

WINTERING DISTRIBUTION OF BREWER'S BLACKBIRD: HISTORICAL ASPECT, RECENT CHANGES, AND FLUCTUATIONS

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INTRODUCTION

Although the boundaries of the ranges of most North American birds are more or less known, still much can be learned about the occurrence of individuals within their range. Even for breeding ranges, which are more familiar, usually only the maximum boundary is documented and perhaps a few generalities are known about the frequencies with which the species is encountered across its range. Our knowledge about most wintering distributions is even less.

The problem becomes more complex when one considers that the distributions of many species have changed recently. For example, icterids, notably the Western Meadowlark (*Sturnella neglecta*) (Lanyon, 1957), Red-winged Blackbird (*Agelaius phoeniceus*) (Stowers et al., 1968), Common Grackle (*Quiscalus quiscula*) (Neff and Meanley, 1957), Great-tailed Grackle (*Cassidix mexicanus*) (Phillips, 1950), and the Brown-headed Cowbird (*Molothrus ater*) (Mayfield, 1965), have undergone general increases in their distributions within this century. Correspondingly, the distributions of many other avian species have decreased. Habitat modification resulting from agricultural activity appears to be a general cause of these changes (Good and Dambach, 1943).

The present study on the wintering distribution of Brewer's Blackbird (*Euphagus cyanocephalus*) is an attempt to obtain a more detailed and updated picture of the wintering range of this species in North America. In addition to the original range never having been documented completely, this blackbird has expanded its distribution within recent years and undergone an increase in numbers. The distribution and, more importantly, the different degrees to which subdivisions of the wintering range are occupied, appear to be related to the effects of snow cover. Elevation, another factor investigated, appears to have a much smaller effect on the wintering pattern.

METHODS

Information about the wintering range of Brewer's Blackbird near the turn of the 20th century was obtained through a literature search. Although reports were few for most areas or lacking for others, some comparisons may be made between the present status of the species in an area with what it was approximately 70 years ago.

The American Bird Christmas Bird Count (formerly *Audubon Field Notes*) from the years 1950, 1951, 1971, and 1972 were used to obtain information detailing changes in both the numbers of wintering individuals and in the distribution of the species that have taken place since 1950.

Wintering distribution maps showing the location and number of birds seen per hour on each count were constructed for each of these four years. Only those counts within and immediately adjacent to the wintering range were plotted. The number of birds seen per hour was obtained by dividing the number of Brewer's Blackbird reported by the total number of party observation hours. Following the inherent groupings apparent within the data, the counts were then divided into five categories: less than 0.09 birds seen per hour (rare); between 0.10 and 1.00 birds seen per hour (scarce); between 1.01 and 10.00 birds seen per hour (common); between 10.01 and 100.00 birds seen per hour (abundant); and greater than 100.01 birds seen per hour (superabundant). After these values were plotted, boundaries were drawn around the counts that reported the species. Counts not reporting the species were excluded. This resulted in a pattern of discrete wintering areas being separated by areas in which the counts did not report the species, or by areas in which no counts were taken. The major zones of topographical relief (not shown) were taken from Bartholomew (1957) and information on snow cover and depth was obtained from Visher (1954).

Several considerations must be kept in mind concerning the data and the interpretations based upon them. Information about the present or past status of the species is not available for many areas and therefore various dates for changes in its range are only approximate. Likewise the boundaries drawn around the wintering areas are arbitrary. In most cases counts reporting the bird are surrounded by regions where no counts were conducted rather than being surrounded by counts not reporting the species. Other features of the data that may lead to misinterpretations are the large number of observers involved in the counts and mistaken identifications resulting from the similarity between Brewer's Blackbird and the Rusty Blackbird (*Euphagus carolinus*) or juvenile Common Grackles. Many blackbirds were not identified to species on several counts, and the degree to which the results of a count may reflect the status of this species in the region surrounding a count are other causes of potential inaccuracies.

Little can be effectively done about these problems. Christmas Count totals for "blackbird species" have been ignored; presumably some of these totals contained Brewer's Blackbirds. The results of each count have been assumed to be indicative of the status of the species throughout that general region. In some cases probably they are not. In several states, notably the Rocky Mountain and Gulf Coast ones, many areas of appreciable extent lack count sites. When joining together two or more counts reporting the bird, the maximum distance shaded in was approximately 150 miles. Although distances of this magnitude were few, the similarity in elevation and snow factors in the intervening region to those on the count sites suggested that the bird probably wintered throughout the region. Most of the groupings involved counts that were closer than 150 miles apart.

The resulting distribution maps are not intended to be complete representations of the wintering distribution of Brewer's Black-

birds. Too few data are available to permit that degree of detail. Rather the maps should be regarded as indications of recent changes in distribution and of the relative importance of various regions of North America as wintering range for this species.

RESULTS

WINTERING RANGE WEST OF THE MISSISSIPPI RIVER HISTORICAL WINTERING AREAS

One of the principal changes in the wintering distribution of *E. cyanocephalus* in this region has been a modification of the range known to have been occupied about 70 years ago. Unfortunately the boundaries of these areas were never determined precisely, but the available records give an indication of their general extent. The information concerning these historically occupied wintering areas will be treated first before discussing recent changes that have occurred in them.

Records support the existence of at least seven historical wintering areas west of the Mississippi River. The four major ones were located in Texas, New Mexico, southern Arizona, and the valley regions of California. A fifth area, or what were at least isolated tracts of suitable habitat, may have existed in the western sections of Washington and the Vancouver lowlands. The same situation appears to have prevailed in Nevada and southcentral Kansas.

The historical wintering sites in Texas apparently covered much of the same areas as the current sites. In southern Texas high numbers of Brewer's Blackbirds wintered in the San Antonio region (Brown, 1882; Attwater, 1892), in Refugio County (Carroll, 1900), and it was the most abundant winter blackbird in Harris, Montgomery, Galveston, and Ford Bend counties (Nehrling, 1882). In west Texas high numbers were recorded in Tom Green and Concho counties (Lloyd, 1887). Early records for Mexico are scarce, but because the localities for the type and lectotype specimens are Mexico City and Temascaltepec, respectively (Stresemann, 1954), Mexico has presumably been a traditional wintering region.

Historical wintering in New Mexico was recorded from Silver City (Hunn, 1906), Chloride, Carlsbad and Rio Grande bird reserves, Engle, and southward from Albuquerque in the valley of the Rio Grande (Bailey, 1928). The species was classed as migratory in Apache (Anthony, 1892), in the upper Pecos River region (Henshaw, 1886), and the region around the headwaters of the Gila River (Bergtold, 1912). These early records indicate that previously this bird wintered in much the same parts of the state as it does today.

Southcentral and southeastern Arizona apparently were historical wintering areas. Brewer's Blackbirds were recorded as abundant wintering birds wherever suitable habitat occurred below an elevation of 3,000 feet in the counties of Pinal, Pima, Gila (Scott, 1887), and Cochise (Osgood, 1903).

The principal west-coast wintering areas occupied about the turn of the 20th century were apparently the valleys of California

and northern Baja California. Brewer's Blackbirds wintered in large numbers at Victorville (Mailliard and Grinnell, 1905), Redlands (Bailey, 1916), Fresno (Tyler, 1909), Yermo and Las Penas (Lamb, 1912), and northwestern Baja (Grinnell, 1928).

It also seems that tracts of suitable habitat occurred in the western areas of Washington and the Vancouver, B. C. region. Rathbun (1902) reported a few birds wintering in Seattle, whereas they were classified as more of a winter than summer resident at Olympia (Keck, 1904). They were apparently common at all seasons at Bellingham (Edson, 1908). Bendire (1895) observed the species at Walla Walla in winter, but it was recorded as a migrant at Prescott (Dice, 1918) and Spokane (Johnson, 1906). Dawson and Bowles (1909) recorded it as "normally migratory but increasingly resident especially on West-side." The species also occasionally wintered in the Vancouver region (Brooks, 1917).

Little information is available about the status of this blackbird in Oregon near the turn of the century. It was reported as migratory in the northeastern portion of the state (Anthony, 1886; Gabrielson, 1924) and from Gray's Harbor (Lawrence, 1892). By 1940 it was recorded as a common resident throughout much of the state, particularly in agricultural areas (Gabrielson and Jewett, 1940). It is quite likely that parts of western Oregon, for example the Willamette River valley, were used as wintering sites about 1900.

The last two potentially historical wintering areas, as evidenced by published accounts, existed in Nevada and Kansas. Although records go back only to the 1930's, Brewer's Blackbird was reported as wintering in Carson Sink (Alcorn, 1946) and in favorable valleys throughout much of Nevada (Linsdale, 1936). It is likely that this distributional pattern existed prior to that time. About 1900 the species also wintered in some areas in Kansas (Carter and Trenton, 1908; Force, 1928; Goss, 1891).

CHANGES IN WINTERING PATTERNS WEST OF THE MISSISSIPPI RIVER

Within the last 22 years there have been several changes from the earlier wintering patterns existing west of the Mississippi River (Figs. 1-4). For the most part these changes involve wintering in areas that are farther north or higher in elevation than sites used previously. Some changes are the result of Brewer's Blackbirds expanding their historical range, but in others they are the result of totally new areas becoming established. Many of the range changes that are apparent when the four figures are compared are due, of course, to Christmas Counts being taken where previously there had been none. Apparent changes such as these have been ignored in this section.

Definite expansions of historically occupied areas are evident in four locations. The species is fairly widespread in central Oklahoma and southcentral Kansas during the 1970's (Figs. 3 and 4) and the 1950's (Figs. 1 and 2), whereas previously only small populations of birds wintered here (Carter and Trenton, 1908; Force, 1928; Goss, 1891).

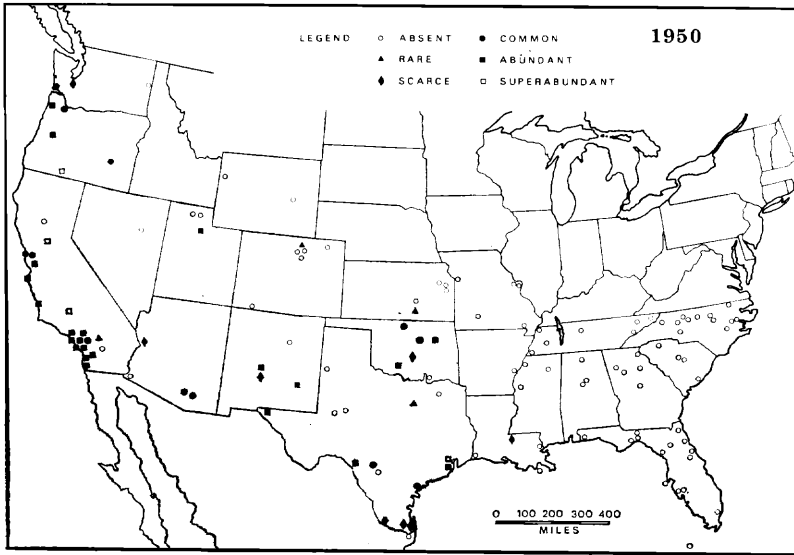


FIGURE 1. Number of wintering Brewer's Blackbirds reported by Christmas Counts in 1950.

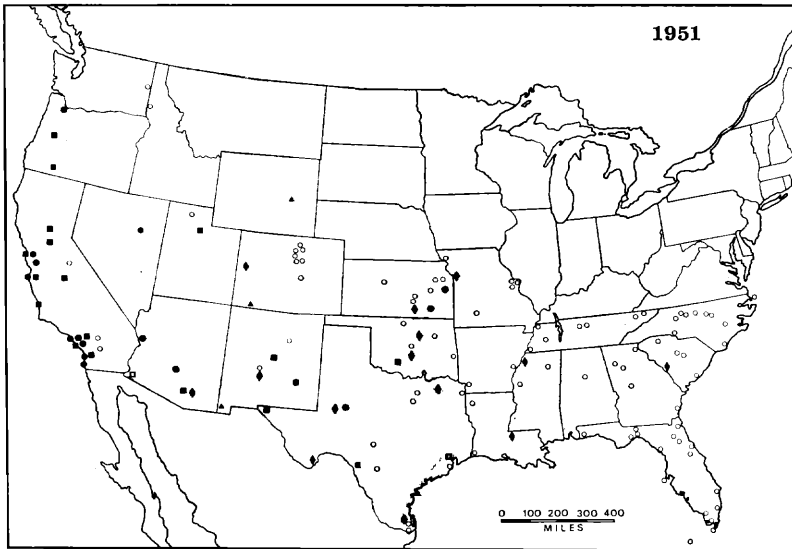


FIGURE 2. Number of wintering Brewer's Blackbirds reported by Christmas Counts in 1951. Symbols as in Fig. 1.

The expansion of the Texas wintering range northeastward into central Arkansas, however, appears to be an expansion into a previously unoccupied region. Prior to this, Brewer's Blackbird had been reported only as sporadic in winter at Stuttgart (Holliester, 1902). The time at which this expansion occurred is indefinite, but as late as the 1950's little information about the bird's occurrence existed (Neff and Meanley, 1957), suggesting that it began wintering in Arkansas only recently. The first Christmas Count reporting the species was Lonoke in 1952 (Coffey, 1952). By 1957 the species wintered there in apparently greater numbers and was reported for the first time on three other Arkansas counts. In 1972 the species was reported, often in high numbers, by most of the counts from the central section of the state, east of the Boston Mountains (Fig. 4).

The use of western Washington and the Vancouver lowlands as a wintering area apparently increased considerably since 1900. The species has gradually expanded its range as a resident into the Puget Sound region and parts of the interior of Washington, following the spread of agriculture (Dawson and Bowles, 1909). The first Christmas Counts in British Columbia were conducted in 1958 at Ladner (Erskine, 1958) and Vancouver (Hughes, 1958). Both counts reported over 1,000 Brewer's Blackbirds, indicating a substantial increase from the low numbers reported previously by Brooks (1917).

A few minor changes have taken place in the distribution in California. Prior to 1950 the species became established as a resident in the Kettleman Hills (Wilson, 1950). The same change in status has occurred at other, local sites (Grinnell and Miller, 1944).

Wintering areas have also developed to the west of the Mississippi River, that, for the most part, appear to be new and distinct from the historical areas. Within the last 30 years southern Idaho and northcentral Colorado have become established as wintering locations. These two sites are among the most northerly wintering areas consistently occupied by the populations wintering in the central part of the continent.

The Snake Indian Plain in southern Idaho apparently became established as a wintering site sometime after 1940. Wintering Brewer's Blackbirds have apparently always been scarce throughout Idaho (Rust, 1915) except for what was described as a resident population around Lewiston (Burleigh, 1923). The species wintered occasionally at Coeur d'Alene (Merrill, 1897; Rust, 1915), but was still predominantly migratory as late as 1941 (Hand, 1941). Although regular counts have been taken in some Idaho locations since 1953, the species was not consistently reported until the early 1960's, suggesting a gradual but steady increase in the use of southern Idaho as a wintering location. At present the species regularly winters in at least five areas (Fig. 4).

The wintering range in northcentral Colorado apparently developed in the 1950's. Previously the species was reported as migratory from Denver (Bergtold, 1917), Greenly (Fitzpatrick, 1930), the Golden region (Lincoln, 1920; Rockwell and Wetmore,

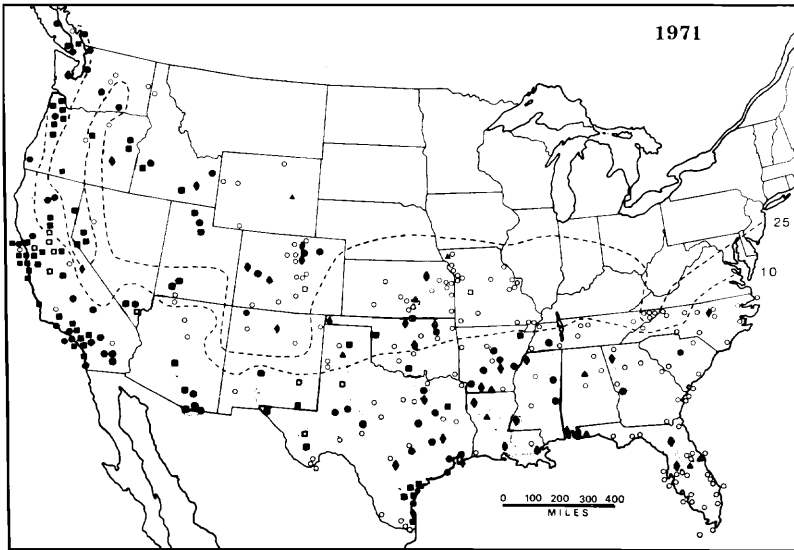


FIGURE 3. Number of wintering Brewer's Blackbirds reported by Christmas Counts in 1971. Regions receiving 10 or fewer and between 10 and 25 inches of snow are indicated.

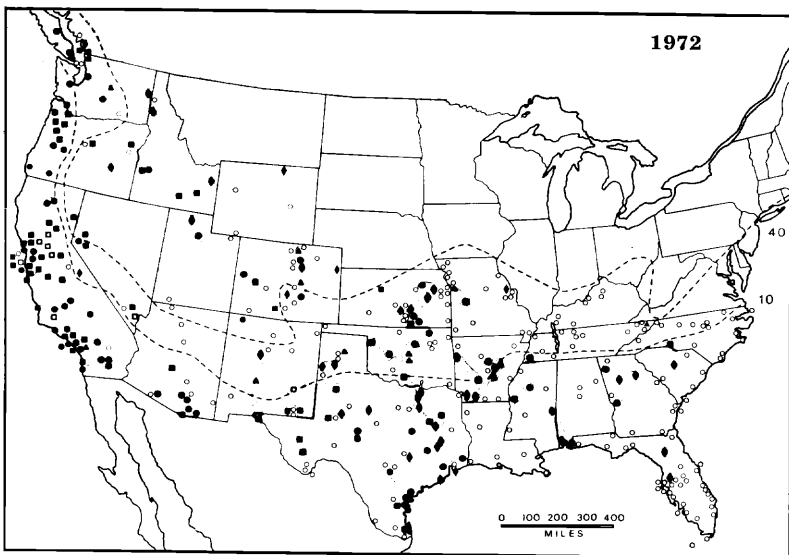


FIGURE 4. Number of wintering Brewer's Blackbirds reported by Christmas Counts in 1972. Regions having 10 or fewer and between 10 and 40 days of snow cover of 1 inch or more are indicated.

1914), and from Colorado Springs (Allen and Brewster, 1883). Occasional wintering occurred in Fruita (Bergtold, 1928) and in the Denver area (Niedrach and Rockwell, 1939). The first Christmas Count report of wintering Brewer's Blackbirds was based on one bird observed at Fort Collins in 1950 (Beidleman, 1950). Within three years the species was reported wintering in Colorado Springs and in Denver and surrounding Jefferson County. Since this time, a small wintering area has become established along the eastern front of the Rocky Mountains (Figs. 3 and 4).

DEVELOPMENT OF WINTERING RANGE EAST OF THE MISSISSIPPI RIVER

About 1900 *E. cyanocephalus* was only a sporadic wintering bird east of the Mississippi River. Since this time, however, it has become established in several locations within the Gulf Coast states. Data from the Christmas Counts indicate that within the last 36 years this bird has expanded progressively farther eastward. The species was recorded first in a Louisiana count, next by one in Mississippi, then in Alabama, Georgia, and finally in Florida. However, as will be seen below, 1948, the starting time for this expansion given by the counts, is at least 25 years later than when the expansion apparently commenced. Also, the dates of collecting the first winter specimens indicate wintering commenced prior to the 1940's and that expansion probably was not accomplished as a progressive eastward movement.

Development of a wintering range in the southeast may be due in part to the eastern expansion of the breeding range of this species into the Great Lakes region (Stepney and Power, 1973; Walkinshaw and Zimmerman, 1961). This suggestion is supported in part by the recovery of six individuals that were banded within or, in the case of a bird from North Dakota, on the western edge of the new breeding area. An individual recovered in Mississippi was banded in Minnesota (Walkinshaw and Zimmerman, 1961), two recovered in Louisiana were banded in Illinois and North Dakota, and one of the three recoveries in Arkansas was banded in Ohio, whereas the remaining two were banded in Minnesota (L. Wright, Canadian Wildlife Service, pers. comm.). These banding results suggest a general tendency for birds occupying the eastern section of the breeding range to winter more to the southeast. In all cases the birds were recovered while wintering within a recently occupied section of range. However, migrational movement does not appear to follow a direct north to south path.

Evidence of another type also suggests a link between these newly inhabited breeding and wintering areas. Development of wintering sites east of the Mississippi River began by 1925 (Burleigh, 1933), only 11 years after the first reported eastward expansion of the breeding range (Roberts, 1914). Dates of the first collected winter specimens in the southeast also agree well with the timing of the breeding expansion. The first Louisiana specimen was collected in 1893 (Beyer et al., 1906), the first for Georgia in 1931 (Greene, 1934), for Alabama in 1936 (Burleigh, 1936),

and individuals were reported in Mississippi by 1940 (Burleigh and Lowery, 1940). The first recorded winter specimens from Florida were two individuals collected near Panama City in 1939 (Hallman, 1940). Another early record for the same region was based on an observation made approximately 100 miles east of Pensacola in 1940 (Burleigh and Lowery, 1940).

The importance of new wintering areas to the survival of the newly developed breeding population is indicated by the fact that although much of the habitat modifications in the Great Lakes region producing suitable nesting areas had occurred by 1880, nearly 40 years passed without the species breeding there (Stepney and Power, 1973). However, at the same time that wintering areas began to be established in the southeast, expansion of the breeding range towards the Great Lakes proceeded very rapidly.

At present the wintering areas in Georgia and Florida appear to be more consistently occupied than those in Louisiana, Alabama, or Mississippi. The 1957 Christmas Count in Rome was the first count record for Georgia (Anderson, 1957). For the next three years this count recorded this blackbird. *E. cyanocephalus* had apparently increased its wintering range in Georgia by 1961, when other counts began reporting the species. To date, wintering Brewer's Blackbirds have been consistently recorded in Georgia in a region extending approximately from Rome south towards Columbus.

Continuously occupied wintering areas have also arisen in two locations in Florida. One is centered around Pensacola in western Florida and the other is located around Gainesville and Kissimmee in peninsular Florida. At present smaller numbers of birds winter at these sites than in Georgia. Christmas Count data indicate these Florida locations developed shortly after the one in Georgia. In 1958 the species was recorded on the Pensacola Count (Weston, 1958), but it was not until 1961 that it was recorded farther eastward on the Cocoa Christmas Count (Cruickshank, 1961). It was apparently rare or absent in this region prior to this time; numerous counts had failed to report it before 1961. Brewer's Blackbird has consistently wintered in Cocoa since 1961 in addition to expanding its range to include Gainesville by 1965 (Austin, 1965), and Kissimmee by 1967 (Steffe, 1967). It has also been reported wintering on Payne's Prairie near Gainesville (Birkenholz and Allen, 1962).

The wintering areas in Louisiana, Mississippi, and Alabama appear to be less consistently occupied than those in Georgia and Florida. The species was first recorded on a Louisiana Christmas Count in 1948 at Saint Francisville (Bruns, 1948). For the next three years it was recorded only on this count, but by 1952 the distribution of the species apparently increased when it was recorded for the first time on the Sabine National Wildlife Refuge and Shreveport counts. Over the years, however, Brewer's Blackbirds have been reported irregularly on these three counts, suggesting it is often absent from these regions.

The wintering distribution in Mississippi appears to be even

less consistent from one year to the next. The species was first recorded on a Christmas Count in 1951 at Moon Lake, Lula (Coffey, 1951), but was not mentioned again until 1955, this time on the Starkville count. In the next 12 years it was reported only twice, at Hickory Flat in 1958 and at Natchez in 1967, although there were five counts being conducted.

The first Alabama Christmas Count record was established at Montgomery in 1954 (Summerour, 1954). The species was noted again in 1956 at Mobile, and in the following year from both Mobile and Dauphin Island, the latter site being part of the previously discussed western Florida wintering area. Since 1957 Brewer's Blackbird has wintered almost every year at Mobile and Dauphin Island, and has been reported on occasion from the Bon Secour and Marion Island counts. However, they are somewhat irregular in their occurrence because in 1958 none of the five counts reported the species.

CHANGES IN NUMBERS OF WINTERING BREWER'S BLACKBIRDS

Within the last 22 years the number of Brewer's Blackbirds reported by observers on the Christmas Counts has increased. A non-parametric sign test, corrected for continuity (Snedecor and Cochran, 1967), was used to compare the numbers of birds per hour reported in those counts common to 1950 and 1951, to 1971 and 1972, and in those counts common to all four years. The null hypothesis of this test is that each count has an equal probability ($P = 0.5$) of showing either an increase or decrease from the value recorded the previous year. A one-tailed chi-square test demonstrated a significant shift ($0.05 > P > 0.025$) of the distribution curve to the right denoting an increase in numbers over the past 22 years (Table 1). The changes in numbers from one year to the next did not prove to be significant.

TABLE 1.

Chi-square and n values for the sign test comparisons between numbers of Brewer's Blackbirds per party hour reported by counts common to 1950 and 1951, to 1971 and 1972, and between counts common to all four years. Asterisk indicates statistical significance at 0.05 probability level.

	1950 and 1951	1971 and 1972	Common to all four years
χ^2	1.254	0.695	4.000*
n	51	207	49
df	1	1	1

In order to learn more about the nature of this increase in numbers of birds, an attempt was made to determine if it was restricted to a particular region. The 49 counts common to the four years in question were divided into two groups according to their location east or west of the Continental Divide. The combined values

derived by summing 1950 with 1951 values and 1971 with 1972 values were then compared. The results indicated the population increases were significant only in wintering regions east of the Divide ($0.05 > P > 0.025$) (Table 2). This region was then subdivided into east and west of the Mississippi River. The resulting test indicated that the significant increases in general numbers of wintering birds over the past 22 years was further restricted to those sites established as new wintering areas, in particular those east of the Mississippi River ($0.025 > P > 0.01$) (Table 2).

TABLE 2.

Chi-square and n values for sign test comparisons between the numbers of Brewer's Blackbirds per party hour reported by counts common to 1950, 1951, 1971, and 1972 after the counts have been placed in geographical groupings. Asterisk indicates statistical significance at 0.05 probability level.

	West of Continental Divide	East of Continental Divide
χ^2	0.190	4.321*
n	21	28
df	1	1
	West of Mississippi River	East of Mississippi River
χ^2	0.450	6.125*
n	20	8
df	1	1

FLUCTUATIONS IN THE RELATIVE NUMBERS OF WINTERING BIRDS

Although annual fluctuations in numbers were not significant, there were often appreciable shifts in yearly distribution (Figs. 1-4). In 1950 *E. cyanocephalus* was recorded by only one count in Kansas whereas many of the counts in Oklahoma recorded it as a common to abundant wintering species. Counts in Texas from Del Rio to Houston also recorded it as common to abundant, but in extreme southern Texas along the Rio Grande valley it was recorded as a scarce wintering bird. In the Rio Grande valley in New Mexico the species was primarily abundant in winter, and the one count conducted in the southeastern part of the state suggested it was abundant in that region also. In southern Arizona Brewer's Blackbird was recorded as common in winter, whereas in California it was recorded primarily as abundant except to the south of San Bernardino. These counts indicated fewer numbers of birds wintered in this area. In the Pacific Northwest *E. cyanocephalus* was primarily abundant in parts of western Oregon, but they were progressively less common more northward in Washing-

ton. Over the central Rocky Mountain states a few counts indicated that the species wintered at several sites in different numbers.

The numbers of birds reported wintering in Kansas and Oklahoma in 1951 differed from those reported in the previous year. Counts in Kansas recorded wintering *E. cyanocephalus* as being common in the southeastern region and scarce in the southcentral area. These counts had not recorded the bird the previous year. In contrast, the counts in Oklahoma indicated the species was scarce. Previously in 1950 it was reported as a common wintering bird.

Additional counts in 1951 revealed a little more about the extent of the distribution of the species in Texas and New Mexico. Counts from the Texas lowlands indicated the bird wintered there in fewer numbers than it had the previous year, and that it was perhaps less widespread because three counts that had previously reported it did not do so in 1951. Counts taken in the Rio Grande valley from El Paso northward also reported a decrease from the primarily abundant numbers reported in 1950. An additional count in the Pecos River region of New Mexico and the recorded occurrence of the species on two counts in the west Texas portion of this valley indicated more fully the extent of the bird's distribution. *E. cyanocephalus* was also apparently more plentiful in most of southern Arizona except to the east of Tucson where it was recorded as scarce. In California and the Pacific Northwest the species remained a common to abundant bird in winter, although fewer counts were held in Oregon and Washington. The species was again recorded by some of the counts in the Rocky Mountain states in numbers varying from scarce to abundant. For the most part, however, the counts recording it differed from those reporting it the previous year. Three counts east of the Mississippi River recorded *E. cyanocephalus* wintering in scarce numbers in Louisiana, Mississippi, and South Carolina. The other counts in this region did not report it.

By 1971 the number of Christmas Counts had increased appreciably. These additional counts confirmed the presence of this species in several more areas as well as denoting some changes in abundance of wintering birds.

A few more counts reported this species in Kansas and Oklahoma in 1971 than had 20 years earlier. Most of the reports indicated it as a rare or scarce bird, although it was recorded as common or abundant on a few counts. Brewer's Blackbird was predominantly common throughout much of the Texas lowlands to the east of Edward's Plateau. In the Brownsville region of southern Texas it was reported as abundant on five counts, a region in which 20 years previously it had been reported as being rare or scarce. Eight counts from the Edward's Plateau did not report the species, suggesting that it is not encountered on the plateau in winter as readily as it is to the east and west. In the Pecos River valley west of the plateau this bird was widespread and recorded as common to superabundant throughout much of the region. Northward in the Texas panhandle a few counts recorded wintering birds. Their numbers, however, varied widely between counts. The

species was recorded as abundant along the Rio Grande valley from El Paso northward to Albuquerque, New Mexico.

The general wintering pattern of this blackbird in Arizona in 1971 was much the same as it was in 1951. It was still more plentiful in the southcentral region than in the southeast. However, where it was previously a common species for the most part in the 1950's, it was now abundant. A similar increase from rare to common occurred in the region east of Tucson. The distribution in 1971 in California can be viewed in considerably more detail than possible 20 years previously. Although many of the counts still reported the species as abundant in winter, it was recorded as only a common wintering species in northern California, in the Bakersfield to Palm Springs region, and in some counts around the major suburban centers of San Francisco and Los Angeles. Five counts in the Sacramento area recorded superabundant numbers of wintering *E. cyanocephalus*, making this, along with the Pecos River wintering range, the most densely occupied wintering region.

The species was common to abundant in much of western Oregon. By 1971 Christmas Counts were held in northwestern Washington and Vancouver, B. C. regions and most of the counts reported common numbers of wintering birds. Two counts reported abundant levels.

The increased number of counts in the central Rocky Mountain states disclosed many locations where Brewer's Blackbird wintered. For the most part these sites were located along the valleys of larger rivers—the Gunnison River valley in westcentral Colorado; the Arkansas River valley around Pueblo, Colo.; Lake Meade and the Virgin River valley of southern Utah and Nevada; the valley of the Truckee River around Reno, Nev.; in the Snake River valley of southern Idaho; and in sites where water was apparently available in the interiors of Oregon and Washington.

By 1971 the newly established wintering area in Colorado extended along the eastern front of the Rocky Mountains from Denver south towards Pueblo. The species appeared to be highly dependent upon wintering in the immediate presence of cities. Although it was common in Denver and Sterling and superabundant in Pueblo, the bird decreased in occurrence to the point where it was only scarce and rare in the two counts held adjacent to Denver. Between 1951 and 1971 two counts to the northeast of Salt Lake City, Utah began reporting wintering Brewer's Blackbirds. One of these count sites, Saint George, was an area from which it had previously migrated (Tanner, 1927).

The bird had become a common wintering species throughout much of central Arkansas by 1971. It was reported as scarce or rare, however, in the southeastern part of the state. The eastward extension into parts of the southeastern states had also progressed to the point where it had encompassed a large area. Eighteen counts now reported the species whereas 20 years previously only three had done so. The general level of birds reported by these counts indicated it was essentially rare or scarce except for a few sites where it was common in Georgia and Mississippi. In 1971 this

species was also recorded on one count in each of the states of Tennessee, South Carolina, and North Carolina. The presence of the species on Christmas Counts in these areas, however, is atypical (Figs. 3, 4).

There were considerable fluctuations in the 1972 wintering distribution. The bird was common or abundant in southcentral Kansas and northcentral Oklahoma, where it had been primarily scarce the previous year. Fluctuations appear to be typical for the Kansas and Oklahoma ranges. The same pattern was observed between the years 1950 and 1951. The most noticeable change within Texas was a tendency for birds to be more scarce in the Dallas region, in the panhandle, and in the eastern portion of the Pecos River valley. In southern Texas the species also apparently decreased from its former numbers. Now it was primarily common whereas previously it had been abundant. In the Rio Grande valley of New Mexico and in southern Arizona, two areas where the species had previously been abundant in 1971, it was now recorded as occurring only as scarce and common, respectively.

The distribution in the remaining western states and Vancouver region was very similar to that in 1971. There was, however, a minor reduction in numbers of wintering birds in western Oregon and Utah. In contrast, the numbers of birds recorded in the Snake River valley increased somewhat and both numbers and occurrence of the bird in Colorado increased.

In the newly established wintering area in the southeast there appears to have been an overall reduction in numbers and occurrence of Brewer's Blackbirds. A total of seven fewer counts reported the bird in 1972. Most noticeable is the complete lack of reports of wintering in Louisiana and a contraction of the distribution in Mississippi.

EFFECTS OF SNOW AND ELEVATION ON WINTERING DISTRIBUTION

Depth of snow fall (Fig. 3) and the number of days per year on which a snow cover of at least one inch exists (Fig. 4) appear to influence strongly the wintering distribution of *E. cyanocephalus*. Of the two, snow cover appears to have the stronger effect. The majority of birds use as wintering sites those regions receiving less than 10 inches of snow or that have 10 or fewer days of snow cover. In these areas, Texas, southern New Mexico, southern Arizona, most of California, and western Oregon, this species is reported as wintering in numbers ranging primarily from common to abundant. In addition to also including two areas where the bird is normally reported in superabundant numbers, the species also appears to be more widespread than it is in regions receiving more snow. The majority of the counts, regardless of their elevation or proximity to areas of human habitation, tend to report this blackbird.

In contrast, where this bird is found wintering in areas receiving up to 25 inches of snow and a cover persisting up to 40 days, it is more likely to be recorded in fewer numbers. The values reported by the counts in question generally indicate rare to common num-

bers of Brewer's Blackbirds. In these areas, which represent Kansas, Oklahoma, central New Mexico, northern Arizona, and the Puget Sound, the species is also seemingly more restricted in occurrence, not being recorded on many of the counts.

In the regions of the United States receiving more than 25 inches of snow and where it normally persists for more than 40 days, this blackbird regularly winters only in a few, apparently restricted sites within the states of Colorado, Utah, Nevada, Idaho, Washington, and Oregon.

Elevation does not appear to influence directly the distribution of this blackbird in winter. Sites ranging from sea level to over 7,000 feet in elevation are chosen. Although it is often not reported by counts from above 6,000 feet, and counts approaching this elevation often report only a few birds, *E. cyanocephalus* shows no broad pattern which appears to conform with elevational influences. In local areas, however, particularly where the habitat may change appreciably with increases in elevation, the boundaries of the range may coincide more directly with elevation (Gabrielson and Jewett, 1940; Scott, 1887). Elevation may be more important in the more northern portions of the range, particularly in these areas receiving more than 25 inches of snow and having protracted periods of snow cover. It is notable that the wintering sites in Idaho and the interiors of Oregon and Washington are at lower elevations.

In a few additional locations there is an apparent association between elevation and the extent to which an area is used in wintering. The species is noticeably absent on the eight counts in the region of the Boston and Ouachita mountains, a region approximately 1,000 feet higher than where the bird winters in the surrounding regions of Kansas and Oklahoma. The species is also generally not recorded on the counts held in the Wichita Mountains in westcentral Oklahoma. Farther south, Brewer's Blackbird is recorded infrequently on the counts from Edward's Plateau in central Texas. The species is also apparently restricted in its distribution in the southern Appalachian Mountains, where it is recorded typically only on the count in Rome, Georgia. Presumably habitat changes that are associated with increases in elevation, for example, increased tree cover or reduced availability of water, are more responsible for these general absences than is elevation itself.

DISCUSSION

During the winter season, North American "blackbird" populations are often quite nomadic. Their location and hence what could be considered the boundaries of their range vary with time. When food, the main requirement of a wintering area (Meanley, 1965), diminishes or becomes inaccessible, populations readily depart to more suitable areas. Accordingly, *Euphagus cyanocephalus* and many other forms which commence wintering in the more northern regions of their range withdraw southward as the season progresses (Bailey, 1966; Goddard, 1971; Jumber, 1956). The outcome of this is more southern populations may not peak

until late in the season and therefore not be accurately assessed by Christmas Counts. This is commonly the situation with Brewer's Blackbird in its northern Florida wintering area (D. W. Johnston, pers. comm.). As the converse situation, numbers peaking early in the season, occurs in the northern limits of the range, the full extent of the wintering area of *E. cyanocephalus* or other species, would not be conveyed by sampling only during one month of the season.

For species such as Brewer's Blackbird with flexible wintering behavior, it seems better to consider their range as a relatively fluid entity. Not only does the occurrence of the species vary within one season as the populations move progressively southward, but within and between years the timing of the onset of winter greatly affects the location of the populations. In contrast breeding ranges tend to be more constant over such short periods of time.

Undoubtedly agriculture has had a major effect upon the occurrence of icterid wintering populations (Meanley, 1971). With the advent of additional food sources many regions now act as at least temporary wintering sites whereas formerly they did not. In recent times the wintering range of this and other species is seemingly more variable as a result.

SUMMARY

Significant changes have taken place in the wintering range of Brewer's Blackbird within this century. At present this species typically winters south of a line extending diagonally from Vancouver southeast to Atlanta, Georgia. Previously the winter range was much smaller. The changes producing this expansion have involved the use of new wintering sites in the southeast, increased wintering in the more northern parts of the range, and wintering at elevations higher than those previously used.

The wintering range of this species may be divided into three sections in accordance with the amount of snow received and the duration of the snow cover. As these two factors vary annually, so do the probabilities of occurrence of the species at many sites. In particular, populations wintering to the north of Texas or east of the Mississippi River characteristically fluctuate from one year to the next. They probably also fluctuate considerably within one season. Populations wintering in the remaining southern areas, particularly those known to have been historically occupied, are much more consistent in numbers and occurrence from one year to the next.

Over the past 22 years there has been an increase in the numbers of wintering Brewer's Blackbirds. This increase, however, has resulted only from the bird's occupancy of new wintering areas. The numbers of birds reported in other areas (Texas, Arizona, California, and Oregon) have remained stable with only minor fluctuations. This underscores the importance the amount of wintering habitat has had upon the size of this bird's population. Although the evidence discussed suggesting a direct connection

between the new eastern breeding and wintering areas is inconclusive, the lack of a significant change in the numbers of birds wintering in those areas where it had historically wintered suggests that the expansion of the breeding range may not have been possible until new wintering sites became available.

In overview we see in the wintering distribution of Brewer's Blackbird a species apparently favored by recent environmental changes. This bird has been able to expand its range northward, occupying sites that normally receive enough snow to preclude occupation. Its range has expanded eastward encompassing portions of Arkansas, Louisiana, Alabama, Georgia, and Florida. As a result Brewer's Blackbird has increased both its numbers and the extent of its wintering distribution in North America.

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