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Source: *The Auk*, Vol. 34, No. 4 (Oct., 1917), pp. 427-433

Published by: American Ornithologists' Union

Stable URL: <http://www.jstor.org/stable/4072271>

Accessed: 27-09-2015 15:40 UTC

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into the body of the partly eaten bantam and replaced it in the same spot where he found it. Next morning the seemingly impossible was made a practical certainty, for he found the body of a screech owl with the claws of one foot firmly imbedded in the body of the bantam. He very kindly presented me with the owl which, upon dissection, proved to be a female, its stomach containing a very considerable amount of bantam flesh and feathers, together with a great deal of wheat. (It seems probable that the wheat was accidentally swallowed with the crop of the bantam during the feast, but there was so much that it seems strange the owl did not discard it while eating). How a bird only 9.12 inches in length could have dealt out such havoc in so short a time is almost incredible, but, although purely circumstantial, the evidence against the owl appeared altogether too strong for even a reasonable doubt. The doctor and I wished to make as certain as possible, however, so the poisoned bantam was replaced and left for several days, but without any further results. For the above mentioned reasons I am rather doubtful as to the net value of this owl from an economic standpoint, although birds in a wild state would not give them such opportunities for such wanton killing as birds enclosed in pens.

THE NICHE-RELATIONSHIPS OF THE CALIFORNIA THRASHER.¹

BY JOSEPH GRINNELL.

THE California Thrasher (*Toxostoma redivivum*) is one of the several distinct bird types which characterize the so-called "Californian Fauna." Its range is notably restricted, even more so than that of the Wren-Tit. Only at the south does the California Thrasher occur beyond the limits of the state of California, and in that direction only as far as the San Pedro Martir Mountains and

¹ Contribution from the Museum of Vertebrate Zoölogy of the University of California.

SAN QUINTIN, not more than one hundred and sixty miles below the Mexican line in Lower California.

An explanation of this restricted distribution is probably to be found in the close adjustment of the bird in various physiological and psychological respects to a narrow range of environmental conditions. The nature of these critical conditions is to be learned through an examination of the bird's habitat. It is desirable to make such examination at as many points in the general range of the species as possible with the object of determining the elements common to all these points, and of these the ones not in evidence beyond the limits of the bird's range. The following statements in this regard are summarized from the writer's personal experience combined with all the pertinent information afforded in literature.

The distribution of the California Thrasher as regards life-zone is unmistakable. Both as observed locally and over its entire range the species shows close adherence to the Upper Sonoran division of the Austral zone. Especially upwards, is it always sharply defined. For example, in approaching the sea-coast north of San Francisco Bay, in Sonoma County, where the vegetation is pre-vaillingly Transition, thrashers are found only in the Sonoran "islands," namely southerly-facing hill slopes, where the maximum insolation manifests its effects in a distinctive chaparral containing such lower zone plants as *Adenostoma*. Again, around Monterey, to find thrashers one must seek the warm hill-slopes back from the coastal belt of conifers. Everywhere I have been, the thrashers seem to be very particular not to venture even a few rods into Transition, whether the latter consist of conifers or of high-zone species of manzanita and deer brush, though the latter growth resembles closely in density and general appearance the Upper Sonoran chaparral adjacent.

While sharply delimited, as an invariable rule, at the upper edge of Upper Sonoran, the California Thrasher is not so closely restricted at the *lower* edge of this zone. Locally, individuals occur, and numbers may do so where associational factors favor, down well into Lower Sonoran. Instances of this are particularly numerous in the San Diegan district; for example, in the Lower Sonoran "washes" at the mouths of the canyons along the south base of the San Gabriel Mountains, as near San Fernando, Pasadena, and

Azusa. A noticeable thing in this connection, however, is that, on the desert slopes of the mountains, where *Toxostoma lecontei* occurs on the desert floor as an associational homologue of *T. redivivum* in the Lower Sonoran zone, the latter "stays put" far

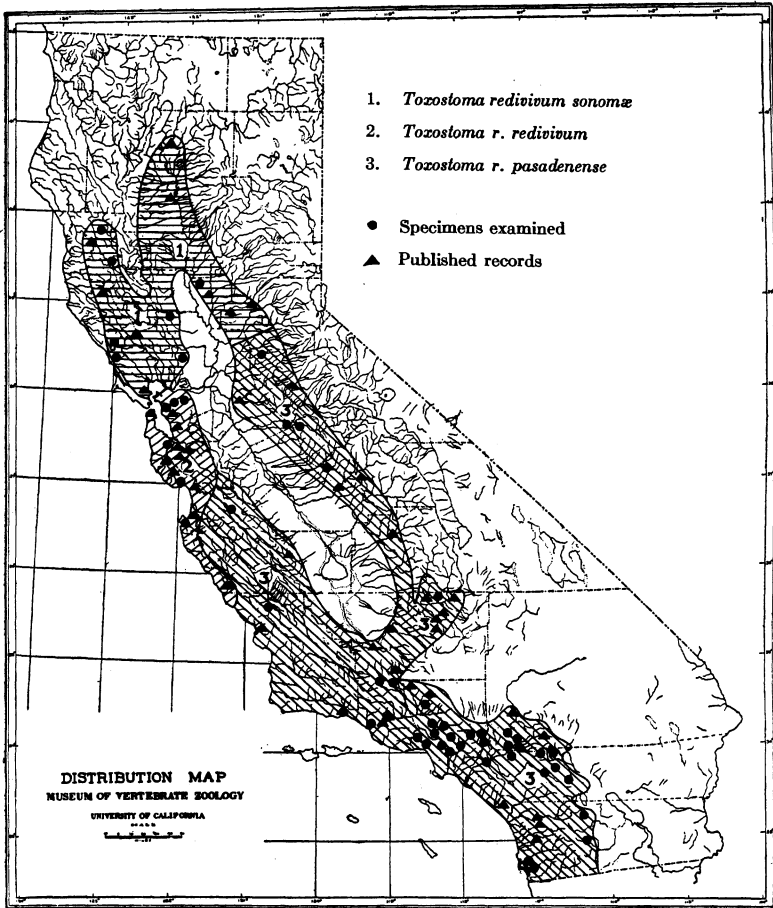


Figure 1.

more closely; that is, it strays but little or not at all below the typical confines of its own zone, namely *Upper Sonoran*. The writer's field work in the vicinity of Walker Pass, Kern County,

provides good illustrations of this. A tongue or belt of Lower Sonoran extends from the Mohave Desert over the low axial mountain ridge at the head of Kelso Creek and thence down along the valley of the South Fork of the Kern River nearly to Isabella. Leconte's Thrasher is a conspicuous element in this Lower Sonoran invasion, but no California Thrashers were met with in this region below the belt of good Upper Sonoran on the flanking mountain sides, as marked by the presence of digger pine, blue oak, sumach, silk-tassel bush, and other good zone-plants. Similar zonal relationships are on record from San Geronio Pass, Riverside County, as well as elsewhere.

Reference now to the general range of the bird under consideration (see p. 429), as compared with a life-zone map of California (Pacific Coast Avifauna No. 11, Pls. I, II), will show to a remarkable degree how closely the former coincides with the Upper Sonoran zone. The thrasher is, to be sure, one of the elements upon the presence of which this zone was marked on the map; but it was only one of many, both plant and animal; and it is concordance with the aggregate that is significant. Diagnosis of zonation similarly is possible in scores of places where change in altitude (which as a rule means change in temperature) is the obvious factor, as up the west flank of the Sierra Nevada, or the north wall of the South Fork valley, already referred to, in Kern County, or on the north wall of the San Jacinto Mountains. The California Thrasher is unquestionably delimited in its range in ultimate analysis by temperature conditions. The isothermic area it occupies is in zonal parlance, Upper Sonoran.

The second order of restriction is faunal, using this term in its narrowed sense, indicating dependence upon atmospheric humidity. The California Thrasher does not range interiorly into excessively arid country, although the Upper Sonoran zone may, as around the southern end of the Sierra Nevada, continue uninterruptedly towards the interior in a generally latitudinal direction. This is true where extensive areas are considered, but locally, as with zones, individuals or descent-lines may have invaded short distances beyond the normally preferred conditions. An example of this situation is to be found on the north and west slopes of the San Jacinto Mountains, where California Thrashers range around

onto arid chaparral slopes, intermingling with such arid Upper Sonoran birds as Scott's Oriole and the Gray Vireo. It is questionable, however, as to what extent faunal restriction really operates in this case; for reference to the zone map, again, shows that a vast tract of Lower Sonoran, lying to the east of the desert divides, extends continuously north to the head of Owens Valley. Really the only unbroken bridge of Upper Sonoran towards the east from the west-Sierran habitat of *Toxostoma redivivum* is around the southern end of the Sierra Nevada — a very narrow and long route of possible emigration, with consequent factors unfavorable to invasion, irrespective of either temperature or humidity, such as interrupted associational requirements and small aggregate area. In this particular bird, therefore, faunal restriction may be of minor importance, as compared with zonal and associational controls.

That faunal conditions have had their influence on the species, however, is shown by the fact of geographic variation within its range. The thrasher throughout its habitat-as-a-whole, is subjected to different degrees of humidity. Amount of rainfall is, in a general way, an index of atmospheric humidity, though not without conspicuous exceptions. Comparing the map of the ranges of the subspecies of *T. redivivum* (p. 429) with a climatic map of the State, direct concordance is observed between areas of stated rainfall on the latter and the ranges of the respective subspecies. It will be seen that the race *T. r. pasadenense* occupies an area of relatively low humidity, the race *T. r. sonomæ* of higher humidity and the race *T. r. redivivum* of highest humidity, in fact a portion of California's fog-belt. The distinctive color-tones developed are, respectively, of gray, slate and brown casts. In the thrasher, therefore, we may look to faunal influences as having most to do with differentiation within the species. In this case it is the faunal variation over the occupied country which is apparently responsible for the intra-specific budding, or, in other words, the origination of new specific divarications.

Wherever it occurs, and in whichever of the three subspecies it is represented, the California Thrasher evinces strong associational predilections. It is a characteristic element in California's famous chaparral belt. Where this belt is broadest and best developed, as in the San Diegan district and in the foothill regions bordering

the great interior valleys, there the Thrasher abounds. The writer's personal field acquaintance with this bird gives basis for the following analysis of habitat relations.

The California Thrasher is a habitual forager beneath dense and continuous cover. Furthermore, probably two-thirds of its foraging is done on the ground. In seeking food above ground, as when patronizing cascara bushes, the thrasher rarely mounts to an exposed position, but only goes as high as is essential to securing the coveted fruits. The bird may be characterized as semi-terrestrial, but always dependent upon vegetational cover; and this cover must be of the chaparral type, open next to the ground, with strongly interlacing branch-work and evergreen leafy canopy close above — not forest under-growth, or close-set, upright stems as in new-growth willow, or matted leafage as in rank-growing annual herbage.

The Thrasher is relatively omnivorous in its diet. Beal (Biological Survey Bulletin no. 30, p. 55) examined 82 stomachs of *Toxostoma redivivum* and found that 59 percent of the food was of a vegetable nature and 41 animal. A large part of this food consisted of ground-beetles, ants, and seeds, such as are undoubtedly obtained by working over the litter beneath chaparral. The bird's most conspicuous structural feature, the long curved bill, is used to whisk aside the litter, and also to dig, pick-fashion, into soft earth where insects lie concealed. Ground much frequented by Thrashers shows numerous little pits in the soil surface, less than an inch deep, steep on one side and with a little heap of earth piled up on the opposite side. As already intimated, the Thrasher at times ascends to the foliage above, for fruit and doubtless some insects. Much in the way of berries and seeds may also be recovered from the ground in what is evidently the Thrasher's own specialized method of food-getting. Even granting this specialization, I do not see why the chaparral, alone, should afford the exclusive forage-ground; for the same mode of food-getting ought to be just as useful on the forest floor, or even on the meadow. The further fact, of widely omnivorous diet, leads one to conclude that it is *not* any peculiarity of food-source, or way of getting at it, that alone limits the Thrasher associationally. We must look farther.

The amateur observer, or collector of specimens, is struck by the

apparent "shyness" of the Thrasher — by the ease with which it eludes close observation, or, if thoroughly alarmed, escapes detection altogether. For this protective effect the bird is dependent upon appropriate cover, the chaparral, and upon its ability to co-operate in making use of this cover. The Thrasher has strong feet and legs, and muscular thighs, an equipment which betokens powers of running; the tail is conspicuously long, as in many running birds; and correlatively the wings are short, rounded, and soft-feathered, indicating little use of the flight function. The colors of the bird are non-conspicuous — blended, dark and light browns. The nests of the Thrasher are located in dense masses of foliage, from two to six feet above the ground, in bushes which are usually a part of its typical chaparral habitat. In only exceptional cases is the chosen nesting site located in a bush or scrubby tree, isolated more or less from the main body of the chaparral.

These various circumstances, which emphasize dependence upon cover, and adaptation in physical structure and temperament thereto, go to demonstrate the nature of the ultimate associational niche occupied by the California Thrasher. This is one of the minor niches which with their occupants all together make up the chaparral association. It is, of course, axiomatic that no two species regularly established in a single fauna have precisely the same niche relationships.

As a final statement with regard to the California Thrasher, we may conclude, then, that its range is determined by a narrow phase of conditions obtaining in the Chaparral association, within the California fauna, and within the Upper Sonoran life-zone.