

THE CONDOR

VOLUME 55

MARCH-APRIL, 1953

NUMBER 2

DISTRIBUTION AND MIGRATION OF THE EUROPEAN STARLING IN NORTH AMERICA

By BRINA KESSEL

Since its first successful establishment in Central Park, New York City, in 1890 and 1891, the European Starling (*Sturnus vulgaris*) has proved itself a resourceful, hardy bird, well adapted to the environmental conditions existing in many parts of North America. The species has extended its range on the continent until currently (1952) it is found throughout southern Canada, the entire United States except southern Florida, and extreme northeastern Mexico. It breeds extensively in the United States and Canada throughout that part of its range northeast of a line extending from south-central British Columbia, northeastern Oregon, and northern Utah to southern Mississippi. Southwest of this line the starling occurs only during the winter months and in migration.

Numerous authors have observed and recorded the westward spread of the starling in North America, and several good summaries have been published: Forbush (1916), Kalmbach and Gabrielson (1921), Wood (1924), Cooke (1925, 1928), Lewis (1927), Hoffman (1930), Dickerson (1938), Wing (1943*a*), and Bent (1950). The last areas to be reached by the starling in its westward spread have been those of the Pacific Coast. To bring the published summaries up to date, table 1 lists the range extensions into this region. The starling has consistently tended to extend its breeding range faster in the north than in the south (fig. 7), and the published breeding records of the starling west of the continental divide further substantiate this: Salt Lake City, Utah (Lockerbie, 1949); William's Lake, British Columbia (Racey, 1950); near Grangeville, Idaho (Jollie, 1951); LaGrande, Oregon (Quaintance, 1951); and Roxboro, Washington (Hudson and King, 1951). The next few years will undoubtedly witness a further extension of the starling's breeding range into the Pacific Northwest.

RESIDENT VERSUS MIGRATORY BIRDS

The starling as a species is a permanent resident within its breeding range in North America. Many individuals of the population are themselves permanent residents. Marked individuals have inhabited the immediate environs of Fernow Hall, Ithaca, New York, throughout the year; and many birds known to have bred in the vicinity of Ithaca in one or more seasons have been found close to these same localities during the winter. On the other hand, some individuals are highly migratory. Birds banded at Ithaca in the winter have been found in the summer in northern New York, and in Quebec, and Ontario, Canada. Others banded in winter at Fort Smith, Arkansas, have been recovered in subsequent summers in Minnesota, Iowa, Illinois, Indiana, Ohio, and Ontario. Still others banded in summer at Union, Ontario, have been found in the winter in Illinois, Indiana, Ohio, Arkansas, Mississippi, and Florida. Present data fail to indicate precisely the composition of the migratory portion of the starling population in North America, but the evidence indicates that some members of each age and sex category may migrate. Many young of the year wander great distances during the summer months and many are found far south of their place of hatching during their first winter, apparently having undertaken a migration in the autumn (Fish and Wildlife Service Bird-Banding Files). Adult birds, that is, birds over one year of age, also mi-

Table 1
Occurrences of the Starling in the Pacific Coast Region

Date	Locality	Number reported	Author
ALASKA			
April 17, 1952	Juneau	1	(See page 65)
BRITISH COLUMBIA			
January 15, 1947	Near Oliver, Okanagan Valley	8	Munro (1947)
March, 1947	Bella Coola	2	Godfrey (1949)
December 1, 1948	Bella Coola	1	Godfrey (1949)
April 30, 1948	150 Mile House	1	Racey (1950)
November 26, 1948	William's Lake	1	Racey (1950)
October-December, 1949	Burns Lake	"many"	Racey (1950)
November 20, 1949	Alkali Lake	4	Racey (1950)
Mid-November, 1949	Near Vernon	"flock"	Racey (1950)
Mid-December, 1949	Surrey (Vancouver)	4	Racey (1950)
January 11, 1950	Lulu Island (Vancouver)	5	Racey (1950)
January 20, 1950	Vancouver	2	Racey (1950)
Winter, 1949-50	Wistaria	30	Racey (1950)
Winter, 1949-50	Fraser Valley and southern British Columbia coast	"have been seen"	Racey (1950)
Summer, 1950?	Onward Ranch, south of William's Lake	Nesting	Racey (1950)
WASHINGTON			
March 20, 1943	North of Pullman, Whitman Co.	5	Wing (1943b)
December, 1945	Fort Lawton, King County	1	Larrison (1947a)
March 3, 1946	Colton, Whitman County	2	Jewett (1946a)
August 14, 1947	Verlot Ranger Station, East of Robe, Snohomish Co.	1	Larrison (1947b)
Winter, 1947-48	Cowlitz County	flocks from 3-10	Ransom (1948)
February-March, 1948	Walla Walla Valley	numerous flocks up to 500	Booth (1948) and Pope (1948)
Late November, 1948- April, 1949	Southeastern Washington	flocks over 1000	Booth (1949)
January 16, 1949	Between Redmond and Bellevue, King County	10	Bennett and Eddy (1949)
December 29, 1949, and January 2, 1950	East of Lake Washington, King County	2	Flahaut (1950) and Hagenstein (1950)
April-June, 1951	Roxboro, Adams County	Nesting	Hudson and King (1951)
OREGON			
December 10-24, 1943	Malheur Nat. Wildlife Refuge, Harney County	1	Jewett (1946b)
January 22, 1946	Near Cove, Union County	1	Quaintance (1946)
November 15-21, 1946	Malheur Nat. Wildlife Refuge, Harney County	1-21	Scharff (MS)
November, 1946	Blitzen Valley, Harney County	"quite a flock"	Jewett (in <i>litt.</i>)
December 16, 1946	Hart Mountain, Lakeview Co.	1	Jewett (in <i>litt.</i>)
December 26, 1947	Meadow View, Lane County	22	Gullion (1951)
December 26, 1947	Eugene, Lane County	100	Eugene Nat. Hist. Soc. (1948)
February 7 and 20, 1948	Near Alvadore, Lane County	30	Gullion (1951)
April 4, 1948	Near Alvadore, Lane County	30	Gullion (1951)
December, 1948	Enterprise, Wallowa County	1	Quaintance (1949)
December 15, 1948	Nestucca Bay, Tillamook Co.	5	Walker (1949)
December 21, 1948	Malheur Nat. Wildlife Refuge, Harney County	5	Quaintance (1949)
December 24, 1948- January 2, 1949	Eugene, Lane County	800	Eugene Nat. Hist. Soc. (1949)
December 30, 1948	Near Alvadore, Lane County	800	Gullion (1951)
Winter, 1948	Portland, Multnomah County	present	Flahaut (1949)

Date	Locality	Number reported	Author
Winter, 1948-1949	Malheur and vicinity, Harney County	abundant	Van den Akker (1949)
February, 1949	Near La Grande, Union County	1	Quaintance (1949)
Winter, 1949-1950	Eugene and vicinity, Lane County	numerous flocks up to 600	Gullion (1951) and Eugene Nat. Hist. Soc. (1950)
January 1, 1950	Portland, Multnomah County	43	Ore. Aud. Soc. (1950)
May-June, 1950	La Grande, Union County	Nesting	Quaintance (1951)
December 31, 1950	Portland, Multnomah County	2	Ore. Aud. Soc. (1951)
CALIFORNIA			
January 10, 1942	Tule Lake, Siskiyou County	1-40	Jewett (1942)
December 5, 1946	Chino, San Bernardino County	1	Stager (1947)
December 18, 1946, and February 23, 1947	Southeast of Needles, San Bernardino County	45	Monson (1948)
December 30-31, 1946	Tule Lake, Siskiyou County	70-100	Jewett (in <i>litt.</i>)
January 3, 1947	Furnace Creek Ranch, Inyo Co.	2, 11	Bolander (1947)
December 8-10, 1947	Leevining, Mono County	5-12	Vestal (1948)
January 13, 1948	Gray Lodge Refuge, Butte Co.	6	Ferrell (1949)
February 8-23, 1949	Point Reyes Peninsula, Marin County	numerous small flocks	Gullion (1949)
November 16, 1949	Orland, Glenn County	2	Linsdale (1950a)
January 18, 1950	Near Willows, Glenn County	20	Jones (1950)
January 25, 1950	Near Hamilton City, Glenn Co.	4	Jones (1950)
January 26, 1950	Point Isabel, near Richmond, Contra Costa County	8-10	Linsdale (1950b)
December 27, 1950	Pasadena, Los Angeles County	1	Barr, <i>et al.</i> (1951)
Late December, 1950, and February 20, 1951	Whittier, Los Angeles County	1	Small and Pyle (1951)
Early October, 1951	Vicinity Julian, San Diego Co.	?	Small and Pyle (1952)

grate. Whether these are second-year birds that have never bred, mature breeding birds, or both, cannot be determined because of inadequacies in the North American banding data, principally the failure of bird-banders to distinguish at the time of banding between first-year starlings and adults. Banding has established that some starlings, both males and females, breed in their first year; many, however, do not (Ticehurst, 1913, 1914; Kluijver, 1935; Berndt, 1939; Kessel, MS). Those that do not breed until their second year, and therefore do not develop an attachment to an area, could be expected to behave much like first-year birds in their wanderings and migrations.

Much the same situation with respect to migration exists in the populations of the British Isles and continental Europe, where one finds some migratory and some resident individuals. Here again first-year and second-year birds migrate (Thomson, 1922; Schüz and Weigold, 1931), but data on the migration of adult breeding birds are meager. Fairly conclusive evidence that some of these birds migrate, however, is found among the banding data for continental European Starlings. The mere fact that most of the continental birds are migratory suggests this, but in addition, Schüz and Weigold (1931) record the recovery in North Africa in winter of five birds at least two and a half years old which had been banded as young in Switzerland, Czechoslovakia, and Austria. Because these birds were certainly old enough to have bred, and because the European Starling is not known to breed in Africa, these birds apparently had migrated to Africa after breeding at least once. It seems likely, then, that some members of each of the age categories are regularly migratory and that others are not; or, as Nice (1937) found with the Song Sparrows (*Melospiza melodia*), some individuals may migrate in some years and not in others.

The actual percentage of migratory and non-migratory starlings in the population varies with geographic locality and with the season of the year. Kalmbach (1932), from the results of 120 recoveries of 4516 birds banded at winter roosts in Washington, D.C., suggests that something more than 23 per cent of the birds wintering in Washington are essentially resident birds. Thomas (1934), from 172 recoveries of 7062 birds banded at Columbus, Ohio, concluded that a much smaller percentage of the birds in large winter roosts there were local residents.

At Ithaca, New York, 1023 starlings were banded from communal roosts during the winters of 1947, 1948, and 1950. To date (June, 1952), 169 of these have yielded returns, 150 of them local (within 20 miles). Of these latter, 57 were taken during the summer months, indicating that at least 38 per cent of the wintering population at Ithaca is resident. Intensive summer field studies, and a strong ornithological education program in the vicinity of Ithaca undoubtedly increased the number of local recoveries over what they might otherwise have been; the figure of 38 per cent, therefore, may not be comparable to the percentages of Kalmbach and Thomas, who did not supplement their winter bandings with summer studies.

In addition to the flock birds banded at Ithaca, 69 birds roosting individually in isolated places were banded during the winter. Thirty-five of these were recovered locally: 20 in the summer months, and 22 in the winter months (7 recaptured in both winter and summer are included once in each of the counts). These numbers suggest that at least 57 per cent of the isolated winter birds are permanent residents. The percentage of residents in these isolated birds probably approaches 100, however, the discrepancy being caused by the methods of recapture. These isolated birds were originally banded at night, from December to March, in nesting boxes, and all but a few of the recoveries were obtained by subsequent visits to these boxes. During the winter both males and females roost in the boxes, but as the breeding season approaches only the females stay in the boxes at night. Hence, during the summer months, as one would expect, the returns consist largely of females: 14 out of the 20 summer recoveries of the isolated birds were females. Of the 22 winter recoveries, 18 were males; one would not expect to find these roosting in the boxes during the breeding season. This evidence, and the fact that only one of these birds has been taken over twenty miles from the banding locality, indicates that a high percentage of the starlings roosting in isolated places are permanent residents.

Taking everything into consideration—flock-banded birds recovered in the summer, isolated roosting birds, and flock-banded birds recovered in the winter some of which are undoubtedly permanent residents—one might estimate that at least 60 per cent of the starlings that winter in Ithaca are permanent residents.

Even less is known about the percentage of migratory and non-migratory starlings in a given area during the summer as compared to the winter. At Ithaca, in the summers of 1947 through 1951, 167 breeding birds were banded at their nest sites. At the time of this writing not one of these birds has been recovered outside of the Ithaca region. Of the 141 birds banded from 1947 through 1950, 67 have been recovered—60 in the summer, and 23 in the winter (16 being recovered in both summer and winter). This evidence indicates that at least 34 per cent, and probably more, of the breeding birds at Ithaca are permanent residents.

Of 1111 nestlings banded at Ithaca from 1947 through 1950, 33 have been recovered: 21 at Ithaca (16 in ensuing summers, and 6 in winters), and 10 over 20 miles from Ithaca (5 in winter and 4 in summer).

To show further the effect of geographic locality on the percentage of migratory starlings in the population, the writer, in 1946, tabulated all the bird-banding recoveries

filed in the bird-banding files of the Fish and Wildlife Service (excluding repeats) and then compared the number of recoveries from outside the state of banding with the total number of recoveries from inside (without segregation by seasons). This admittedly rough method indicates the regions in which starlings are relatively migratory or non-migratory. In Texas and the Southwest, where flocks winter but do not breed, the population must be 100 per cent migratory. In Louisiana, Arkansas, Kansas, Missouri, and western Tennessee, over 67 per cent of the recoveries of birds banded within the state were out-of-state. Indiana had 62 per cent of its recoveries taken outside the state, Ohio 31 per cent, Kentucky 22 per cent, and Ontario 22 per cent. Recoveries are too few from the states of the Southeast for consideration. The eastern states have a much lower percentage of out-of-state recoveries than the midwestern states do. With the exception of Vermont and New Hampshire, all have a percentage of out-of-state recoveries of 20 per cent or less, some as low as 5 per cent. Wisconsin, Michigan, and northern Illinois are also low, being 3 per cent, 10 per cent, and 6 per cent, respectively. From these figures it appears that, on an annual basis, more migratory starlings occur in the central and southern midwestern states than in the Lake States, the Northeast, and the Atlantic seaboard. There are two possible reasons for this. First, the starling may be more migratory on the edge of its range, or at least in areas where its population is relatively sparse. Second, the areas of the highest percentage of out-of-state recoveries fall along what appears to be one of the main trunk lines of migration for starlings in this country, that is, from Ontario, through Ohio, along the Ohio River, and down the Mississippi River (fig. 1). These areas should, therefore, have larger numbers of wintering migrants than do some of the adjacent states.

ANNUAL MIGRATION DATES

The dates of starling migration in North America agree closely with those of Europe and the British Isles. In general, the spring migration occurs from mid-February to the end of March, and the fall migration from late September and October through November.

The actual dates of migration vary somewhat from year to year and with geographic locality. At Abilene, Kansas, for instance, starlings were present from November 3, 1939, to March 14, 1940; November 14, 1942, to March 11, 1943; and from November 30, 1949, to March 14, 1950 (Fish and Wildlife Service Bird Distribution File). At North Bay, Ontario, the spring migration peak comes early in April, and the fall peak late in August (*loc. cit.*). At Ithaca, New York, the first large influx of the spring migration came during the last week of February in 1947 and 1948, but not until the second week in March in 1951, and the third week in March in 1950. Fall migratory flocks are usually common about the countryside near Ithaca by the middle of October, and they disappear in the last half of November.

EXTENT AND DIRECTION OF MIGRATION

The geographic pattern of starling migration in North America shows little resemblance to that of Europe. The birds of each region show several distinct directions of movement, but the topographic features of the respective continents seem to determine these directions. There is little evidence to indicate that the migration routes in North America have been established as a result of characteristics inherited from European ancestors.

The migratory movements of the starling in Europe have been well summarized and mapped by Schüz and Weigold (1931). Roughly, the movements fall into three groups. The birds from Norway, Sweden, and Finland migrate in the autumn in a south-westerly direction, probably affected by the coastlines. Those from the areas immedi-

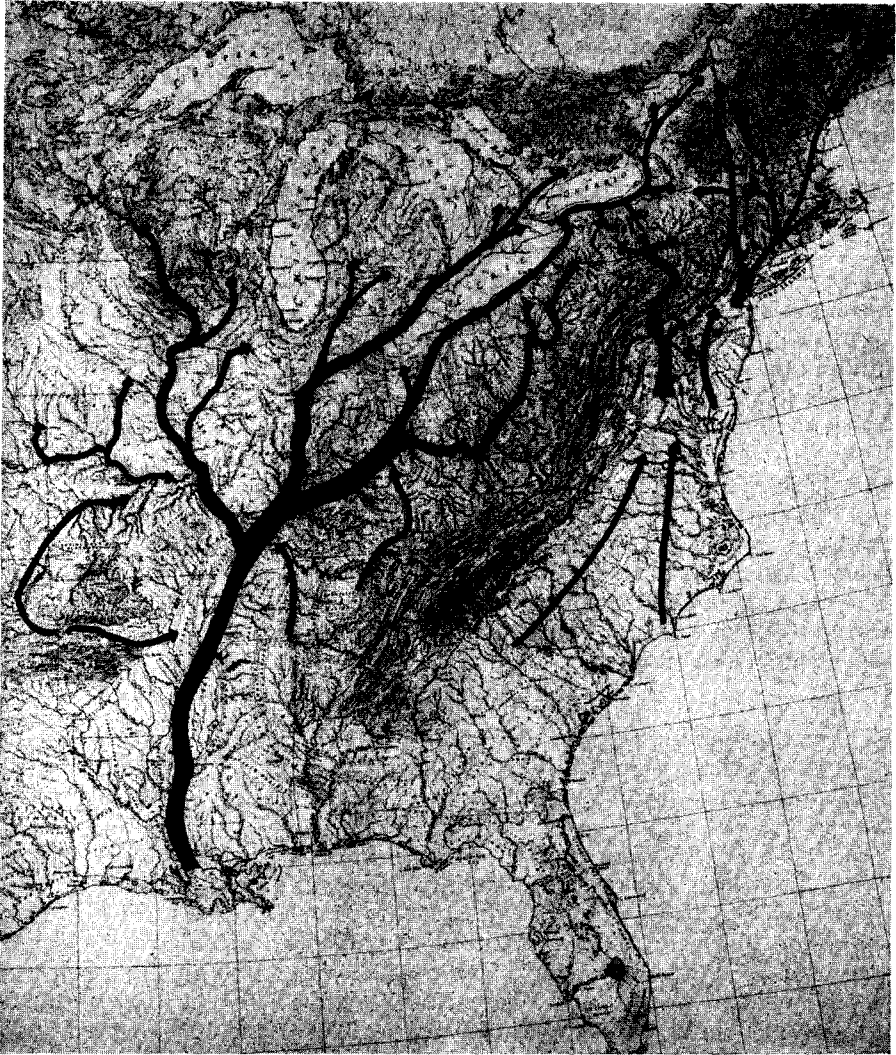


Fig. 1. Main migration routes for the Starling in the eastern United States.

ately south and east of the North Sea and Baltic Sea exhibit a strong tendency to migrate in a west-east direction along the coast—west in autumn, and east in spring. Those from central Europe, like those from Scandinavia, tend to migrate in a northeast-southwest direction, the autumnal migration tending to be more westerly in the western parts, and more southerly in the eastern parts. The birds from Finland apparently split their flight in East Prussia; some continue their autumnal flights in a southwesterly direction as far as France and Spain, and some join the flocks along the Baltic coast and migrate westward as far as the British Isles.

The breeding birds from the Scandinavian and Baltic regions migrate through Denmark, Belgium, Holland, and northern France to the British Isles, with some of the Finnish birds migrating into France and northern Spain. Migrating birds from Germany move as far southwest as southern Europe, southern Spain, and occasionally Africa. The

birds from Switzerland, Saxony, Silesia, Austria, and Czechoslovakia move into Italy, southern France, southern Spain, and Africa.

North American banding studies by Kalmbach (1932), Thomas (1934), Hicks (1938), and others have shown that here also the starling exhibits several directions of migration. In the areas between the Atlantic seaboard and the Appalachian Mountains the direction is north-south or northeast-southeast; west of these mountains it tends to be almost entirely northeast-southwest.

Since the early studies of Kalmbach (1932), Thomas (1934), and Hicks (1938), many starlings have been banded in North America, especially in the eastern portions. These banded birds have yielded a wealth of data that are now filed at the bird-banding office of the Fish and Wildlife Service on IBM cards. In the course of the present study the writer tabulated, analyzed, and mapped all recoveries from a distance of more than 100 miles from banding that were reported to the bird-banding office prior to January 1, 1951. The results corroborate and augment the observations of earlier workers. Figures 2-5 show the geographic distribution of the recoveries of starlings banded at various localities in North America. The large stars on the maps indicate the region of banding, and the smaller, circular dots indicate the sites of recoveries of individual birds. The season of banding is noted in each legend.

A study of the migrations of banded starlings in relation to the topographic features of North America shows that starlings, like many other birds, seem frequently to utilize river valleys, lake plains, and coastal plains as flyways. Figure 1 indicates the probable main routes of starling migration in this country.

In general, the starlings banded along the Atlantic coastal plain migrate north-south, or northeast-southwest, along this plain, tending to leave the plain only through the larger river valleys. The birds banded on the western end of Long Island, New York, for instance, have been recorded from Florida to the Gaspé along the coastal plain. They have entered upper New York through the Hudson Valley, whereas they entered Vermont through the Connecticut River Valley (fig. 2*d*). The birds banded in eastern Massachusetts, and in the vicinity of Philadelphia, Pennsylvania, show the same pattern (figs. 2*b*, 2*d*). One bird banded on Long Island in one winter was recovered in Ohio the following winter. This bird probably migrated up the Hudson River Valley the spring following banding and at some time crossed the state through the Mohawk Valley. Then, that fall it probably migrated with the starlings that go to the midwest in the winter via the route south of Lake Erie.

The starlings from the vicinity of Washington, D.C., deviate from the coastal route. They apparently move northward in spring west of Chesapeake Bay and then follow the Susquehanna River through the mountains straight northward (fig. 3*b*). Only a few cross over the Susquehanna River and follow the coastal plain northward.

The majority of the birds of the Delaware-Maryland-Virginia Peninsula, across Chesapeake Bay from Washington, D.C., tend to follow the coastal plain to the Hudson River and New England. A few cross to the northwest and join the Washington flocks in coming north via the Susquehanna River to central New York State (fig. 2*a*).

The starling populations to the west of the Appalachian Mountains exhibit a strong northeast-southwest movement (figs. 3-5). Individuals banded in the winter in central Tennessee (Nashville, Murfreesboro, and Pulaski), southeastern Indiana (Lawrenceburg Junction), and southern Ohio (Cincinnati, Columbus, and Canal Winchester) migrate mainly northeastward into Ohio, northwest Pennsylvania, and western and central New York State; most apparently remain south of the Great Lakes, but a few are found in Ontario (figs. 3*c*, 4*a*).

A large number of the starlings wintering to the west and south of these areas—

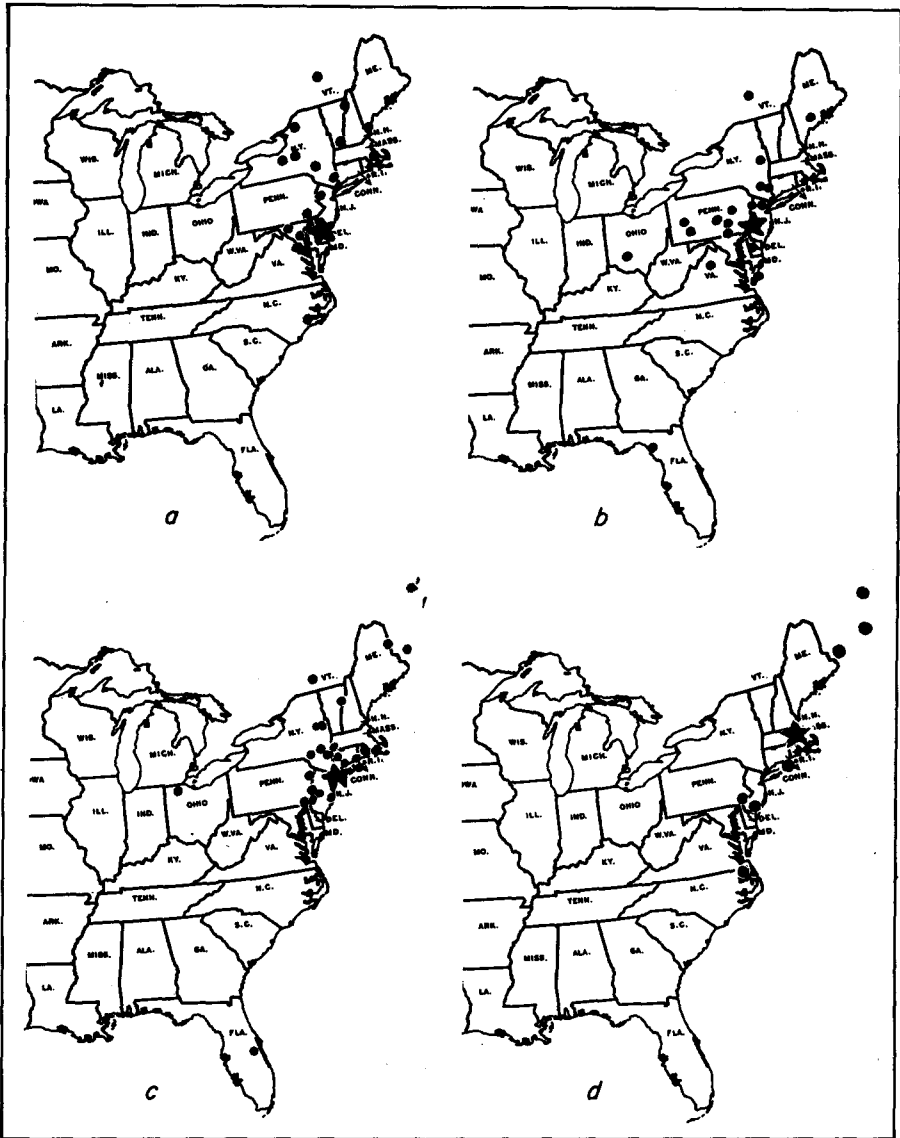


Fig. 2. Recoveries of Starlings banded (a) in winter in Delaware; (b) throughout year in and near Philadelphia, Pennsylvania; (c) throughout year near New York, New York; (d) throughout year in eastern Massachusetts. For d, southern recoveries made in winter; northern recoveries in both winter and summer.

those banded in Memphis, Tennessee, Fort Smith, Arkansas, and Avery Island, Louisiana—migrate northeastward through southern Illinois, Indiana, northwestern Ohio, and enter southern Ontario from southeastern Michigan. Some migrate through Kentucky and Ohio, and a few reach New York. Most, however, stay farther west, with those which migrate as far as Lake Erie going north of the Lake rather than south of it (figs. 3d, 4c, 4d).

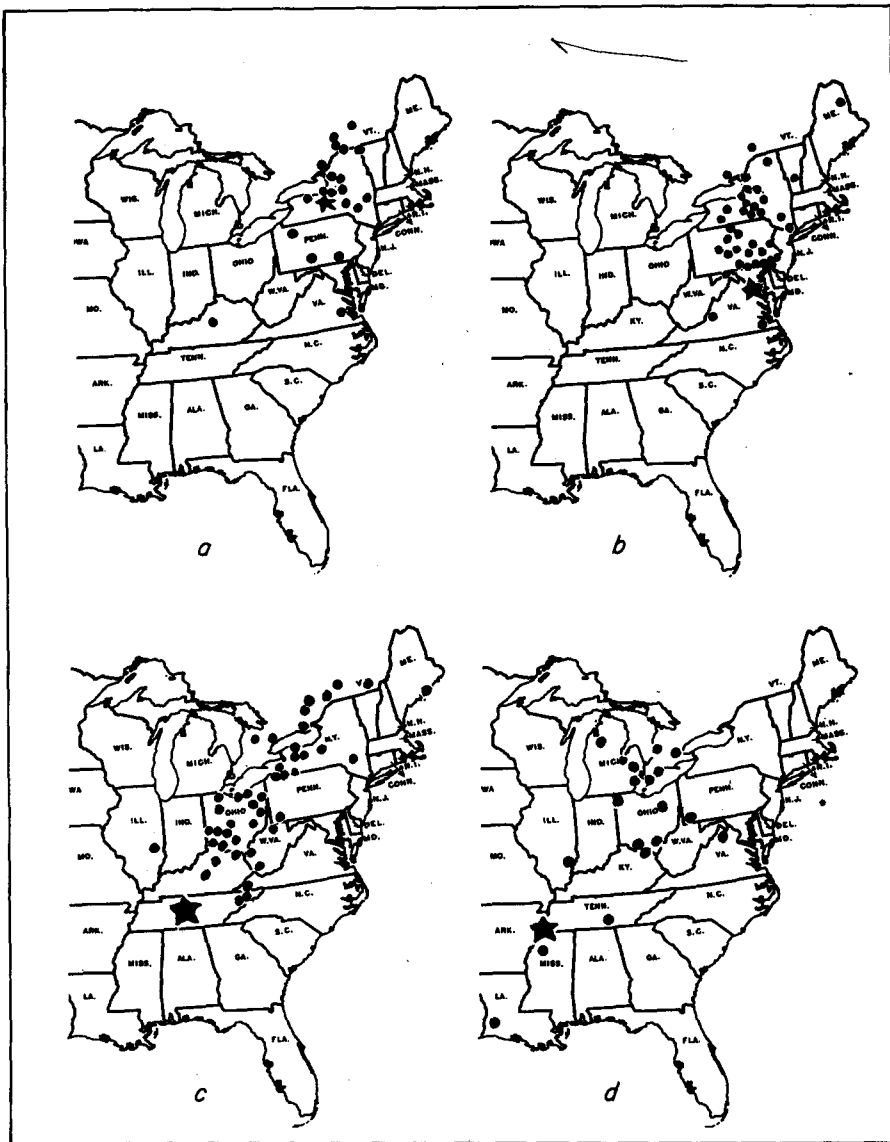


Fig. 3. Recoveries of Starlings banded (a) throughout year at Ithaca, New York; (b) in winter in and near Washington, D.C.; (c) in winter in central Tennessee (Murfreesboro, Nashville, and Pulaski); (d) in winter at Memphis, Tennessee.

Some of the starlings banded in the winter at Avery Island, Louisiana, and at Fort Smith, Arkansas, have been recovered in areas directly north of the banding site (figs. 4c, 4d). It seems likely that these birds, instead of crossing the Mississippi River and continuing in a northeast direction on their spring migration, followed the Mississippi River straight north. Some of the Fort Smith birds, in order to skirt the Ozark Mountains, may also have moved westward up the Arkansas River and then northward via the Cherokee Plains and the Missouri River.

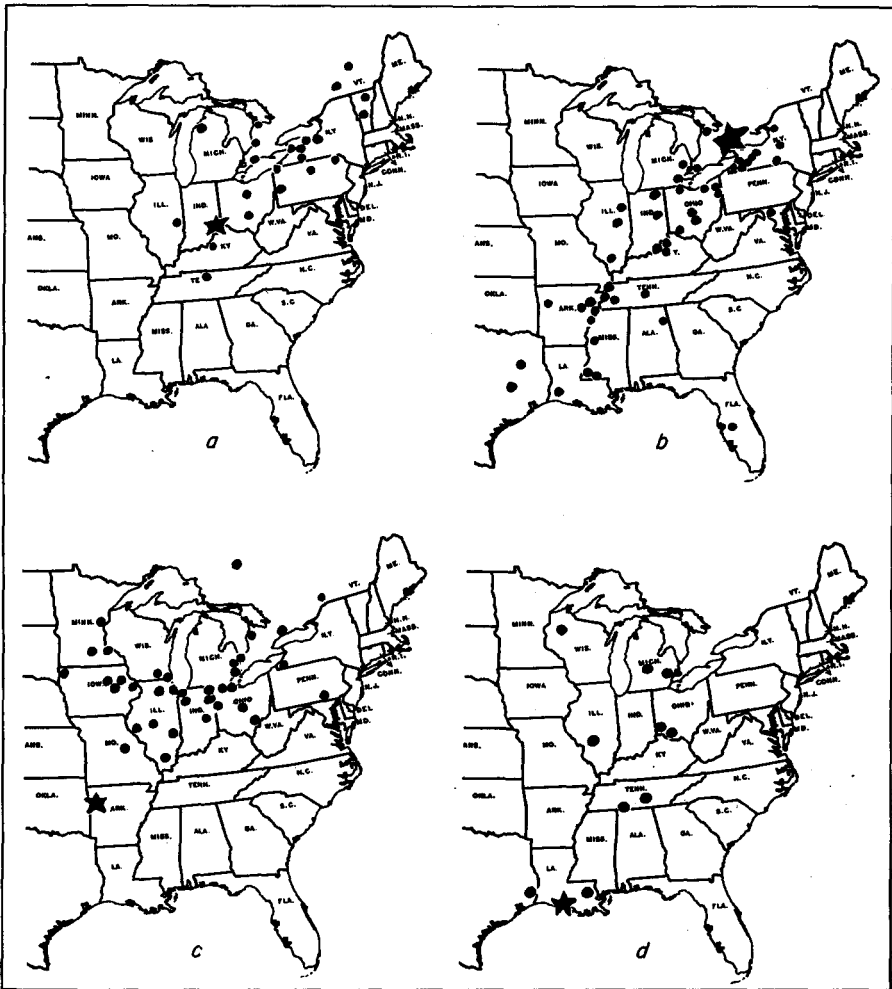


Fig. 4. Recoveries of Starlings banded (a) in winter at Lawrenceburg Junction, Indiana; (b) throughout year in southern Ontario (all recoveries for winter, except one in Kentucky and several in New York); (c) in winter at and near Fort Smith, Arkansas; (d) in winter at Avery Island, Louisiana.

The majority of the wintering starlings banded in Ellinwood, Kansas, and in the vicinity of Independence, Missouri, migrate northeastward into Iowa, northern Illinois, and Wisconsin in the spring. A few of the Missouri birds have been found as far east as southern Michigan, and Leeds County, Ontario (figs. 5*b*, 5*a*).

The starlings from the Chicago region and from northwestern Indiana are largely resident birds. Those that do migrate move southwest in the autumn to southern Illinois, Missouri, Arkansas, Louisiana, and Texas (figs. 5*c*, 5*d*). The spring migration moves in two general directions: one, the expected direction, in which the birds move in an east and northeasterly direction to Michigan, Ontario, New York, and Pennsylvania; the other, a more limited movement, to the northwest. Apparently some birds move into the urban areas of the region from Chicago to Waukegan during the winter months

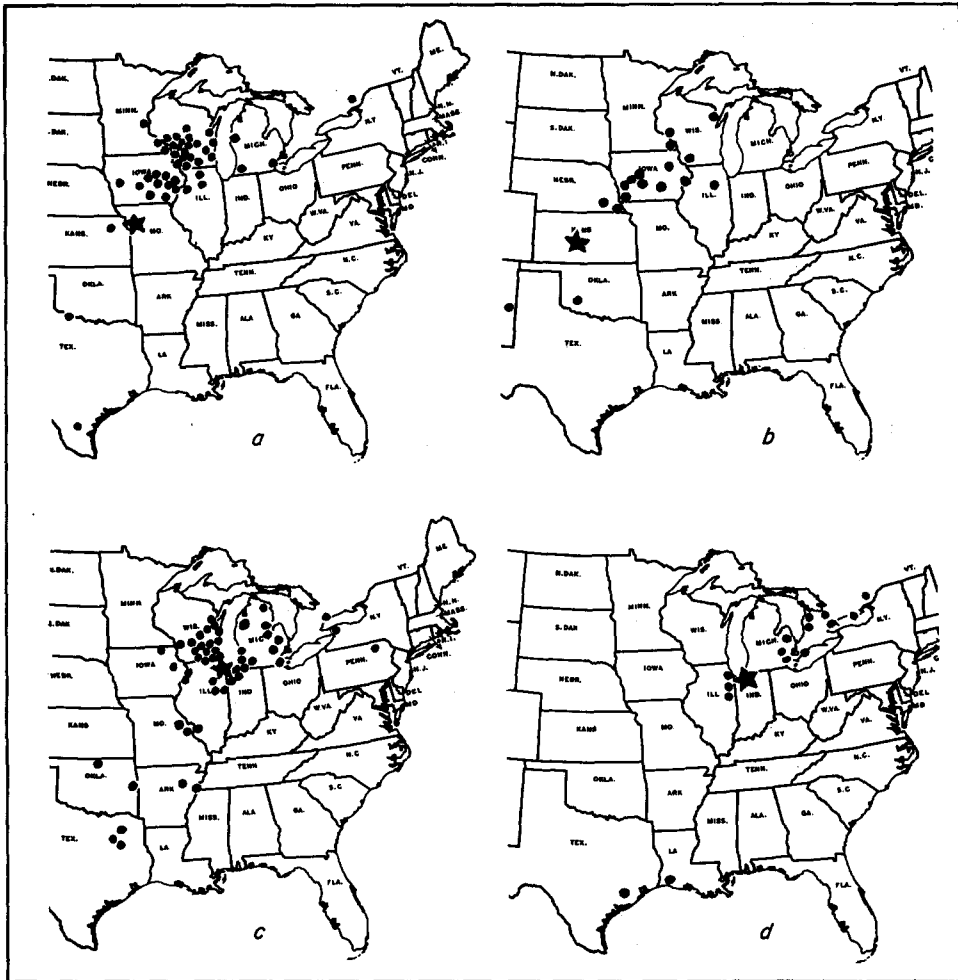
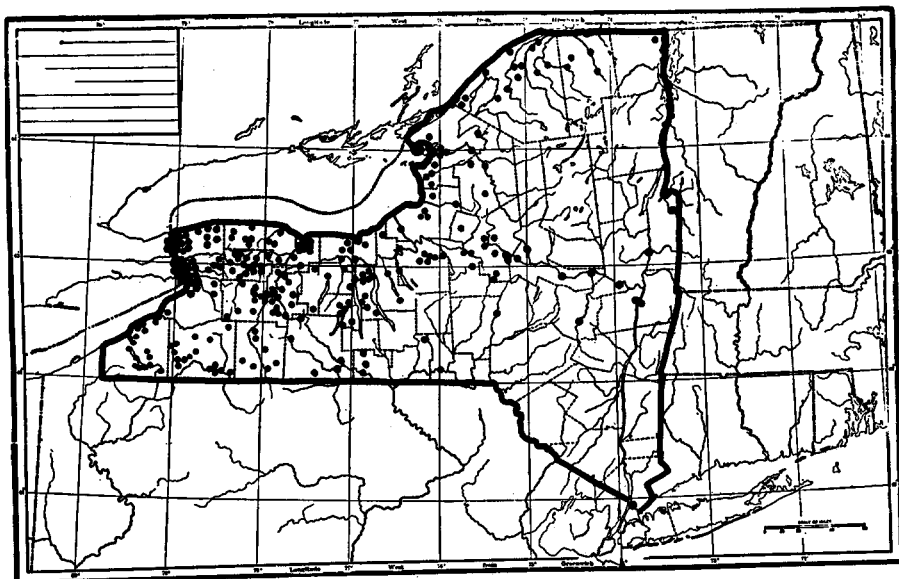


Fig. 5. Recoveries of Starlings banded (a) in winter at and near Independence, Missouri; (b) at Ellingwood, Kansas (all winter-banded except those recovered in Oklahoma and New Mexico, which were banded as juveniles in June); (c) throughout year in northeastern Illinois; and (d) in winter in northwestern Indiana. For c, southwestern recoveries made in winter; those from eastern Michigan and eastward in summer; those from northwestern Michigan and Wisconsin throughout year.

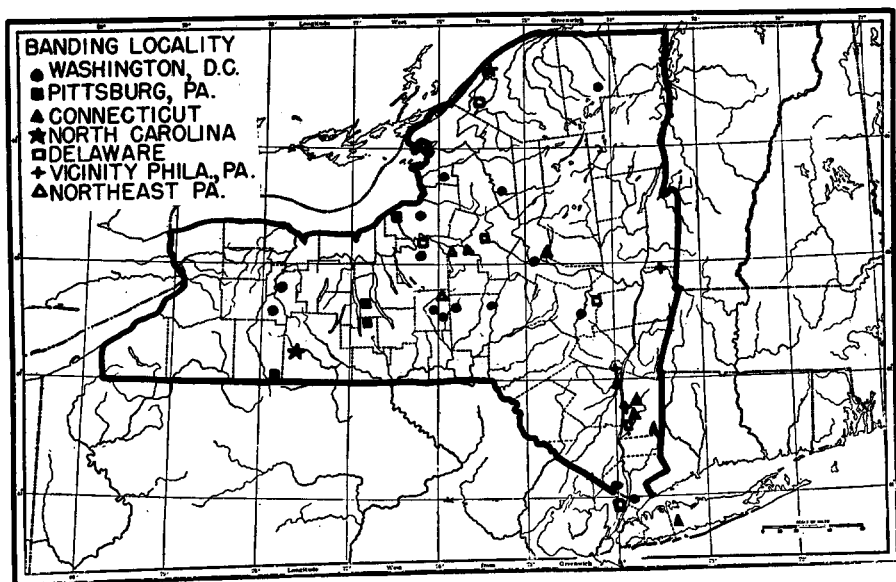
and then return to southern Wisconsin during the summer. Lake Michigan blocks the possibility of a northeast movement from this limited area.

In summary, the general migratory trend of the starling in the midwestern states is northeast-southwest. Within these areas the topography, except in the region of the Ozark Mountains, does not obstruct the migration routes. Even under these conditions, however, if river valleys exist in the general direction of migration, they are apparently frequently utilized as flyways (see especially figs. 4b, 4d).

In the present study special note has been made of the source and routes of the migratory starlings of New York State. Analysis of the Fish and Wildlife banding data shows that starlings enter the state in the spring through three main migration routes:



a



b

Fig. 6. (a) Recoveries of Starlings in New York State banded in southern Ohio. Same patterns shown by birds banded in central Tennessee and southeastern Indiana. (b) Recoveries of Starlings in New York State banded to the south.

southwestern New York, either along the south shore of Lake Erie or up the Allegheny River; up the Susquehanna River; and up the Hudson River. A few starlings also enter the western end of the state through the Buffalo-Niagara Falls region from Ontario, but this does not appear to be a regular migration route, and it is relatively unimportant.

Figure 6a plots all the starlings banded in southern Ohio (Cincinnati, Columbus, and Canal Winchester) and later recovered in New York State. The recoveries in New York State of starlings banded in central Tennessee and southern Indiana show a pattern identical to that of the Ohio birds. The map shows that most of the birds probably enter the state along the southern shore of Lake Erie, follow the Great Lakes plain northward to the Buffalo-Niagara region, and then fly eastward along the plain south of Lake Ontario. From this plain, the birds fly southward up the valleys of the north-south drainage systems of that part of the state. E. M. Reilly finds this same pattern of movement in many other species of birds that move into New York State from the west (verbal communication). Other starlings from the west reach the southwestern part of New York through the valley of the Allegheny River. Some follow the Lake Ontario plain around the east end of the Lake and northward to the St. Lawrence River, Montreal, and Ottawa. Others enter the Mohawk River Valley, and a few follow it as far as the Hudson River. One Ohio-banded bird, recovered near the mouth of the Hudson River, undoubtedly followed the Mohawk Valley route in getting there.

Figure 6b plots all the starlings recovered in New York State from bandings in states to the south. These starlings apparently entered the state by all of the three main migration routes. Those from Pittsburgh, Pennsylvania (west of the Appalachians), entered the state through the Allegheny River Valley and were found primarily in the western part of the state. Three birds banded at Laceyville, Pennsylvania (northeast Pennsylvania, on the Susquehanna River), were recovered in central New York and undoubtedly migrated up the Susquehanna River Valley. Most of the birds from the vicinity of Washington, D.C., as discussed earlier, migrate northward via the Susquehanna and are found through the central part of the state and to a lesser extent in the western part. Two birds banded in North Carolina, one from Castonia and one from Raleigh, evidently came into New York via the Susquehanna River, too; one was recovered in the western part of the state and the other in the northern part.

A few of the birds from Washington, D.C., come up the Atlantic coastal plain and enter New York by the Hudson River Valley. The birds of the coastal plain, north of the mouth of the Susquehanna River, migrate north along the plain, and those that enter upper New York come up the Hudson River. Birds banded in the region of Philadelphia, Pennsylvania, and southern New Jersey follow this pattern. Most of the birds banded in Delaware, as discussed earlier, move up the coastal plain and thence into the Hudson Valley, but some come north via the Susquehanna Valley into central New York.

Some birds from Connecticut enter New York State in the region of the Hudson River and may even push westward up the Mohawk River Valley. The Mohawk Valley serves as a connecting link between the migrants of central New York and those of the Hudson River Valley.

A study of out-of-state recoveries of starlings banded at Ithaca (central New York) traces the same pattern of migration routes as the foreign-banded recoveries (fig. 3a). Two birds recovered in southern Pennsylvania, and one in Virginia, evidently followed the Susquehanna route. Two birds recovered in northwest Pennsylvania seem to have migrated down the Allegheny River Valley, whereas three in central and eastern Kentucky and one in northern Alabama could have gone either down the Allegheny Valley or along the south shore of Lake Erie and thence down the Ohio River. A number of winter-banded starlings from Ithaca, New York, have been recovered to the north: several in Ontario, one in Quebec, and one in northern Vermont. These birds undoubtedly followed the migration route along the Lake Ontario plain and up the valley of the St. Lawrence River.

To summarize, both in summer and in winter, migratory birds augment the resident

starling population of Ithaca and central New York State. Most of these migrants come from the west from western Pennsylvania, Ohio, southern Indiana, Kentucky, and Tennessee; or from the south from central Pennsylvania, the vicinity of Washington, D.C., and areas to the west and south of Chesapeake Bay. Only occasionally do starlings from Delaware, New Jersey, southeastern Pennsylvania, and New York City or from areas west of Ohio, Kentucky, and Tennessee reach central New York. In the winter, birds from Ontario and northern New York migrate southward, and some remain as winter residents in central New York.

MIGRATION IRREGULARITIES

As a migratory species the starling appears exceptionally plastic in its habits. As already seen, some members of the population do not migrate, whereas others do. Nestlings from one nest may migrate, whereas others from the same nest apparently do not. At Ithaca, New York, for instance, of two siblings banded together in a nest on May 30, 1947, one was found in Ithaca on February 25, 1949 (almost certainly a winter resident), whereas the other was found on June 6, 1949, near Riversburg, Clarion County, Pennsylvania. Where siblings do migrate, they may winter far apart at different wintering areas. Two siblings banded as nestlings at McMillan, Michigan, on July 14, 1932, were recovered in the following winter at Porterfield, Wisconsin, and Palmyra, Missouri, respectively. It seems probable, too, that some starlings migrate one year, and not another.

After leaving their nests in late spring or early summer, many young starlings stay within twenty miles of their place of hatching, but others wander considerable distances (Kluijver, 1935; Creutz, 1939; and Schüz and Weigold, 1931). Schifferli (1932) records their wandering 170 miles, and Schüz and Weigold (1931) record distances of 200 to 340 miles. Some of these birds may remain as residents in the areas to which their wanderings take them, as Bullough (1942) found for British birds, but others turn south after their wanderings and migrate (Schüz and Weigold, 1931).

Some birds return to their place of hatching to breed (Kluijver, 1935; Creutz, 1939; Kessel, MS), but many do not. Ithaca-banded nestlings have been found both north and southwest of Ithaca in subsequent breeding seasons, some 200 to 250 miles distant: one, banded as a nestling on May 30, 1947, was recovered west of Riversburg, Clarion County, Pennsylvania, on June 6, 1949; another, banded as a nestling on May 27, 1948, was recovered near Valleyfield, Sonlanges County, Quebec, on July 23, 1949. A young bird banded at East Durham, New York, May 20, 1933, was recovered in West Allis, Wisconsin, on July 7, 1934. This bird must have wandered into the Mohawk Valley and westward after leaving the nest. It probably migrated via Lake Erie and the Ohio River to the Mississippi River in the fall and then northward into Wisconsin the following spring. A bird banded as a juvenile on June 8, 1936, near Ottawa was recovered at Sherrill, Oneida County, New York, on April 24, 1940; it was probably a breeding bird of the latter area. A young bird banded at Kenmare, North Dakota, August 28, 1938, was recovered to the northwest, in Tyvan, Saskatchewan, on May 12, 1939.

Thus it will be seen that young starlings are extremely variable and show few definite patterns in their movements. They wander and migrate, and then they appear to settle in any suitable place when they are ready to nest. The final spot may or may not be near their place of hatching.

Because many starlings apparently do not breed in their first year (page 51) and therefore do not become attached to a given locality before the end of their second year, some second-year birds should show the same heterogeneity of movement that is found among the young birds. Again the pattern is difficult to establish because of the lack of

aged, banded starlings. Several banding records, however, show starlings that shifted localities in consecutive summers, probably because they were unattached, second-year birds. A bird banded in Toronto, Ontario, on March 12, as an "adult" was recovered in Louisville, Kentucky, in the middle of the breeding season on May 22, 1940. Another bird banded at Buffalo, New York, on April 7, 1934, was recovered at Maberely, Ontario, on May 20, 1935. Of two birds banded in Michigan, one was an "adult" banded at Whittlemore, Iosco County, on April 10, 1932, and was recovered about 80 miles to the southwest at Rodney, Mecosta County, Michigan, on June 16, 1933; the other was an "adult" banded at Alpina, Michigan, on April 10, 1946, and was recovered at Webbwood, Ontario, on May 23, 1946.

As one might expect, old adult birds exhibit more uniformity in movements than do the younger birds. The available European literature and North American banding records offer no evidence that a starling that has bred once in a given area has ever left that locality to breed at some distant place (over 20 miles). There are numerous instances, however, of adult breeding birds returning to breed in the same areas year after year (Kluijver, 1935; Kessel, MS).

One other outstanding irregularity occurs in the migration of the starling. Numerous times birds banded at a given site one winter have been recovered in subsequent winters at some distance from that site, some perhaps having migrated in one year and not in another. Nice (1937) has described similar irregularities for the Song Sparrow (*Melospiza melodia*) where it was found that some of the birds migrated some winters and not others and where migratory tendencies were not always the same among siblings of the same nest. Again, because of the lack of records of aged starlings it is not possible to say whether second-year birds or older birds contribute most to this migratory irregularity, although probably both are involved.

PROBABLE MECHANISMS OF SPREAD IN NORTH AMERICA

The discussion of starling movements and migrations makes interesting a postulation of the mechanisms that have contributed to the rapid advance of the starling across the North American continent. Distribution maps (fig. 7) prepared from data available in the Fish and Wildlife bird distribution files plot the approximate extent of the breeding range of the starling in 1918, 1921, 1926, 1932, 1941, and 1949. These maps show all winter occurrences for that winter and those for the two preceding winters that extended beyond the breeding range. The result is striking, but not unexpected in the light of the present study. With few exceptions, all the winter extensions occur to the south, southwest, and west of the breeding range. These, then, are almost certainly records of migrant birds. And it is apparently these birds that have been responsible for the rapid southwest extensions of the starling range, which have been particularly evident during the winter months.

The extension of the breeding range has apparently been due to the migrations and wanderings of the first-year and non-breeding second-year starlings. The apparent attachment of adult starlings to their annual breeding grounds prevents their being an important factor in the expansion of the breeding range. The irregular movements, and the apparent random selection of breeding areas by younger birds, however, would be sufficient to account not only for extensions of the breeding range but also for many of the winter extensions.

SUMMARY

The European Starling, since its first successful establishment in New York City in 1890 and 1891, has expanded its range, and now occurs throughout southern Canada,

the United States except southern Florida, and in extreme northeastern Mexico. It breeds only in the eastern and northern part of its range, from British Columbia, Washington, Oregon, and Utah to Mississippi and eastward.

The migratory habits of the starling in North America are essentially the same as those of Europe. Some individuals are apparently sedentary whereas others are migra-

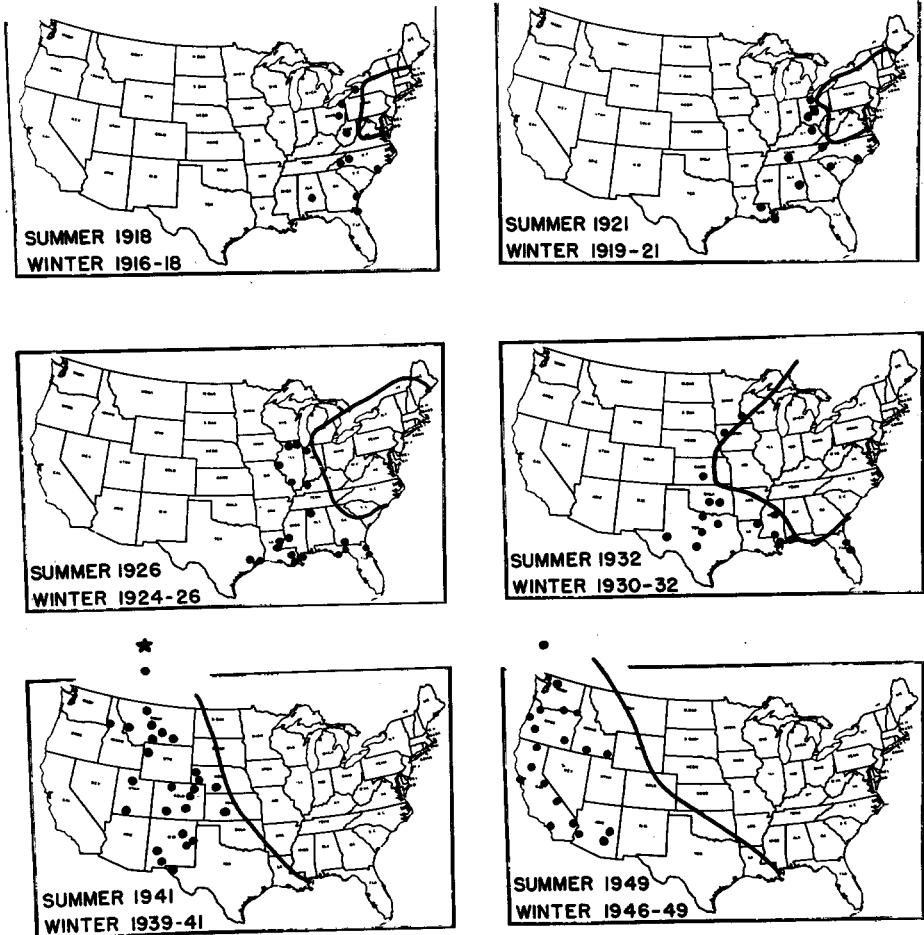


Fig. 7. Westward expansion of the range of the Starling. The line indicates approximate limit of breeding range for a given summer; dots indicate winter occurrences outside of the breeding range for the same and two or three previous years. The star indicates an unusually advanced breeding record, in 1934, at Camrose, Alberta.

tory; some apparently migrate in some years but not in others. The percentage of migratory starlings in a given population varies with geographic locality, season of the year, and type of aggregation studied. Migration occurs in the spring from mid-February to the end of March and in the fall from late September through November.

The topographic features of the continent seem in large part to determine the migration routes in North America. Starlings banded along the Atlantic coastal plain migrate north-south, or northeast-southwest along this plain, tending to leave it only along the

larger river valleys. West of the Appalachian Mountains, migrating starlings exhibit a strong northeast-southwest movement.

Juvenal, first-year, and second-year starlings that have not bred are extremely variable in their migratory behavior, showing few definite patterns of movement. Their irregular movements and random selection of breeding areas appear to be the mechanism through which the starling has extended its range across North America.

ACKNOWLEDGMENTS

The author wishes to express appreciation for the assistance and cooperation received during the course of this study from the staff and students of the Department of Conservation, Cornell University, and from the staff of the bird-banding office of the United States Fish and Wildlife Service.

ADDENDUM

The first record of the starling in Alaska has been reported by Tarleton F. Smith. Mr. Smith, accompanied by Gomer Hilsinger and Lewis McDonald, observed a single starling in a cow pasture near the Juneau airport in the late afternoon of April 17, 1952. Unfortunately, attempts to collect the specimen were unsuccessful.

This occurrence of the starling at Juneau, Alaska, is not as surprising as might seem. Starlings already have been recorded as far north in British Columbia as Burns Lake (Racey, 1950) and the Queen Charlotte Islands (G. Clifford Carl, British Columbia Provincial Museum: verbal communication, 1952); it is not a long flight for a starling from there, up the coast, to the meadow-like fields at the base of the mountains near Juneau.

LITERATURE CITED

- Barr, A., *et al.*
1951. 51st Christmas bird count. No. 421. Aud. Field Notes, 5:179.
- Bennett, H. S., and Eddy, G.
1949. European starling in King County, Washington. Murrelet, 30:18.
- Bent, A. C.
1950. Life histories of North American wagtails, shrikes, vireos, and their allies. U. S. Nat. Mus. Bull. 197, 411 pp.
- Berndt, R.
1939. Untersuchungen über die zweite Brut beim Star (*Sturnus v. vulgaris* L.) im Braunschweiger Hügelland. Vogelzug, 10:7-16.
- Bolander, G. L.
1947. Notes from Death Valley, California. Condor, 49:85.
- Booth, E. S.
1948. Starlings in Washington State. Condor, 50:165.
1949. Winter season. Palouse, northern Rocky Mountain region. Aud. Field Notes, 3:177-178.
- Bullough, W. S.
1942. The reproductive cycles of the British and continental races of the starling (*Sturnus vulgaris* L.). Philos. Trans. Roy. Soc. (London), series B, 231:165-246.
- Cooke, M. T.
1925. Spread of the European starling in North America. U. S. Dept. Agr. Circ. 336, 7 pp.
1928. The spread of the European starling in North America (to 1928). U. S. Dept. Agr. Circ. 40, 9 pp.
- Creutz, G.
1939. Biologische Beringungsergebnisse bei Staren, *Sturnus v. vulgaris* L. Mitt. Ver. Sächs. Ornith., 6:18-26.
- Dickerson, L. M.
1938. The western frontier of the European starling in the United States as of February 1937. Condor, 40:118-123.

- Eugene Natural History Society.
 1948. 48th Christmas bird count. No. 294. Aud. Field Notes, 2:112-113.
 1949. 49th Christmas bird count. No. 336. Aud. Field Notes, 3:142.
 1950. 50th Christmas bird count. No. 378. Aud. Field Notes, 4:167-168.
- Flahaut, M. R.
 1949. Winter season. Northern Pacific Coast region. Aud. Field Notes, 3:181-183.
 1950. Winter season. Northern Pacific Coast region. Aud. Field Notes, 4:216-218.
 1951. Fall migration. Northern Pacific Coast region. Aud. Field Notes, 5:35-36.
- Ferrel, C. M.
 1949. Starling in the Sacramento Valley, California. Condor, 51:150.
- Forbush, E. H.
 1916. The starling. Mass. State Bd. Agr. Circ. 45, 2nd revised ed., 23 pp.
- Godfrey, W. E.
 1949. Notes and observations. Canad. Field Nat., 63:165.
- Gullion, G. W.
 1949. Starlings on Point Reyes Peninsula, Marin County, California. Condor, 51:273.
 1951. Birds of the southern Willamette Valley, Oregon. Condor, 53:129-149.
- Hagenstein, W.
 1950. European starling (*Sturnus vulgaris*) at Medina, King County, Washington. Murrelet, 31:11.
- Hicks, L. E.
 1938. Population studies of the European starling in America. C. R. 9me Congr. Orn. Intern. Rouen, 1938:457-474.
- Hoffman, E. C.
 1930. The spread of the European starling in America. Wilson Bull., 42: opposite 80.
- Hudson, G. E., and King, J. R.
 1951. Nesting of the European starling in Adams Co., Washington, Murrelet, 32:24.
- Jewett, S. G.
 1942. The European starling in California. Condor, 44:79.
 1946a. The starling taken in the state of Washington. Condor, 48:143.
 1946b. The starling in Oregon. Condor, 48:245.
- Jollie, M.
 1951. A positive breeding record of the starling in Idaho. Murrelet, 32:13.
- Jones, F. L.
 1950. The starling in Glenn County, California. Condor, 52:141.
- Kalmbach, E. R.
 1932. Winter starling roosts of Washington. Wilson Bull., 44:65-75.
- Kalmbach, E. R., and Gabrielson, I. N.
 1921. Economic value of the starling in the United States. U. S. Dept. Agr. Bull. No. 868, 66 pp.
- Kluijver, I. H. N.
 1935. Waarnemingen over de levenswijze van den spreeuw (*Sturnus vulgaris*) met behulp van geringde individuen. Ardea, 24:133-166.
- Larrison, E. J.
 1947a. General notes. Murrelet, 28:11-13.
 1947b. Eastern starling in Snohomish County, Washington. Murrelet, 28:21.
- Lewis, H. F.
 1927. A distributional and economic study of the European starling in Ontario. Univ. Toronto Stud. Biol. Ser., No. 30:1-56.
- Linsdale, J. M.
 1950a. Fall migration. Middle Pacific Coast region. Aud. Field Notes, 4:32-34.
 1950b. Winter season. Middle Pacific Coast region. Aud. Field Notes, 4:218-219.
- Lockerbie, C. W.
 1949. Utah Audubon News, June, 1949.
- Monson, G.
 1948. The starling in Arizona. Condor, 50:45.

- Munro, J. A.
1947. Starling in British Columbia. *Condor*, 49:130.
- Nice, M. M.
1937. Studies in the life history of the song sparrow. Vol. I. *Trans. Linnaean Soc. of N. Y.*, 4:1-247.
Oregon Audubon Society.
1950. 50th Christmas bird count. No. 381. *Aud. Field Notes*, 4:168-169.
1951. 51st Christmas bird count. No. 409. *Aud. Field Notes*, 5:173-174.
- Pope, P.
1948. European starling at Walla Walla, Washington. *Murrelet*, 29:29.
- Quaintance, C. W.
1946. The starling arrives in Oregon. *Condor*, 48:95.
1949. Further records of the starling in Oregon. *Condor*, 51:271.
1951. Pioneer starling nesting in eastern Oregon. *Condor*, 53:50.
- Racey, K.
1950. Status of the European starling in British Columbia. *Murrelet*, 31:30.
- Ransom, W. H.
1948. European starling taken in Cowlitz County, western Washington. *Murrelet*, 29:28.
- Schifferli, A.
1932. Bericht der Schweizerischen Vogelwarte Sempach. (1930). *Ornith. Beobachter*, 29:66-84.
- Schüz, E., and Weigold, H.
1931. Atlas des Vogelzugs nach den Beringungsergebnissen bei palaearktischen Vögeln (Kommission-Verlag: R. Friedländer und Sohn, Berlin).
- Small, A., and Pyle, R. L.
1951. Winter season. Southern Pacific Coast region. *Aud. Field Notes*, 5:225-228.
1952. Fall migration. Southern Pacific Coast region. *Aud. Field Notes*, 6:37-39.
- Stager, K. E.
1947. Starling in southern California. *Condor*, 49:169.
- Thomas, E. S.
1934. A study of starlings banded at Columbus, Ohio. *Bird-Banding*, 5:118-128.
- Thomson, A. L.
1922. The migration of British starlings: results of the marking method. *Brit. Birds*, 16:62-76.
- Ticehurst, N. F.
1913. Recovery of marked birds. *Brit. Birds*, 7:9.
1914. Recovery of marked birds. *Brit. Birds*, 8:45.
- Van den Akker, J. B.
1949. Winter season. Great Basin, central Rocky Mountain region. *Aud. Field Notes*, 3:178-180.
- Vestal, E. H.
1948. The starling appears at Leevining, Mono County, California. *Condor*, 50:89.
- Walker, A.
1949. The starling reaches the Pacific. *Condor*, 51:271.
- Wing, L.
1943a. Spread of the starling and English sparrow. *Auk*. 60:74-87.
1943b. The starling in eastern Washington. *Condor*, 45:159.
- Wood, C. A.
1924. The starling family at home and abroad. *Condor*, 26:123-136.

University of Alaska, College, Alaska, September 12, 1952.