MOVEMENTS OF STARLINGS BANDED IN CALIFORNIA

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INTRODUCTION

The earliest records of the Starling (*Sturnus vulgaris*) in California and elsewhere in the Pacific Coast Region have been summarized by Kessel (1953). More recently, Howard (1959) reviewed and discussed the increase of the Starling in California and predicted that as it became a well established resident it would cause serious crop damage. In 1961, the Denver Wildlife Research Center of the Bureau of Sport Fisheries and Wildlife instigated a Starling banding program in cooperation with the California Department of Agriculture, the University of California at Davis, and the California County Agricultural Commissioners, to delineate the movement patterns of this species. This program was conducted from 1961 through 1964 under the direction of the third author.

BANDING AND RECOVERIES

Banding and recovery data are summarized in Table 1. More than 41,000 Starlings were trapped and banded at livestock feedlots and other sites under the cooperative program; over half of these were banded at Kerman, in Fresno County, and at Modesto, in Stanislaus County. Winter banding (1 October - 31 March) was done in 21 counties and summer banding (1 April-30 September) in 13.

From 1959 through 1969, the Bird Banding Laboratory processed recoveries of 822 Starlings banded in California through 1964. For this period, the only recoveries not associated with the cooperative banding program were four from an unknown number banded in San Luis Obispo County by C. F. Tolman in 1964, and one from 13 banded on the Sacramento National Wildlife Refuge, Glenn County, by refuge personnel in the winter of 1958-1959 (Stoner, 1969).

In Table 1 and elsewhere in this report, birds banded in southern California are treated separately from those banded in the northern part of the state. The dividing line between these two distinct banding regions—southern California and the Central Valley—has been taken as latitude 35° N., which runs through the Tehachapi Mountains separating the two regions.

MIGRATION

Winter banding in northern California resulted in 343 out-of-state recoveries (Fig. 1). As would be expected, these were most concentrated in areas with the highest human populations. Exceptionally large numbers of recoveries in parts of southern Idaho and southern Washington were due to Starling control operations at cattle feedlots and other sites, primarily in late winter. During May and June, the peak nesting period, recoveries were well dispersed: 29 in Canada, 33 in Washington, northern Idaho, and Montana, and 41 in Oregon, southern Idaho, Utah, and Nevada.

TABLE 1. Starling-banding by county and season, with resulting recoveries.

Banding location (county)	1 Oct.-31 March		1 April-30 Sept.	
	No. banded	No. recovered	No. banded	No. recovered
		Northern California		
Lassen	0	—	49	1
Glenn	13	1	0	—
Colusa	2,358	23	415	2
Yolo	544	10	1,772	48
Sonoma	40	1	0	—
Solano	1,222	20	0	—
Sacramento	1,519	29	0	—
San Joaquin	1,600	42	44	1
Stanislaus	10,986	197	514	17
Merced	628	9	0	—
Santa Clara	0	—	760	17
Santa Cruz	59	1	0	—
Monterey	82	5	0	—
Fresno	8,362	147	2,636	67
Kings	1,100	18	31	0
Tulare	880	18	655	9
San Luis Obispo	?	4	?	0
Kern	576	10	0	—
Total	29,969	535	6,876	162
		Southern California		
Ventura	34	2	152	8
Los Angeles	1,192	30	0	—
Orange	0	—	6	0
San Bernardino	1,031	35	1,615	39
Riverside	50	1	0	—
San Diego	398	9	3	0
Imperial	71	1	0	—
Total	2,776	78	1,776	47

Recoveries in the first few months after banding provided some information on the spring migration period. The earliest migrants progressed at least as rapidly as follows: southern Idaho, 7 February; northern Oregon, 14 February; southern Washington, 1 March; southwestern Montana, 5 March; east-central Alberta, 23 March; eastern Montana, 2 April; and east-central Saskatchewan, 4 April. However, 30 birds recovered out-of-state were banded as

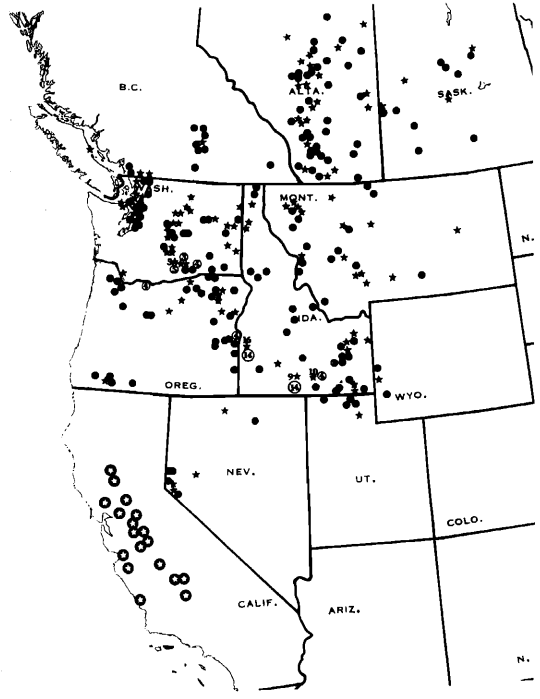

FIGURE 1. Out-of-state recoveries of Starlings banded in winter in northern California. Black stars show direct recoveries (those through the first August after banding) and black dots show indirect recoveries (those thereafter). Multiple direct recoveries in one area are shown by a number adjacent to the star; multiple indirect recoveries, by an encircled numeral. White stars within black circles represent banding locations.

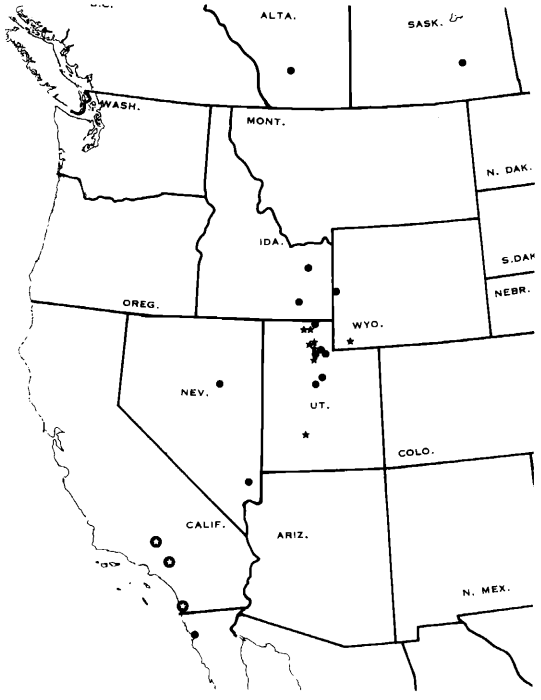

FIGURE 2. Out-of-state recoveries of Starlings banded in winter in southern California. Legend as in Fig. 1.

late as 4 February through 13 March, indicating that migration from California extends through at least this 5-week period.

Twenty-one Starlings winter-banded in southern California were recovered from southern Nevada north to Canada (Fig. 2). Most migrants wintering in southern California apparently returned north to or through northern Utah; six Utah and Wyoming recoveries were in March. The two earliest direct recoveries during northward migration were in northern Utah on 8 and 11 March. One bird, banded in Los Angeles County on 9 March, was retrapped in northern Utah 13 days later.

Kessel (1953), in discussing the migration irregularities of the Starling, calls the species exceptionally plastic in its migratory habits. She states that frequently 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 but not in another. She found it impossible to relate migration to age because of the lack of records of aged birds, but felt that probably both second-year and older birds were involved in migration. In looking at the California data, we attempted to focus on this aspect of migration in two ways. First, from among the 123 out-of-state recoveries in October through March, we listed only those that most reliably indicated wintering status, i.e., shot or trapped in late December and January (thereby excluding any extremely late or early migrants or any found dead long after death occurred). Under these strict limitations, only eight birds (Table 2) were classed as

TABLE 2. Year-to-year shifts in Starling wintering areas, from northern California to other states.

Banding data				
Date	Age[a]	Sex	Recovery location	Recovery date
19 Nov. 62	?	♂	Washington	27 Dec 63
6 Jan. 64	Adult	?	Washington	31 Dec. 64
27 Nov. 63	Adult	?	Washington	6 Jan. 66
4 Dec. 63	Adult	?	Oregon	27 Jan. 66
3 Dec. 63	Adult	?	Oregon	23 Dec. 67
1 Nov. 62	?	♂	Idaho	2 Jan 66
5 Dec. 62	?	?	Idaho	30 Dec. 65
29 Nov. 63	Adult	?	Idaho	27 Jan. 67

[a]Accuracy of "Adult" designation might be questionable; possibly birds in their first winter were recorded as adults after they had completed the postjuvenal molt.

having wintered in California one winter, then elsewhere in a later winter. Next, for Starlings banded in northern California in winter, the 535 recoveries are plotted in Figure 3 according to seasons, with in-state and out-of-state recoveries graphed separately. The consistent seasonal fluctuations in the numbers of recoveries, with in-state and out-of-state fluctuations seasonally opposite, suggest that

many migrant Starlings returned to California in at least three subsequent fall migrations. One problem with Figure 3, however, is that in the graph of in-state recoveries, the winter recoveries undoubtedly include permanent residents as well as migrants, the two populations being inseparable. A different interpretation seems implausible: the out-of-state recovery rate is innately higher in summer than in winter and the California recovery rate is innately the opposite. We can suggest from the above data that many Starlings return to California in succeeding winters but others winter farther north. However, no judgments about age in relation to migration can be made because age data for California winter-banded birds are largely lacking.

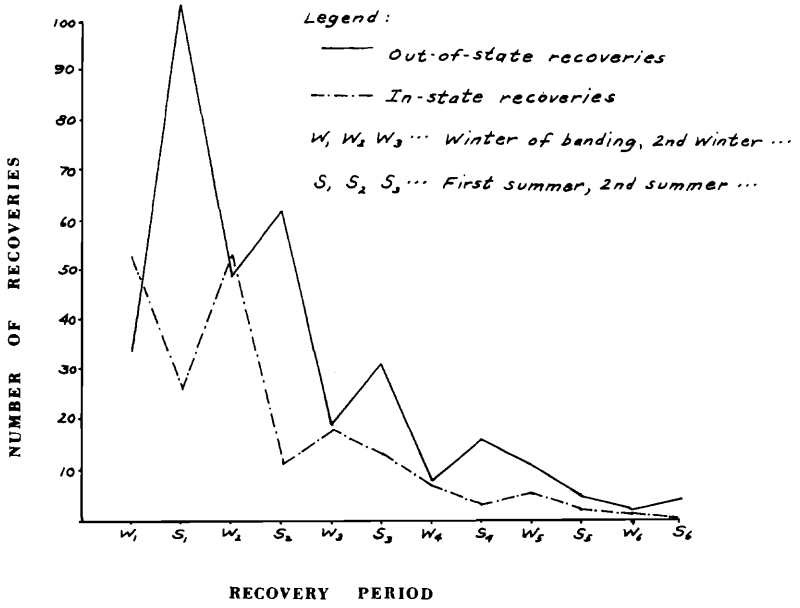

FIGURE 3. Recoveries of Starlings banded 1 October through 31 March in California north of latitude 35° N.

MOVEMENTS WITHIN CALIFORNIA

In northern California, winter and summer banding resulted in 192 and 162 in-state recoveries, respectively. Recovery patterns from winter banding at Modesto and Kerman (Figs. 4 and 5), and from summer banding at Davis and Gilroy (Figs. 6 and 7), best exemplify the in-state movements. Most Starlings banded in the Central Valley were recovered within the Valley, but some dispersed westward in summer into Sonoma and other counties. Conversely, the few winter recoveries from summer banding in Santa Clara County showed eastward movement. Trapping and reductional control operations at livestock feedlots caused clustering of a dozen or more recoveries at such locations in Merced, Solano, Kings, and

Fresno counties. These recoveries showed considerable movement of Starlings among feedlots during the winter months. March recoveries in Sierra County (Fig. 4) and Modoc County (Fig. 5) occurred the winter of banding and are evidently recoveries of migrants from the Central Valley.

Distances between banding and recovery locations were very roughly estimated from latitude-longitude differences. These ranged from 0 to about 500 miles, but two-thirds of the recoveries were within an average distance of 69 miles of the banding location. In the period of time between banding and recovery, both an increase in time *per se* and a change of season affected dispersal distances. Among winter-banded birds, those recovered the same winter as banded averaged 57 miles; those in all later winters, 76 miles. Among Starlings banded in summer, those recovered the same summer averaged 25 miles; those in all later summers, 53 miles. Even greater dispersal occurred with change of season. Starlings banded in winter and recovered in summer averaged 93 miles (91 miles for recoveries the first summer). Summer-banded birds recovered in winter averaged only 58 miles (61 miles for recoveries the first winter). The shorter dispersal in fall than in spring might be due in part to the proximity of most summer banding locations to major wintering locations. Also, proximity of banding sites to later trapping and poisoning operations biased dispersal data. Sixty-four winter-banded Starlings reported as retrapped or poisoned averaged only 45 miles displacement. Thirty-three summer-banded birds similarly obtained averaged 52 miles.

In southern California, winter and summer banding resulted in 56 and 47 in-state recoveries, respectively. There were no consistent differences between winter and summer recovery locations. Recoveries from winter and summer banding at Ontario, San Bernardino County, were the most numerous (Figs. 8 and 9). Although no summer recoveries are shown in San Diego County, there were two in that county resulting from banding in Los Angeles and Ventura counties. A bird banded at Lancaster, Los Angeles County, in December 1963, and recovered a year later at Ensenada, Baja California, was the only Mexican recovery (Fig. 2).

Dispersal from southern California banding locations to recovery locations ranged from 0 to about 225 miles, and averaged 53 miles. About half of the recoveries were within 45 miles of banding sites. The only two summer-banded birds recovered the same summer had moved less than 20 miles. Average dispersal distances for all other Starlings banded in the south fell within a narrow range of 50 to 56 miles regardless of seasons or lengths of time between banding and recovery.

Little exchange of Starlings appeared to take place between northern and southern California. Only five Starlings banded in the north (all in the Central Valley) were recovered south of latitude 35° N: two banded in summer in Colusa and Fresno counties were recovered in winter in Santa Barbara and Ventura counties; two banded in winter in Tulare and Fresno counties were retrapped the same winter in northern Los Angeles County (one shown in Fig. 5);

FIGURE 4. Starlings banded (star) in winter near Modesto, Stanislaus County, and recovered (circle—summer; triangle—winter) elsewhere in California.

FIGURE 5. Starlings banded (star) in winter at Kerman, Fresno County, and recovered (circle—summer; triangle—winter) elsewhere in California.

FIGURE 6. Starlings banded (star) in summer at Davis, Yolo County, and recovered (circle—summer; triangle—winter) elsewhere in California.

FIGURE 7. Starlings banded (star) as juveniles in summer near Gilroy, Santa Clara County, and recovered (circle—summer; triangle—winter) elsewhere in California.

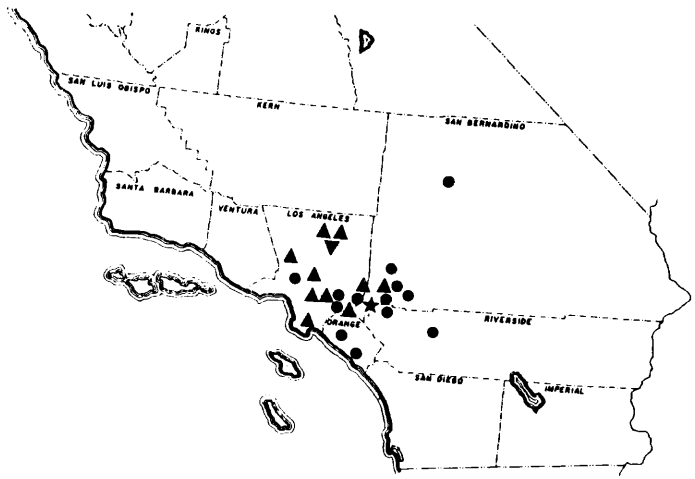

FIGURE 8. Starlings banded (star) in winter at Ontario, San Bernardino County, and recovered (circle—summer; triangle—winter) elsewhere in California.

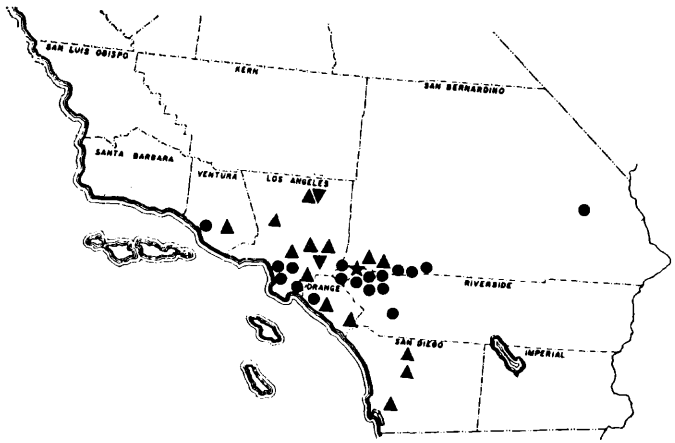

FIGURE 9. Starlings banded (star) in summer at Ontario, San Bernardino County, and recovered (circle—summer; triangle—winter) elsewhere in California.

and one October-banded juvenile from Modesto was recovered in Riverside County the following May (Fig. 4). Two Starlings banded in southern California were recovered short distances north of latitude 35° N in the Mohave Desert region of San Bernardino County

(one shown in Fig. 8), but none banded in southern California were recovered in the Central Valley.

DISCUSSION

From an examination of Figures 1 and 2, it is not hard to accept the hypothesis that migratory Starlings in California inherit from their European ancestors an instinctive tendency to migrate on a southwest-northeast axis. Burtt and Giltz (1966) and others believe that eastern and midwestern Starlings follow such an axis by instinct. Kessel (1953) and Bordner *et al.* (1968), on the other hand, concluded that topographic features seem in large part to determine direction of movement, and Burtt and Giltz conceded that the Appalachian Mountains might impose some limitation to the southwest progress of the more eastern population. However, the western mountain ranges are no barrier to migrant Starlings wintering in California.

Several aspects of Starling migration remain unclear despite large-scale winter banding in California. The origin of fall migrants entering the state is not yet definitely known. A few thousand Starlings were summer-banded in the Yakima Valley of Washington, but none have been recovered in California. Few have been banded in summer elsewhere in northwestern areas. It is not entirely safe to conclude that Figures 1 and 2 give the answer indirectly because, from the rapid extension of the Starling's range across the continent, we know that all migrants do not return to the places they were raised (Kessel, 1953). Presently, we can only suppose that many Starlings return in spring to their previous summer ranges whereas others pioneer into new regions. Berndt and Sternberg (1968) provide a good general review of the complex dispersal processes that might result in either home-area or foreign-area settlement of first-breeders or older birds.

From only the California banding data, the fall migration period for birds entering California is not presently clear. A check of the banding dates for birds later recovered out-of-state shows that these were banded as early as 29 October, 1962 (Kerman); 30 October, 1963 (Grimes); and 15 October, 1964 (Modesto). These dates might approach dates of fall arrival or only reflect the beginning of trapping and banding operations.

The numbers of Starlings that enter California during fall migration and the proportion of these that remain to breed in the state are still unknown. Also undefined are the principal year-to-year migration and winter distribution patterns of individual Starlings from their hatching year through adulthood; some evidence indicates that many winter-banded birds in California return in subsequent fall migrations, but others remain in more northern areas.

CONCLUSIONS

The 1961-64 banding program revealed that California's winter Starling population is a mixture of permanent residents and migrants, the latter dispersing in late winter to regions north and north-

east of California. Large numbers of recoveries in Idaho feedlots and in the fruit-growing areas of Washington and British Columbia show that migrant Starlings trapped at California feedlots might cause problems at other areas during the year.

The 354 Starlings recovered in California show an average displacement of 62 miles from banding sites, with a change of season and longer periods of time between banding and recovery resulting in greater dispersal. There were slight indications of some movement inland from coastal counties to the Central Valley in winter and the reverse in summer. However, this type of seasonal movement cannot be clearly defined without banding of nestlings and juveniles that would result in recoveries of birds of known age, sex, and origin. Color-marking with plastic leg streamers (Guarino, 1968) would help in detecting local, seasonal movements.

The Starling populations of the Central Valley and those south of the Tehachapi Mountains appear to be more or less distinct. However, fewer than 4,500 birds were banded in Kern, Los Angeles, and San Bernardino counties. A resumption of winter and summer banding in those counties might reveal more conclusively the degree of interchange between the two regions.

As Davis (1960) has suggested, the best means of answering several remaining questions about Starling migration would be to band birds of known age and sex during the breeding season and in early summer. With nest boxes (Kessel, 1957) and decoy traps (Zajanc and Cummings, 1965) deployed over a wide region of northwestern United States and western Canada, many nestlings and juveniles could be captured and banded to provide this information.

SUMMARY

Over 41,000 Starlings were banded in California from 1961 through 1964 under an interagency program. Of these and other Starlings banded before and during that period, 822 were recovered through 1969.

Out-of-state recoveries of Starlings winter-banded north of the Tehachapi Mountains were mainly in the northwestern United States and western Canada; those for birds winter-banded south of the Tehachapis were chiefly in northern Utah. The northeastward trans-mountain recovery pattern fits the view that Starlings inherently follow a SW-NE migrational route. Fall migration into California occurred at least as early as the last half of October and spring migration out-of-state extended from early February into mid-March. Recovery data suggest that many banded Starlings returned to California in successive winters, whereas a few remained north of the state in later years.

Starlings recovered in-state had dispersed an average distance of about 62 miles (range, 0-500). In most cases, dispersal distances were greater when a change in season or a greater number of years intervened between banding and recovery dates. Retrapping and reductional control operations biased recovery patterns but revealed considerable winter movement among livestock feedlots.

Apparently Starlings rarely moved between the Central Valley and the area south of the Tehachapi Mountains. Recovery data gave some slight indication of a west-in-summer and east-in-winter movement between the Central Valley and coastal counties.

Further banding of known-aged birds in and out of state could provide additional data on migrant and resident populations.

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