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CHARACTERISTICS OF NESTING AREAS USED BY SAN CLEMENTE ISLAND SAGE SPARROWS¹

DAVID W. WILLEY

*Colorado Plateau Research Station, Northern Arizona University,
P.O. Box 5614, Flagstaff, AZ 86011-5614, e-mail: daw@nbs.nau.edu*

Abstract: I examined the nest habitat used by Sage Sparrows (*Amphispiza belli clementeae*) on San Clemente Island, one of the California Channel Islands, during March through June 1986. All nests were found in boxthorn shrubs in coastal scrub habitat. The cover of vegetation was greater and more evenly distributed at nest sites than in surrounding habitat. Nests were placed most often on the leeward side of live boxthorn shrubs interspersed by cactus.

Key words: Sage Sparrow, *Amphispiza belli*, San Clemente, island, habitat, nest.

Sage Sparrows (*Amphispiza belli*) are widely distributed in western North America, breeding from southern Idaho and eastern Washington south to the Mexican Plateau, including islands off the coast of southern California (Bent 1968). The San Clemente Island (SCI) Sage Sparrow (*A. b. clementeae*) inhabits maritime desert scrub habitat on the west side of SCI, the southern-most of the California Channel Islands (Philbrick and Haller 1977, Willey 1990). The Sage Sparrow was a common island resident but experienced severe declines due to habitat loss caused by livestock (Jorgensen and Ferguson 1984). In 1977 it was listed as "threatened" by the U.S. Fish and Wildlife Service (Greenwault 1977). Previous investigation of Sage Sparrow habitat use has focused on populations in the Great Basin (Rich 1980, Reynolds 1981, Petersen and Best 1985, Winter and Best 1985), and prior to my study, work on the island race was restricted to nesting success (Willey 1990) and taxonomy (Van Rossem 1932, Miller 1968). The purpose of this study was to identify habitat used by Sage Sparrows during the breeding season on SCI using methods developed by Petersen and Best (1985). Vegetation structure, plant composition, and nest placement were measured at nest sites and surround-

ing habitat to address the following questions: (1) do Sage Sparrows select nest sites that were distinct from the average scrub habitat, and (2) are patterns of nest placement consistent among pairs of Sage Sparrows?

STUDY AREA AND METHODS

San Clemente Island (143 km²; 33.6 km long; average of 12.8 km wide) is located approximately 110 km northwest of San Diego, California at 118°30'W 33°00'N. Topographically, the island is characterized by steep escarpments on the east, sloping plateaus cut by steep canyons in the central highlands, and marine terraces on the west side. The highest point on the island is approximately 610 m above sea level. The Mediterranean climate features strong westerly winds, dry summers, mild winters, and 270 mm average annual precipitation (Philbrick and Haller 1977). The island's vegetation has been described by Philbrick and Haller (1977). Several exotic animals have been introduced to the island in the early 1900s and the endemic flora was seriously damaged by feral goats and pigs (Jorgensen and Ferguson 1984).

The study area occurred along an 8 km strip of coastal scrub habitat on the two lowest western terraces of the island, located 5 km southwest of Wilson Cove (Willey 1990). Vegetation at the study site was dominated by boxthorn (*Lycium californicum*) shrubs, interspersed with prickly pear cactus (*Opuntia* spp.), cholla cactus (*O. prolifer*), snake cactus (*Berberocactus emoryi*), and various grasses (*Avena* spp., *Stipa comata*, and *Hordeum jubatum*).

I located nests by observing nest building by adults from early March through June 1986. Habitat structure and composition within the study area were quantified using ten 350-m parallel transects placed in the study area at 500-m intervals. To assess available habitat, I measured vegetation at 80 sample points located every 50 m along the transects. Habitat characteristics also were measured at 31 nests located in the study area. At each sample point and nest site, shrub cover was estimated using line intercept

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TABLE 1. Habitat characteristics in the vicinity of 31 San Clemente Island Sage Sparrow nest sites compared to available habitat. Values shown are means (\pm SD).

Variable	Nest site	<i>n</i>	Available	<i>n</i>	<i>P</i> -value
Shrub cover (%)	55 (15)	31	40 (19)	80	0.001* ^a
Shrub dispersion ^b	63 (17)	31	70 (17)	80	0.09
Shrub height (cm)	43 (7)	31	41 (10)	166	0.04*
Cactus cover (%)	21 (12)	31	12 (8)	80	0.001*
Herb cover (%)	50 (14)	31	39 (16)	80	0.01*
Litter (%)	5 (4)	31	6 (3)	80	0.07
Bare ground (%)	29 (13)	31	44 (18)	80	0.001*

^a Comparison of nest sites versus available habitat, two-sample two-tailed *t*-tests unequal sample sizes and pooled variance estimate. * = $P \leq 0.05$.

^b Coefficient of variation of inter-shrub distances.

distances measured from a cable extended 5 m in the four cardinal directions (Canfield 1941). Shrub dispersion and condition, shrub height, and nest placement measurements were calculated following the methods of Petersen and Best (1985). Cover of herbaceous vegetation, litter, and bare ground was estimated using quadrats measuring 1,000 cm² (Daubenmire 1959). The vertical profile of shrubs was recorded with a steel rod passed vertically through shrubs 1 m from the nest in each of the four cardinal directions, and counting the number of hits in 10-cm height classes. Nest sites were compared with the available habitat using the *t*-test (Zar 1974). Chi-square analyses compared nest placement among nesting pairs and condition class of boxthorn shrubs (Wilkinson 1990). The condition of each shrub was recorded as dead or 25, 50, 75, or 100% of the shrub living. Kuiper's test for uniformity was used to analyze the nest orientation data (Mardia 1972). Statistical significance was set at $P \leq 0.05$.

RESULTS

The nest sites differed significantly from the surrounding habitat for all variables except shrub dispersion and percent cover by litter (Table 1). The cover of boxthorn was greater and more evenly distributed at nest sites than in surrounding habitat. Percent cover of cactus and forbs also was higher at nest sites. The amount of bare ground and litter were significantly less at nest sites than in the overall habitat. The distribution of boxthorn shrub heights was significantly different (Mann-Whitney *U*-test statistic = 3,169.5, $n = 31$ nests and 166 random shrubs, $P = 0.04$) between nest sites and surrounding habitat, with nest sites characterized by relatively tall boxthorn shrubs. Mean (\pm SD) height of nest shrubs was 45 ± 7 cm, and ranged from 30–52 cm. Shrubs that contained nests were thickest 20–30 cm above the ground, which was a typical height for nest placement by Sage Sparrows (Reynolds 1981, Petersen and Best 1985, Willey 1990).

Nest orientation with respect to the center of the nest shrub was significantly different from uniform (Kuiper's test, $V = 6.68$, $P = 0.001$), with eastern sides selected most frequently (Fig. 1). Condition of nest shrubs used by Sage Sparrows was significantly different from that of a random sample of shrubs ($\chi^2_1 = 9.2$, $P = 0.002$). Seventy-one percent of nest shrubs were $\geq 75\%$ living, and 29% were $\geq 50\%$ liv-

ing; no Sage Sparrow nests were found in shrubs with $\leq 50\%$ living foliage.

DISCUSSION

I used univariate methods to describe Sage Sparrow nest sites and then compared them with surrounding scrub habitat to identify patterns of habitat use. My analyses suggested that Sage Sparrows selected dense shrubby sites within the overall habitat for their nests. Rotenberry and Wiens (1989) implied that predation strongly influenced habitat use patterns of Sage Sparrows, and Reynolds (1979) reported that Loggerhead Shrikes (*Lanius ludovicianus*) "scuttled" the reproductive effort of Sage Sparrows in the Great Basin. All of the SCI Sage Sparrow nests I found were placed within impenetrable thickets of shrubs and cactus that provided protection from most island predators. Willey (1990) reported high nesting success for SCI Sage Sparrows, with no documented predation; however, George (1987) reported that birds on Baja California islands commonly experienced less predation pressure and higher nest success than mainland counterparts.

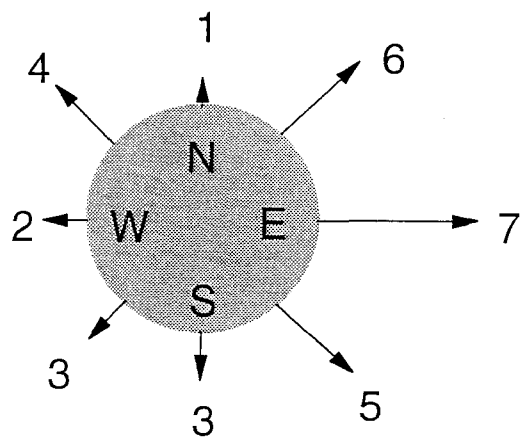


FIGURE 1. The compass orientation of San Clemente Island Sage Sparrow nest sites with respect to the center of the nest shrub. The value given shows the number of nests placed at a given compass direction.

The nonrandom placement of nests by Sage Sparrows on San Clemente Island (Willey 1990) and by Song Sparrows (*Melospiza melodia*) on San Miguel Island (Kern et al. 1993) suggests a common selection force may be present among the California Channel Islands. Extreme onshore winds occur seasonally throughout the California Channel Islands and may influence nest site selection by birds (Sogge et al. 1991, Kern et al. 1993). I speculate that dense vegetation provides cover that ameliorates exposure to environmental (i.e., prevailing winds) and biotic (i.e., predators) factors.

My results differ from a study conducted in the Great Basin (Petersen and Best 1985), where nest sites were characterized by abundant bare ground, no spinescent vegetation, and all nests were placed within Great Basin sagebrush (*Artemisia tridentata*). The Great Basin habitat possessed more bare ground and a higher proportion of shrubs with at least 50% living foliage at nest sites (Petersen and Best 1985) than my study on SCI. Despite these differences, Sage Sparrows on SCI and in the Great Basin showed important similarities: nests were preferentially placed within the live, leeward side of shrubs, and the birds showed similar preferences with respect to nest sites they selected and the manner in which nests were placed within shrubs (Petersen and Best 1985, Willey 1990).

Finally, my study identified characteristics of SCI scrub habitat that correlated with nesting Sage Sparrows. From a management perspective, maritime desert scrub habitat on SCI should be protected from activities such as livestock grazing and off-road vehicle use that destroy or degrade boxthorn thickets that are used for nesting. Unless maritime scrub habitat is protected on SCI, future management options could be lost, and Sage Sparrows may be eliminated from large portions of their range.

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