per cent), the numbers of species in these classes are 62, 14, 7, 14, and 4, respectively, and these figures also represent the percentage of species in each group in the whole list recorded for the area. Thus the distribution of species among the classes of frequency is remarkably like that revealed in similar surveys of other localities. The only perceptible difference is in classes D and E. The small number of species in class E may result, we suspect, from the circumstance that the thick screen of the predominantly brushy habitat in Alum Rock Park hinders the detection of every species on each trip. Because the present use of the records was not anticipated, the observers may not have made special effort to record all the common species noted. Despite this possible lack in materials, the species appear generally to be arranged in the proper sequence, and the index numbers are useful aids in judging the place of each bird in the fauna.

Museum of Vertebrate Zoology, University of California, Berkeley, January 21, 1937.

A JAY SHOOT IN CALIFORNIA

By MARY M. ERICKSON

The killing of vermin believed to be destructive to game is common practice among sportsmen, but the result of a campaign for this purpose has rarely been recorded. As an outgrowth of a request for information on the inter-relationships of jays and quail, Mr. E. T. Hooper and I were given the opportunity to witness a jay shoot held by the Associated Sportsmen of Calaveras County, California, on Sunday, April 26, 1936.

The sportsmen in this region are interested in upland game birds, particularly the California Quail, and they seek to maintain this species in sufficient numbers to make good hunting. Their reason for holding a jay shoot, reduced to its simplest terms, is that jays have been seen to kill young quail and are known to destroy eggs, and therefore, the argument goes, any decrease in the number of jays must benefit the quail. This opinion was not unanimous. Some hunters expected real benefit to the quail to result from the shoot; a few were skeptical, but they felt that the quail should be given the benefit of the doubt.

Jay shoots have been held in Calaveras County for many years. Two persons reported that hunts have taken place about once a year during the eleven and fourteen years they had lived in the vicinity. Two old-time residents said that occasional shoots had been held thirty or forty years previously. Recently, one or two shoots a year have been held, usually in the fall, sometimes in the spring, but the time of year and the number are irregular. The last shoot had been held on October 20, 1935, when, according to a local newspaper, 1368 jays were killed.

The shoots, at least in recent years, have been conducted as contests between two teams, and after the count there has been a dinner, or as this year, a barbecue in which wives and friends shared, at the expense of the losing side.

Previous to the 1936 shoot, two captains, one from San Andreas and one from Angels Camp, each selected a team from among the men planning to participate. Contrary to previous practice, the personnel of the teams this year was kept secret until the time of the count.

On the day of the shoot each participant was free to hunt when and where he liked until 4:30 p.m., when the count was to be started. As would be expected, certain enthusiasts started at daybreak and hunted until the time set for checking in. At

the other extreme a few came in with one or two jays taken incidentally in the course of other activities. The majority made the most of the chance to be out in the hills, but hunted only part of the day. By five o'clock the teams had gathered for the barbecue, and the count began. Mr. Hooper, a non-partisan, was asked to count the birds, while a member called the count and recorded each man's total on a score card. Men with gunny sacks, hunting coats, or whatever held their bags clustered around these two, and one after another dumped his birds on the ground until the last one had been checked.

All told, thirty-four men took part in the shoot. The teams as originally listed had 27 men on a side, but a number of these did not hunt, while some who were not listed brought in jays.

In scoring, each jay, whether Steller (*Cyanocitta stelleri frontalis*) or California (*Aphelocoma californica immanis*), counted one point, and each hawk, regardless of species, three points. Several men remarked that feral house cats should have counted from 5 to 25 points each, but the suggestion was not adopted. A horned owl and a shrike were not counted. A number of men said that "brush robins" (brown towhees), woodpeckers, and flickers were occasionally shot for jays, but these were not brought in.

Three hundred and ninety-eight (398) California Jays, 214 Steller Jays, 1 Red-tailed Hawk, 1 Cooper Hawk, and 3 Sparrow Hawks were brought in, making a total of 627 points. The highest individual score was 76, made on a game refuge south of San Andreas. The lowest score was 1, and the average was about 30 points. As the count progressed, one side was obviously well in the lead, and thereafter little interest was shown in the score. Some of the group seemed disappointed in the number of jays killed; they felt that the shoot had been held too late in the year. They believed that the jays were abundant in March, and that more would have been killed at that time. One hunter thought that the scarcity resulted from the movement of the jays out of the region. Actually, this may have been true in the case of the Steller Jay, but with the California Jay the scarcity was probably apparent rather than real, and it may have resulted from a change in behavior at the beginning of the nesting season.

As soon as the count was finished, the barbecue began. A quarter of beef and two lambs, which had been cooking during the day, were served with a picnic meal of beans, salad, coffee, and relishes. Beer kegs had been broached at the ranch during the afternoon, and a guitar, accordion, and group singing added to the spirit of the gathering, which broke up reluctantly with nightfall.

Figures as to the approximate amount of ammunition used in the shoot and its cost were secured through the store which handled the shells for the San Andreas group. Here, twenty-one men bought 58 boxes of shells at a total cost of $35. (It is my understanding that a special price was made to the organization.) If each of the twelve men from Angels Camp purchased an equivalent amount, 33 more boxes were purchased, to make a total of 91 at an approximate cost of $55, or an average cost of 9 cents for each bird killed. Some of these shells may not have been used, but this discount was undoubtedly compensated for to some extent by the use of such shells as were already on hand. If the equivalent of the ammunition sold was used, the men averaged 69 rounds apiece, and they used an average of 3.7 shells for each bird killed. The guns, with the exception of one 20 gauge, were about evenly divided between 12 and 16 gauge. The shells were loaded with number 7½ or 8 shot.

The area covered by the shoot can only be estimated. Most if not all of the hunting took place within the digger pine and blue oak belt which stretches 4 to 5

miles northeast and about 10 miles southwest of San Andreas and Angels Camp. In this belt, a section was covered from 7 to 8 miles northwest of San Andreas and 5 to 6 miles southeast of Angels Camp. This amounts to a rectangle of foothill country some 25 by 15 miles in extent, or covering some 375 square miles (U. S. G. S., Jackson, Big Trees, Copperopolis, and Sonora quadrangles). The actual ground covered was naturally much less. Some effort was made to get hunters to concentrate on the game reserves (closed ranches) in the region, but for the most part the men went where they thought the jays were most abundant. The activity probably centered around San Andreas and Angels Camp within a total area of 200 square miles, but even this does not mean that such an area was covered with systematic thoroughness.

An estimate of the number of jays in this area can be little more than speculation, but it will be suggestive. On the day before the shoot, fifteen hours were spent by Mr. Hooper and me in taking a census in three sample areas of typical jay habitat, and every effort was made to get an accurate count. On this meager basis, the jay population is estimated as one jay, either California or Steller, for every 5½ acres of suitable habitat, or 118 jays per square mile of such habitat.

In the Berkeley Hills, during the winter and spring of 1935-36, two pairs of California Jays lived in a small canyon somewhat less than 8 acres in extent, or on an average of 2 acres for each jay. In another canyon, near Berkeley, containing about 20 acres, there were two breeding pairs in 1932, or one jay for every five apparently suitable acres. These both represent minimum numbers, for they include only the breeding California jays, and do not include the Steller Jays which were also present.

In comparison with these figures, an estimate for Calaveras County of one jay for every 5½ acres, in an area of equally good or better habitat, does not seem excessive. Assuming that only half of the total area is suitable for occupancy by jays, the jay population of the 200 square miles in which the hunting was most concentrated, would be 11,636. On this basis, the shooting of 612 jays resulted in the destruction of about 5 per cent of the jay population.

Since the shoot took place at the beginning of the nesting season, whatever reduction occurred had a maximum effect, for it cut into the breeding population. Nonetheless, a reduction of 5 per cent, even if of annual occurrence, would probably have little effect upon the year-to-year population of jays. By the end of the breeding season, the population is doubled in wren-tits (Erickson, MS), and nearly tripled in quail (Sumner, Calif. Fish and Game, vol. 21, 1935, pp. 165-342). Similar figures are not available for the jays, but normal broods and a probable increased survival resulting from less competition should quickly compensate for the relatively small reduction. The shoot held in the fall of 1935 when the population was near its maximum, probably did not eliminate more than 5 per cent of the next breeding population, even though twice as many were killed, for part of the kill was composed of birds which in time would have been destroyed by natural forces.

If, as is generally believed, the toll levied by natural forces automatically decreases as the surplus is removed, the number of individuals surviving to the following breeding season would not have been altered perceptibly by either shoot. Furthermore, if the young-of-the-year show the same tendency to disperse as certain other species, such as the wren-tit, do, the kill would have had no local effect whatever, but would have served to reduce only faintly the numbers of emigrants to more or less distant regions. In other words, nothing less than a sweep of the surrounding country on a quite impracticable, large scale could have an effect on the population of a given central area. Long before this comparatively slow process could operate, however,

whatever reduction in numbers had occurred as a result of the shoot, probably would be lost. At least two instances in which jays quickly filled an emptied area have been recorded (Grinnell and Storer, Animal Life in the Yosemite, 1924, pp. 385-386; Sumner, *op. cit.*, p. 323).

This conclusion is substantiated by the fact that we obtained no specific evidence that the shoots have ever noticeably decreased the number of jays. To be sure, most accounts of previous shoots included statements to the effect that in former days the shoots resulted in larger kills, 2000 to 2500 rather than 600 to 700; but the number killed in the shoot six months ago, in the fall of 1935, was variously reported as from five or six hundred to two thousand, and the tendency of a story to grow with age and repetition is proverbial. One man stated that the number killed in recent years was smaller, but he believed this was because of lack of interest on the part of those participating rather than to any change in the number of jays. At least two men stated that there was no appreciable decrease even immediately following a shoot.

The interrelationships of the jays and quail have occasioned much controversy for many years. Conversation with different individuals of the Calaveras County community brought forth the usual arguments. Almost everybody had seen jays kill young quail or had come upon a jay just after such an incident. One person told of seeing a jay catch a young quail that had been flushed by his car. He saw the jay open the head and eat the brain of the quail. Most witnesses stated that the jays regularly eat the brain and leave the carcass. In view of the care with which jays bury all surplus food, I am inclined to think that if not interrupted they would probably use all the carcass or bury what was not eaten at the moment. I have one record of a jay which I frightened away from the remains of a wren-tit nestling, but which returned for it when I withdrew.

Jays were generally reported to eat eggs. In most instances, they had been seen to rob chicken houses. One man had seen a quail's nest destroyed. At least one man felt that, though the jay kills some young quail, it does more good than harm because its alarm notes on sighting a hawk warn the quail of the danger. We had little opportunity to gather direct evidence on this question. Sumner considers all these aspects, and, on the basis of his study of quail, concludes that the effect of the jay on the numbers of the quail is negligible.

Other enemies of quail besides the jay were recognized by the vermin hunters. One of these is the house cat which all reported as numerous and destructive. Such animals, which abound in a feral or semi-feral state, are shot on sight. Most of these are, of course, local animals "run wild;" but one man told of a neighbor that had chanced on a party from Stockton, about to release three gunny sacks full of cats on his place, and this method of benefiting one neighborhood at the expense of another was common.

Hawks, since they were included in the shoot, were obviously considered as enemies, but opinions varied as to which kinds were destructive. Several men, when looking at the Cooper Hawk, remarked that it was the kind that could work havoc in a covey of quail. At least, some men in the group knew that the red-tail was protected by law, and one man reported the finding of a nest of downy young red-tails which he had left undisturbed. Several men expressed a desire to know something of the food habits of the Red-tailed Hawk and the Sparrow Hawk. The exclusion of the Horned Owl from the scoring was unexpected. Two conflicting stories were told, of its value as a rodent killer and of its harmfulness as a chicken thief, but no definite evidence on its relation to quail was brought forward.

Weather conditions were discussed as affecting the number of quail. The recent years of drought and the reduction of the water supply were said to have affected the survival of both young and adults, and the late rains of the preceding year were believed to have soaked some of the eggs and reduced the hatch.

Man, in one way or another, was implicated as an important agent affecting the number of quail. Generally emphasized was the use of poisoned grain against ground squirrels. The kind of poison used was not definitely known. One of the men said that after poisoned grain had been put out, he had found numbers of quail, rabbits, and even deer dead in fields or along the margins of areas kept green by springs. He thought the squirrels should be controlled, but he felt that a squirrel shoot, on the order of a jay shoot, would be good fun, would be as effective in reducing the squirrels as poisoned grain, and would operate only against the animal which they wished to kill.

Illegal practices such as spotlighting and bootlegging game were mentioned, but the present game warden is believed to be successfully eliminating these practices. The increase in the number of hunters on account of good roads and cars seems to be a problem without a solution. One non-hunter believed that if the sportsmen were better "sports," the quail would have a chance, since most of the hunters regularly shot until they got the bag limit, whether they could make use of the birds or not.

Besides attempting to protect the quail already present, the local hunters are trying to increase their number by the establishment of areas closed to shooting, by keeping water holes available, by feeding, and by rearing and planting young stock. The latter has been accompanied by the release of the Hungarian Partridge and the Wild Turkey, neither of which has become established. Hopes were expressed that the Chukar Partridge could be planted when stock is available.

Whatever the relation of the jays and quail, the shoot described would likely at best bring only an imperceptible reduction in the numbers of jays. Vermin shoots persist partly because the enmity of the sportsman is inflamed by seeing jays kill young quail, partly because, like the husking bee or barn raising, they constitute a pleasant aspect of rural society.

Museum of Vertebrate Zoology, University of California, Berkeley, November 27, 1936.

WATER BIRDS OF THE BOULDER DAM REGION

WITH MAP

By DWIGHT C. SMILEY

At intervals from January 20 to June 30, 1936, I made wildlife studies for the National Park Service in the vicinity of Lake Mead—the reservoir of Boulder Dam. The Colorado River drains the western slope of the central Rocky Mountains. It flows westward through the Grand Canyon of northern Arizona, and then it turns abruptly southward. In its southward flow to the Gulf of California, it forms a boundary which separates Arizona from southern Nevada and from southern California. Boulder Dam is situated ten miles south of the west-to-south turning point of the river.

Late in the winter of 1935, the flow of the Colorado was first checked by Boulder Dam, and Lake Mead reservoir began to fill. The latter is now a Y-shaped body of water; two arms of the "Y" are formed by the valley of the Colorado, and