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RANGE AND HABITAT OF THE COLIMA WARBLER

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ABSTRACT.—We surveyed the breeding range of the Colima Warbler (*Vermivora crissalis*) in northeastern Mexico and western Texas between April and June 1983 and located 167 Colima Warblers within an area that included Coahuila, Nuevo Leon, Tamaulipas, and Texas—states where they previously were known to occur. In addition, we observed 13 warblers in San Luis Potosi and Zacatecas. We found Colima Warblers at elevations between 1800 and 3000 m in oak-pine (*Quercus* spp. and *Pinus* spp.) habitat with bunchgrass (*Muhlenbergia* spp.) ground cover.

Colima Warblers also were observed in their winter range in west-central Mexico during February 1983. We found eight Colima Warblers in Jalisco and Michoacan in oak-conifer habitat at 2400 to 3000 m elevation. These are the first published observations of Colima Warblers in western Mexico since 1963.

Breeding habitat at 180 plots where Colima Warblers were sighted was compared with 24 unoccupied plots of oak-pine vegetation. Colima Warblers used sites where the trees were shorter ($\bar{x}$ = 8.1 ± 4.0 [SD] m), the shrubs were taller ($\bar{x}$ = 2.30 ± 0.80 m), and the ground vegetation was taller ($\bar{x}$ = 0.63 ± 0.29 m) relative to unoccupied sites. The species used areas where the shrub cover was greater ($\bar{x}$ = 42 ± 22%) and the ground vegetation (≤1 m tall) cover was greater ($\bar{x}$ = 51 ± 22%) relative to unoccupied plots.

Colima Warblers often foraged and perched in the dense, lower vegetation in both breeding and winter habitats. The tree, shrub, and ground vegetation strata were often contiguous. Colima Warblers were found in undisturbed sites and in areas of light-to-moderate grazing, selective logging, and burning. *Received 19 Dec. 1988, accepted 9 March 1989.*

The Colima Warbler (*Vermivora crissalis*) is known during the breeding season from only a few locations in northeastern Mexico in the states of Coahuila (Bangs 1925, Burleigh and Lowery 1942, Urban 1959, Ely 1962, Wauer and Ligon 1977), Nuevo Leon (Miller et al. 1957, Hubbard and Crossin 1974), and Tamaulipas (Griscom 1923, Bangs 1925). It is known

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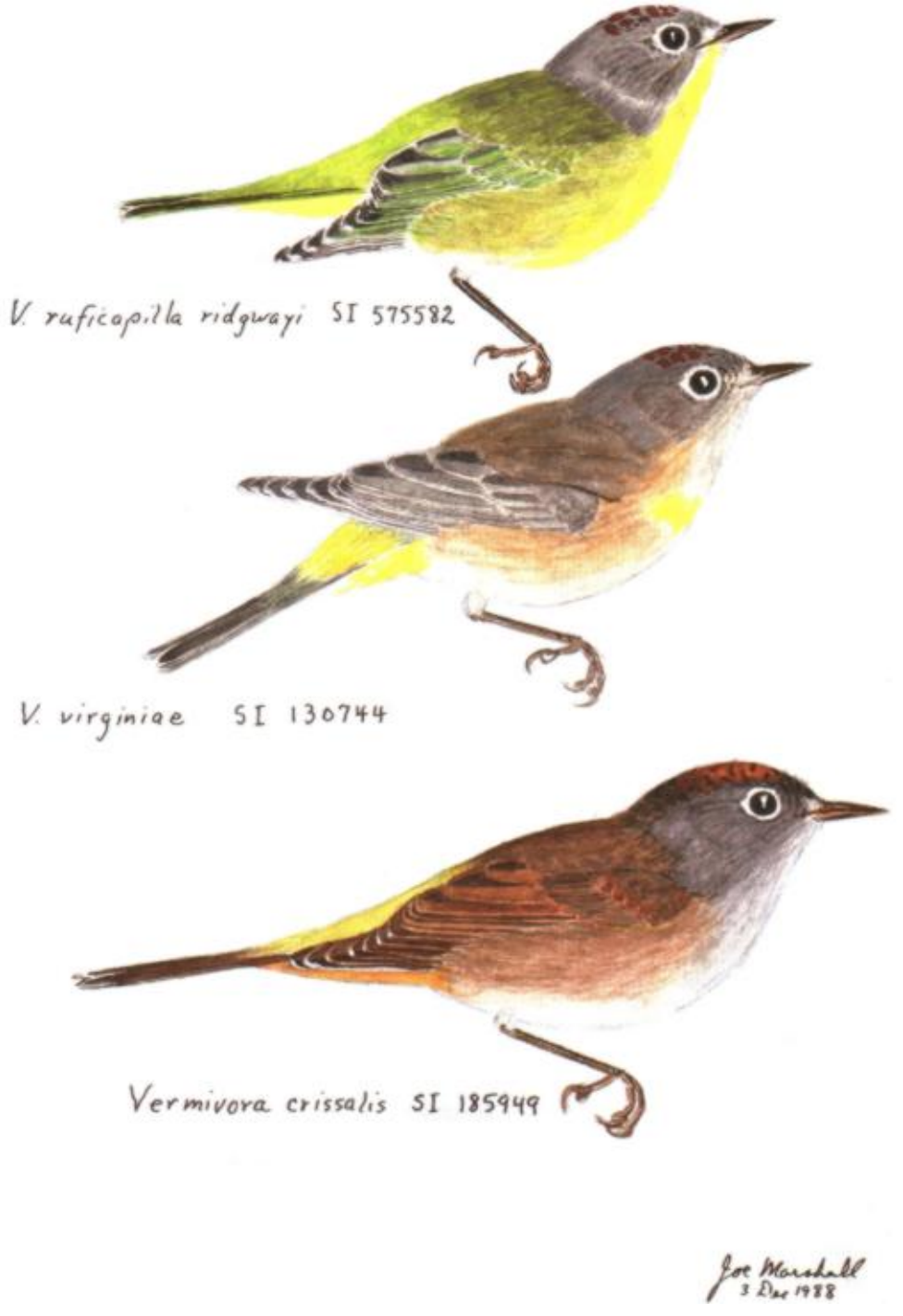

The Colima Warbler (*Vermivora crissalis*) compared with its close relatives, as seen in adult males in fresh fall plumage from the Smithsonian Institution collection. From top to bottom are the Nashville Warbler, (*V. ruficapilla*), Virginia's Warbler (*V. virginiae*), and the Colima Warbler. These three species are similar in their "plisk" call-note, their habitat, and their nest upon the ground. Notice the large size and comparatively long tail of the Colima Warbler and the gray overlying the green back of the Nashville Warbler, whose yellowish rump distinguishes it as the western race, *ridgwayi*. Painting by Joe T. Marshall.

from a single location in the United States—the Chisos Mountains of Texas (Van Tyne 1929, Wauer 1973).

The American Ornithologists' Union (AOU 1983) summarizes the Colima Warbler breeding habitat as thickets and scrubby woodland, primarily oak (*Quercus* spp.), maple (*Acer* spp.), cypress (*Cupressus arizonica*), and juniper (*Juniperus* spp.) scrub in hilly areas. Descriptions of the Colima Warbler's breeding habitat in Mexico are limited (Burleigh and Lowery 1942, Ely 1962, Hubbard and Crossin 1974). The habitat, insectivorous food habits, and ground nests of Colima Warblers in Texas are described by Van Tyne (1936), Van Tyne and Sutton (1937), Blake (1949), Snyder (1957), Gehlbach (1967), Wauer (1973, 1979), and Oberholser and Kincaid (1974).

The Colima Warbler winters in west-central Mexico from southern Sinaloa south through Jalisco, Colima, and Michoacan to Guerrero (AOU 1983). The last published record of a Colima Warbler in west-central Mexico was by Schaldach (1963), who collected one bird during October, 1958, in Jalisco in fir (*Abies religiosa*) forest. Winter habitat includes open woodland, thickets, and scrub (AOU 1983).

The Colima Warbler is closely related to the Nashville Warbler (*V. ruficapilla*) and the Virginia's Warbler (*V. virginiae*; see Frontispiece); together they constitute a superspecies (Mengel 1964, Stein 1968, Mayr and Short 1970, Brush and Johnson 1976, AOU 1983). Phillips et al. (1964) considered them a single species.

During nine weeks from April to June 1983, Lanning and Marshall searched for Colima Warblers in the Sierra Madre Oriental in northeastern Mexico and Texas. Their objectives were to locate and observe these birds in selected areas throughout their previously established and suspected breeding range, describe their habitat, and evaluate threats to their habitat. During two weeks in February 1983, Lanning and Shiflett located and observed Colima Warblers in parts of the warbler's known winter range in the Trans-volcanic Belt in Jalisco and Michoacan.

STUDY AREAS

The Sierra Madre Oriental is the prominent mountain range in northeastern Mexico. The northern half of this range, terminating in western Texas, is a series of isolated mountains and ridges <3000 m in elevation. The southern half of this range, extending to the Trans-volcanic Belt of central Mexico, is a nearly continuous massif ranging from 50 to 100 km wide, with elevations up to 3700 m. In the Trans-volcanic Belt in Jalisco and Michoacan there are numerous volcanic peaks, some with elevations >4000 m.

Three major biotic communities occur in these montane areas (classification in Brown et al. 1979, and a thorough description in Brown 1982): Interior Chaparral consists of short oaks and a variety of other shrubs and compact trees; Madrean Evergreen Woodland is

dominated by a variety of oaks and pines (*Pinus* spp.); and Madrean Montane Conifer Forest is dominated by pines and other conifers. The biotic communities intergrade locally.

The climate in the Sierra Madre Oriental during the spring is warm and sporadically wet. Temperatures generally range between 10 and 25°C. In southeastern Coahuila, 71% of the precipitation (390 mm at San Antonio de las Alazanas) falls between May and October (Instituto de Geografia, Univ. Nac. Auton. Mex. 1975). Daily maximum temperatures in the Chisos Mountains average about 30°C during the five warmest months, and most precipitation comes between May and October (400 mm average in the Chisos Basin; Wauer 1973). In the Trans-volcanic Belt, winters are usually dry with temperatures between −5 and 25°C.

METHODS

Before field work we surveyed museum specimens and pertinent literature to locate Colima Warbler records. We communicated with individuals who had observed Colima Warblers in Mexico.

Breeding season survey.—From April to June we visited locations and habitats where Colima Warblers had been collected or observed, as well as additional regions and habitats where they had not been observed. During the first five hours each day, we looked for birds while we walked along trails, roads, ridges, valleys, and up and down slopes. Each time we located a Colima Warbler, we collected data on its activity, position in the habitat, geographic location, and the characteristics of the terrain and vegetation. Elevations (above sea level) were determined from topographic maps (Cartas Topografica; 1:250,000 scale). We measured slope direction with a compass and estimated slope angle. We visually estimated the location and extent of oak and conifer vegetation with the aid of vegetation maps (Cartas Uso del Suelo; 1:1,000,000 scale). The series of topographic and vegetation maps were obtained from the Secretaria de Programacion y Presupuesto of the Mexican government.

We described vegetation characteristics at 180 Colima Warbler sites, with each vegetation plot centered at the point where we first observed the bird. Canopy coverage of trees (>3 cm diameter at breast height [dbh] and >1 m tall) was measured with a spherical densiometer (Lemmon 1956). We took sightings in four directions from the center of each plot and averaged the results to provide a measurement of tree canopy cover within a 90° arc over the plot. We measured the height of the tree canopy foliage, using a tape measure for heights ≤4 m and visual estimates for heights >4 m.

The height of shrubs (≤3 cm dbh and >1 m tall) and ground vegetation (all the plants ≤1 m tall) and depth of litter layer were measured within a 2 m radius around the center of the plot. We made visual estimates of the canopy cover of each of the three layers.

We assessed the same vegetation characteristics with the same methods at 24 plots in areas where we were unable to locate Colima Warblers. We located the center of each vegetation plot in an area that appeared to be representative of the surrounding vegetation and terrain. All of the unoccupied plots were in oak-pine vegetation that contained shrubs and trees and within 4 km from where we observed Colima Warblers and at ≥1700 m elevation.

We compared vegetation characteristics at occupied plots and unoccupied plots using two-tailed *t*-tests. Before statistical comparison, the data were transformed (where necessary) to correct heteroscedasticity (Sokal and Rohlf 1981).

Winter observations.—During two weeks in February, we searched for Colima Warblers in and near areas where they previously were observed or collected. We looked for birds, usually in the morning, while walking along roads and trails. We collected data on each

Colima Warbler's activity and on the basic characteristics of the terrain and vegetation in the vicinity of the bird. We visually estimated the extent of oak and conifer vegetation within the winter range of the Colima Warbler with the aid of the vegetation maps from the Mexican government.

RESULTS

Breeding season survey.—We located 167 Colima Warblers in oak-pine habitat in the four states where they previously were known to occur (Fig. 1). We sighted 117 birds on nine different mountains (1800 to 3000-m elevation) throughout Coahuila, 35 birds along the main massif of the Sierra Madre Oriental (2150–2900 m) in southern Nuevo Leon, eight birds in the Sierra Madre Oriental (2200–2900 m) in southwestern Tamaulipas, and seven birds in the Chisos Mountains (2100–2300 m) in western Texas. Singing Colima Warblers were present in all of these areas.

We observed 13 Colima Warblers in oak-pine habitat in two states (Fig. 1) that were not part of their previously known breeding range. We found a pair of birds, including a singing male, on 17 May in the Sierra Catorce (2800 m) in northern San Luis Potosi. We observed four birds, including one singing male, on 12 May in the Sierra Concepcion del Oro (2600–2800 m) in northeastern Zacatecas. The following day, we found seven birds, including three singing males, in a part of the Sierra Encarnacion (2700–2800 m) in Zacatecas.

We checked several other areas surrounding the known geographic and elevation range of the species and were unable to locate additional Colima Warblers (Fig. 1). We searched two mountains in oak-pine vegetation west of the species' range, in the Sierra Rica (2000–2400 m) in northern Chihuahua and in the Sierra Parras (1900–2700 m) in southern Coahuila. We searched in the high pine forest (3400–3700 m), above the warbler's elevational range, on Cerro Potosi in Nuevo Leon. We examined four locations in oak-pine woodland and forest on the relatively humid and lush lower slopes of the Sierra Madre Oriental, east and south of the species' range: one site (1300–1600 m) in northern Coahuila, two sites (1000–1700 m) in southern Nuevo Leon, and one site (1300 m) in southwestern Tamaulipas.

Colima Warblers seemed to be common birds in suitable oak-pine habitat throughout much of their geographic and elevational range. During our morning transects (totaling 110 km) through chaparral, woodland, and forest vegetation, we observed an average of one Colima Warbler per 0.6 ± 0.7 [SD] km of transect. When the warblers were seen frequently, they were spaced about 100 to 200 m apart. We did not find them in meadows and areas that had been cleared for agriculture or dwellings.

Eight other species of breeding birds were common in the oak-pine

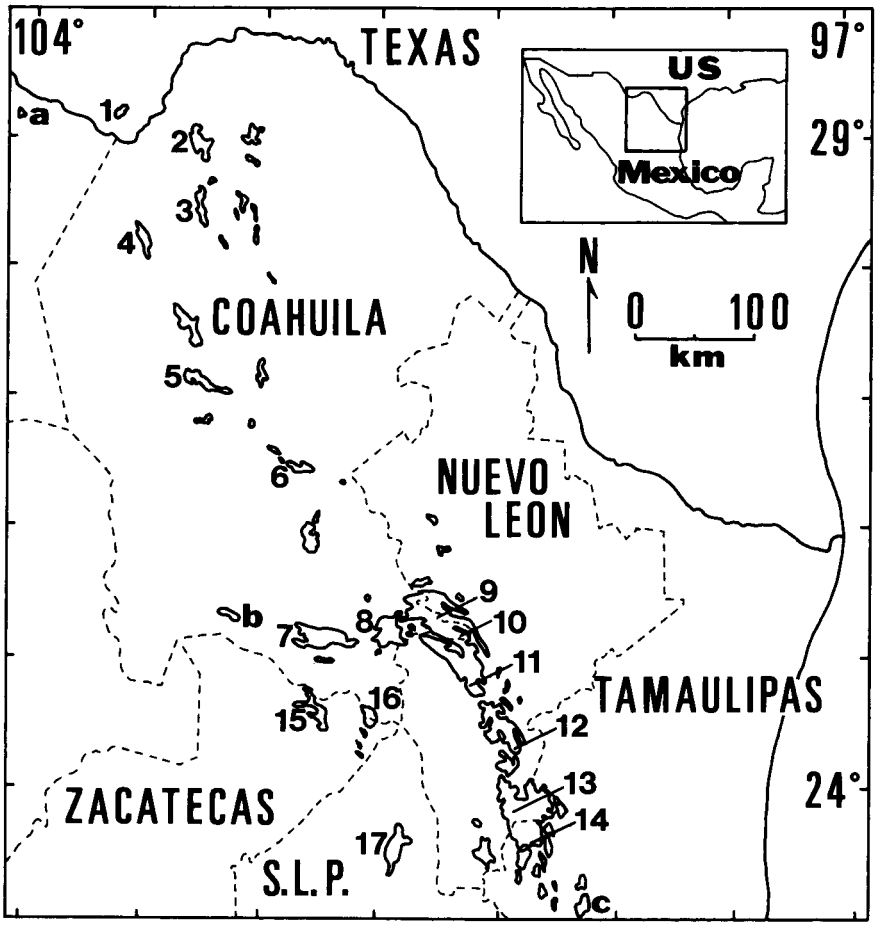

FIG. 1. Map of northeastern Mexico and adjacent United States showing the range of the Colima Warbler during the breeding season. Areas enclosed by solid lines indicate oak and conifer vegetation above 1800 m elevation. Numbers indicate areas where we observed Colima Warblers during spring 1983: (1) Chisos Mountains, (2) Sierra (S.) del Carmen, (3) S. la Encantada, (4) S. del Pino, (5) S. la Madera, (6) S. del San Marcos, (7) S. Guadalupe, (8) S. Zapaliname, (9) S. la Viga and S. Potrero de Abrego, (10) S. San Antonio and S. la Marta, (11) Cerro Potosi, (12) S. 4 km NE of Ascension, (13) S. Pena Nevada, (14) S. 5 km S and 10–15 km NE of Miquihuana, (15) S. 13 km W of Concepcion del Oro, (16) S. Encarnacion, and (17) S. Catorce in San Luis Potosi (S.L.P.). Letters indicate areas that were outside the warbler's breeding range: (a) S. Rica in Chihuahua, (b) S. Parras, and (c) S. de Guatemala.

habitat where we observed Colima Warblers: Broad-tailed Hummingbird (*Selasphorus platycercus*), Northern Flicker (*Colaptes auratus*), Gray-breasted Jay (*Aphelocoma ultramarina*), Bushtit (*Psaltriparus minimus*), Bewick's Wren (*Thryomanes bewickii*), Hutton's Vireo (*Vireo huttoni*), Rufous-sided Towhee (*Pipilo erythrophthalmus*), and Yellow-eyed Junco (*Junco phaeonotus*). All were observed <1 km from Colima Warblers and on at least 21 of the 29 days that we saw Colima Warblers. The Brown-headed Cowbird (*Molothrus ater*), a potential brood parasite, was observed <1 km from Colima Warblers on only one of those days.

When first observed, 99 of the Colima Warblers were in oaks, 32 in pines, and the remaining 49 in other conifers and broad-leaf trees and shrubs. The warblers were either perched on or foraging among the vegetation. Ninety-two of the birds were singing. Most (N = 173) birds were surrounded by vegetation; only seven were first observed while perched on the highest, most exposed twigs. The birds were between 0.9 and 14 m ($\bar{x}$ = 4.2 ± 2.3 m) above ground, in trees (N = 150) and shrubs (N = 30) that were 1 to 22 m ($\bar{x}$ = 6.3 ± 3.5 m) tall. When foraging, Colima Warblers were usually gleaning small arthropods from leaves, twigs, and flowers. They occasionally caught flying insects.

Colima Warblers were observed at elevations between 1800 and 3000 m ($\bar{x}$ = 2505 ± 250 m). They were observed on slopes that varied from 0 to 90° ($\bar{x}$ = 30 ± 18°). Eighty-three warblers (47%) were sighted on northwestern, northern, and northeastern slopes. Slope direction where Colima Warblers were sighted was not uniformly distributed among the eight major compass points (N = 177 slopes >0°, χ^2 = 25.89, df = 7, P < 0.001). The oak-pine habitat used by the Colima Warblers was more abundant on northern exposures than on the more arid southern exposures.

Oaks were found in 178 of the 180 plots containing Colima Warblers (Table 1). The following species were identified by J. Tucker (pers. comm.; specimens collected by Marshall and deposited in the herbarium at the Univ. of Calif. at Davis): *Quercus glaucoides, Q. gravesii, Q. grisea, Q. hypoxantha, Q. intricata, Q. pringlei,* and *Q. saltillensis.* Pines and grasses, especially bunchgrasses (*Muhlenbergia* spp.), were the next most abundant plant categories and were each found in two-thirds of the plots (Table 1).

There were significant differences in the structure of the vegetation between the 180 plots containing Colima Warblers and the 24 unoccupied plots containing oak-pine vegetation (Table 2). Warblers used sites where the trees were shorter (P = 0.002), the shrubs were taller (P = 0.002), the ground vegetation (≤1 m tall) was taller (P < 0.001), and the litter (leaves and twigs) were deeper (P = 0.016) relative to unoccupied plots. The warblers used sites where the shrub cover was greater (P < 0.001) and

TABLE 1
PLANTS THAT OCCURRED ON AT LEAST 5% (9) OF THE 180 PLOTS WITH COLIMA WARBLERS

Plant category (representative species)	Percent of plots
Oak (*Quercus gravesii, Q. glaucoides, Q. pringlei*[a])	99
Grasses (especially *Muhlenbergia* spp. bunchgrasses)	68
Pine (*Pinus cembroides, P. montezumae, P. ponderosa*)	67
Annual flowering plants (Class Dicotyledonae)	44
Madrone (*Arbutus xalapensis*)	43
Juniper (*Juniperus deppeana, J. flaccida, J. occidentalis*)	23
Douglas-fir (*Pseudotsuga menziesii*)	22
Beargrass (*Nolina erumpens*)	17
Agave (*Agave macroculnis, A. palmeri, A. scabra*)	15
Sumac (*Rhus trilobata, R. virens*)	15
Arizona Cypress (*Cupressus arizonica*)	14
Ferns (Class Pteropsida)	12
Chokecherry (*Prunus serotina*)	12
Yucca (*Yucca baccata, Y. elata*)	11
Mountain-mahogany (*Cercocarpus montanus*)	10
Sotol (*Dasylirion wheeleri*)	9
Quaking Aspen (*Populus tremuloides*)	9
Buckbrush (*Ceanothus caeruleus, C. fendleri*)	8
Club Mosses (Class Lycopsida)	7
White Fir (*Abies vejari*)	6
Silktassel (*Garrya ovata*)	5

[a] See text for additional species of oaks.

the ground vegetation cover, especially bunchgrass, was greater ($P < 0.001$) relative to unoccupied plots. The tree, shrub, and ground vegetation strata in Colima Warbler habitat were often contiguous, with nearly continuous foliage from the ground to the top of the trees. In the plots where Colima Warblers did not occur, there was less shrub and ground vegetation cover, and the different vegetation strata were more disjunct.

Contiguous oak and conifer vegetation that contained Colima Warblers varied from habitat islands as small as 10 km^2 on isolated mountains to large expanses as large as 2000 m^2 in the main massif of the Sierra Madre Oriental.

Winter observations.—We found five Colima Warblers at two locations (2400 and 3000 m) on the Volcanes de Colima (19°35′N, 103°35′W) in Jalisco. We found three Colima Warblers at two locations (2400 and 2500 m) on Cerro Tancitaro (19°25′N, 102°20′W) in Michoacan. We did not hear any Colima Warblers sing, but we did hear their sharp call notes. We saw Colima Warblers that appeared to be alone and individuals in mixed-species flocks.

TABLE 2

CHARACTERISTICS OF THE VEGETATION IN 180 PLOTS WITH COLIMA WARBLERS AND 24 PLOTS WITHOUT COLIMA WARBLERS

Vegetation characteristic	Plots with Colima Warblers Mean ± SD	Plots without Colima Warblers Mean ± SD	P[a]
Tree canopy height[b] (m)	8.1 ± 4.0	11.6 ± 5.5	0.002
Shrub height[c] (m)	2.30 ± 0.80	1.75 ± 1.06	0.002
Ground vegetation height[d] (m)	0.63 ± 0.29	0.40 ± 0.26	<0.001
Litter depth (m)	0.06 ± 0.04	0.04 ± 0.03	0.016
Tree canopy cover (%)	70 ± 21	71 ± 24	0.660
Shrub cover (%)	42 ± 22	23 ± 21	<0.001
Ground vegetation cover (%)	51 ± 22	33 ± 23	<0.001
Litter cover (%)	65 ± 20	71 ± 21	0.138

[a] Two-tailed *t*-tests.
[b] Tree canopy = vegetation >3 cm dbh and >1 m tall.
[c] Shrub layer = vegetation ≤3 cm dbh and >1 m tall.
[d] Ground vegetation = all the plants ≤1 m tall.

The eight Colima Warblers were observed at heights between 0.1 and 6.0 m ($\bar{x}$ = 2.6 ± 2.2 m) in the lush understory in oak-conifer habitat with an average tree canopy height of 16 ± 7 m. Tree canopy cover ($\bar{x}$ = 54 ± 24%), shrub cover ($\bar{x}$ = 53 ± 35%), and ground vegetation cover ($\bar{x}$ = 34 ± 19%) were similar to that found in the breeding season habitat. The three strata in the winter habitat were often contiguous, as they were in the breeding season habitat.

Nine species of birds were common in the lush understory of the oak-conifer woodland and forest where we observed Colima Warblers: White-eared Hummingbird (*Hylocharis leucotis*), House Wren (*Troglodytes aedon*), Russet Nightingale-Thrush (*Catharus occidentalis*), McGillivray's Warbler (*Oporornis tolmiei*), Red Warbler (*Ergaticus ruber*), Golden-browed Warbler (*Basileuterus belli*), Rufous-capped Brush-Finch (*Atlapetes pileatus*), Green-striped Brush-Finch (*A. virenticeps*), and Yellow-eyed Junco. All were observed <1 km from Colima Warblers and on at least three of the four days that we saw Colima Warblers.

Colima Warblers accounted for 2.1% of the 388 wood warblers of 19 species that we observed throughout the oak-conifer woodland and forest; they ranked 13th in abundance. The three most common warblers were Orange-crowned Warblers (*Vermivora ruficapilla*; N = 141), Yellow-rumped Warblers (*Dendroica coronata*; N = 76), and Red Warblers (N = 22).

At least 20 observations (including three specimens) of Colima Warblers

have been recorded in central Mexico between Schaldach's (1963) record and our 1983 observations. There were 19 observations of single birds between September and May in the oak-conifer woodland and forest of central Mexico (1700–3000 m elevation): seven in Distrito Federal, nine in Jalisco, two in Mexico, and one in Michoacan (P. Alden, F. M. Garcia, R. L. Hutto, A. R. Phillips, G. D. Schnell, J. T. Shiflett, and R. H. Wauer, pers. comms.). In addition, Hutto (pers. comm.) observed a Colima Warbler in riparian gallery forest at 640 m elevation in Colima in February 1975.

DISCUSSION

Range and relative abundance.—Our spring field work covered the entire known breeding range of the Colima Warbler. Most of our observations of breeding Colima Warblers were within their previously known distribution. The observations in Zacatecas and San Luis Potosi were apparently new state records. These new sightings were in similar habitat and within 100 km of the warblers' distribution in the adjacent states of Coahuila and Nuevo Leon. There is no evidence that breeding Colima Warblers occur in the oak-pine vegetation south of their known southern limit in Tamaulipas. Colima Warblers have not been found in the Sierra de Guatemala in southern Tamaulipas (Fig. 1), which contains oak chaparral and oak-pine woodland (Robins and Heed 1951, Webster 1974).

Where the Colima Warbler was common during the breeding season, it was often the major representative of the Parulinae. Painted Redstarts (*Myioborus pictus*) occurred in the Colima Warbler habitats where oaks were large and dense. Olive Warblers (*Peucedramus taeniatus*) tended to reside where there were tall pines and other tall conifers. Crescent-chested Warblers (*Vermivora superciliosa*) were common only in the southern half of the Colima Warbler's geographic breeding range and were usually at elevations above most of the Colima Warblers, in cool-moist undergrowth under conifers and quaking aspens (*Populus tremuloides*).

Current observations of the Colima Warbler during the winter season are absent from two recent compendia on nearctic migrants in the Neotropics. Keast and Morton (1980) make no mention of observations of Colima Warblers, not even in the chapter on winter habitat distribution of migratory land birds in western Mexico (Hutto 1980). Rappole et al. (1983) presented only general information on the Colima Warbler, but listed it as most vulnerable in winter and likely to show serious decline within the next decade because of small population size and restricted range (ibid., p. 91). During our communications with observers, we learned of sightings of 20 Colima Warblers in west-central Mexico between 1959 and 1982.

Wintering Colima Warblers were less conspicuous than they were during the breeding season. The paucity of observations of wintering Colima Warblers may be partly explained by their seasonal dispersal from the small breeding range to the larger winter range. We estimated the area of oak and conifer vegetation was 12,000 km^2 in the breeding range and 72,000 km^2 in the winter range. We observed four wintering Colima Warblers per week versus 20 per week in the breeding range, but the oak and conifer vegetation in the winter range covered an area six times larger than the area of similar vegetation in the breeding range.

Breeding habitat.—In Texas, Van Tyne (1936) observed the species frequenting young maples (*Acer grandidentatum*) and deciduous oaks and perching as high as 6 m above the ground. Wauer (1973, 1979) found the species associated with oak–pinyon pine (*P. cembroides*)–juniper and oak–maple–Arizona Cypress environments at elevations between 1700 and 2370 m.

There are only limited descriptions of the Colima Warbler's breeding habitat in Mexico. In southeastern Coahuila, they are a common breeder in chaparral interspersed with pines 4.5 to 6.0 m tall, at elevations from 2180 to 3180 m; in some areas they are common in low encinal (oak-pine woodland; Brown 1982) bordering conifer forest (Ely 1962). Burleigh and Lowery (1942) considered these warblers fairly common above 2270 m on the steep slopes above Diamante Pass in southeastern Coahuila, where singing males have been observed feeding in small oaks. At La Esperanza, Nuevo Leon, Hubbard and Crossin (1974) found Colima Warblers apparently taking nectar from agave (*Agave* sp.) flowers in an area at 2730 m with pines, yuccas (*Yucca* spp.), and scrub oak.

Our observations corroborate and expand these published habitat descriptions. Colima Warblers often foraged and perched in the dense, lower vegetation. Bunchgrass, along with litter, exposed roots, and rocks, provided suitable cover for nests. We observed Colima Warblers and measured features of the habitat in the vicinity of the birds; we did not actively search for the warblers' nests.

We found Colima Warblers in suitable habitat, containing a combination of oak and pine trees, oak shrubs, and bunchgrasses that was present on every mountain of sufficient stature to nourish woodland and forest. The habitat was often on the northern slopes and frequently at the higher elevations of the chaparral and woodland communities and the lower elevations of the pine-conifer forest. Suitable habitat was only in a narrow elevational band in some areas. However, other areas of suitable oak-pine habitat were scattered at various elevations and on diverse exposures of the rugged Sierra Madre Oriental.

Colima Warblers were in undisturbed sites, but they were also found

in areas of light-to-moderate grazing (by domestic animals), selective logging, and burning. Such disturbances to the habitat seemed to be tolerated by the warblers. In some areas, grazing and selective logging seemed to perpetuate the oak chaparral and oak-pine woodland, based on Lanning's (unpubl. data) observations in Coahuila and Nuevo Leon between 1976 and 1986. Colima Warblers were not found in heavily disturbed areas, where the shrubs and ground vegetation under the trees had been destroyed by grazing or recent fires, or in areas that had been cleared for agriculture or dwellings.

Colima Warblers inhabit an area of northeastern Mexico and western Texas that is remote and sparsely populated by humans. Limited areas of oak and conifer vegetation have been cleared for pastures, crops, and dwellings, and some additional areas will undoubtedly be cleared in the future. Most of the habitat occupied by Colima Warblers appears to be too rugged, remote, and unsuitable for agriculture and will only be used for grazing and selective logging. Based on current land-use patterns and the ruggedness of the terrain, there will be suitable habitat in northeastern Mexico and western Texas for breeding Colima Warblers for the foreseeable future.

Winter habitat.—Descriptions of the Colima Warbler's winter habitat is limited to the AOU (1983) general description of woodland, thickets, and scrub and to Schaldach's (1963) specimen from fir forest. Our few observations affirm that Colima Warblers are found in woodland and forest containing oaks, pines, and fir. Further research is needed on what percentage of the available oak and conifer vegetation within the warblers' winter range is used by the Colima Warblers.

We observed wintering Colima Warblers in woodland and forest that had been subjected to limited grazing and selective logging. Several of Mexico's major population centers are in the highlands of central Mexico. Forested areas have been destroyed and replaced by cities and agricultural areas. The extant woodlands and forests near human settlements have been subject to intensive grazing, burning, and logging, whereas more remote montane regions appeared to be less disturbed. The effect of the habitat disturbances and habitat destruction on wintering Colima Warblers needs further study.

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