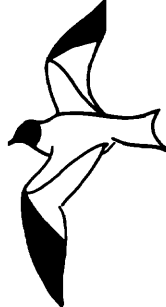


WESTERN BIRDS



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COSTA'S HUMMINGBIRD: ITS DISTRIBUTION AND STATUS

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Although Costa's Hummingbird (*Calypte costae*) is a common species of the arid Southwest, its status remains poorly understood or poorly documented in much of its range. This is due in part to the female and young of this species being frequently inseparable in the field by sight from those of Black-chinned (*Archilochus alexandri*), Ruby-throated (*Archilochus colubris*), and, to a certain extent, Anna's (*Calypte anna*) hummingbirds. The problem is further compounded by recent range expansions and by apparent resurgence into some areas of historic occurrence where, until recently, there had been few records since the late 1800s. Aids to identification recently published by Baltosser (1987) and the references cited therein provide sufficient information to identify virtually any bird in the hand and even many seen at close distances. In addition, the call of Costa's Hummingbird is diagnostic (Stiles 1971) and being learned by many observers. In time, therefore, some of the inherent mystery associated with this and similar species may dissipate.

The Check-list of North American Birds (A.O.U. 1983) lists the breeding distribution of Costa's Hummingbird as extending from central California (north to Monterey, Merced, and Inyo counties), southern Nevada, and southwestern Utah (Beaverdam Mountains) south to southern Baja California (including the Channel Islands off California and islands off both coasts of Baja California), Sonora (including Tiburon and San Esteban islands), southern Arizona, and southwestern New Mexico. The same source lists the winter range as southern California and southern Arizona south to Sinaloa, casually north to southwestern British Columbia (Vancouver Island, sight record), western Washington (actual data lacking—assumed to occur), Oregon, central Nevada (Toiyabe Mountains), and northern Utah, and east to central Texas (Hays Co., also sight records east to Aransas Co.). Here I document the status and distribution (including seasonal aspects) of Costa's Hummingbird and report extensions to its known range.

METHODS

The status of Costa's Hummingbird as presented is based on over 500 distinct localities of occurrence (i.e., areas separated by 10-20 km) and on over 1,500 records consisting of three types of data, which I have arranged hierarchically (specimens, photographs, and sight records). Presentation of the data in this way should enable readers to formulate their own opinion regarding the species' status and, I hope, will induce some to fill in gaps or to validate occurrences at more definitive levels.

I have placed the most faith in specimen evidence (museum abbreviations explained in the acknowledgments), which includes study skins or, in some instances, select rectrices plucked and preserved from birds that were subsequently released (e.g., many of the Guadalupe Canyon records from extreme southwestern New Mexico) or voice recordings (e.g., recordings from the San Francisco area by L. F. Baptista). Photographs can occasionally be misleading, so I have not equated them with specimens. The problems associated with sight records have been discussed by Van Tyne (1956) and Zimmerman (1973); sight records suffer primarily from their lack of tangible evidence for subsequent scrutiny. I have therefore relegated them to the least definitive category of verification. Most sight records I include are of adult males, although some of adult females and young males showing metallic purple/violet flecks on their chins or sight records in conjunction with call notes (heard but not recorded) have occasionally been included.

Throughout, I present the most fundamental aspects of the distribution and status of the species first, then discuss peripheral and vagrant occurrences or, in some cases, the apparent resurgence of the species into an area following an absence of decades. Distributional accounts are arranged by state/province and depicted by region and degree of verification. Mapped locations, based on records through 1987, are as accurate as logistically possible, with more than 90% of all localities plotted. The relatively few records not depicted were lumped with adjacent localities (i.e., locations within ca. 10-20 km). Stippling is used to signify the normal range of the species, while occurrences outside shaded areas are of a more peripheral nature. Maps showing seasonal aspects of occurrence (Appendices A-D), while computerized by degree of verification, have not been depicted in this way because it was not feasible on maps of this scale.

BREEDING

The breeding range of Costa's Hummingbird (Figure 1) occupies much of the Lower Sonoran and limited portions of the Upper Sonoran life zones of western North America. The species nests from below sea level (Death Valley, California) to about 2000 m in some desert mountain ranges (Garrett and Dunn 1981). A. W. Anthony's report of nesting to 2,273 m (7500 feet) in the Sierra San Pedro Martir of Baja California Norte, cited by Brewster (1902) and Grinnell (1928), is exceptional if accurate.

Breeding occurs earlier in southern regions such as Baja California Sur, where it extends from late January through March (Brewster 1902). At intermediate latitudes the nesting period is often the same (e.g., many

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southern California and southern Arizona records) or slightly delayed (e.g., Monson 1951). At higher latitudes, as from the eastern Mojave Desert and Owens Valley to the lower slopes of the White Mountains, nesting may ex-

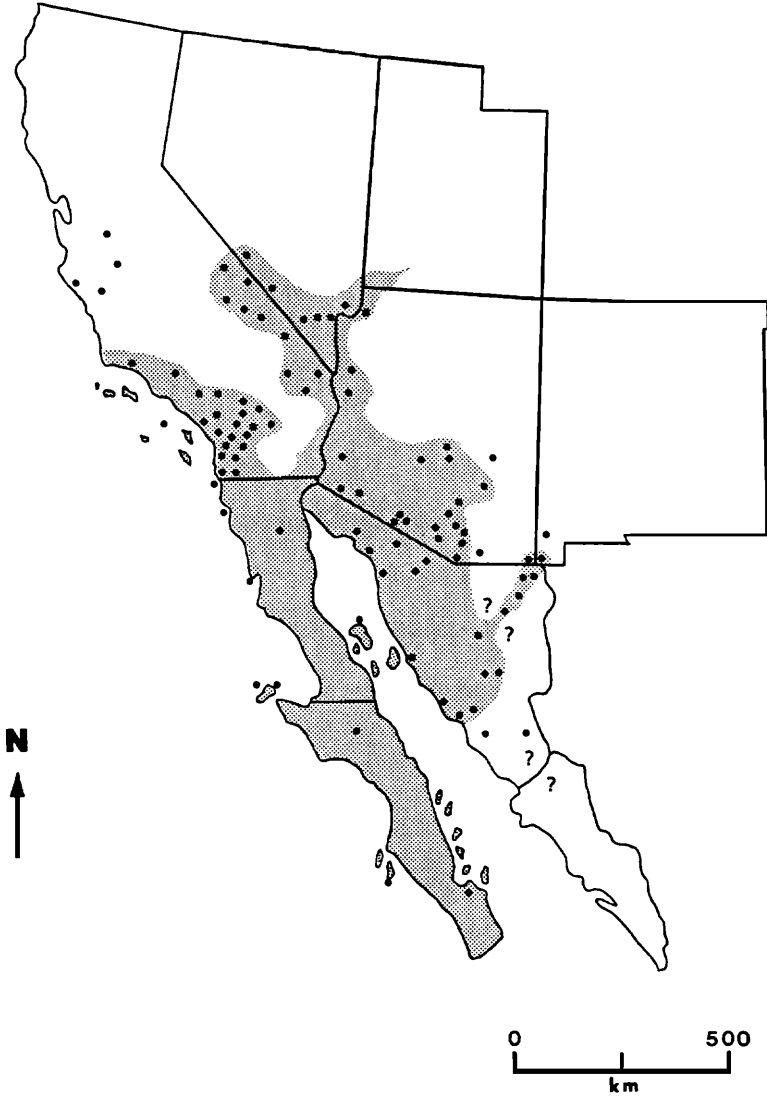


Figure 1. Breeding range of Costa's Hummingbird based on actual evidence (dots) and on extrapolation (shaded areas).

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tend from early March through late July (Garrett and Dunn 1981). Extreme dates range from 17 January on Santa Margarita Island in Baja California Sur, where Bryant observed a nest containing large young (Brewster 1902), to early July at Sabino Canyon, Pima Co., southern Arizona (young in nest, Witzeman and Stejskal 1987) and to mid-July at Bixby Canyon, Monterey Co., along the California coast (LeValley and Evens 1981).

Nesting in peripheral areas such as Bixby Canyon is frequently delayed in comparison to that within the normal range of the species. In other areas of peripheral nesting such as Guadalupe Canyon (Cochise Co., Arizona, and Hidalgo Co., New Mexico), nesting extends into early June (Baltosser 1986, 1989). Many if not most nesting attempts after late April I suspect to be second nestings, and thus peripheral nestings perhaps represent attempts after subsequent dispersal to new areas.

DISTRIBUTION

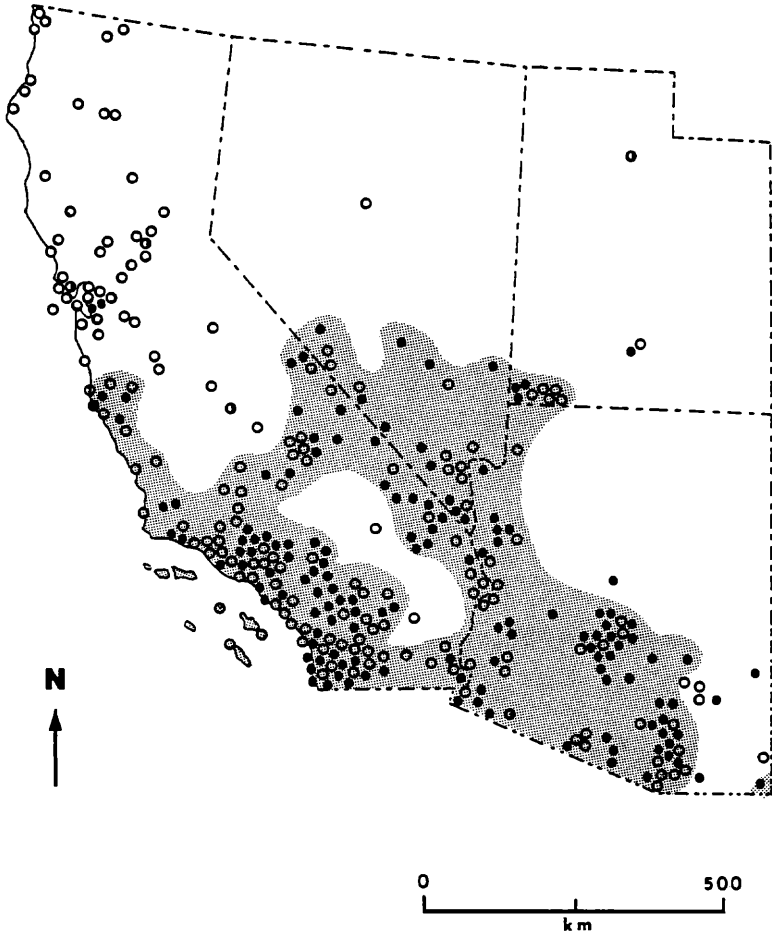
California

Costa's Hummingbird is resident, although during late fall and early winter in relatively low numbers, along the coast from southeastern Santa Barbara County south through San Diego County, with some birds resident in the southern and southeastern desert regions of San Bernardino, Riverside, and Imperial counties (including the Colorado River Valley) (Figure 2). From mid-February to early April the species occurs in all of the former areas (including offshore islands), but by this time numbers have been augmented by birds returning from wintering areas. By mid-April the species is also found in the mountains of the eastern Mojave Desert (Kingston Range, Ivanpah Mountains, New York Mountains, and Providence Mountains) and north to central and northern Inyo County (the Owens Valley and the lower slopes of the White Mountains), with a few birds in these areas lingering into July and perhaps longer.

The status of the species in central and northern California is in a state of flux. In the past, the species was believed to be restricted to the hills along the western edge of the San Joaquin Valley north to Stanislaus County, where it nests (McCaskie et al. 1979). Grinnell and Miller (1944), however, cited records as far northwest as Hayward (1875) and Oakland (1890), Alameda County, and within the last decade many Costa's Hummingbirds have been sighted north of Stanislaus County. Recent records for central and northern California are most frequent during winter (possible sampling bias resulting from Christmas Bird Counts) and spring and cluster around the San Francisco Bay and Monterey areas. There are numerous recent records of spring vagrants, post-breeding vagrants, and winter vagrants along the coast from Santa Cruz County north to Del Norte County and inland as far east as Mariposa, Placer, and Nevada counties and north to Siskiyou County. Costa's Hummingbirds have now been reported from all but 19 of the 58 California counties, being absent from areas in the northeast at the edge of the Great Basin and, with the exception of a single bird in Yosemite National Park, Mariposa County (LeValley and Evens 1983), from the Sierra Nevada. While the nonbreeding range of Costa's Hummingbird in northern California has spread beyond the western edge of the San Joaquin Valley, virtually all

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of these records are of vagrants; the species has not yet extended its normal breeding range to the northwest.



DEGREE OF VERIFICATION

- SPECIMEN
- ◐ PHOTOGRAPH
- SIGHT

Figure 2. Distribution of Costa's Hummingbird in the southwestern United States showing the normal occurrence of the species, all seasons combined (shaded areas), and its documented presence (dots). Filled circles, specimens; half-filled circles, photographs; open circles, sightings.

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Nevada

Costa's Hummingbird is probably not a true winter resident in Nevada, contrary to the A.O.U. (1983), as there are no December or January records. By early February, however, a few individuals arrive, and the species remains at least through June. Records for July, August, and September are few and presumably represent post-breeding vagrants or misidentifications. Reports of Costa's Hummingbirds being common and even abundant in the yellow-pine belt of the Charleston and Sheep mountains between 8000 and 9000 feet (2438 and 2743 m) from July to September (van Rossem 1936) are unsubstantiated. Post-breeding wanderings to such elevations occur, but in no case is this widespread within a population, particularly into September at such a northern latitude. Van Rossem's records from the Charleston and Sheep mountains therefore have not been mapped.

The species is known from at least 22 localities in the southern one-third of the state (Esmeralda, Nye, Clark, and Lincoln counties) and one locality farther north in the Toiyabe Mountains of Lander County (19 June 1930, Linsdale 1936). The documented presence of the species in the late 1800s in many of the same areas where it is still found indicates that the occurrence of Costa's Hummingbirds in southern Nevada is not recent.

Utah

The range of Costa's Hummingbird in Utah is confined primarily to Washington County in the extreme southwest (Behle and Perry 1975, Hayward et al. 1976). In this area, records extend from early March into late May; a few birds undoubtedly linger at least into June. The species also occurs occasionally in adjacent Garfield County, where birds have been reported from the Hell's Backbone area west of Boulder from late March into mid-May (Behle and Perry 1975) and a single post-breeding vagrant was seen on 15 September 1971 (G. Kashin in litt.). The first report of the species for Garfield County (Porter and Bushman 1956), which provided few details, has recently been clarified by W. H. Behle (in litt.). The date of collection is 16 May 1953 and the site is Salt Gulch, 8 miles west of Boulder. The only record from elsewhere in Utah is of a vagrant male in Salt Lake City. This bird appeared at a feeder in October 1974 and, after failing to migrate, was maintained through the winter until 16 March 1975 with the aid of artificial heat (Kingery 1975).

The occurrence of the species in Utah does not appear to be recent at most of the 11 or so localities from which it has been reported. Costa's Hummingbirds were found in May 1891 in the Beaverdam Mountains in the extreme southwestern portion of the state (Hayward et al. 1976), still one of the primary areas where the species is found today.

Arizona

The status of Costa's Hummingbird in Arizona is complicated. The species is resident along the southern border from the Baboquivari Mountains west of Nogales to the California border and north along the Colorado River to the Bill Williams Delta, and there are small resident populations also around

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Phoenix and Tucson. From late winter to early summer, the species is common in much of Mohave, La Paz, Yuma, Maricopa, and Pima counties.

Costa's Hummingbird is locally distributed and often uncommon elsewhere in Arizona. The species occurs fairly regularly in Pinal County from Florence west, but only sporadically farther east, as at Superior, in Aravaipa Canyon, and at Oracle. A juvenile male was also taken in 1867 at Old Fort Grant at the junction of Aravaipa Creek and the San Pedro River (A. R. Phillips in litt.). The species is sporadic and localized in Santa Cruz County, with records from Gardner Canyon in the Santa Rita Mountains, Sonoita Creek below Patagonia, Peña Blanca, and from the Nogales area. In Graham County, the species is known from Aravaipa Canyon and the Galiuro Mountains (nests in the latter, G. Monson in litt.). It is rare in Cochise County, but a small population nests in Guadalupe Canyon (Baltosser 1986, 1989), and there is evidence that historically (1890s) it was perhaps more common in or near the Huachuca Mountains (there are at least seven specimens for which the locality is simply Huachuca Mountains). The only other area of occurrence in Cochise County is around Portal. There is at least one locality within Yavapai County, 6 miles southeast of Camp Verde, where the species is known to occur on the basis of two specimens (MNA Z8.2626 and Z8.2627). The species has also been collected in Greenlee County at Clifton (Monson and Phillips 1981).

Costa's Hummingbird is one of the more common species of hummingbird found in the arid regions of Arizona. Even though it is resident in several of these areas, its seasonal abundance fluctuates greatly, and in some areas, such as the Sierra Estrella, Maricopa County, its arrival can also be highly variable (Rea 1983). Relatively few birds winter so few if any individuals are truly sedentary. The number of birds begins to increase in late winter around the first of February, and the species remains relatively common until about the first of May. It is less numerous in June and uncommon to rare from July through September. Adult males have generally dispersed by July and are not seen again until late fall, and even then their numbers are low until January or early February. The status and extent of dispersal of adult female and young birds are not well documented, and from June through September there are relatively few records.

In much of Arizona the occurrence of Costa's Hummingbird has been repeatedly documented since the mid-1800s. In other areas, like eastern Pinal County, records date back to 1867, yet few have been reported from such eastern sites until recently. In still other areas, such as the Huachuca Mountains, the data suggest that the species was perhaps more abundant around the turn of the century than it is at present. For Guadalupe Canyon, in Cochise County and adjacent Hidalgo County, New Mexico, there are only recent records despite fairly extensive earlier sampling efforts. The distribution of Costa's Hummingbird in Arizona is therefore dynamic, exhibiting stability in some areas, a resurgence into historically occupied sites in others, and expansion into previously unoccupied sites in still others.

Baja California

Costa's Hummingbird occurs throughout the Baja California peninsula and on its offshore islands (Figure 3) and is a common, if not abundant, resi-

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dent species (Grinnell 1928, Wilbur 1987). Presumably the wintering population is augmented by migrants from the north, although populations in the lower peninsula may contain a greater proportion of truly resident birds than those in the upper peninsula. There is no evidence that populations in the south are ecologically different from those in the north.

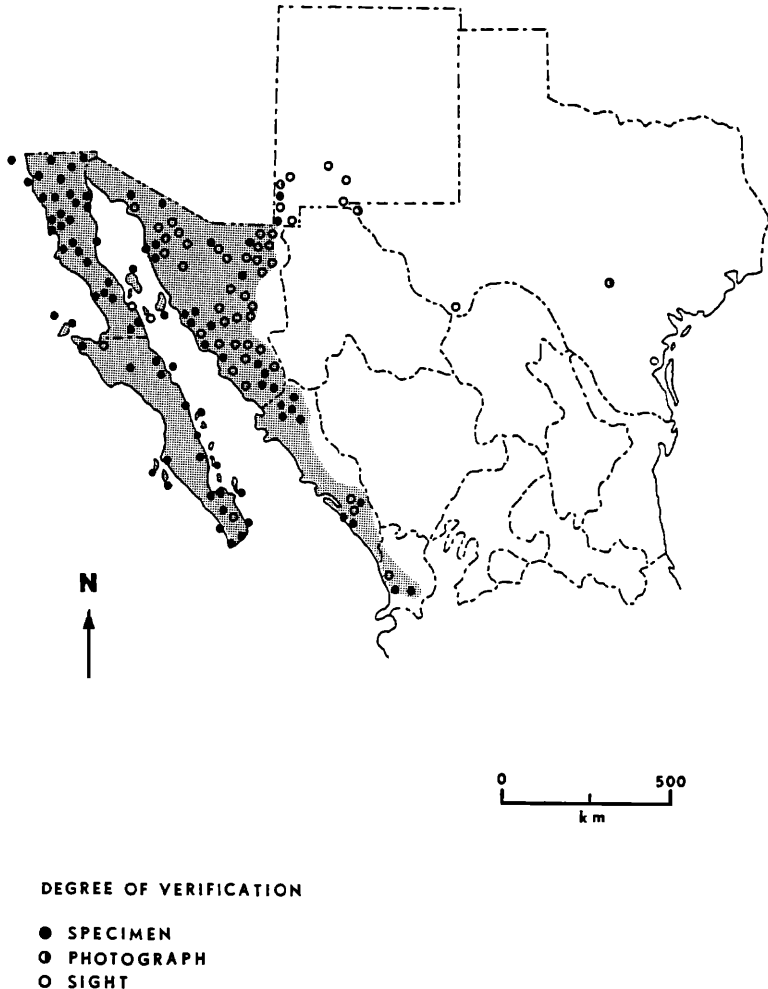


Figure 3. Distribution of Costa's Hummingbird in New Mexico, Texas, and Mexico showing the normal occurrence of the species, all seasons combined (shaded areas), and its documented presence (dots). Filled circles, specimens; half-filled circles, photographs; open circles, sightings.

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Sonora

The species is resident in the western and central portions of the state from Guaymas north along the coast to the U.S. border and in the east to Moctezuma. Wintering populations are found in the southern half of Sonora from Guaymas south to El Siari in the extreme southwest (S. M. Russell in litt.) and to Guirocoba in the extreme southeast (MLZOC 4258). With further investigations, however, some populations south of Guaymas may prove to be resident.

In northwestern Sonora and the islands of the Gulf of California, the seasonal occurrence and status of Costa's Hummingbird are similar to those in Baja California. The status of the species is less well understood in southern and eastern Sonora. Both resident and wintering birds probably occur at the more northern sites. The origin of birds occurring during winter in southern areas is unknown because it is only the species, rather than individual birds, that is resident farther north. Van Rossem (1945), however, indicated that during winter there are notable concentrations in the south, which he attributed to the partial withdrawal of birds from the north.

The status of the species in northeastern and perhaps extreme north-central Sonora is changing. In contrast to other areas of Sonora (including the extreme southeast), where there is generally an extended record of occurrence for Costa's Hummingbird, northeast of Nacozari records are relatively recent. The area east of Nogales may also be experiencing change with respect to this species. In this area, a resurgence into previously occupied sites may be inferred if historic and recent records from across the border in Arizona are of Sonoran birds moving north rather than of Arizona birds moving east.

Sinaloa

Costa's Hummingbird winters in Sinaloa, but its status during other seasons is uncertain. The occurrence of a male in heavy molt at Los Leones in northeastern Sinaloa on 28 March 1934 (MLZOC 11607) suggests possible resident status. Collection records from at least ten localities date back to 1925, although a specimen (USNM 25870) supposedly taken at Mazatlan (no other data) and attributed to John Xantus, if correct (validity in doubt, A. R. Phillips and R.L. Zusi in litt.), would document the species back to the mid-1800s.

Nayarit

The 1983 A.O.U. Check-list does not list Costa's Hummingbird as occurring south to Nayarit. The species nevertheless occasionally, perhaps even regularly, winters here. This is not necessarily recent, since two birds were collected 1 mile west of Las Varas in late November 1952 and a third was taken 3 miles southeast of La Galinda in late October 1957 by L. D. Yaeger and A. R. Phillips (DelMNH 18825, 18826, and 18828). A fourth bird was seen near San Blas in late December 1973 (LeValley and Rodriguez 1974).

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New Mexico

In New Mexico, Costa's Hummingbird is a rare spring and early summer resident. During this period it is confined primarily to Hidalgo County in the extreme southwest, although occasionally it occurs to the north along the Gila River in Grant County. As a vagrant, the species occurs along the Rio Grande in south-central New Mexico from Dona Ana County (Ligon 1961, Hubbard 1978) north as far as Truth or Consequences in Sierra County (Hubbard 1982).

New Mexico has been included in the range of Costa's Hummingbird for over a century on a basis of a report by Frank Stephens in 1876 of a male constructing a nest near Fort West (Bendire 1895). Stephens' report has been questioned by Hubbard (1976) because males are not known to participate in nest construction and there is some doubt as to Stephens' whereabouts during this period (he may have actually been 30 river miles downstream in Arizona). Not until 66 years later was the species reported for a second time in New Mexico, and only since the early 1970s have Costa's Hummingbirds been reported there with any regularity.

While subsequent sightings in an area do not validate previous reports, I nonetheless believe that the 1876 report may be credible and what is presently occurring in New Mexico is both a resurgence into historically occupied sites and a true range expansion into other areas. The bird that Stephens saw probably had some rather long projecting metallic feathers on its throat or several metallic feathers on its chin. Such characters typify males, but among females appearing to be quite old (extremely polished and worn bills), an occasional bird has extensive metallic feathering. The bird Stephens observed was perhaps such a female, and as for the date, Stephens himself was not sure ("about the end of May").

Texas

Of the eight records of this irregular vagrant, those from Rockport, Aransas County, in 1956 and 1957 (Webster 1957, 1958) have been questioned since first reported. Few details were provided, and the presence of four adult males, as reported for 1956, seemed unlikely. Fueling the confusion was also a prevailing belief that Costa's Hummingbirds were not particularly prone to wandering. While it does seem unlikely that four vagrants would end up at the same place at the same time, recent extralimital records indicate that the species is probably more nomadic than previously thought. Such are the problems associated with sight records, and thus the two reports from Rockport should, if cited, be listed as hypothetical. Localities for Costa's Hummingbird in other areas of Texas through 1987 are the El Paso area (late July and late August 1958, Monson 1958, 1959, and March 1975, Williams 1975), Big Bend National Park (August and December 1966, Wauer 1973), and San Marcos, Hays County (adult male, February 1974, Webster 1974).

Oregon

Only recently have Costa's Hummingbirds been noted in Oregon (Figure 4), where the status of the species is complicated and changing. As a whole, Costa's Hummingbird is only a vagrant to Oregon, but recurrences at the

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same locations (e.g., Bend, Deschutes Co.) for 3 or 4 consecutive years suggest that some individuals return to a site annually, in an incipient regular migration.

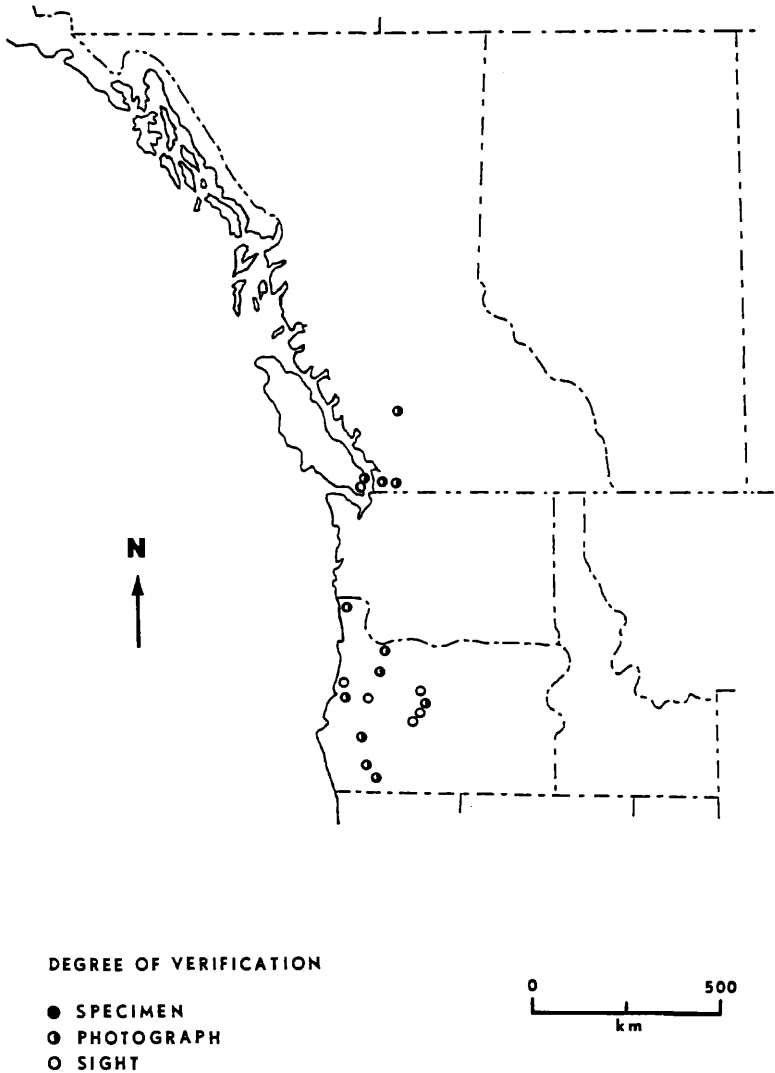


Figure 4. Distribution of Costa's Hummingbird in the northwestern United States and southern Canada based on its documented presence (dots). Filled circles, specimens; half-filled circles, photographs; open circles, sightings.

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There have been at least 21 sightings, many of which are supported by photographs, of Costa's Hummingbird for Oregon through 1987. Six of these are from the 1970s; the remainder are from the 1980s. The first was of an adult male in Astoria, Clatsop County, from 5 to 20 April 1972 (Crowell and Nehls 1972), followed by another male at Eugene, Lane County, from 12 to 16 April 1974 (Crowell and Nehls 1974). Additional records during the 1970s were from Portland, Multnomah County, in 1977 (Mattocks and Hunn 1978), Roseburg, Douglas County, in 1977 (C. Watson in litt. and Roberson 1980), Molalla, Clackamas County, in 1979 (Tweit et al. 1979), and Florence, Lane County, in 1979 (Mattocks and Hunn 1980, Hunn and Mattocks 1980).

Oregon reports of the species to date have been from coastal areas and both the eastern and western flanks of the Cascade Range. Of particular interest is the seasonality of occurrences: the only months for which there are no reports are just August and September. From March through June, which in many other areas is the breeding season, there are Oregon records along the coast from Florence north to Astoria, west of the Cascades from Ashland, Jackson County, north to Molalla, and east along the east slope of the Cascades north to Bend. Post-breeding records for July include reports from Bend, Molalla, and Medford (Jackson Co.). October through February records, all west of the Cascades, are from Portland, Roseburg, Florence, and Newport (Lincoln Co.).

British Columbia

As elsewhere in the Pacific Northwest, the occurrence of Costa's Hummingbird in British Columbia, based on sightings and photographs of adult males, is recent. The five universally accepted records (R. W. Campbell, R. Howie, and W. C. Weber in litt.) are as follows: 14-17 April 1972 at Cadboro Bay (Mackenzie-Grieve and Tatum 1974), 3 July 1984 at Nanaimo (Campbell 1984), 17 May 1986 at Pitt Meadows (Mattocks 1986), 17-19 May 1987 at Lillooet (Mattocks and Tweit 1987), and 20 May - 1 June 1987 at Burnaby (Mattocks and Tweit 1987, Tweit and Mattocks 1987). Sightings from West Vancouver (Shepard 1974, the basis for the statement in the 1983 A.O.U. Check-list that Costa's Hummingbird winters casually north to Vancouver Island) and from Gabriola Island in Whaler Bay (Campbell 1985), if cited, should be listed as hypothetical since there are no supporting details (W. C. Weber in litt.).

DISCUSSION

"*Calypte costae*, collected by Neboux, described by Bourcier, named in honor of Costa, and based on a specimen from 'California,' has long been shrouded in mystery. . .," so Palmer (1918) began his paper aimed at clarifying the early history of this species. Palmer did much to rectify various misconceptions, but more than 70 years later there is still considerable confusion and even mystery associated with this species.

The expansion and contraction of the range of a species at its periphery is natural. When these fluctuations serve to isolate populations or when they

bring previously isolated populations into contact, however, the relevance of documenting the range of a species and the subsequent study of the underlying causes of these shifts take on added meaning and biological importance. Such fundamental aspects of the biology of a species as breeding status, distribution, and seasonal occurrence are also important if one is to study and interpret other biological questions pertaining to a given taxon.

Biogeographical considerations are a natural outgrowth of distributional studies. The discovery of new areas of occupancy does not necessarily imply that a species has acquired a new adaptation nor that the newly occupied areas have changed from their former state. Conversely, absence from previously occupied sites does not necessarily imply change in the organism or modification of the site. Such discoveries may simply be artifacts of past and present sampling efforts.

There can be no denying that there is an ever-growing number of more highly skilled observers, given the increased popularity of birdwatching and the universal availability of numerous excellent guides to bird identification. Perhaps the most tangible result of this is the increased frequency with which vagrant birds are detected. Collectors in the late 1800s and throughout the first half of the present century were nonetheless very adept and in many areas few species went undetected. The decision as to whether an observed shift in the range of a species is real or simply the result of sampling bias requires careful study and the evaluation of various factors.

Growing human populations and the subsequent cultivation of exotic flowering plants, coupled with the widespread use of feeders for the last 40-45 years, have allowed the numbers of hummingbirds in urban areas to increase tremendously. The effects of urbanization were well documented by Zimmerman (1973) for Anna's Hummingbird, and similar expansions may be anticipated among other species. The cultivation of exotic plants and the use of feeders is nonetheless generally restricted to areas of human habitation.

Extensive tracts of sparsely inhabited land remain throughout the range of Costa's Hummingbird. While feeders and residential plantings provide satisfactory explanations for the maintenance of the species once it reaches new areas such as northern California and the Pacific Northwest, an explanation of what sustains birds between urban centers and thus facilitates their reaching new areas is still needed.

Information from throughout the species' range is lacking, but I have investigated the ecology of Costa's Hummingbird in southeastern Arizona and southwestern New Mexico. The recent establishment of non-native Tree Tobacco (*Nicotiana glauca*), a nectar-rich and often perpetually flowering species, throughout much of northern and eastern Sonora appears to be having a major impact on local hummingbird populations. Increased densities of Broad-billed (*Cynanthus latirostris*) and Violet-crowned (*Amazilia violiceps*) hummingbirds in northern Sonora seem to be especially tied to the widespread establishment of Tree Tobacco (Baltosser 1983). Costa's Hummingbirds in eastern and northern Sonora are also feeding in Tree Tobacco and presumably responding similarly, though an increase is hard to measure since the number of Costa's Hummingbirds in these areas is much less than that of the other species.

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The recent occurrence of Costa's Hummingbirds in southeastern Arizona and southwestern New Mexico is presumably linked to a certain degree to the widespread establishment of large stands of Tree Tobacco just to the south in Sonora. The propensity of Tree Tobacco to occupy disturbed soils as along highways is well known (Goodspeed 1954, Stiles 1973). Agricultural practices and the completion of highways in central and northeastern Sonora during the last 30 years have been followed by the spread of Tree Tobacco, which is unpalatable to goats and cattle. Large and continuous stands now extend, for example, in central Sonora as far north as Arizpe and Nacozari, areas in which Tree Tobacco was formerly less common to absent (Goodspeed 1954). Large stands of Tree Tobacco do not yet, and may never, form a continuous link with areas such as Guadalupe Canyon in extreme southeastern Arizona and extreme southwestern New Mexico, but natural north-south routes of dispersal in Mexico have been greatly enriched. Densities of 57, 13, and 7 birds per hectare for Broad-billed, Violet-crowned, and Costa's hummingbirds, respectively (Baltosser 1983), would not be maintained for extended periods in central and northeastern Sonora on the relatively meager nectar supplies produced by native vegetation. The density and perhaps even the occurrence of various hummingbirds in many of the former areas is therefore probably dependent upon Tree Tobacco.

Hummingbirds in Baja California, southern California, southern Arizona, and southern Texas appear to be responding similarly to the establishment and proliferation of Tree Tobacco. There are numerous anecdotal references in the literature to the use of Tree Tobacco by various species of hummingbirds. Occasionally, these indicate that the presence of a species that was formerly absent or rare is perhaps linked to the presence of this flowering plant, e.g., Howell and Cade (1954) regarding *Calypte anna*, or that its seasonal occurrence and abundance is correlated with the occurrence of Tree Tobacco, e.g., Unitt (1984) regarding *Calypte costae*.

The continued influence of man upon this and other species of southwestern hummingbirds, many of which are closely related, will undoubtedly produce additional oscillations in their ranges. The ultimate effects are hard to predict, but through time it will be interesting to note the extent of increased hybridization, if any (hybrids are known for various species), and the extent to which other isolating mechanisms and competition play a role in the structuring of the various populations.

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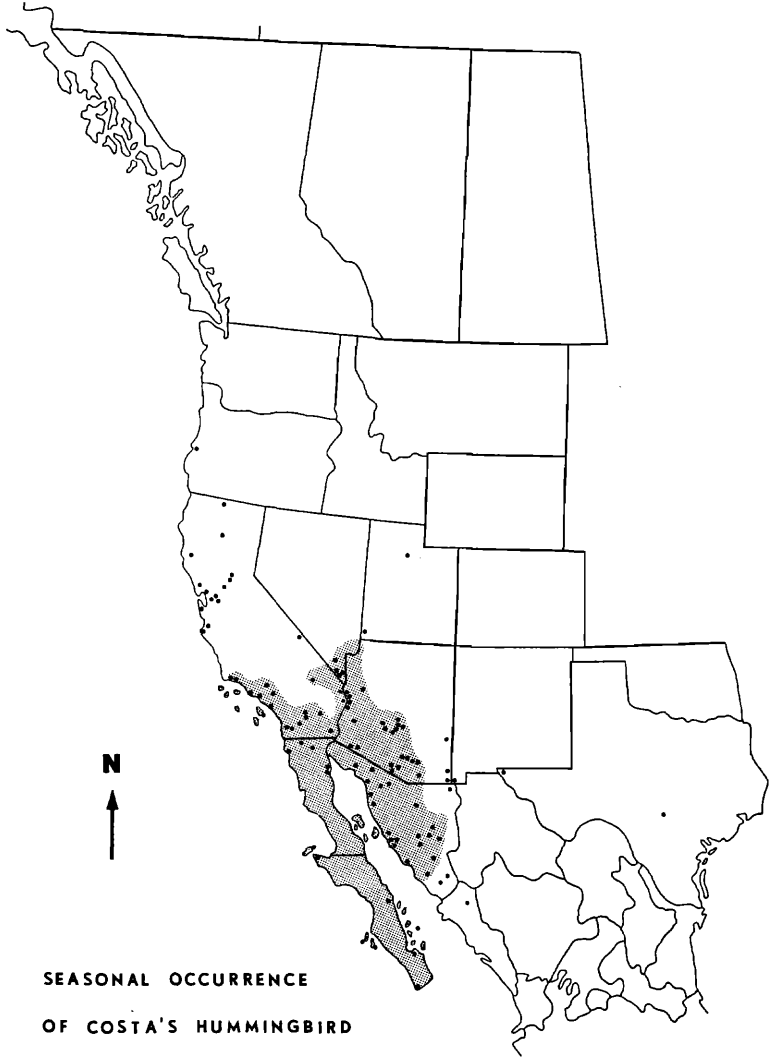
Costa's Hummingbird

Photo by Alan B. Meyerfeld

COSTA'S HUMMINGBIRD

APPENDIX A

Seasonal occurrence of Costa's Hummingbird between January 6 and March 15, showing the normal distribution of the species (shaded areas) and its documented presence (dots) during this period.

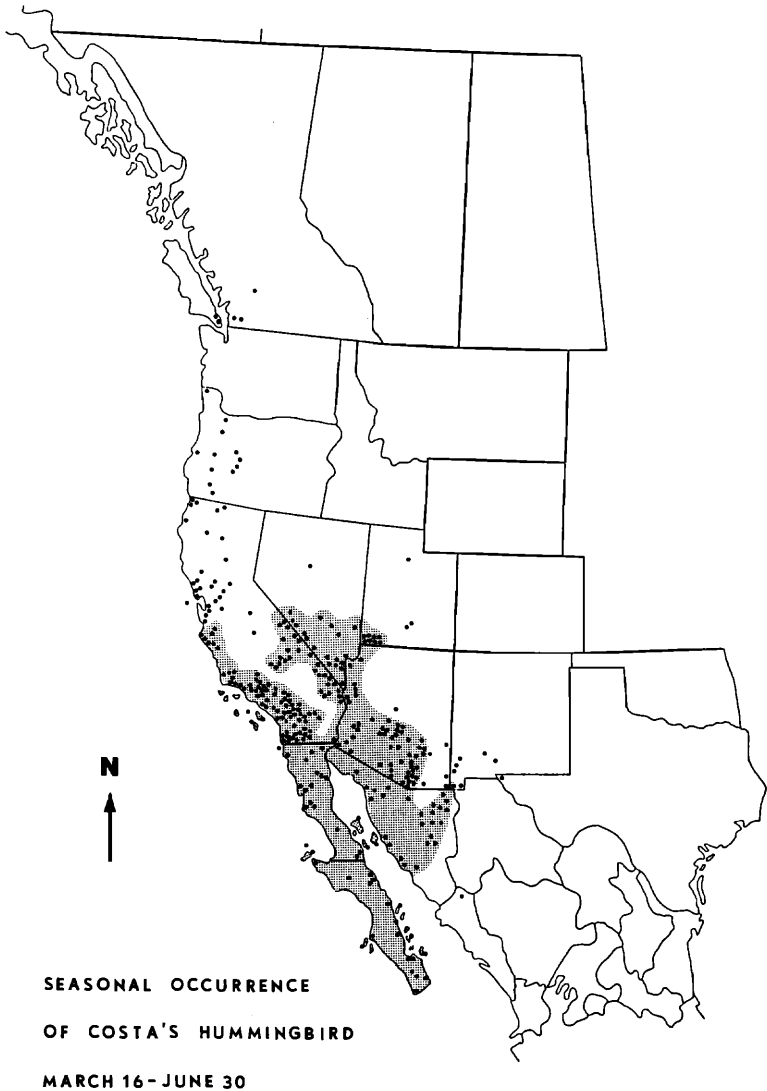


SEASONAL OCCURRENCE
OF COSTA'S HUMMINGBIRD
JANUARY 6 - MARCH 15

COSTA'S HUMMINGBIRD

APPENDIX B

Seasonal occurrence of Costa's Hummingbird between March 16 and June 30, showing the normal distribution of the species (shaded areas) and its documented presence (dots) during this period.



COSTA'S HUMMINGBIRD

APPENDIX C

Seasonal occurrence of Costa's Hummingbird between July 1 and October 31, showing the normal distribution of the species (shaded areas) and its documented presence (dots) during this period.



SEASONAL OCCURRENCE
OF COSTA'S HUMMINGBIRD
JULY 1-OCTOBER 31

COSTA'S HUMMINGBIRD

APPENDIX D

Seasonal occurrence of Costa's Hummingbird between November 1 and January 5, showing the normal distribution of the species (shaded areas) and its documented presence (dots) during this period.



SEASONAL OCCURRENCE
OF COSTA'S HUMMINGBIRD
NOVEMBER 1 - JANUARY 5