

DISTRIBUTION, BIOLOGY, AND STATUS OF A RELICT POPULATION OF BROWN TOWHEE (*Pipilo fuscus eremophilus*)

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The Inyo Brown Towhee (*Pipilo fuscus eremophilus*) is a relict population of a species that was formerly widespread in the southwestern United States and northern Mexico (Davis 1951). A member of the *Crissalis* group of subspecies, *eremophilus* became restricted to mountain areas in the northern Mojave Desert as a result of climatic changes beginning in the Pliocene (Davis 1951). Currently it is known only from the Argus Range of Inyo County, California (Cord and Jehl 1978, contra AOU 1957) (Figure 1). The nearest neighboring population, *P. f. carolae* (formerly *kernensis*) occurs 65 km due west in the Walker Basin of the southern Sierra Nevada.

Like all other races of *P. fuscus*, *eremophilus* is considered resident (Davis 1951). It was described by Van Rossem (1935) on the basis of specimens he collected at Mountain Spring (1400 m) and Lang Spring (1830 m) in the southern Argus Range, and from a single specimen taken by F. Stephens at "Searle's Garden" (Fisher 1893).¹

Because of its limited and largely inaccessible range, which is rarely visited by ornithologists, very little is known about the biology, requirements, or population size of this isolated desert dwelling race. We attempted to gather such data at the request of the Desert Land Plan staff of the U.S. Bureau of Land Management.

METHODS

In May-June 1978 Cord visited water sources in the Argus Range between Indian Joe Spring and Stone Canyon, with the exception of La Motte Spring (Figure 2). Surveys were restricted to riparian habitats because they provide the only towhee nesting habitat in the Argus Range; the surrounding area is high desert. Extensive hiking was required, usually through trailless canyons with steep slopes and rugged rock formations.

¹The exact location of "Searle's Garden" has been disputed. We (Cord and Jehl 1978) have argued that it is immediately adjacent to Indian Joe Spring, which is in southern Inyo County, and not in San Bernardino County as suspected by some (e.g., AOU 1957).

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Whenever a towhee was observed, a 50 pace toe-point transect was taken to the nearest riparian habitat to provide precise data on vegetative components. Other data collected were: legal description of site, description of locality, water flow (gpm), stream length, area of free surface water, mean water depth, major plant species, area of riparian growth, degree of recreational use, and evidence of use by burros. Photographs were taken at each water source and at each locality where towhees were found.

In late 1978 Cord discovered extensive riparian growth in the Quail Spring-Benko Canyon area, in the center of the apparent

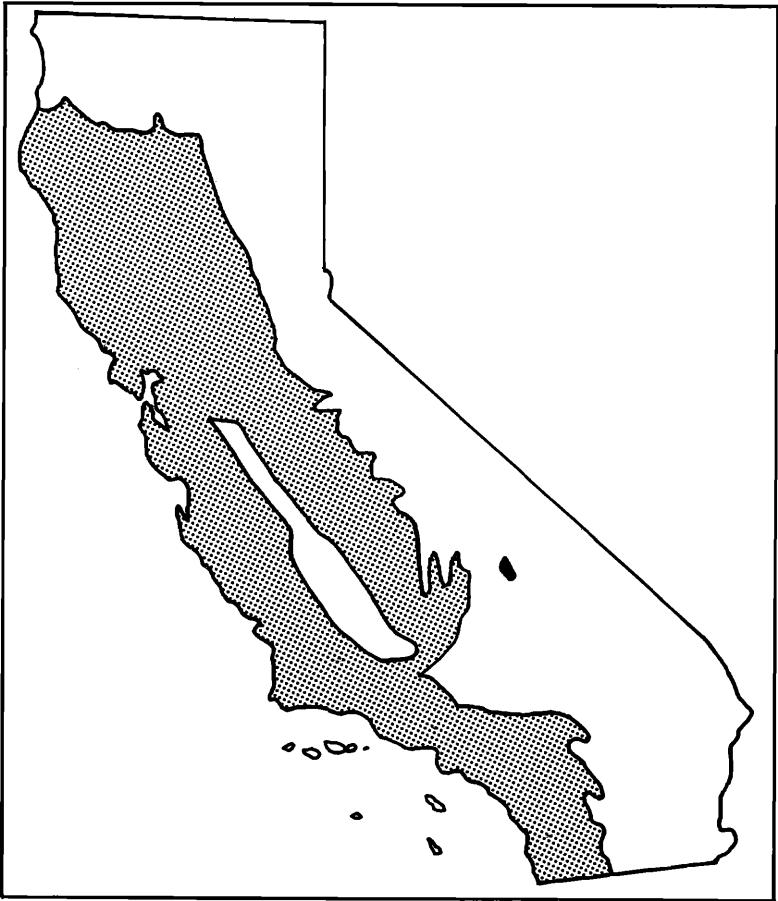


Figure 1. The range of Brown Towhee populations in California (stippled). The range of the Inyo Brown Towhee (solid) is confined to the southern Argus Range.

range of *eremophilus*. Supplementary field work was carried out in that area in April-May 1979, as well as in a few areas surveyed in 1978. In both years, the extent of riparian habitat was carefully mapped.

Field work in fall and winter 1978-79 was aimed at determining *eremophilus*' status and requirements at those seasons and investigating the possibility of seasonal dispersal or emigration. Detailed descriptions of the habitat and of the itinerary are available in Cord's field notes; copies are on file at the Bureau of Land Management, Riverside, California, and Hubbs/Sea World Research Institute.

RESULTS

DISTRIBUTION

In May-June 1978, towhees were found at only 6 of 24 areas in the southern Argus Range (Table 1): Indian Joe Spring, Great Falls Basin, Crow Canyon, North Homewood Canyon, Ruby Spring, and Mountain Spring Canyon (Figure 3). None were found in 10 canyon areas (20 water sites) in the northern Argus. In April-May 1979, towhees were present in 8 of 10 areas in the southern Argus, including the following additional localities: Shelf Canyon, Rusty Canyon, Green Canyon, Benko Canyon, Layne Canyon, and the Bobcat Canyon-Water Canyon complex (Figure 4). No further studies were made in the northern Argus. However, in response to the report of a possible sighting in the Coso Mountains, just to the north of the Argus Range, Cord visited Black Spring on 8 May; he found a lone Green-tailed Towhee (*Pipilo chlorurus*).

In both years, all 12 sites combined, a total of 75 birds (including three nestlings in one nest) was recorded. This figure is conservative. Desert towhees are difficult to census in the rugged canyon country, because they have large home ranges and often remain silent and hidden in dense riparian cover.

P. f. eremophilus is evidently confined entirely to the southern Argus Range of Inyo County. Thirty-six percent of the sightings were made within a circle of 3 miles diameter centered at Benko Canyon, and 100% within an 11-mile circle. The vast majority of the sightings (85%) were made within a 6-mile circle; most of this land is within the confines of China Lake Naval Weapons Center (Figure 2).

Towhees are more common on the east side of the Argus, apparently because of the larger riparian habitats there. Their absence from the northern Argus seems due to lack of habitat; soil formation is poor, water sources are few and widely scattered, and riparian vegetation is scanty. There were, and still are, active mines at almost every water source in the northern Argus, which has further depleted riparian growth. In some areas only Squaw Waterweed (*Baccharis sergiloides*) remains; it does not provide nesting habitat (see below).

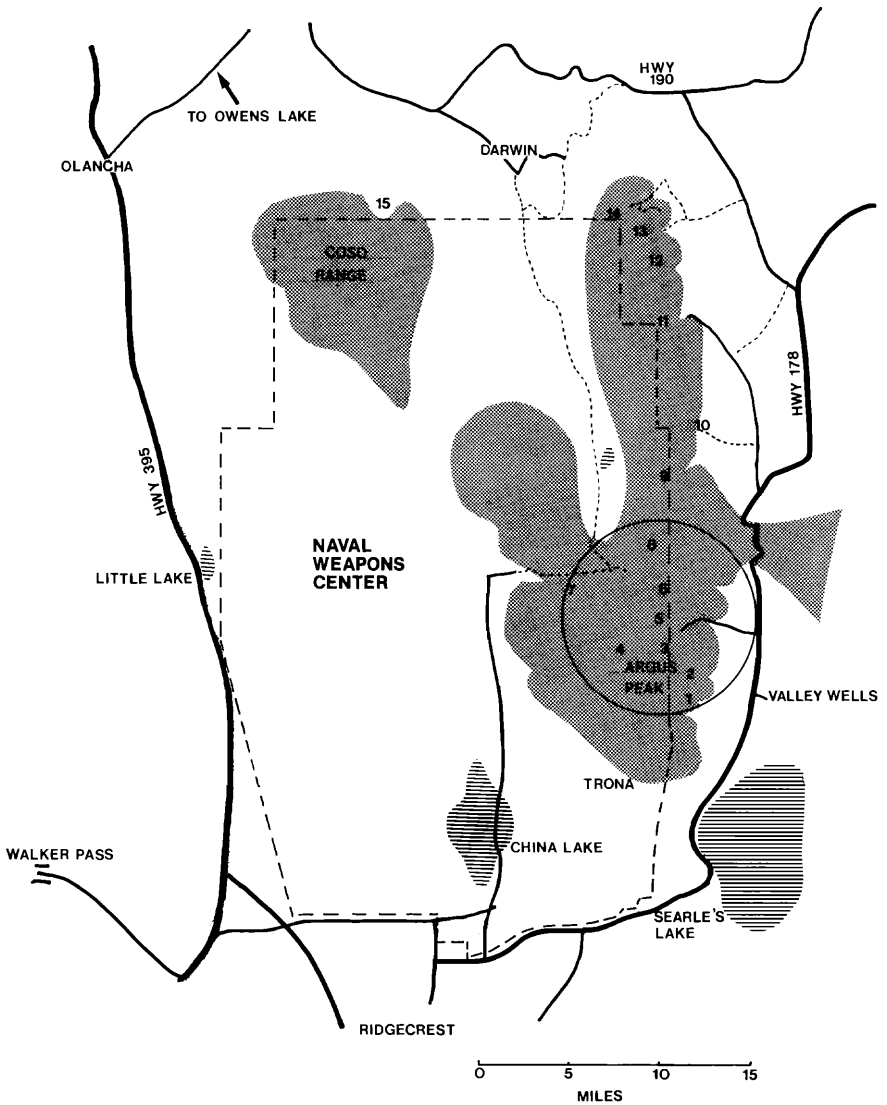


Figure 2. The Argus Range area. Numbers refer to the major spring or canyon areas visited in this study. 1) Indian Joe Spring (+ Searle's Garden); 2) Great Falls Basin; 3) Crow Canyon; 4) Moscow Canyon; 5) Benko Canyon complex (includes Shelf Canyon, South Homewood Canyon, Rusty Canyon, Benko Canyon, Benko Spring and Green Canyon); 6) North Homewood Canyon, Ruby Spring, Layne Canyon; 7) Mountain Spring Canyon; 8) Water Canyon-Bobcat Canyon complex (includes Coyote Spring); 9) Shepherd Canyon; 10) Onyx Mine area (3 springs); 11) Revenue Canyon; 12) Snow Canyon; 13) Thompson Canyon; 14) Stone Canyon (French Madam Spring, Jack Gunn Spring); 15) Black Spring, Coso Mountains. The Inyo Brown Towhee is confined to the area within the circle.



Figure 3. Mountain Spring Canyon, site 5. Two pairs of towhees are estimated to inhabit this area



Figure 4. Coyote Spring, at the head of Water Canyon. One pair of towhees is estimated to occur here.

Table 1. Distribution, habitat parameters, and population size of Inyo Brown Towhees, Argus Range, Inyo County, California 1978-1979.

Site	Surface water (sq. ft.)	Riparian vegetation components (see key)	Area of riparian vegetation (sq. ft.)	Length of riparian vegetation (feet)	Birds found spring 1978	Birds found spring 1979	Min. no. known	Est. Pop.
Indian Joe Spring	150	ARG	3,750+	125+	2	NV	2	2
Great Falls Basin								
Site 1	450	AYNS	5,000	200	2	1	2	2
Site 2	1	AY	36,000	810	3	0	3	4
Site 3	400	NS	4,500	180	0	2	2	2
Site 4	450	A	8,000	220	2	2	2	2
Site 5	600	AN	6,000	240	2	0	2	2
Site 6	600	AS	9,000	230	2	2	2	2
Site 7	700	ANS	13,000	260	1	2	2	2
Site 8	800	ANS	10,000	275	NV	2	2	2
Site 9	5,000	A	128,000	2,100	NV	5	5	8
Site 10	300	AYPS	2,400	120	NV	0	0	0
Site 11	3,000	ANŞ	25,000	500	NV	3	3	4
Site 12	1,000	AN	8,000	200	NV	0	0	2
Site 13	800	AYNS	29,000	1,000	2	1	2	4
Crow Canyon								
Site 1	300	N	10,000	300	1	NV	1	2
Site 2	10	A	6,000	200	1	NV	1	2
Site 3	500	N	35,000	350	0	NV	0	2
South Homewood Canyon								
	0	TA	4,500	150	NV	0*	0	2

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Table 1. (Cont.)

Site	Surface water (sq. ft.)	Riparian vegetation components (see key)	Area of riparian vegetation (sq. ft.)	Length of riparian vegetation (feet)	Birds found		Min. no. known	Est. Pop.
					spring 1978	spring 1979		
Shelf Canyon								
Site 1	0	TA	2,100	70	0	0	0	0
Site 2	500	A	12,000	300	NV	1	1	2
Site 3	600	TAS	2,100	70	NV	0	0	0
Site 4	20	TA	4,000	160	NV	0	0	0
Site 5	10	TA	6,000	240	NV	0	0	2
Site 6	100	A	3,600	120	NV	0	0	2
Site 7	0	T	2,000	80	NV	0	0	0
Rusty Canyon								
Site 1	0	TB	2,000	100	NV	1†	1	2
Site 2	0	TB	2,500	100	NV	0	0	0
Site 3	300	A	5,000	125	NV	0	0	0
Site 4	800	A	15,000	300	NV	0	0	2
Site 5	50	TA	6,000	260	NV	0	0	0
Site 6	800	A	4,800	90	NV	1	1	2
Site 7	240	TA	36,000	240	NV	2	2	2
Site 8	0	A	15,000	125	NV	0	0	2
Site 9	400	ATB	17,000	280	NV	0	0	2
Site 10	350	AT	15,000	250	NV	1	1	2
Site 11	200	AT	10,000	180	NV	0	0	2
Site 12	150	AT	6,000	140	NV	0	0	0
Site 13	180	A	9,000	180	NV	0	0	2
Site 14	160	AT	8,000	160	NV	0	0	0
Site 15	80	AT	6,000	120	NV	0	0	2

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Site 16	1,000	AT	75,000	950	NV	3	3	4
Site 17	600	A	45,000	650	NV	0	0	4
Site 18	80	AC	5,000	100	NV	0	0	0
Benko Canyon								
Benko Spring	1,000	A	5,700	240	0	1	1	2
Site 1	200	A	16,000	200	NV	2	2	2
Site 2	300	AS	13,500	450	NV	1	1	2
Site 3	150	A	3,500	80	NV	1	1	2
Site 4	0	T	3,000	100	NV	0	0	0
Site 5	40	TAH	5,000	130	NV	2	2	2
Site 6	100	TAYP	8,000	200	NV	2	2	2
Green Canyon								
Site 1	100	A	3,500	80	NV	0	0	0
Site 2	175	A	5,000	110	NV	2	2	2
Site 3	150	A	4,000	90	NV	0	0	0
Site 4	200	A	4,000	100	NV	2	2	2
Site 5	1,000	A	36,000	1,000	NV	1	1	4
Site 6	0	T	12,000	300	NV	1	1	2
Site 7	0	T	10,000	250	NV	0	0	2
Site 8	180	A	8,000	200	NV	1	1	2
North Homewood Canyon								
North Homewood Canyon	250	A	6,000	240	2	2	2	2
Ruby Spring								
Ruby Spring	900	AT	30,000	300	2	2	2	2
Layne Canyon								
Site 1	450	A	21,000	350	NV	1	1	2
Site 2	100	AT	4,000	100	NV	0	0	0
Site 3	0	TIF	8,000	200	NV	2	2	2
Site 4	50	TA	5,000	120	NV	0	0	2

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Table 1. (Cont.)

Site	Surface water (sq. ft.)	Riparian vegetation components (see key)	Area of riparian vegetation (sq. ft.)	Length of riparian vegetation (feet)	Birds found spring 1978	Birds found spring 1979	Min. no. known	Est. Pop.
Water Canyon								
Site 1	700	ATY	11,000	275	0	0	0	0
Site 2	800	AYT	14,000	300	0	0	0	0
Site 3	600	A	8,000	260	0	0	0	0
Site 4	700	ATC	20,000	400	0	0	0	0
Bobcat Canyon								
Site 1	600	A	14,000	350	0	1	1	0
Site 2	500	A	11,000	200	0	0	0	0
Site 3	250	TA	12,500	250	0	0	0	0
Coyote Spring	350	AT	15,000	375	0	0	0	2
Mountain Spring Canyon								
Site 1	500	AT	15,000	300	2	0	2	2
Site 2	200	AT	5,000	130	0	0	0	2
Site 3 (Lang Spring)	450	AT	40,000	1,400	1	3	3	8
Site 4	0	AC	6,000	110	1	0	1	2
Site 5	1,000	AY	24,000	900	0	2	2	4
Site 6	1,000	YA	6,000	200	0	0	0	2
Totals					28	58	72	138

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- KEY: A— Arroyo Willow (*Salix lasiolepis*)
 B— Waxy Bitterbrush (*Purshia glandulosa*)
 C— Fremont Cottonwood (*Populus fremontii*)
 F— Mountain Joint Fir (*Ephedra viridis*)
 G— Desert Wild Grape (*Vitis girdiana*)
 H— Rubber Rabbitbrush (*Chrysothamnus nauseosus hololeucus*)
 I— Great Basin Sagebrush (*Artemisia tridentata*)
 J— Rush (*Juncus* sp.)
 N— Narrow-leaf Willow (*Salix exigua*)
 R— Western Raspberry (*Rubus leucodermis*)
 S— Squaw Waterweed (*Baccharis sergiloides*)
 T— Tanglebrush (*Forestiera neomexicana*)
 Y— Yellow Willow (*Salix lutea*)
 NV—not visited

• Pair present in winter only

† Site assignment is tentative, see text

NESTING HABITAT

Brown Towhees require dense shrubby thickets for nesting and open area in the vicinity for foraging (Grinnell and Miller 1944). According to Davis (1951) the foraging area may be almost any open place providing the necessary food.

In the Argus, Brown Towhees forage among the sparse, widely spaced vegetation on the desert hillsides. The substrate there is largely decomposed granite with little soil and little or no litter. The dense, shrubby thickets required for nesting and shelter occur only where there is a year-round supply of water, which only a spring can provide. When the flow is sufficient, it may generate a small stream a foot or two wide, bordered by dense patches of Arroyo Willow (*Salix lasiolepis*) or, in a few areas, Yellow Willow (*S. lutea*) or Narrow-leaf Willow (*S. exigua*). If the stream continues below the surface, the willows are replaced by Tanglebrush (*Forestiera neomexicana*). This appears somewhat like an odd, stiff, opposite branching willow, but is a member of the olive family. In these thickets the substrate consists of a shallow soil layer and a thin layer of litter, usually less than 6 mm deep. Waxy Bitterbrush (*Purshia glandulosa*), Great Basin Sagebrush (*Artemisia tridentata*), and Rubber Rabbitbrush (*Chrysothamnus nauseosus hololeucus*), members of the desert scrub plant community, occasionally intermingle with Tanglebrush along the drier edges.

Squaw Waterweed, a bright green chest-high shrub grows commonly near water in the Argus Range, especially in poor and very shallow soils. Where the soil is better, it is replaced by *Salix* sp. and is restricted to the fringes of the riparian growth. Towhees were never seen using this shrub. Fremont Cottonwood (*Populus fremontii*), Desert Wild Grape (*Vitis girdiana*) and Western Raspberry (*Rubus leucodermis*) were used by towhees when in association with desirable willows, but those three species are seldom found in the Argus.

At the 40 sites where towhees were observed, 35 were dominated by or contained extensive stands of Arroyo Willow, 2 by Yellow Willow, 2 by Narrow-leaf Willow, and 1 by a mixture of Tanglebrush, sage and Mountain Joint Fir (*Ephedra viridis*) (Table 1). Evidently the willow species and Tanglebrush provide preferred habitat for towhees during the breeding season. (Narrow-leaf Willow is found only in Great Falls Basin and Crow Canyon, where it is rather abundant; towhees have been seen passing through it, but it is not known whether it is actually used for nesting.)

WATER

Many birds rely on water sources in the Argus Range. Even Costa's Hummingbird (*Calypte costae*), which Grinnell and Miller (1944) called "xerophilous in extreme degree," was twice observed drinking. However, the towhee was not, and Miller and Stebbins (1964) never observed drinking by the resident towhee (*P. f. senicula*) in Joshua Tree National Monument.

At Mammoth Mine (Mountain Spring Canyon, Site 4), where there was no surface water, a singing towhee was present. Site 2 in Great Falls basin contained at least three towhees in 1978; no more than 1 ft² of surface water was available. At some sites with abundant water and over 4000 ft² of apparently suitable willow habitat, towhees were not present. These observations suggest that the presence of standing water enhances an area's suitability, but may not be essential. Dawson (1954) reported that *P. f. senicula* needs to drink daily and that some individuals from the Los Angeles area were unable to survive high environmental temperatures (39° C) if deprived of drinking water for 24 hours. On the other hand, Abert's Towhee (*P. aberti*), a species of the Colorado Desert, was able to survive those conditions. Since the environment of *eremophilus* is more like that of *aberti* than of *senicula*, perhaps the Inyo race can tolerate moderate water deprivation.

Miller and Stebbins (1964:251-252) have considered how water resources might affect the distribution of Brown Towhees in Joshua Tree National Monument, and their remarks seem pertinent to the Argus population as well. In the Monument towhees occur "where water is permanently available. . . [they] must have good shade during the maximum heat period of each summer day and that even with this protection they may need to take on water if sustained high temperature prevails for many days. Possibly, then, this species can tolerate neither dense or open brush. . . without water sources. There is, then, a climatic factor, namely high summer heat, which in a sense may bound the species in the desert area and which can be overcome only by use of water. Dense brush may help but alone may not provide enough relief."

SONG, PAIRING, TERRITORIALITY

The vocalizations of *P. f. petulans* described by Childs (1968) presumably apply to *eremophilus* as well. Basically, *petulans* males defend territorial boundaries using chip notes from early spring until the start of nesting. Song is given almost exclusively by unpaired males, which begin singing in late January.

In two springs Cord heard *eremophilus* sing only once. On 18 June 1978 he heard the repeated call-note of a towhee, then watched as the bird worked its way to the top of a large cottonwood, where it sang twice. No mate was observed. Even chip-notes were rarely heard from the desert towhees, which suggests that they had paired and established territories before spring observations commenced.

We do not know when pairs are established. Evidently, as with other races of Brown Towhee (Davis 1957: 148, Marshall and Johnson 1969) *eremophilus* remains in pairs year-round. In this study (all seasons combined) 70 of 98 adults (71%) were associated with one other bird, presumably the mate; on 24 (of 35) occasions members of the presumed pair were within 1 m of each other. Since no songs were ever heard with the exception noted above, we assume that most lone individuals in spring represented birds temporarily parted from the mate. Several observations showed members of a pair separating by distances of up to 400 m. In fall and winter pairs seem even more closely associated; 83% of the sightings were of two birds.

Cord observed only one overt display of territorial behavior. On 9 May 1979 he flushed from the desert shrub a towhee which sought shelter in the nearest riparian growth. Immediately thereafter two birds flew straight up from the riparian vegetation for about 7 m, pecking and clawing at each other. One then perched 5 m above the ground in a yellow willow, and the other quickly flew off. The apparent resident then dropped into the Tanglebrush and shortly reappeared with another bird. In the next 7 minutes they made two sorties of about 20 m to the edge of the desert vegetation, then returned to the willows. Cord was unable to determine if they were carrying food.

LOOKOUTS

Commonly a towhee was seen in the upper branches of a shrub (usually Tanglebrush or willow) or dead tree. Often, if not disturbed, a second bird would soon appear and the pair would perch together for several minutes. These "lookout posts" or lookout-headquarters (Davis 1957) were used repeatedly.

Of other races of *fuscus*, Davis (1957) remarked: "Trees may be utilized as song or lookout posts if they are present in conjunction with the primary habitat, but they are not necessary." Where trees were not present, Tanglebrush was preferred, probably because it is stiffer and sways less in the strong winds that sometimes swirl through the canyons. Once Cord watched a pair battling fierce gusts of wind that literally upturned birds and branches; they refused to let go or retreat into the shelter of the thicket.

When approaching a nest at Ruby Spring, the parents landed in the lookout. After feeding the nestlings, they worked their way back to the lookout and surveyed the situation before returning to the desert to forage.

FORAGING

Brown Towhees spend most of their time foraging in open terrain (Davis 1957: 157), which in the case of *eremophilus* is provided by the open desert hillsides. Typically they land on high boulders, look over the area, then fly to small rocks and scan the bare ground. They often hop and flutter-fly across the open areas, looking for food, but rarely stop to peck and never scratch, as there is no litter on the bare ground to make scratching necessary. They seem to feed mainly on insects in spring, but the only specific food seen was a bluish-green insect, which an adult carried to the nest. Virtually all their time on the desert seems to be spent in active foraging.

Towhees were never seen foraging within the riparian vegetation, either on the ground or among the branches. We cannot preclude that possibility, because the willows and Tanglebrush are so dense that one cannot see into them. However, Cord spent long periods sitting quietly inside thickets known to be inhabited but never saw the birds feeding there.

Because of the rugged terrain and obstructed lines of sight in the mountain canyons, it is difficult to obtain precise data on foraging ranges. The birds may fly directly into the desert, or fly along the

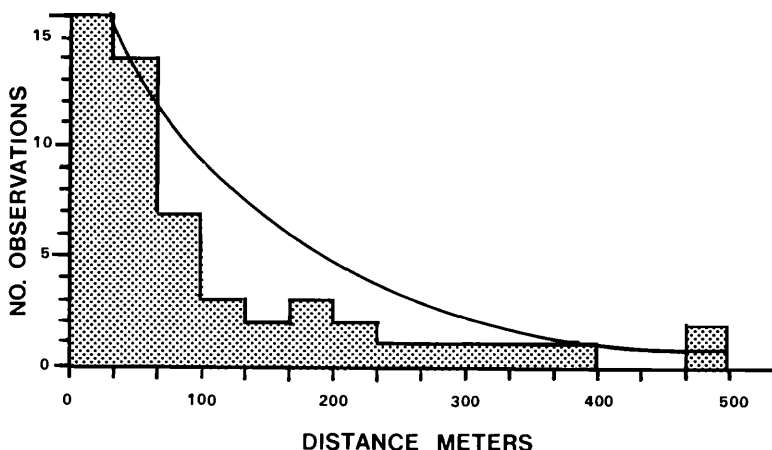


Figure 5. Distances at which Inyo Brown Towhees were observed foraging from nearest riparian vegetation.

streambed for 200-300 m before disappearing around the bend. They have been seen foraging as much as 400 m from nesting habitat, but more than half of Cord's observations were made within 70 m, and 90% within 300 m, of riparian situations (Figure 5). The nesting pair at Ruby Springs normally fed 100-300 m from the nest area.

Although these observations reflect observer bias, most observations being made in the proximity of the streambeds, we believe that most foraging is done within about 250 m of the nesting areas. Some circumstantial evidence comes from Water Canyon, which appears to offer the best riparian habitat anywhere in the Argus but which is evidently unused. The canyon walls there are extremely steep and the talus slopes are devoid of vegetation. The only towhee recorded appeared at dusk, briefly chased a singing House Finch (*Carpodacus mexicanus*), and then dropped from the rim of the canyon into the vegetation. We suspect that the bird used the area only for roosting and that foraging areas were too distant to permit its use for nesting.

NESTING AND PRODUCTIVITY

Essentially nothing is known of the nesting biology of *eremophilus*. At Berkeley, *P. f. petulans* begins nesting in mid-April and some pairs may nest three times in one season. Incubation, by the female alone, requires 11 days; the fledging period is 8 days. Young may remain with the adults for 4-6 weeks if there is no renesting (Childs 1968:608).

Prior to this study, Mountain Spring Canyon was the only established nesting place for *eremophilus* (specimen, 22 May 1935, Appendix I). Subsequently, Cord found a nest at Ruby Spring on 16 May 1978; it was 1 m above the ground in a 1.3 m rabbitbrush and closely canopied by Tanglebrush, which shaded and hid the nest. Placed on several tiny horizontal branches, it contained three small young (bodies unfeathered, pin feathers on primaries) and one egg. Both parents returned and scolded when Cord examined the nest.

The meager data suggest that the peak of nesting is in early May.

During the spring surveys, Cord observed only adult towhees. Even though surveys in 1978 were made into late June, he saw no juveniles at any time (except the nestlings noted above). Although the desert towhees are silent near their nesting areas, and the young may be inconspicuous among the thick vegetation, it seems unlikely that adults feeding young would be completely undetected, especially since the adults spend so much time seeking food. Thus, indications that productivity may be low cannot be confirmed. Productivity could be adversely influenced by the sparseness of food and the

distance adults must forage from the nest on the open desert. This would seem especially important during the hotter months, when activity might be suppressed during the heat of the day, leaving too little time for food gathering.

SPATIAL REQUIREMENTS AND ESTIMATED POPULATION SIZE

Vegetation along canyons in the Argus Range is not continuous but occurs in patches as determined by water resources. In Table 1, each area consisting of at least 2000 ft² of riparian growth has been termed a "site." Single pairs of towhees occupied sites ranging from 3750 ft² (Indian Joe Spring), to 30,000 ft² (Ruby Spring). Some large areas of apparently suitable habitat (e.g. Water Canyon) seemed unoccupied. Evidently acceptability involves a combination of factors including composition of plant community, distribution of vegetation, and proximity to suitable foraging conditions as well as total size of riparian area.

As noted, towhees prefer sites that are dominated by Arroyo Willow or similar species, and which are in close proximity to desert foraging areas. We estimate that the minimum riparian area required for nesting is 4000-5000 ft² (e.g., Green Canyon, Site 4; Great Falls Basin, Site 3; Rusty Canyon, Site 6). Whether smaller areas are used by unpaired birds is unknown. Twice a single bird was seen foraging near Rusty Canyon, Site 1, a 2000 ft² area dominated by Tanglebrush. That site, however, is only 1200 ft from Site 4, a prime area including 15,000 ft² of Arroyo Willow; towhees were not observed there. Since towhees forage widely, the allocation of the bird to Site 1 is suspect. Towhees were never seen in riparian areas smaller than 2000 ft².

The configuration of the habitat is also important. In the Argus most patches of riparian vegetation are strongly linear and form a fringe along the stream course. The densest concentration of towhees occurred near the confluence of Green and Benko canyons, where four pairs inhabited a narrow stretch of scattered willows; adjacent pairs were seen at intervals of approximately 450 feet, which generally corresponded to the distribution of the willows. Marshall and Johnson (1968) reported that *P. f. mesoleucus* pairs were generally spaced 900 feet apart and that the nests of adjacent pairs were no closer than 525 feet.

In estimating the total population size of *eremophilus*, we have assumed that a nesting pair requires a minimum of 4000 ft² of riparian habitat but further that a minimum of 450 feet of riparian

habitat is required in areas where the vegetation is linear.² Thus, the large Ruby Spring site (30,000 ft²) is judged to hold only a single pair because the configuration of the vegetation is largely circular, the largest linear dimension, 300 feet, being too small to accommodate the spacing requirements of more than one pair. Using these assumptions, we calculate that the maximum number of Inyo Brown Towhees in 1978-79 is 138 (Table 1).

The table is subjective—necessarily. Some areas which apparently meet our criteria were judged not to shelter towhees because the vegetation was too sparse (e.g., Benko Canyon, Site 4) or because sites were not 450 ft from a larger area to which we ascribed a breeding population. And in a few areas (e.g., Coyote Spring) we assumed the presence of towhees on the basis of our estimation of the quality of the habitat, even though none were observed. We estimated Great Falls Basin Site 13 (29,000 ft²) to hold only the two pairs observed even though the extent of the vegetation (1000 ft) might accommodate an additional pair. We have not explained all of these inconsistencies in detail, but reasons for them are evident in Cord's field notes. However, our treatment of the Water Canyon-Bobcat Canyon area requires elaboration. Inasmuch as only a single bird was seen there in 2 days of intense study, and because hillsides immediately adjacent to ostensibly excellent breeding habitat do not provide good foraging areas, we surmise that towhees do not breed there, even though the riparian area is extensive enough to support up to seven pairs (Figure 6).

No area in the northern Argus was sufficiently large to meet the requirements outlined above. Evidently the lack of sufficient riparian habitat is responsible for the absence of towhees there.

FALL AND WINTER OBSERVATIONS

Eremophilus has been considered a year-round resident of the desert mountains. There are no specific records for mid-summer (Appendix I), and its fall and winter status are unknown. On 19-20 November 1978, Cord surveyed Mountain Spring Canyon and part of Great Falls Basin and found only a single bird in areas where towhees were present the previous spring. Davis (1951) searched Mountain Spring Canyon on 18 December 1948 without success. In

²The only exception was at Indian Joe Spring, which consists of 3750 ft² of riparian growth. However, water from Indian Joe Spring flows into a flat area about 100 feet long by 30 feet wide, Searle's Garden, that is contiguous with that site. In the latter area, surrounded by Creosote Bushes, Burrobush, Bladder Sage and other desert scrub, a dozen overgrown fig trees grasp the edge of the stream; a pepper tree, an apple tree, a peach tree and even a mesquite are obvious transplants. The total area of Searle's Garden-Indian Joe Spring complex is 6750 ft².

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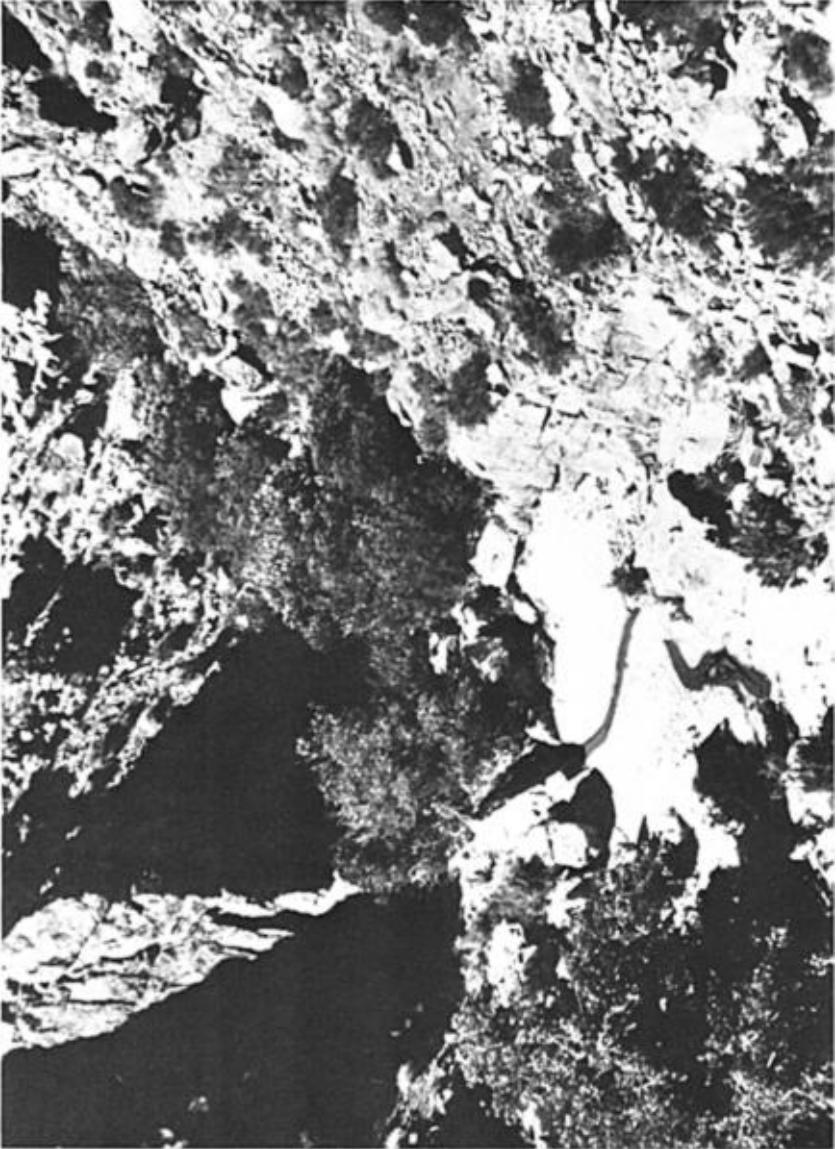


Figure 6 Water Canyon, site 2 Towhees were not found in this area. Apparently the steep canyon walls, talus slopes and the lack of foraging areas in the immediate vicinity of the nesting habitat make it unsuitable, even though adequate vegetation is present

both years it had snowed shortly before the surveys, and Davis (1951) suggested that the birds might descend to lower altitudes in winter. However, two specimens ascribed to *eremophilus* were collected in January and March along the foothills of the Sierras (see below) which suggested that part of the population might winter in willow scrub areas along streams that emanate from the Sierras. (Wintering in open desert habitats is highly unlikely since, except for the populations in the Argus Range and Joshua Tree National Monument, the only records for the California deserts at any season pertain to scattered individuals wintering along the foothills of the San Bernardino Mountains or Sierra Nevada; Jehl et al. 1977.)

To determine whether *eremophilus* might winter along the base of the Sierras, in early January 1979 we surveyed all likely areas of willow scrub in the vicinity of Hwy. 395 between 10 km north of Lone Pine (Moffat Ranch Road) and the Ridgecrest area, and along Hwy. 14 between Jawbone Canyon and Ridgecrest. In most areas we found flocks of wintering birds including Rufous-sided Towhees (*Pipilo erythrophthalmus*). The only Brown Towhees, a pair seen on a desert hillside, 1.2 km from Isabella Lake, Kern County, were within the range of the resident race, *carolae*.

We also investigated several areas of desert scrub on hillsides and major washes along Highway 136 between Lone Pine and Panamint Springs. In addition, Cord surveyed several areas on the east side of the Argus Range north of Trona. No Brown Towhees were found, even though mixed flocks of wintering fringillids were present in some areas.

On 13-14 January Cord returned to the breeding area and revisited Indian Joe Spring (plus Searle's Garden), South Homewood Canyon (four sites) and Great Falls Basin; he also examined desert hillsides in adjacent areas to 1158 m elevation. Eleven towhees were counted. The meager evidence suggests that towhees are year-round residents that may wander to lower elevations or disperse onto the desert during harsh weather.

We have little ecological information for fall and winter. Evidently, the birds roost in the dense riparian vegetation and by day disperse to the open sagebrush-covered hillsides. Large tree-sized willows seemed to be ignored, the birds preferring to roost in or retreat to more shrubby cover. Areas of large willows which had held towhees during the breeding season were vacant.

During the breeding season, towhees were never observed pecking the ground and presumably spent most time foraging for insects. In winter on the same hillsides they do peck on the ground, feeding on seeds. They seem to forage mainly on the warm south-facing slopes. On cloudy days they seem less likely to venture far from the riparian habitats.

The birds remain in pairs through the winter. Scott Horton (field notes) found two pairs feeding on desert slopes at Great Falls Basin on 3 November 1977. Of the 11 birds observed in January 1979, there were three pairs, a group of four (two pairs?) and one single bird. Previous authors (Davis 1951, Childs 1968) have indicated that Brown Towhees remained paired year-round.

FUTURE PROSPECTS

The Inyo Brown Towhee requires adequate riparian habitats in proximity to desert foraging areas. The latter are plentiful, but riparian areas are few and scattered. They are also susceptible to rapid degradation as a result of changes in available water due to increased usage by man and livestock or changes in water output from the aquifer.

The drying of springs is potentially disastrous for the towhee; as water flow declines, willow and Tanglebrush disappear and may be replaced by Squaw Waterweed or other species that the towhees do not use, or, eventually, by desert plants. This has happened at a few sites: Onyx Spring in Onyx Canyon; French Madam Spring and Jack Gunn Spring in Stone Canyon.

In the northern Argus many water sources have been and still are used by miners, with a general trampling of vegetation and packing of soil, making it habitable only for plants such as Squaw Waterweed. The effects of mining activities are particularly pronounced in the lower reaches of Shepherd Canyon, Revenue Canyon, Snow Canyon, in all three springs around Onyx Mine, and in all of Thompson and Stone canyons. Peoples Spring, near Great Falls, which can be reached by ordinary car on a gravel road, is so badly trampled that only rushes and grasses grow there, even though water is plentiful.

Uncontrolled livestock pose further problems. Wild burros occur throughout the entire Argus Range, except at Water Canyon, which is apparently too steep and rocky for them. They seem especially abundant in Moscow Canyon, where a herd of 18 was observed drinking. Their evidence—hoofprints, droppings, browse marks—is everywhere. Their “burro baths,” which may be 10 feet in diameter, destroy all vegetation and create miniature dust bowls. Though burros do not normally browse on willows and Tanglebrush, they push through the bushes to obtain water if it is not more readily available in open situations. In doing so, they trample plants, compact soils, and make mudholes out of beautiful springs (Figure 7).

Riparian areas in the Argus used by towhees are mostly confined to a very small area in the southern mountains. Most are within the

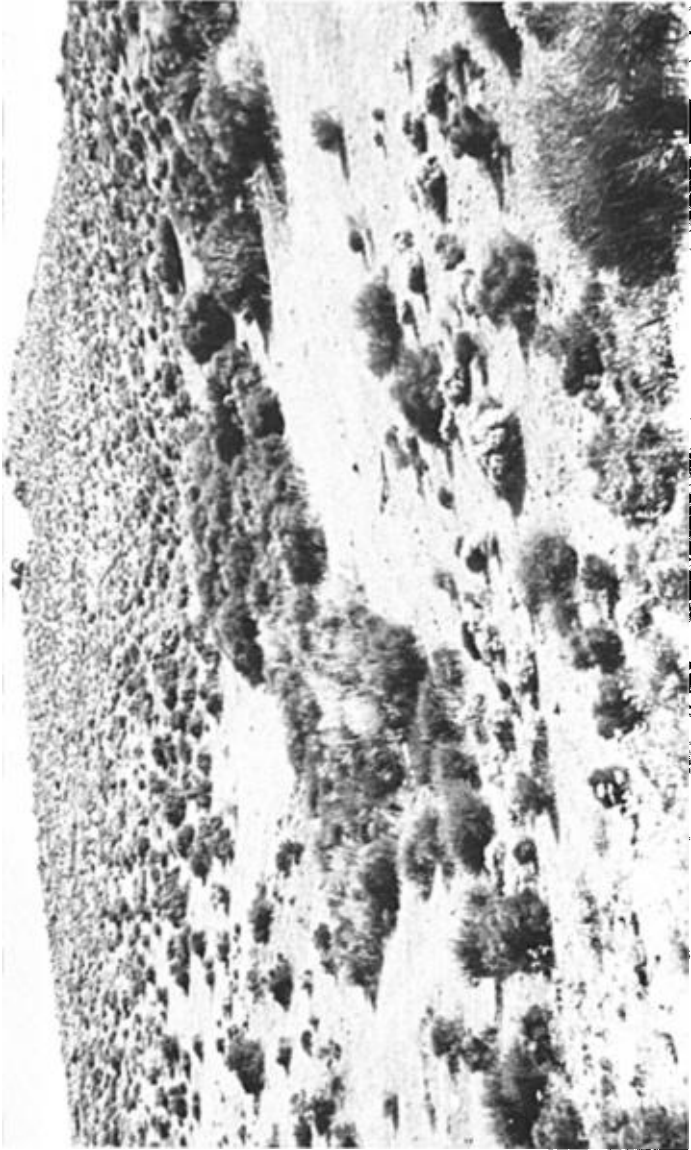


Figure 7. Moscow Canyon, site 5. The vegetation has been severely depleted by burros and no towhees are present.

confines of the Naval Weapons Center, China Lake; Great Falls Basin, Indian Joe Spring, and Benko Spring are outside the military area. They can be reached by hiking but not by off-road vehicles. Because human access to most of the towhee's range is under military jurisdiction, the possibility of further human recreational disturbance to water sites seems minimal. It can be controlled with the cooperation of local authorities and the education of those using the area for mining, hunting, or recreation. Burros are a more important problem, as it is impossible to restrict their activities to areas away from water sites. Indeed, the continued presence of unregulated burro populations in the California deserts has significance for the entire fauna and flora that far transcends the status of the Inyo Brown Towhee.

Although we have followed the AOU (1957) in considering *eremophilus* as a distinct race, we note that it is very weakly differentiated from some other members of the *Crissalis* group, especially *kernensis* (Grinnell and Behle 1937, Davis 1951) from the Walker Pass area of Kern County, and *carolae*, a wide-ranging form in northern California. Whether *eremophilus*, as an isolated population at the terminus of a cline, would be accorded formal taxonomic recognition in a modern revision of the species is debatable. We take no position on that subject as we have not been able to critically compare the limited specimen material. However, because there is so much overlap in size and color, and color differences are complicated by foxing and fading, the identification of single specimens would seem impossible. The assignment of extralimital birds must therefore be treated cautiously, even skeptically, and we are not necessarily convinced that the Lone Pine and Mojave specimens (Appendix I) are either correctly identified or identifiable.

What is important, however, is not taxonomic ranking, which will vary with time and philosophy, but the existence of a remnant population of a formerly widespread species that has successfully adapted to extreme conditions *which are not fully duplicated elsewhere in the species' range*. The value of such populations for evolutionary and biological studies has been amply demonstrated, and the continued existence of the desert towhee is a matter of legitimate concern.

ACKNOWLEDGMENTS

We are grateful to Tilly Barling, Carolyn Shepherd, and Tom McGill, Naval Weapons Center, China Lake, for granting access to government property. The following curators provided information on specimens in their trust: Amadeo Rea, Richard L. Zusi, Kenneth

C. Parkes, Ralph Schreiber, Laurence C. Binford, Robert W. Storer, Thomas R. Howell, Wesley E. Lanyon, and Eugene A. Cardiff. We are especially indebted to William Laudenslayer and Kristin Berry of the Desert Land Plan Staff for their help and encouragement in all phases of the research, and to John Davis for his helpful criticisms of the manuscript. This study was supported by funds provided by the Bureau of Land Management.

SUMMARY

The Inyo Brown Towhee (*Pipilo fuscus eremophilus*) is a desert-inhabiting towhee confined to the southern Argus Range of Inyo County, California. It represents an isolated, relict population of a species formerly widespread in the southwest.

The towhees are wary and difficult to census in the rugged desert canyons. We estimate the current population at 72-138 individuals. The entire population is confined to a circle of 11-mile diameter centered at Benko Canyon. Most of this area is within the Naval Weapons Center, China Lake.

This towhee requires a minimum of 4000 ft² of riparian vegetation dominated by *Salix lasiolepis*, *S. lutea* and/or *Forestiera neomexicana* for shelter and nesting. In areas where the vegetation is strongly linear, a single pair required approximately 450 feet of continuous riparian growth. Apparently the birds do not require standing water.

Foraging is accomplished on open, desert hillsides.

Towhees remain in pairs year-round on the breeding grounds. They may descend to lower elevations in winter, but there is no unequivocal evidence of dispersal away from the immediate vicinity of the Argus Range.

The peak of the breeding season seems to occur in May. Productivity is unknown; only one nest was found and no juveniles were seen during two springs. However, the riparian vegetation is so dense that young birds would be virtually undetectable.

The major adverse impact on this desert towhee is the destruction of riparian habitat by past or present human activity (mining, recreational use) and by wild burros, which trample vegetation and compact the soil.

P. f. eremophilus is a poorly-marked race and does not differ strongly from other members of the *crissalis* group. The limited specimen material is reviewed in an Appendix.

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APPENDIX I. Specimens of *Pipilo fuscus eremophilus*¹

Date	Locality	Museum No.	Sex	Collector
25 Apr 1891	Searle's Garden	USNM 135848	M	Stephens
31 Jan 1905	Mojave, CA	USNM 195885	M	Hollister
22 Mar 1919	Lone Pine		F	Smith
22 May 1935	Mtn. Spr. Cn. ²	SDNHM 17082	M	van Rossem
22 May 1935	Mtn. Spr. Cn.	SDNHM 17083	M	van Rossem
22 May 1935	Mtn. Spr. Cn.	SDNHM 17084 ³	F	van Rossem
23 May 1935	Mtn. Spr. Cn.	SDNHM 17085	M	van Rossem
23 May 1935	Mtn. Spr. Cn.	SDNHM 17086	F	van Rossem
24 May 1935	Mtn. Spr. Cn.	SDNHM 17087	M	van Rossem
27 Oct 1935	Mtn. Spr. Cn.	SDNHM 17333	F	van Rossem
27 Oct 1935	Mtn. Spr. Cn.	SDNHM 17334	F	van Rossem
27 Oct 1935	Mtn. Spr. Cn.	SDNHM 17335	M	van Rossem
27 Oct 1935	Mtn. Spr. Cn.	SDNHM 17336	M	van Rossem
17 Nov 1935	Mtn. Spr. Cn.	SDNHM 17340	F	van Rossem
17 Nov 1935	Mtn. Spr. Cn.	SDNHM 17341	M	van Rossem
17 Nov 1935	Mtn. Spr. Cn.	SDNHM 17342	M	van Rossem
17 Nov 1935	Mtn. Spr. Cn.	SDNHM 17343	F	van Rossem
17 Nov 1935	Mtn. Spr. Cn.	SDNHM 17344	M	van Rossem
27 May 1940	Mtn. Spr. Cn.	MVZ 80366		
8 Nov 1940	Mtn. Spr. Cn.	UMMZ 117124	M	Stager
8 Nov 1940	Mtn. Spr. Cn.	UMMZ 117125	F	Stager
25 Feb 1975	Indian Joe Cn.	SBCM 30284	M	Ardahl and Wessman

¹ Based on museum records provided by the Desert Land Plan, examination of the literature, inquiries to museum curators and/or personal inspection of the following collections: San Diego Natural History Museum, U.S. National Museum of Natural History, Carnegie Museum, Los Angeles County Museum of Natural History, California Academy of Sciences, the University of Michigan Museum of Zoology, University of California, Los Angeles.

² Several specimens taken in 1935 from Mountain Springs Canyon, including the type, are labeled "Lang Spring, 5500' elevation"; one specimen in the type series gives the elevation as 6000'. The exact locality of Lang Spring is not known. Today there is no towhee habitat in the area higher than 5500'.

³ Mate 17083; parent 17082

Accepted 12 October 1979