

## AN ECOLOGICAL STUDY OF NESTING BIRDS IN THE VICINITY OF BOULDER, COLORADO

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During the summer of 1941, while doing biological field work in the Rocky Mountains west of Boulder, Colorado, I became interested in the distribution of birds as related to life-zones. Many Colorado birds are listed in ornithological manuals as characteristic of particular zones. I determined to investigate whether their nesting sites were chosen because of the altitude and zone or because of local habitat conditions.

This study was made at Science Lodge, the University of Colorado biological station, at an elevation of 9500 feet in the mountains twenty-eight miles west of Boulder, and covered a five weeks' period, July 21 to August 22, 1941. In this time I attempted to discover all the nests possible by covering the area in and around the biological station, and by censusing all regions, from the plains to above timber line, that were visited by the class field trips made on three days of each week. In addition, I obtained authentic records and descriptions of nests from two naturalists of the Rocky Mountain National Park and from several members of Science Lodge. It was my intention to analyze the nests, nest environment, and vegetation and to determine, after a study of many nests, whether life-zone or local habitat conditions appeared more important in the selection of nest sites.

This paper is inconclusive, but it is hoped that the data may make a contribution to the broad topic of life-zones and bird distribution.

### LIFE ZONES

Before discussing the data, it seems advisable to summarize briefly the life-zones in Colorado, in order that each zone may be defined clearly in the reader's mind when mentioned in this paper. The altitudinal limits given for the zones are those in the region near Science Lodge.

Five life-zones are represented in Colorado. (1) The Upper Sonoran, or Plains zone, below 6000 feet, is characterized chiefly by narrow-leaved cottonwoods and willows along streams, herbs such as yucca, prickly poppy, and prickly pear; and rattlesnakes. (2) The Transition, or Foothills zone, 6000-8500 feet, is the zone of yellow pine (*Pinus ponderosa*) predominantly, with Douglas fir (*Pseudotsuga mucronata*) and Colorado blue spruce (*Picea pungens*) abundant in moist areas. (3) The Canadian zone, 8500 to 10,500 feet, is the zone dominated by the lodgepole pine (*Pinus murrayana*), with aspen (*Populus tremuloides*) and sub-alpine fir (*Abies lasiocarpa*) groves abundant; it is invaded in its lower limits by yellow pine and in its upper by Engelmann spruce (*Picea engelmanni*) and sub-alpine fir. (4) The Hudsonian zone, 10,500 feet to timber line, is the region of moist dense forests of Engelmann spruce and sub-alpine fir, extending up through timber line. (5) The Arctic-Alpine zone covers the area above timber line, usually 11,500 feet and up, characterized by dwarf willows and numerous low-growing herbs and shrubs.

There is little question that in many regions Colorado shows life-zones, as indicated by vegetation, very clearly, but it must be admitted that "birds are naturally less restricted to zones than mammals and plants, and in the field the question of correlating them to zones is rendered difficult by the modifying conditions which complicate the zones themselves" (Bailey, 1921:xxxvi). A complicated life-zone situation was in evidence near Science Lodge in a ravine called Little Royal Gorge: here, in one small

area, were trees representative of three zones. An ecological study of this area ended with the conclusion: "It is evident from this study that plants typical of many altitudes and habitats can grow in close proximity to each other where the topography furnishes the proper conditions as it does in Little Royal Gorge" (Crumpacker, 1939). Another area, Lakewood, within thirty minutes' drive of the station, presented an unusual habitat. Along a creek at Lakewood were found narrow-leaved cottonwoods, alders, Colorado blue spruce, lodgepole pine, limber pine, and Engelmann spruce, representative trees of the Transition, Canadian, and Hudsonian zones, respectively, all growing together in a relatively small area at an elevation of 8500 feet. These two instances, and others like them, definitely complicate the life-zone picture, but the life-zone concept stresses them as the exceptions which prove the rule and claims that in most regions of the Rockies life-zones are clearly marked by vegetation, particularly trees. It is not the purpose of this paper to discuss the validity of life-zones, but to determine whether bird distribution correlates with them as they have been described above, or with local habitat.

On the basis of bird distribution, Betts (1913) stated that it was difficult to recognize more than two zones between plains and tundra. He suggested that the bird life-zones be classified as follows: (1) Plains, (2) Yellow Pine, (3) Mountain (including Canadian and Hudsonian), and (4) Tundra. Alexander (1937) agreed with this zonation and went further to say: "Actually bird distribution seems to be less a matter of altitude *per se* than of habitat preference, and before we can pass judgment upon the desirability of recognizing two zones in the higher forested portions of the Rockies we must collect more data of a statistical nature on the bird communities." Alexander later in this same work remarks: "It seems evident that birds are more influenced in a choice of nesting habitat by purely local conditions than by what we might call geographic conditions. A statistical field study of birds during the nesting season should help determine the nature of this choice, and whether or not the conclusions drawn from unorganized observations are justified." It is this type of statistical field study which I have made, and my data point to several possible conclusions.

#### NEST TOTALS

Nests, or records of nests, were obtained for thirty-three species of birds and reached a total of one hundred and two nests. The species are listed below, along with numbers of nests found.

Red-tailed Hawk ( <i>Buteo borealis</i> )	1
Spotted Sandpiper ( <i>Actitis macularia</i> )	2
Avocet ( <i>Recurvirostra americana</i> )	2
Nighthawk ( <i>Chordeiles minor</i> )	1
Broad-tailed Hummingbird ( <i>Selasphorus platycercus</i> )	5
Red-shafted Flicker ( <i>Colaptes cafer</i> )	2
Red-naped Sapsucker ( <i>Sphyrapicus varius</i> )	5
Western Flycatcher ( <i>Empidonax difficilis</i> )	6
Empidonax Flycatcher ( <i>Empidonax</i> sp.)	1
Western Wood Pewee ( <i>Myiochanes richardsonii</i> )	2
Olive-sided Flycatcher ( <i>Nuttallornis mesoleucus</i> )	1
Horned Lark ( <i>Otocoris alpestris</i> )	1
Violet-green Swallow ( <i>Tachycineta thalassina</i> )	3
Barn Swallow ( <i>Hirundo erythrogaster</i> )	1
American Magpie ( <i>Pica pica</i> )	15
Mountain Chickadee ( <i>Penthestes gambeli</i> )	1
White-breasted Nuthatch ( <i>Sitta carolinensis</i> )	1
Brown Creeper ( <i>Certhia familiaris</i> )	1

Dipper ( <i>Cinclus mexicanus</i> )	4
House Wren ( <i>Troglodytes aëdon</i> )	2
Robin ( <i>Turdus migratorius</i> )	11
Hermit Thrush ( <i>Hylocichla guttata</i> )	2
Mountain Bluebird ( <i>Sialia currucoides</i> )	4
Townsend Solitaire ( <i>Myadestes townsendi</i> )	2
American Pipit ( <i>Anthus spinoletta</i> )	4
Warbling Vireo ( <i>Vireo gilvus</i> )	2
Audubon Warbler ( <i>Dendroica auduboni</i> )	1
Western Meadowlark ( <i>Sturnella neglecta</i> )	1
Red-winged Blackbird ( <i>Agelaius phoeniceus</i> )	7
Green-tailed Towhee ( <i>Oberholseria chlorura</i> )	2
Gray-headed Junco ( <i>Junco caniceps</i> )	7
White-crowned Sparrow ( <i>Zonotrichia leucophrys</i> )	2
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Total	102

#### ECOLOGY OF THE NESTS

Each species for which two or more nests were found is discussed individually, with the exceptions of the Spotted Sandpiper and Red-winged Blackbird, where details of nests were lacking.

Avocet.—The Avocet is a bird of the plains region, being found as a summer resident at prairie ponds. Avocets were discovered nesting at a small prairie pond near Fort Collins in 1940, at 5100 feet, and at a large pond near Boulder, 5300 feet, in 1941. This species is confined to the Upper Sonoran zone, but it occurs only in the parts of that zone where local nesting conditions are suitable.

Broad-tailed Hummingbird.—Below is listed the plant cover in which each of the five hummingbird nests was found, and the elevation.

Sub-alpine fir .....	10,000 feet
Lodgepole pine .....	9,500
Jamesia .....	8,300
Alder .....	8,100
Douglas fir .....	8,100

The Broad-tailed Hummingbird is found in the summer from plains to timber line, and according to Kleinschnitz (1939), "these birds nest earliest on the plains and in the lower foothills, and as the season progresses they migrate gradually to higher altitudes following the profusely blooming wild flowers. For this reason they are able to nest again in a higher zone." Total zonal changes undoubtedly bring about their migration, but the added flower nectar in each local habitat is the bird's immediate target. The zone in which a later blooming season occurs indirectly affects each habitat in it, but the items of importance to the bird are (1) whether or not food is available locally and (2) whether or not suitable nest sites are present. These two conditions are apparently met in any of four zones.

Red-shafted Flicker.—The flicker breeds from plains to timber line, usually selecting nest sites in dead trees. The two nests found were located in cavities in dead trees, one eighteen feet off the ground at 9400 feet, and the other in the open top of a fifteen-foot tree at 10,500 feet. Nest sites are apparently determined by local conditions, as altitude does not restrict the flicker.

Red-naped Sapsucker.—This is a species on whose nest site all Colorado bird authorities seem to agree. The Red-naped Sapsucker always excavates a hole in an aspen, usually a live one, and rears its family therein. The five nests I recorded were in live

aspen trees in groves at elevations of 8600, 8800, 8800, 9000, and 9900 feet. Since the bird's breeding is confined to aspens and since aspens grow chiefly in the upper Transition and Canadian zones, the Red-naped Sapsucker is found principally in those zones. Yet it is found breeding only in the parts of those zones where aspens grow, so that local conditions must be important in nest selection.

**Western Flycatcher.**—The Western Flycatcher seems to be adapting itself to the ways of human beings. Six nests of this species were recorded, some from 1941 and some from previous years, and all were in or on buildings. One brood was reared in late July of 1941 on a rafter under the eaves of the laboratory building at Science Lodge, in full view of students studying in the laboratory. In 1940 a nest was built on a rafter in the sawmill in camp and brooded successfully, undisturbed by men working in the mill daily. Another nest in 1940 was built on a rafter inside the boiler room, the door of which was always left open, and the bird flew in and out at will; a nest under the front porch of a building has been used yearly since 1935. In 1940 a Western Flycatcher built a nest on a two-by-four above the window inside a cabin which was unoccupied for the first two weeks of camp and the door of which stood open. When the cabin had to be used, the bird refused to leave and stayed until the nest and eggs were forcibly removed and the door shut. In 1941 a nest of this species was discovered on a rafter inside a barn at 9800 feet elevation. I have no records of Western Flycatcher nests to compare with these from the Science Lodge vicinity, but according to Betts (1913), the birds breed from 8500 to 10,000 feet, and the nests formerly were placed on rocky ledges or the sides of prospect tunnels. It is interesting to observe their apparent preference for buildings as nest sites. They appear to occur solely in the Canadian zone, but my data are insufficient for a definite statement.

**Wood Pewee.**—Two records were obtained for the Wood Pewee, a nest at 8800 feet, and a nest in a yellow pine at 8200 feet. Kleinschnitz (1939) states that the bird is "found mainly among the ponderosa pines on the open hillside," but Alexander (1937) and Sclater (1912) list it as breeding from the plains to 10,000 feet. The author has observed the Wood Pewee on the plains, in ponderosa pines, and above 10,000 feet, and feels that its range is wide. The data are insufficient to prove any point except that the bird does nest around 8500 feet; it may nest above or below as well.

**Violet-green Swallow.**—Three nest records were obtained for this species, two nests constructed under the eaves of buildings at 8200 and 8400 feet, respectively, and one nest "in the cavity of a sheet metal Kodak sign on the main street of Estes Park, Colorado" (Rodeck, 1941). These birds breed from the plains up to 10,000 feet (Alexander, Kleinschnitz, and Sclater), and apparently are commencing to make use of crevices and crannies around human buildings as nest sites more than previously. They are not restricted by zone or by habitat; and they appear to utilize many types of local situations in nesting.

**American Magpie.**—Fifteen nests of the American Magpie were found, eleven in willows at 5000 feet, two in narrow-leaved cottonwoods at 5300 feet, and two in narrow-leaved cottonwoods at 8500 feet at Lakewood. All were along streams. These records seem to indicate that magpies in this section of Colorado prefer willows and narrow-leaved cottonwoods near water for nest sites. Sclater (1912) mentions this preference. These two trees are found chiefly in the plains region, but extend into the foothills as stream-side members. Willows occur higher, but not as large trees bordering streams. Lakewood, at an elevation of 8500 feet, might be classed as in either the upper Transition or the lower Canadian zone, but this is insignificant. The important fact is that a thick stand of narrow-leaved cottonwoods is present there, and because magpies prefer

them with the stream beside them as nest sites, they nest there. They appear to select their nests for local habitat reasons, not because of zone or altitude.

However, there is an indirect relationship between these two apparently opposite factors. The suitable nest sites, dependent on local habitat, occur only in certain zones, because the willows and cottonwoods as large stream-side trees, grow commonly only on the plains and in the foothills. Thus, the nesting occurrence of the magpie is determined directly by local habitat conditions and indirectly by altitude and zone.

Dipper.—Four nests of the Dipper were recorded, two at an elevation of 9400 feet, one at 7500 feet, and one in Boulder at 5300 feet. The nest at Boulder was situated under a bridge on Broadway; the nest at 7500 feet was placed on a sloping rock ledge six feet above water; the third nest was placed on a rock behind a curtain of water at Arapahoe Falls; and the fourth in a rock fracture at Alberta Falls. These data indicate in a small way a point on which all Colorado bird authorities are agreed concerning the Dipper: it occurs from 5000 feet to timber line! This is a species which, perhaps more definitely than any other, breeds in a spot determined by habitat, utterly regardless of life-zone and altitude. The "Water Ouzel" is always found along rushing mountain streams. These turbulent waters and scattered boulders alone meet its nest site requirements, and by these streams the Dipper nests, no matter what the altitude. Its nest site is determined solely by habitat conditions.

House Wren.—This species is restricted by neither zone nor habitat. It is found breeding from the plains to timber line, although Kleinschnitz records it as most common around 8500 feet. It has been known to nest in deserted cabins, empty fruit cans, under logs, in old woodpecker holes, between logs of miners' cabins, and in all sorts of places. I recorded two nests, one from an old woodpecker hole in an aspen at 9000 feet, in the same tree as a Red-naped Sapsucker nest, and one in Moraine Park at 8500 feet.

Robin.—The Robin has a wide breeding range, nesting from the plains up to timber line and showing no limitations in choice of nesting site. Of the eleven nests found, three were in narrow-leaved cottonwoods at 8500 feet, one in a willow at 8400 feet, one in a Douglas fir at 8800 feet, one in a lodgepole pine at 9500 feet, one on a rafter of a Science Lodge cabin at 9500 feet, one in an aspen at 9500 feet, one in a limber pine at 10,500 feet, and one at 10,800 feet. I was unable to secure a nesting record from below 6000 feet, but Betts and Alexander in their surveys of the birds of Boulder County both list the Robin as a species nesting on the plains, as well as in all zones except the Alpine.

Hermit Thrush.—The Hermit Thrush is recorded by most Colorado bird writers as nesting commonly from 8000 feet to timber line. This species nested on a rafter under the roof of a building at Science Lodge in 1936. In 1941, a nest containing eggs was discovered in a limber pine about six feet off the ground at an elevation of 11,000 feet on Mount Niwot. The bird appears not confined to any zone and probably selects its nest site according to local conditions, although the nest sites may vary considerably.

Mountain Bluebird.—The Mountain Bluebird breeds from the plains to timber line. (Betts, 1913; Alexander, 1937). My four records show one nest in an aspen at 9000 feet, and three in dead trees at 10,800, 11,000, and 11,300 feet. "A few nest on the creek bottoms and about the prairie towns, later to ascend into the hills with the growing abundance of insect life. In this way, a second brood is often raised, and it is not unusual to find them nesting in July in the wind-twisted trees of timberline" (Kleinschnitz, 1939). The nest observed at 11,000 feet had young birds in it on July 31, and the nest at 11,300 feet had three young on August 6. These birds appear wide-ranging, choosing nest sites according to local conditions, regardless of altitude.

**Townsend Solitaire.**—This species constructs an interesting nest, always a bulky, untidily thrown-together affair of sticks on the outside and lined with grasses within. The two nests found were placed on the ground on a steep slope, one under an overhanging rock, and one in a pothole, under overhanging roots; both of these nests were at a 9000-foot elevation. This bird, according to Sclater, Betts, and Alexander, breeds from 7000 feet to timber line. It seems not restricted by zone or altitude, nesting entirely according to suitable local habitat conditions, which appear to include a slope as essential to the site of the nest.

**American Pipit.**—The pipit is a bird which definitely breeds only above timber line! My four nest records were from elevations of 11,300, 11,500, 12,000, and 13,100 feet. This species is characteristic of the Arctic-Alpine zone, and probably occurs there because suitable nesting sites are present there alone. "The pipit confines itself to one nesting habitat, preferring the grassy slopes of the Arctic-Alpine region" (Kleinschnitz, 1939). Grassy slopes occur in other zones, but they are not like the grassy slopes above timber line. The bird seems restricted to this zone by its own local nest requirements.

**Warbling Vireo.**—The Warbling Vireo has been recorded from the plains to 10,000 feet, and is considered by Sclater, Betts, and Kleinschnitz to breed most commonly in cottonwoods and aspens. The two nests found of this species were in aspens, one at 8200 feet and the other at 9000 feet. Since this vireo seems to prefer these two as nest sites, it apparently confines itself to regions where they occur. Cottonwoods grow on the plains and in the lower Transition, and aspens are numerous throughout the Canadian zone. Thus the Warbling Vireo's breeding range is determined by its habitat requirements; it seems to nest in any part of these three zones where aspens or cottonwoods are found.

It is not an uncommon occurrence for a Warbling Vireo to sing while sitting on the nest. This was observed by Alexander, two biology students, and the writer at the nest discovered at 9000 feet near Little Royal Gorge in early July, 1941.

**Green-tailed Towhee.**—Two nests of the Green-tailed Towhee were found, both on the ground and well hidden. One was situated amid creeping juniper at 9900 feet and the other at the base of sagebrush at 8400 feet. These data indicate that the bird ranges through at least two zones, and Alexander and Betts state that it breeds from the foothills to timber line. It is, therefore, clearly not confined to one zone and appears to nest wherever local conditions fit its requirements.

**Gray-headed Junco.**—Seven nests of the Gray-headed Junco were discovered, all on the ground and well-concealed, but in a great variety of cover. The following list gives the cover of each nest and its elevation.

Amid shrubby cinquefoil.....	10,100 feet
Amid creeping juniper .....	9,900
Under a log .....	9,700
Amid creeping juniper .....	9,500
Under dead lodgepole branches .....	9,400
Under dead lodgepole branches .....	9,200
Under an overhanging rock .....	9,000

All these nests are in the Canadian zone, but a summer's observations have convinced the author that this species breeds all the way from 8000 feet to timber line. Alexander (1937) verifies this. Young birds just out of the nest were observed in late July at Lake Isabel, an elevation of 11,000 feet. The great inconsistency in type of nest cover

seems to fit in well with a wide breeding range, for the bird is not limited to any particular vegetation and thus to no certain zone.

White-crowned Sparrow.—Two nests of this species were found, one about twelve inches off the ground in a sub-alpine fir at 11,300 feet, and the other just above the ground in a willow at Goose Lake, 10,500 feet. Sclater and Betts list this bird as breeding from 8000 feet up through timber line. Alexander states that it is especially abundant in the wind-timber just below timber line. This latter fact has been observed by the writer, but White-crowned Sparrows have been seen commonly between 9800 feet and timber line, making it seem probable that they are not restricted to any one zone, but breed in spots determined by local conditions. It is likely that many of the best nesting sites occur in the Hudsonian zone, making the bird a common species there.

#### DISCUSSION AND SUMMARY

The distribution of birds as related to life-zones is a topic which will require a tremendous amount of study and a large accumulation of data before any satisfactory answers can be given. I have attempted to make a contribution of nesting data and possible conclusions toward that end. It seems obvious that life-zone and local habitat are indirectly related. Local habitat refers chiefly to vegetation, or a lack of it; and vegetation of a certain type usually grows in certain zones. There are many exceptions to this rule.

The American Pipit appears to be confined to one zone, the Arctic-Alpine, and may be accurately said to be "characteristic" of that zone. Undoubtedly local habitat varies within the zone and is important in the selection of a nest site, but the bird's distribution certainly comes closer to correlating with one life zone than that of any other observed in this study.

The Dipper definitely is a bird of opposite tendencies, breeding entirely according to local conditions, regardless of zone and altitude.

The American Magpie, Red-naped Sapsucker, and Warbling Vireo appear restricted to certain vegetation for nest sites and breed wherever their preferred vegetation grows, regardless of zone. However, that vegetation usually occurs only in certain zones, so that these species are somewhat limited to zones by their own habitat requirements, a correlation of the two apparently opposite factors.

A large number of species appear to breed practically from the plains to timber line, disregarding zone and altitude, and nest wherever local conditions are satisfactory. In this group are the Robin, Mountain Bluebird, Broad-tailed Hummingbird, House Wren, and Red-shafted Flicker.

A number of other birds appear to breed from 8000 feet to timber line, regardless of zone. In this class may be listed the Gray-headed Junco, Green-tailed Towhee, Townsend Solitaire, and Hermit Thrush.

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