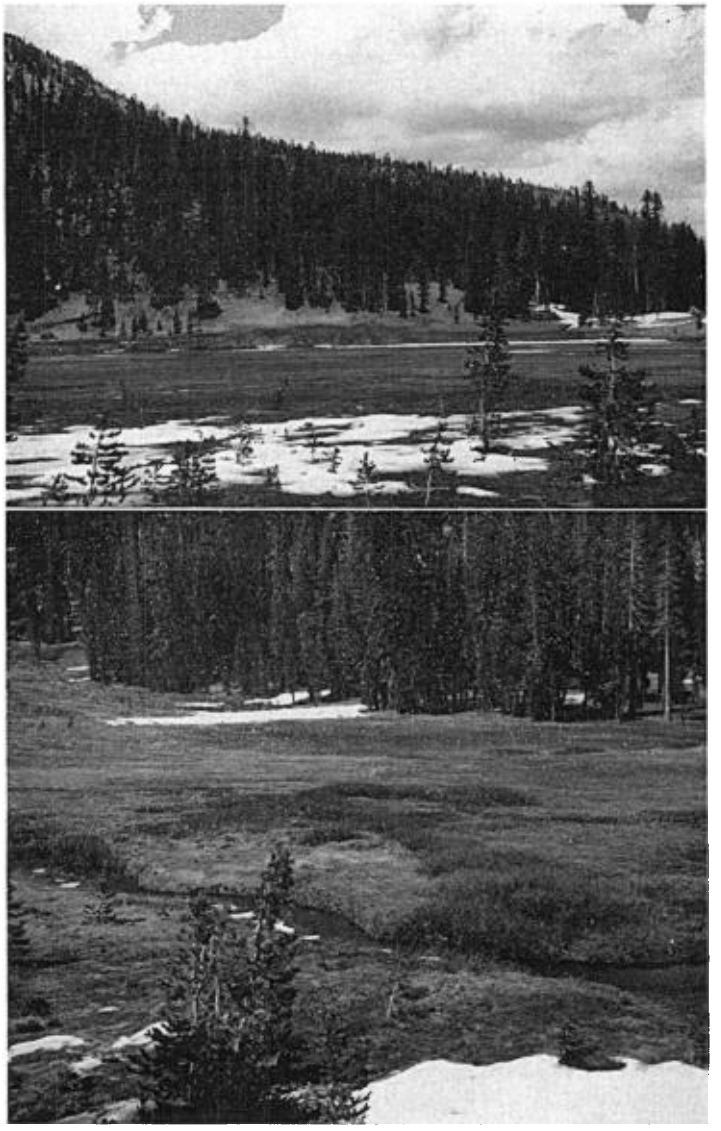

Fig. 3. Above: General aspect of King's Creek Meadows, June 25, 1960. Below: A part of the same meadow on same date. Note presence of all five common habitat elements. A male *Z. l. oriantha* was seen here, singing regularly.

stands of conifers. The only bare ground we saw lay under the larger trees at the north edge of the meadow.

Dana Meadow, Tuolumne County, California.—Latitude 37° 53′N, elevation 9700 ft. Observations were made here on June 20. There was no snow. We heard one White-crowned Sparrow sing from the south edge of the meadow but found none in the center or on the north rim of the meadow beside the road. The difference between the part of Dana Meadow where we found no birds and Tuolumne Meadows, where they were common, appeared to consist chiefly in the smaller numbers

and sparser distribution of scrub lodgepole pines at Dana Meadow (fig. 2). More refined analysis might reveal a quantitative difference between the main part of Dana Meadow and Tuolumne Meadows, that is, the limiting factor might be the size of the area of scrub pine dense enough to provide protection for nests. Another possibility is that the numbers of White-crowned Sparrows in the Yosemite area were at a minimum that year. William Neely (personal communication) writes "I saw very few White-crowned Sparrows in Tuolumne this year, and only one or two around my own area . . . Bridalveil Creek, where last year they were more abundant. The dry conditions may have had something to do with it . . . the meadows drying earlier and also less insect life. I located only one nesting family in Bridalveil Creek Camp this year. Our meadows here seem to be ideally suited to them. Another possibility to consider for the Tuolumne region would be the wholesale spraying of malathion over about 10,000 acres last summer and the year before for the Lodgepole needleminer infestation. However the region around Tioga Pass and down to Dana Meadows was not sprayed to my knowledge." This letter suggests a number of interesting projects to follow up in areas where man is modifying the environment. Since White-crowned Sparrows regularly choose to nest close to human habitation, the effects of human interference, either beneficial or harmful, may be accentuated for this species.

Mineral, Tehama County, California.—Latitude 40° 20′N, elevation 4800 ft. Observations were made here from June 24 to 26. There was no snow.

Grinnell, Dixon, and Linsdale (1930) cite a record of a pair of White-crowned Sparrows summering at Mineral. In 1960 we found no White-crowns here, and Ranger Naturalist Merle Stitt stated that none now nest at Mineral. Except for lawns and landscaped areas at the Park Headquarters, there is no suitable country for White-crowns at Mineral. The terrain consists of forest and open pastures, with clearings devoid of streams, and grass unbroken in extent. Mr. and Mrs. Stitt reported seeing White-crowned Sparrows in migration, both in spring and fall. Their last observation date this season was May 24, two days after the last snowfall of the season.

Dersch Meadows, Lassen National Park, Shasta County, California.—Latitude 40° 30′N, elevation 6500 ft. Observations were made on June 25. There was no snow present. These little meadows lie on the main road in Lassen Park between Summit Lake and Hat Lake, in the midst of country obviously unfit for White-crowned Sparrows, but no more remote than other meadows where we found nesting birds. In comparison with King's Creek Meadows, where males of *oriantha* were common, these meadows lacked streams, the scrub lodgepole pines were sparser, and clumps of willow were absent. Except for the adjacent highway, bare ground was also absent.

Manzanita Lake, Lassen National Park, Shasta County, California.—Latitude 40° 32′N, elevation 5846 ft. Observations were made on June 25. There was no snow present.

Grinnell, Dixon, and Linsdale (*op. cit.*) report taking a pair of White-crowned Sparrows at the head of Manzanita Creek on June 11, 1926. The female contained eggs ready for laying. The Museum of Vertebrate Zoology has two specimens collected by Linsdale at Manzanita Lake on June 19 of the same year. When we visited the lake on June 25, 1960, we failed to find any ground suitable for nesting *oriantha* in the immediate vicinity, but we did not check the head of the creek. The vegetation at the edge of the lake was obviously too dense and unbroken and the extent of grass too restricted to constitute suitable territory for White-crowned Sparrows. Mr. Stitt (personal communication) has records of White-crowns seen at Manzanita Lake in mid-May, 1960, but he knew of no record of this species nesting there.

Panther Meadow, Mount Shasta Recreation Area, Shasta County, California.—Latitude 41° 21′N, elevation 7500 ft. Observations were made on June 26. There was snow in patches, melting to produce little streams coursing down the meadow.

Merriam (1899) reports that W. H. Osgood shot a White-crowned Sparrow at the head of Mud Creek on August 4, and concludes that at Mount Shasta the White-crowned Sparrow probably breeds in the Hudsonian Zone near timberline. He states also that about the middle of September numbers were seen at Panther Creek and Wagon Camp.

On June 26, 1960, we searched Mount Shasta as high as the main road goes, which is within sight of the summit, but found no White-crowned Sparrows. The only spot which looked even approximately suitable for the species was Panther Meadow, a short distance below the end of the road. This is a sloping area, a few acres in extent, which lacked grass in sufficient quantity to be classified as a

meadow in the strict sense. The melting snow ran down the slope in small streams, and patches of bare ground were interspersed with low dense shrubbery. We also checked Wagon Camp, which appeared to have the requisite combination of grass, bare ground and shrubbery for nesting White-crowned Sparrows, but found none. At this spot, several hundred feet lower than Panther Meadow, other species of birds were nesting, and there was no snow. It seems unlikely that we were too early in the season to find White-crowned Sparrows, had they been destined to breed there that summer.

Fort Klamath, Oregon.—Latitude 42° 43′N, elevation 4200 ft. Observations were made on June 27. There was no snow present.

Mearns (1879) states that Lieutenant Wittich collected White-crowned Sparrows at Fort Klamath in April of 1875 and 1878. On July 13, 1882, a nest with four eggs was collected there (USNM no. 89534).

On June 27, 1960, we searched Fort Klamath and the surrounding area but found no ground typical of the nesting habitat of White-crowned Sparrows. We saw large pastures bordered by hedgerows of the type often frequented by wintering or migrating flocks, but no suitable nesting sites. This may be one example where, in three-quarters of a century since the observations mentioned previously were made, the country may have been modified by man so as to become unsuitable for nesting White-crowned Sparrows.

Crater Lake National Park, Klamath County, Oregon.—Latitude 42° 53′N, elevation 6177 ft. Observations were made from June 27 to 28. The snow was gone or was rapidly melting at the lower elevations. It was heavy at higher elevations, obscuring trails and the main road.

A. H. Miller (personal communication) reports finding White-crowned Sparrows in this area in summer at about 5000 ft. elevation. Farner (1952) searched the suitable areas in the park and found none. In 1960 we searched the areas in the park which were free of snow and found one or two places near the park headquarters which appeared suitable, but we neither saw nor heard White-crowned Sparrows. Most of the higher ground we saw would not be suitable even when the snow had melted.

Diamond Lake, Douglas County, Oregon.—Latitude 43° 08′N, elevation 5186 ft. Observations were made on June 27. There was no snow present.

In 1896, Preble (*in* Farner, 1952) took a specimen here and reported finding a nest of a White-crowned Sparrow on August 12. The nest contained one young just hatched and one egg about to hatch. If this record is accurate, this is the latest date in the literature for a nest of any race of White-crowned Sparrow on the Pacific coast.

In 1960, we searched the south and east shores of the lake and found at least one spot which appeared suitable for White-crowned Sparrows, but neither saw nor heard any. This area has obviously been greatly modified by human interference, and perhaps ground once suitable for nesting White-crowns is no longer so today.

Our failure to find White-crowned Sparrows in the Mount Shasta region and in southern Oregon is substantiated by Richard Banks' observations that same year (personal communication). He visited Panther Meadow on June 13 and Diamond Lake on June 15, and found no White-crowned Sparrows.

THE HABITAT

By comparing the localities in the Sierras and Lassen Park where we found *Z. l. oriantha* nesting, or about to nest, with those nearby where this race was absent, we arrive at a definition of the habitat in terms of five elements: grass, bare ground, dense shrubs or scrub conifers, water, and, on the periphery, tall conifers. The nature of the grass, bare ground, and shrubbery vary with the locality. The grass may be pure, or mixed with mosses, sedges, or flowering plants. The bare ground may be the shore of a mountain lake, a pack trail, or sand bars between small streams. The shrubs may consist of any species of plant which grows thick enough to shelter a nest or to provide a roost. It is not the species of the individual grass or shrub that is important, as will be shown later, instead it is the arrangement of the grass and other vegetation in relation to the bare ground. At each of the places in California where we failed to find *oriantha*, either one or more of the elements listed above was lacking, or their arrangement was different from that where *oriantha* was present. For example, Big Meadow, where we failed to

find the birds, contained all five elements, but they were arranged differently than at nearby Horse Meadow, where we found *oriantha* nesting. At Big Meadow the grass and shrubs grew side by side, in almost solid masses and over extensive areas. The interface between grass and shrubs was abrupt and almost linear. Bare ground was scanty and restricted to areas beneath the conifers at the edge of the meadow. At Horse Meadow, in contrast, the same elements of grass, shrubs and bare ground were mixed. Owing to the interdigitation of the shrubs with bare ground and grass, this meadow had a patchy appearance which Big Meadow lacked. A comparison of the part of Dana Meadow where *oriantha* was absent with Tuolumne Meadows (fig. 2) reveals what may be a second essential of the habitat of *oriantha*, namely, the necessity for an area of dense cover. Both meadows had grass, bare ground, and scrub lodgepole pine, but at Dana the little trees, although thick enough to conceal a nest, were scattered singly, whereas at Tuolumne, pines of the same size grew in clumps. The contrast between Dersch and King's Creek meadows, both in Lassen Park, is more obvious. At Dersch the grass was solid, uninterrupted by either bare ground or shrubs, and the vegetation on the edge consisted only of scrub lodgepole pine, sparser than at King's Creek. Willow clumps characteristic of the latter were absent.

Because the difference between suitable and unsuitable ground for nesting of *Z. l. oriantha* may lie in the relation of vegetation to terrain, it is quite possible that fluctuating conditions at the same locality might render it periodically unsuitable for nesting. A series of dry years might transform a place like Big Meadow into a spot unsuitable for a sizable population of these birds. Over-browsing by deer or removal of grass and shrubs by man might render a spot which was marginal as to extent of grassland and cover completely unfit for White-crowned Sparrows. Conversely, human activities may open up new country by the extension of bare ground and grassland into a once heavily wooded area. That this has happened on the coast, in the ranges of *Z. l. nuttalli* and *Z. l. pugetensis*, is obvious.

The first three habitat elements, grassland, bare ground, and shrubbery, are also characteristic of all the nesting habitats of White-crowned Sparrows with which the senior author is familiar. In fact, some of the localities where we found *Z. l. oriantha* were similar to places on the coast where the Nuttall Sparrow lives. Such climatically different places as Horse Meadow and Guadalupe (Santa Barbara County) are similar in terrain and in the patchy appearance which the mixtures of grass, shrubs, and bare ground impart to the landscape. In essence the stark country beside Lake Aloha in Desolation Valley possesses the same habitat elements as Point Lobos on the Monterey Peninsula. In Desolation Valley the body of water is a mountain lake fed by melting snow; the open ground consists of pack trails and bare granite, the shrubs are wind-wracked juniper and dwarfed pines. At Point Lobos the same effect is produced by the juxtaposition of ocean, rocky cliffs, and cypress.

These comparisons bring out the fact that the mountain White-crowned Sparrows, and the other Pacific coast races as well, live in habitats with at least two sorts of landscapes, both having grassland, bare ground, and shrubs: one is either a sheltered high mountain meadow or a lowland pasture bordered by lush vegetation; the other is an exposed spot with rocks and water and warped trees. Both landscapes occur on the coast in the range of the Nuttall and Puget Sound races of White-crowned Sparrows, and both occur in the high Sierra Nevada where the mountain sparrows nest.

Two other elements present in localities where we found *Z. l. oriantha* nesting are tall conifers and fresh water. Both commonly occur in the habitats of the coastal forms, but not invariably. We were especially impressed by the nearness of nests of *Z. l. oriantha* to running water. We do not know whether water is an essential element for *oriantha*,

or whether it is merely a high-mountain concomitant of the three elements essential for all races of this species.

TIMING OF THE BREEDING CYCLE

The late start of breeding in the *Z. l. oriantha* population at Lassen in 1960, and the variation in calculated dates of first eggs laid for the populations we observed that year, led us to search the literature and museum collections for additional data on time of breeding. Much of the information in this section is from specimens examined at the Museum of Vertebrate Zoology in Berkeley and from the Dawson egg collection at the Santa Barbara Museum of Natural History. Records in the literature, unless otherwise stated, are from Grinnell and Storer (1924), Keyes (1905), Ray (1903, 1912), Ridgway (1877), Rowley (1939), and Sumner and Dixon (1953).

The earliest and latest dates for males collected in breeding condition (testes 100 mm.^{3} or over) in all years for which specimens are available, span a period of 69 days, from May 21 to July 29. The comparable span for nests with eggs is also 69 days, from May 30 to August 7. The lag of nine days between the beginnings of these periods is close to that for *Z. l. nuttalli* between first observed copulations and first eggs laid. For nine banded pairs of *nuttalli* at Berkeley this interval ranged from four to nine days (Blanchard, 1941).

The records which furnish the above inclusive dates are as follows. The earliest date for a record of a male with "testes fully developed" is May 21, for MVZ no. 57012 taken at Fyffe, Eldorado County, in 1908. That this was not an exceptionally advanced individual is indicated by the fact that on May 24, 1959, Richard Banks (personal communication) collected three males, all in breeding condition, at Hobart Mills, Nevada County. The latest date for any specimen with testes not yet of full breeding size is May 28, for a male taken by K. E. Stager at Big Pine Creek, Inyo County, in 1940. The earliest date for a specimen with regressing testes is July 9, for a male collected in 1959 by Banks in Kaiser Pass Meadow at 9100 feet elevation. The gonads of this individual were still about 53 mm.^{3} in volume, indicating that they had only recently begun to regress. In addition, 26 males with testis volumes still 100 mm.^{3} or over were collected in several years between July 6 and 29.

Data for females are as follows: One female not yet in breeding condition (described as having "small ova") was taken by W. C. Russell in 1942 in Inyo County, at 6000 feet elevation, on May 29. For 157 records of nests with eggs, the earliest date is May 30, for a nest with four eggs collected by Milton S. Ray in 1910 at Bijou, in the Tahoe region. The latest date is for a nest with three eggs found on Mount Silliman on August 7, 1891 (Fisher, 1893). The median date for these records is June 22. A scatter diagram of the records, graphed according to the date on which each nest was found, reveals no obvious break, nor any suggestion of a bimodal curve indicating two broods per season. We found in 1960 that the first clutch may be started much later in one locality than another. Hence it is probable that the records for July include some first clutches as well as re-nestings after one or more failures. We calculated dates for first eggs laid from 42 records of nests with eggs described as "fresh." These ranged from May 24 to July 6. Since eggs incubated one to three days may still appear fresh and be recorded as such, the actual dates may be slightly earlier. The median date for the calculated "first eggs laid" falls between June 12 and 15.

CLUTCH SIZE

For 154 records of *Z. l. oriantha* taken in California, the clutch size varies from two to seven eggs, with a mean value of 4.0 ± 0.03. The majority of clutches (88 per cent) had four eggs.

NUMBERS

Although every mountain meadow with the essential habitat elements suitably arranged had its population of *Z. l. oriantha*, the numbers at each place were small indeed. At Horse Meadow we heard only four singing males. At Donner Lake we searched the south edge thoroughly and found only one pair. Even at Tuolumne Meadows the number was not great. The small populations were only in part a result of sparse distribution of breeding pairs within a suitable area. Even under optimum conditions the meadows suitable for *oriantha* are widely scattered in the Sierras, often separated from each other by miles of unsuitable country. In some places the suitable areas are so narrow as to render the distribution of this race almost linear. This was true especially along the shore of Lake Aloha in Desolation Valley and along the south edge of Dana Meadow. This spotty, almost linear, distribution reminded us of the occurrence of *Z. l. nuttalli* along some parts of the California coast, where suitable habitat is restricted to small discontinuous areas in a narrow strip bordering the ocean.

SONG PATTERN

As was expected, the song pattern of *Z. l. oriantha* showed geographic variations. With one notable exception, the birds of each locality sang a distinctive pattern, with only minor variations. The exception was a single male at King's Creek Meadows which sang a song identical with that of the population of Tuolumne Meadows. We listened to this male on two consecutive days, and although he was alternating in singing with a male using the pattern typical of King's Creek Meadows, he never deviated from the Tuolumne pattern as long as we listened. This may be one indication of the place this male was hatched, should song pattern in this species turn out to be either genetically determined or set during the nestling or fledgling period. As one sign of the constancy of song pattern for a given area, we note that Peterson (1941) diagrams a song for "Yosemite" closely similar to those we heard at Tuolumne Meadows.

The songs of *Z. l. oriantha* reminded us more of those of *Z. l. nuttalli* than of either *Z. l. pugetensis* or *Z. l. gambelii*. The males at Horse Meadow and Desolation Valley used patterns reminiscent of *Z. l. nuttalli* of San Francisco and the song pattern typical of King's Creek Meadows was similar in rhythm to that of residents of Carmel and Gaviota on the coast of California.

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