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BREEDING RANGE EXPANSION OF THE STARLING IN UTAH

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Abstract. — The discovery and observation of colonies of starlings nesting in the eastern Great Basin desert indicates further expansion of the breeding range of this species in Utah. Data on nest site selection, nesting productivity, food habits, and relationships with other avian species are presented.

The dispersal and establishment of starlings (*Sturnis vulgaris*) in North America has been well documented (Bent 1950; Davis 1960). In Utah information on the initial spread of this species was summarized by Behle (1954). While studying raptor populations in central Utah from 1967 to 1972 I observed several small colonies of starlings nesting in desert habitats. I believe these colonies show the establishment of starlings as members of the breeding avifauna of the central Utah Great Basin desert. As such, they represent a breeding range expansion which reflects the general adaptability of this species.

History of the Starling in Utah

The range expansion of starlings in Utah was initially gradual. Starlings were first observed in the state in February 1939 near Salt Lake City. In the next year small winter flocks were observed in other parts of Salt Lake Valley and a lone individual was reported near Lehi, Utah County. In January 1941 a flock of 200 was observed at Mt. Carmel, Kane County, in south central Utah (Behle 1958). From 1941 to 1947 small winter flocks were frequently observed near feedlots and ranches in Salt Lake Valley. In 1948 their winter range again expanded; a flock of 1,000 individuals was seen northward in Davis County; and a single individual was found in Kanab, Kane County. Their winter range expansion continued in 1950, when they were recorded for the first time northward in Box Elder County and westward in Tooele County. During the decade 1950-1960 winter flocks of starlings increased tremendously. Bailey (1966) reported flocks as large as 100,000 and noted that they constituted an important agricultural pest of feedlots and orchards in 16 counties of the state, from Washington County in the south to Box Elder County in the north.

The first nest of the starling in Utah was found on 25 May 1949 in an old woodpecker or flicker hole on the west side of Salt Lake City. In the following year a nest was discovered in a shed at Randolph, Rich County (Behle 1954). Within six years starlings were nesting at many localities in the central, populated valleys of the state. In 1956 a starling nest containing young was found in a shed at Lynn, in the northwestern corner of the state (Behle 1958). Starlings have since spread throughout most of the state and now are a sizable component of the breeding bird populations of the towns, settlements, and ranches of the northern Great Basin area (Hayward 1967). During my study of raptor populations in Cedar Valley, Utah County, and Rush Valley, Tooele County, I found starlings and house sparrows (*Passer domesticus*) to be the most common breeding birds in small towns such as Fairfield and Cedar Fort. In these settlements they typically nested in a variety of buildings and in holes in cottonwoods and willows. They were also frequently observed nesting in wind breaks bordering agricultural fields and pastures. Here they usually nested in holes in living and dead trees, but unused bulky stick nests of hawks and magpies (*Pica pica*) were also appropriated. My observations in other settled areas of Tooele, Juab, and Millard counties showed similar choices of nesting site selection and habitats by starlings.

I believe that my observations of starlings nesting in desert habitats warrant particular interest because this suggests invasion and adaptation to a new habitat as well as a further range extension by this species in Utah.

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Nesting Localities and Nest Sites

I observed nine breeding sites located in three counties, all judged to be examples of a starling breeding range expansion into habitats of the northern Great Basin desert. It should, however, be mentioned that each spring and summer I frequently observed starlings in additional localities, and the breeding range expansion of this species is undoubtedly occurring over a much wider area than my records indicate. Four of the nine sites supported small but regular breeding populations during the six-year study. The other sites were irregularly active.

Starlings displayed their well-known adaptability in choosing nest sites (Kessel 1957), and a comparison of nesting habitats and nest site selection indicates some degree of opportunism. Although Michael (1971) considered his observations of starlings nesting in rocky cliffs in Kentucky and West Virginia to be significant, I found 18 of 42 (42.9 percent) of the nests I actually located to be placed in crevices in the sheer walls of quarries and cliffs. Of the remainder, 9 (21.4 percent) nests were located in some type of abandoned mining structure, 8 (19 percent) were found in holes in junipers (*Juniperus osteosperma*), and 7 (16.7 percent) in stick nests of hawks, owls, and ravens (*Corvus corax*). The choice of nesting sites reflected the diversity of the nesting habitat. Usually pairs of a colony were found nesting in a variety of sites where available.

Several sites will be described in some detail to facilitate comparison with possible future breeding locations.

Utah County.— Five sites were found, all in the western section of the county.

A colony was located in the vicinity of an abandoned mine and clay pit operation at Five Mile Pass, which is about six miles west of Fairfield. The habitat at this locale is desert scrub intermixed with widely scattered junipers. Four mine structures are still standing and there are six large quarries and clay pits. From 1967 to 1972 a total of 17 nests were found at this site as follows: 2 in 1967; 4 in 1968; 5 in 1969; 3 in 1970; 1 in 1971 and 2 in 1972. Several additional pairs were seen each year after 1968, and some may have been nesting. Of the nests found, seven were placed in crevices in the rock walls of clay pits, four in holes in junipers, three in the walls of a mine shack, two in mine bunkers, and one in the beam supports of a mine tunnel.

A second colony active during all six breeding seasons was located in the vicinity of the abandoned Little Topliff quarry at Ten Mile Pass. This site was approximately 14 miles southwest of Fairfield and 5 miles northwest of Allan's Ranch. The habitat of this site is a mixture of grasses and desert scrub. Fourteen nests were found at this site: 2 in 1967, 2 in 1968, 5 in 1969, 3 in 1970, 1 in 1971, and 1 in 1972. Again, additional pairs were observed each year after 1968. Eight of the nests were located in crevices in the sheer rock face of the quarry, two in an unused golden eagle (*Aquila chrysaetos*) nest, one in an abandoned prairie falcon (*Falco mexicanus*) nest, and three in cracks in a wooden retaining wall.

Another Ten Mile Pass site was located in the abandoned Big Topliff quarry which is about one mile east of Little Topliff. This quarry, one of the largest in the area, is bordered entirely by desert scrub communities. Two nests were found in 1970, both constructed in an unused golden eagle nest. Several individuals, some of which may have been paired, were observed in 1971.

In 1969 a third colony was found at Ten Mile Pass, about two miles east of Big Topliff quarry and three miles northwest of Allan's Ranch. Several individuals and two nests each were found in 1969 and 1970 in a large limestone cliff line 400 feet above the valley floor. The surrounding habitat is sparse desert scrub devoid of trees.

Three of the four nests were located in crevices in the cliff face. The fourth was in an unused red-tailed hawk (*Buteo jamaicensis*) nest constructed in a large crevice.

A fifth colony was found in the vicinity of the abandoned Tintic Empire Mine, located in the foothills of the Boulter Mountains approximately four miles north of Eureka and two and one-half miles southeast of Allan's Ranch. The surrounding habitat of this colony was a large stand of widely spaced junipers. Two nests, both located in holes in junipers, were found in 1969; other pairs

were present. Only one bird was seen when this site was rechecked in 1970, and none were observed in 1971. I was unable to visit this site during the 1972 breeding season.

Tooele County.— I found nests at two separate sites in this county and evidence of nesting activity at one additional site.

In 1968 and again in 1969 I found a starling nest in a hole in a juniper near the entrance to Black Rock Canyon. This nest site was approximately seven miles east of Vernon. This site was unusually interesting because it was located in a juniper which also supported an active great horned owl (*Bubo virginianus*) nest during the two nesting seasons. Both starling and great horned owl nesting attempts were successful during the two nesting seasons. No nest was present in 1970 or 1971, but starlings were observed in May and June in the same juniper stand, although about one-half mile above the original nesting site.

On 15 June 1969 I observed several starlings in a juniper stand in the northern foothills of Simpson Mountains. This site is approximately 16 miles northeast of Simpson Springs. One nest was found in a hole in a juniper, and, judging by the behavior of the other birds, additional nests may have been present.

Juab County.— Murphy et al. (1969) observed 12 starlings near a golden eagle nest located in sandstone cliffs at Yuba Dam State Park and presumed them to be nesting.

On 15 May 1970 a pair of starlings was observed approximately six miles north of Trout Creek in the foothills of the Deep Creek Mountains. One carried nesting material and was seen in the vicinity of a small stand of junipers. We were, however, unable to locate a nest.

Reproductive Chronology and Success

Starlings were not found in the vicinity of the desert nesting sites during the fall and winter months (September through February), although small flocks were frequently observed in nearby settlements. They began appearing in the future nest site vicinity in early March, and the majority were present by late March and early April. During this time they were frequently seen inspecting dilapidated mine buildings and holes in junipers and often reacted to my presence near these sites by protesting vigorously.

Adults carrying nesting material were seen in late March and throughout April. Most nests were constructed of grass, primarily wheat grass (*Agropyron spicatum*), and frequently lined with feathers. Four of the nests I found were decorated with juniper greenery.

Nests containing eggs were found from late April through mid-June. Dates of the 24 nests with eggs which we found are as follows: 27, 30 April; 1, 2, 4(3), 10 (2), 17(4), 19, 21(2), 30 May; 4, 9(3), and 19 June. I found no evidence of attempts to raise a second brood in July and August.

The clutch size of these nests averaged 4.2 ± 1.2 eggs (range, 3-7; mode, 4). A clutch size comparison with other areas is presented in Table 1. Utah clutch size averaged significantly smaller than those of New York and Holland ($t=3.95$, 2.84 respectively; $P<0.05$ for both) but not significantly different from northwestern England ($t=1.5$, $P>0.90$).

Young were in the nest from mid-May through mid-July. My earliest and latest dates for nests with young are 14 May and 28 July. The brood size of 17 nests was 3.9 ± 1.1 young (range, 2-7; mode, 4). Interestingly, there was no significant difference among brood sizes of Utah,

Table 1. Clutch and brood size comparison of central Utah nests.*

Location	No. clutches	No. eggs per clutch	No. broods	No. young per brood	Author
Central Utah	24	4.5 ± 1.2	17	3.9 ± 1.1	Present Study
Ithaca, New York	199	5.5 ± 0.9	230	4.3 ± 1.3	Kessell (1957)
Holland	1592	5.2 ± 1.0	1377	4.4 ± 1.3	Kluijver (1933)
NW England	105	4.9 ± 1.1	913	4.2 ± 1.1	Lack (1948)

*Data is average ± one standard deviation.

New York, Holland, and England nests, indicating perhaps a somewhat higher overall hatching success of Utah nests.

Overall reproductive success was high. Of 13 nests on which I was able to obtain complete information, 12 successfully hatched young; and of these, 11 nests fledged young. Two nests were abandoned; one containing three eggs and one with five young. Neither pair attempted to renest. Overall hatching and fledging success was 94.2 percent and 84.6 percent, respectively. Both percentages are slightly higher than reported from previous studies in other areas.

Foraging and Food Habits

Information on foraging and food habits is limited and was obtained from morning observation of three nests, two in 1969 and one in 1970, all located in the Five Mile Pass nesting colony. Adults were observed from a parked vehicle with a 40X spotting scope attached to a window mount. Only those food items brought to the nest site which could be identified are included in the results presented in Table 2.

Adults foraged predominantly in the sagebrush-wheatgrass (*Artemisia-Agropyron*) associations which were the common plant communities in the nesting site vicinities. They spent considerably less time in the ground layer vegetation of pinyon-juniper (*Pinus-Juniperus*) communities and among the rubble-strewn floor of quarries.

Over 86 percent of the arthropod food items brought to the nest were insects. Of these, Orthoptera comprised 56 percent and Coleoptera almost 27 percent. Araenids were the only other animal food which was taken in significant quantities. In a food habit study in eastern Texas based on stomach contents, Russell (1967) found Orthoptera and Coleoptera, particularly Carabidae, to comprise 84 percent of the total insects eaten and 68 percent of the total food, with other arthropods and some plant material constituting the remainder of the diet. I did not identify any utilization of plant material for food, but results are undoubtedly biased because the small nesting populations precluded collection of adults and young for stomach contents analysis. Both Killpack and Crittenden (1952) and Bailey (1966) noted the extensive use of such plant materials as grain and corn silage by wintering flocks of starlings. Starlings are undoubtedly opportunistic in their feeding habits and utilize the most available food. This is reinforced by a comparison of the food habits of these desert nesting starlings with the result of Fautin's (1946) investigations of the invertebrate populations of the sagebrush community. Analysis reveals that, with the exception of Formicidae, starlings utilized the most prevalent ground layer invertebrates in the sagebrush community.

Table 2. Arthropod food of starlings in the eastern Great Basin.

Item	No. indv.	% Freq.
Acrididae	31	47.0
Tettigoniidae	6	9.1
Carabidae	11	16.7
Tenebrionidae	3	4.5
Scarabidae	3	4.5
Cicadellidae	2	3.0
Formicidae	1	1.5
Araneidae	9	13.6
Totals	66	99.9

Relations with Other Species

Starlings appear to be the predominant avian species in the vicinity of their breeding locales. Other birds observed in the same locale included the house sparrow, pinyon jays (*Gymnorhinus cyanocephala*), scrub jays (*Aphelocoma coerulescens*), mourning doves (*Zenaidura macroura*), common nighthawks (*Chordeiles minor*), and mountain bluebirds (*Sialia currucoides*). Only house sparrows were common nesting associates, and at two sites, Big and Little Topliff quarries, they outnumbered the starlings. At these and other sites the two species appeared to mutually tolerate one another and no aggressive interactions were observed. We did observe starlings interacting aggressively with scrub jays (twice) and mourning doves (twice) which had perched in the immediate vicinity of the nesting site. In each instance the starlings displaced the intruding birds. The only direct evidence of nest displacement which we observed concerned a mountain bluebird nest which contained six eggs when discovered on 15 May 1970. When this nest was rechecked five days later we found an

adult starling sitting on a clutch of six eggs. No trace of the mountain bluebird was found, and the adults were not observed again in the nesting territory.

In a previous study of the food habits of raptors breeding in the eastern Great Basin Desert, starlings were occasionally recorded as prey of several hawk and owl species (Smith and Murphy 1973). It is possible that their plumage, size, and aggressive habits make them conspicuous targets and hence more liable to be preyed upon by raptors.

Discussion

Within the relatively short time span of 30 years the starling has become a predominant component of Utah's avian fauna. Its successful invasion and establishment can be roughly delineated into three segments, each of approximately 10 years duration. In the first 10-year period (1939-1948) following their appearance in the state, starlings were observed only as individuals or small flocks of winter visitants. In the next 10 years (1949-1958) these winter flocks increased tremendously in size and greatly expanded their winter range to include most of the populated central portions of the state. The first nesting attempts were reported early in this period and by the end of the decade small nesting populations were found in many widely separated towns and settlements of the state. In the third 10-year period (1959-1968) both winter and summer starling populations had increased in size to the point at which the starling had achieved the status of a major pest species. During this time the starling became (with the possible exception of the house sparrow in some areas) the most abundant bird throughout most of the settled portions of the state. Although most common in cities and towns, they were also found in widely separated settlements and ranches. In winter they formed large flocks which, through their feeding and roosting activities, became an economic nuisance to feedlot owners and fruit growers throughout the state.

At the present time, so far as is known, starlings nest in all the settlements and towns in the state and have recently extended their breeding range into desert habitats. Although initially sporadic, their occupation of distinctly desert habitats for nesting purposes has recently become more widespread, suggesting that they have been able to adapt to a new habitat type.

In analyzing the range expansion and establishment of starlings in Utah I consider the following to be of significance: (1) mobility, (2) suitable climate, (3) suitable habitat, and (4) sufficient population pressure. The four factors are, in fact, a measure of the starling's adaptability and, when considered together, explain the success of this species. Although not specifically investigated in this study, their rapid range expansion across North America indicates that starlings have adequate powers of mobility and wide climatic tolerances. While largely nonmigratory, their behavorial adaptation of forming large, mobile winter flocks which break up and disperse to favorable nesting areas in spring undoubtedly allows some exploratory activity which may in turn lead to further range expansion.

Water, but not food, may pose the only potential limiting factor for starling range expansion into the Great Basin desert. Starlings at their desert breeding sites were observed drinking water from ephemeral rain puddles and from livestock watering troughs.

The adaptability of starlings to new habitats is well known (Kessell 1957). A review of the pattern of starling invasion in Utah suggests that a habitat with some form of human modification provides a favorable impetus for range expansion. Thus, widely separated towns and settlements were occupied within 20 years, but the intervening areas of desert were not invaded until after starling populations were well established in nearby settlements. Only after starling populations had occupied these locales did a further range expansion into the upper Great Basin desert take place. It is quite possible that the human habitats provided breeding sites, probably due to the well-known breeding behavior adaptations of this species with reference to man, which resulted in local population increases. Pressures resulting from these local population increases may have encouraged starlings to examine the adjacent habitats of the upper Great Basin desert.

The short time span of their successful utilization of this new habitat suggests behavorial adaptations rather than genetic changes within the population. However, the possibility of future evolutionary changes in populations occupying such habitats may warrant further study.

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