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**Landbird Monitoring
Channel Islands National Park
1994 Annual Report**

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ABSTRACT

Landbird monitoring was conducted during 1994 at Channel Islands National Park for the second year. Line transect counts were conducted on Santa Barbara, East Anacapa, Santa Rosa and San Miguel Islands, whereas point counts were conducted only on Santa Rosa Island. Landbirds were surveyed during both spring (March-April) and fall (September-October) seasons. Of the 13 landbird monitoring sites established on Santa Rosa Island, only 4 were surveyed, due to time and personnel constraints.

During line transect sampling, observers recorded all birds heard or seen within 100 m of the transect midline. Similarly, all birds seen or heard within 50 m of point count sites were recorded during point count sampling. To quantify some differences in detectability between seasons, detection cue type (song, call or visual) was recorded for all birds observed during both point count and line transect sampling.

Fifty-five species were observed during spring and fall sampling on all islands. Not all breeding species were observed on all islands, probably due to the inability of the current landbird monitoring program to detect some species. Spring abundance counts for some species were compared. Between 1993 and 1994, Horned Lark observations decreased 37%, Orange-crowned Warbler observations increased 16%, Song Sparrow observations showed no change, and Western Meadowlark observations increased 16%.

The resolution of the current landbird monitoring program is unknown. It is therefore recommended that a power analysis be performed on the data to determine the level of population change currently detectable by the program. It is further recommended that line transect sampling be replaced with point count sampling, in order to allow the data to be analyzed by habitat type, and to bring the program into line with other regional and national landbird monitoring programs.

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San Miguel Island Song Sparrow

INTRODUCTION

National Park Service (NPS) managers are charged with maintaining all the components and processes of naturally evolving park ecosystems (NPS 1988). In order to make intelligent decisions regarding management of complex natural resource systems, managers of parks and other natural reserves require information on long-term resource condition and trend. Without such information, managers cannot gauge the effects of human activities on park resources, and therefore cannot prescribe and implement appropriate mitigative measures.

Recognizing that long-term datasets are required for management of park areas, the NPS has directed its managers to acquire such information in order to detect changes that may require mitigation and to provide reference points for comparison with other, more altered environments (NPS 1988). Accordingly, the NPS at Channel Islands National Park has initiated a long-term ecological monitoring program for both marine and terrestrial natural resources (Davis and Halvorson 1988), based primarily upon monitoring the population dynamics of selected organisms. This population-based approach was chosen rather than other indices (biodiversity, energy flux, nutrient budgets, etc.) because the former integrates the effects of a broad range of ecological factors, permits projections into the future, reflects chronic system effects quickly, can be measured simply and interpreted directly, and provides information at levels most amenable to management: that of the species and population (Davis 1989). Protocols for monitoring populations and communities of terrestrial

resources have been designed for terrestrial vertebrates, terrestrial vegetation, landbirds, terrestrial invertebrates and landbirds (Fellers and Arnold 1988, Halvorson et al. 1988, van Riper et al. 1988, Fellers and Drost 1991).

In 1993, landbird population monitoring was initiated at Channel Islands National Park.

Other land management agencies and scientific organizations are initiating population monitoring programs for landbirds (Butcher et al. 1993, Geupel 1993, Manley 1993, Sauer 1993), prompted by an increasing concern about the effects of habitat destruction and fragmentation, and specific concerns for the fate of neotropical migrant species (Terborgh 1989, Hagan and Johnston 1992). The importance of monitoring landbird populations at Channel Islands National Park is underscored by the existence of several endemic insular subspecies on the islands, as well as the recent history of habitat alteration due to human influences.

Landbird communities on southern California's Channel Islands are well-documented. As near-shore, or continental islands with faunal affinities to the adjacent mainland, California's Channel Islands have been the focus of studies on species composition and turnover among insular landbird populations (Diamond 1969, Power 1972, Lynch and Johnson 1974, Jones 1975, Jones and Diamond 1976, Power 1976, Diamond and Jones 1980, Kiff 1980) as well as studies on the origin and differentiation of island avifauna (Miller 1941, Miller 1951, Johnson 1972, Power 1979, Power 1980). Autecological studies have focused on endemic island subspecies such as the Santa Cruz Island scrub jay (*Aphelocoma coerulescens insularis*) (Atwood 1980), and San Miguel Island song sparrow (*Melospiza melodia micronyx*) (Sogge and van Riper 1988). Population

monitoring of landbirds occurring on California's Channel Islands has not been previously attempted, although The Nature Conservancy is currently monitoring landbird populations on Santa Cruz Island (R. Klinger, pers. comm.).

Breeding landbird communities on the islands are depauperate when compared to those of the mainland. Diamond and Jones (1980) summarized the breeding avifauna on the Channel Islands and noted the differences between island avifauna and that of the adjacent mainland. Approximately 160 species breed on the adjacent mainland, whereas each of the eight Channel Islands support between eight and 39 species. Mainland species absent on the islands include sedentary species such as the Wrentit (*Chamaea fasciata*) and California Towhee (*Pipilo crissalis*), strong overland fliers such as the Red-shouldered Hawk (*Buteo lineatus*) and Turkey Vulture (*Cathartes aura*) which are not inclined to cross water, species for which there exists no suitable breeding habitat on the islands, such as Hermit Thrush (*Catharus guttatus*) and Fox Sparrow (*Passerella iliaca*), and some species which may be outcompeted by other successfully breeding island species (Anna's Hummingbird [*Calypte anna*] and Allen's Hummingbird [*Selasphorus sasin*]). Those species which do breed regularly on the islands are characterized by a high degree of endemism. Of the approximately 41 island landbird species, 13 have differentiated into 18 endemic subspecies (Johnson 1972).

The landbird monitoring protocol developed for Channel Islands National Park (van Riper et al. 1988) is designed to monitor populations of landbird species which breed on Santa Barbara, Anacapa and San Miguel Islands through the use of line transect sampling during both the breeding and non-breeding seasons. Line transects utilizing existing trail systems were

chosen over point counts because they minimize impact to vegetation and while accurately sampling avian species composition, relative abundance and seasonal distribution patterns (Sogge et al. 1989). The landbird monitoring program currently being developed for Santa Rosa Island (Super et al., in prep.) primarily utilizes point count sampling, which is more appropriate for that island's structurally complex habitats and rugged terrain, both of which make line transect sampling difficult to implement. Line transect sampling is most appropriate for sampling landbird populations in open, low-growth habitats (Dawson 1981), such as those on the smaller, less topographically diverse Channel Islands.

The objectives of the landbird monitoring program at Channel Islands National Park are to determine annual relative abundance of each species breeding on park islands, and to detect substantial changes in the abundance and/or distribution of landbirds. Such changes may be due to either natural factors or human-caused influences; historic and recent land-use practices have had severe consequences for island avifaunas. For example, the Santa Barbara Island Song Sparrow (*Melospiza melodia graminea*) was driven to extinction by 1959 due to a combination of conversion of native habitat for agricultural purposes, habitat destruction by introduced rabbits (*Oryctolagus cuniculus*) and other grazing stock, and predation by feral cats (*Felis catus*) (Sumner 1959). These same land-use practices on Santa Barbara Island have also reduced available breeding habitat for the Orange-crowned Warbler (*Vermivora celata sordida*), a neotropical migrant which, on Santa Barbara, nests only in the thick stands of *Coreopsis* scrub in the canyons. As the island recovers from the influences of past grazing, expansion of *Coreopsis* stands may be accompanied by an increase in breeding Orange-crowned Warblers. The landbird monitoring

program is designed to detect such changes, through correlation of landbird trends with attendant trends in other ecosystem components.

MATERIALS AND METHODS

Study Area

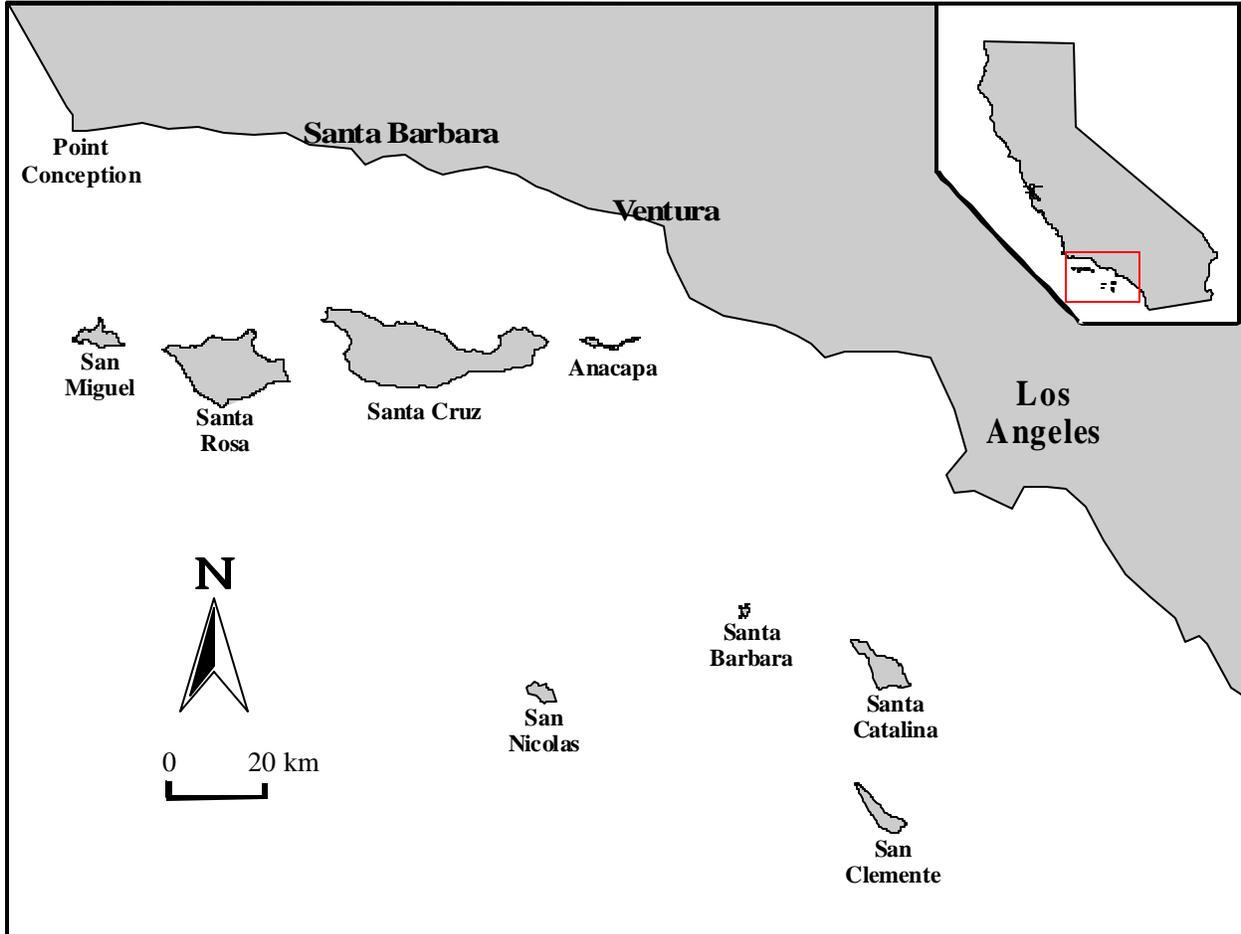


Figure 1. Channel Islands National Park, California. The Park comprises San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara Islands.

The purpose of this report is to present results from the second year of landbird monitoring at Channel Islands National Park. Data presented include abundance counts for line transect and point count sampling, and data on detection cue type.

The California Channel Islands comprise eight islands located at various distances from the mainland in the Southern California Bight (Fig. 1), of which five are included in Channel Islands National Park. The islands range in size from less than 300 ha (Anacapa and Santa Barbara) to over 25,000 ha (Santa Cruz). Of the park islands,

Anacapa is closest to the mainland, being 22 km from the coast, whereas Santa Barbara lies 73 km from the mainland. The larger islands are topographically diverse, and support a variety of habitat types, ranging from annual grasslands to coastal scrub communities and oak and conifer woodlands (Halvorson et al. 1988). The landbird monitoring program samples populations in all habitats on Santa Barbara, East Anacapa, Santa Rosa and San Miguel Islands (Tables 1 and 2).

Landbird Monitoring Methods

Van Riper et al. (1988) identified three methods for monitoring landbird populations at Channel Islands National Park. First, species relative abundance was to be estimated annually during both breeding and non-breeding seasons via a line transect sampling method from the islands' trail systems. Second, landbird densities were to be estimated via line transect sampling and variable circular plots once every five years, with the intention of subsequently applying conversion factors to the annual relative abundance data to produce estimates of relative density. Third, intense observations were to be made throughout the breeding season of species selected as representative of various feeding guilds.

The first method, estimation of relative abundance from transect counts, was the only method implemented in 1993 and 1994, for the following reasons. First, the method of calibrating the annual relative abundance counts via variable circular plot density estimation has been found to be unworkable and so has been abandoned (Mark Sogge, personal communication); simple annual line transect counts are sufficient to detect significant changes in avian species diversity and abundance (Sogge et al. 1989). Second, problems with the use of indicator species has rendered that approach untenable (Mark Sogge, personal

communication), and thus, there are no plans to develop monitoring methods for such.

Line transect counts were conducted on the transect routes identified by van Riper et al. (1988) for Santa Barbara, East Anacapa, and San Miguel Islands (Table 1, Figures 2-4), with the exception of Elephant Seal Cove Trail on Santa Barbara Island, which is near a large Western Gull (*Larus occidentalis*) colony on Webster Point. Vocalizations by gulls made it impossible to detect landbird calls and songs during the spring; therefore, that transect was surveyed only in the fall. In 1993, an additional transect route was added on San Miguel (Nidever Canyon) in order to sample the *Coreopsis* scrub habitat in that canyon.

Super et al. (in prep.) established 11 point count transects and four line transects for monitoring landbirds on Santa Rosa Island (Fig. 5). In 1994, the Lobo Canyon and Torrey Pines transects were surveyed during both spring and fall, and the Island Oaks transect was surveyed only in the fall.

Transects were surveyed in both breeding (March - April) and non-breeding (October - November) seasons. Spring surveys were conducted between 16 March and 29 April; fall surveys were conducted between 28 September and 28 October. Transects were surveyed once each season. Line transect survey techniques used were those prescribed by van Riper et al. (1988). The observer recorded all landbird species detected, by visual or audio cue, within 100 m of the transect midline, while walking the transect at the prescribed time of day and at windspeeds less than 10 knots. Point count survey techniques used were those identified by Super et al. (in prep.). After arriving at a point count location, the observer waited for at least one minute before starting the count. The observer

then recorded all birds detected within a 50 m radius for a 10 minute period.

Table 1. Landbird line transects surveyed at Channel Islands National Park in 1994 (habitat types are from Halvorson et al. 1988 and Clark et al. 1990).

Island	Transect	Length (km)	Habitat Types	Route
Santa Barbara	Canyons	2.5	Coreopsis Scrub Wild Oats Boxthorn Scrub Maritime Cactus Scrub	Starts in Landing Cove Canyon and proceeds through Cave, Middle and Graveyard Canyons to the large Coreopsis stand east of Signal Peak.
	Arch Point Loop	5.4	Wild Oats Sea Cliff Scrub Coastal Sage Scrub	Starts at the island residence, proceeds up to the Saddle between North and Signal Peaks, follows the upper east slope of North Peak out to Arch Point and returns to the residence via Cliff Canyon.
	Elephant Seal Cove Trail	1.5	Wild Oats Sea-blite Scrub Coastal Sage Scrub	Starts at the Saddle, proceeding west down across Webster Point to Elephant Seal overlook.
	Signal Peak	6.25	Wild Oats Sea Cliff Scrub Coastal Sage Scrub	Proceeds from the Saddle to Signal Peak, east through Cat Canyon, and across the Badlands.
East Anacapa	Trails	3.5	Coreopsis Scrub Annual Iceplant Coastal Sage Scrub	Starts at the lighthouse gate, proceeds past the bunkhouse and helicopter pad to the campground, on to Inspiration Point and return to residence via Cathedral Cove trail.
Santa Rosa	Estuary/Marsh 1	0.5	Coastal Marsh	Surveys the northern two pools of the marsh at Old Ranch Canyon, between Skunk and East Point.
	Estuary/Marsh 2	0.5	Coastal Marsh	Surveys the southern portion of the marsh.

Island	Transect	Length (km)	Habitat Types	Route
San Miguel	San Miguel Hill	2.3	Coreopsis Scrub Wild Oats Coastal Sage Scrub Caliche Scrub Haplopappus Scrub	Starts at Nidever Canyon residence, proceeds up past airstrip to San Miguel Hill.
	Dry Lakebed	5.4	Wild Oats Coastal Sage Scrub Caliche Scrub Haplopappus Scrub Lupine Scrub	Proceeds along Cross-Island Trail from San Miguel Hill over Green Mountain to Dry Lakebed.
	Harris Point	1.6	Lupine Scrub Haplopappus Scrub	Proceeds from junction of Harris Point trail and jeep trail 1.6 km north.
	Willow Canyon	3.0	Coreopsis Scrub Coastal Sage Scrub Haplopappus Scrub	Proceeds down Willow Canyon to Willow Cove.
	Nidever Canyon	1.4	Coreopsis Scrub	Proceeds from the mouth of Nidever Canyon to the junction with the campground trail.

Although not included in the monitoring protocol, I also collected data on detection cue type to investigate some aspects of detectability. Thus, on all surveys (except those on San Miguel in the fall), the type of cue (call, song or visual) was recorded for each bird detection.

To quantify one aspect of seasonal variability in detection, the distribution of detection by cue type was summarized for each species with more than 15 detections per season. Chi-

square tests were used to determine whether the proportion of audio (call and song) cue types and visual cue types differed between seasons for those species. Yates correction for continuity was applied to decrease bias in 2 X 2 contingency tables (Zar 1987). Significance level was set at 0.05 for all tests.

Landbird observations derived from the line transect counts were summarized by species for each transect in each season.

Table 2. Landbird point count transects surveyed at Channel Islands National Park in 1994 (habitat types are from Halvorson et al. 1988 and Clark et al. 1990).

Island	Transect	No. of Stations	Habitat Types	Route
Santa Rosa	Lobo Canyon	20	Riparian	10 stations are located upstream and 10 downstream from where the road crosses the canyon.
	Torrey Pines	10	Torrey Pine Woodland	The 10 stations are located primarily on the east-west ridges that finger into the Torey pine grove above Beecher's Bay.
	Island Oaks	10	Island Oak Woodland	7 stations are located in the island oak groves on Black Mountain; an additional 3 are located in the Soledad groves.

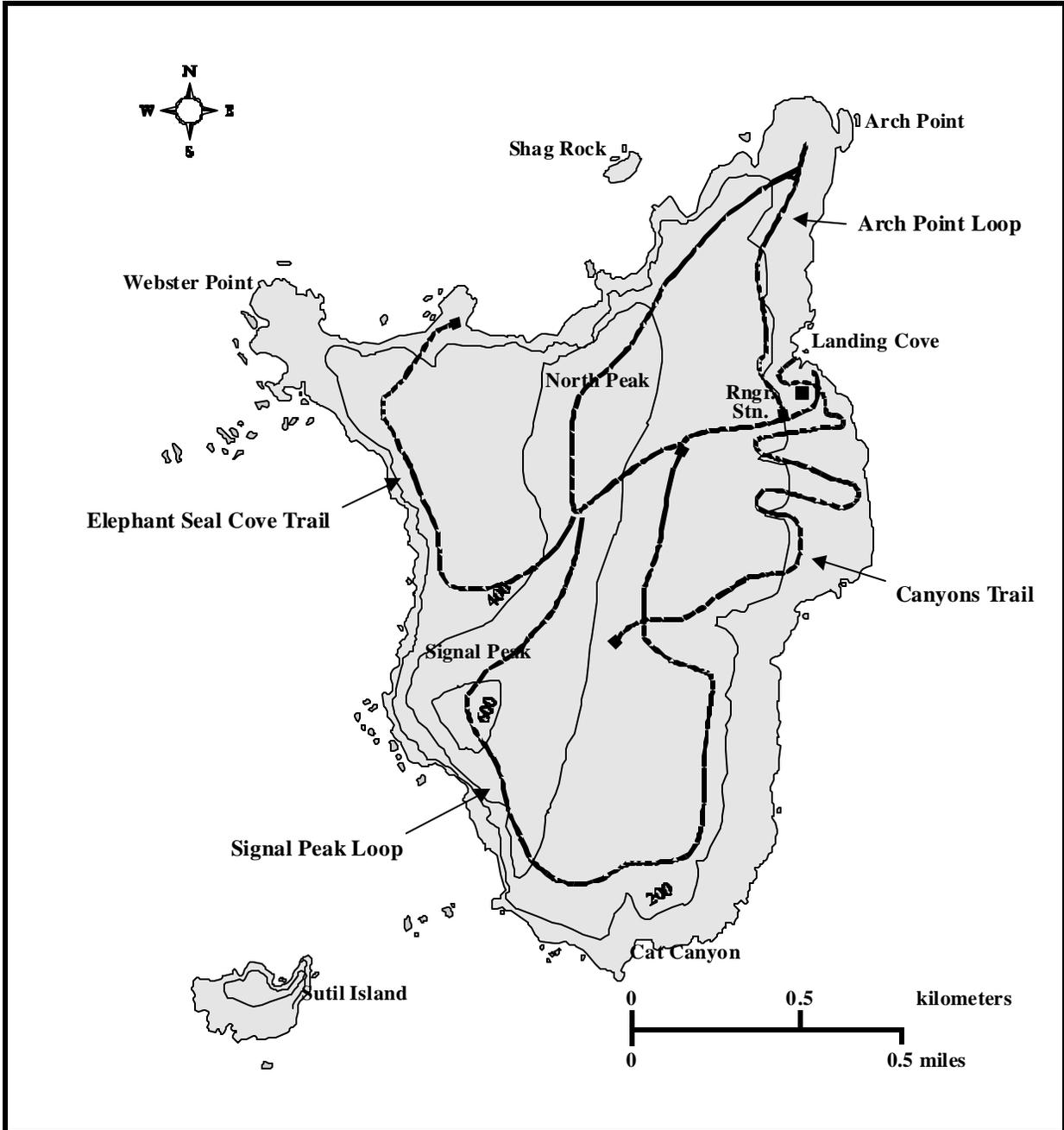


Figure 2. Landbird transect locations, Santa Barbara Island, Channel Islands National Park.

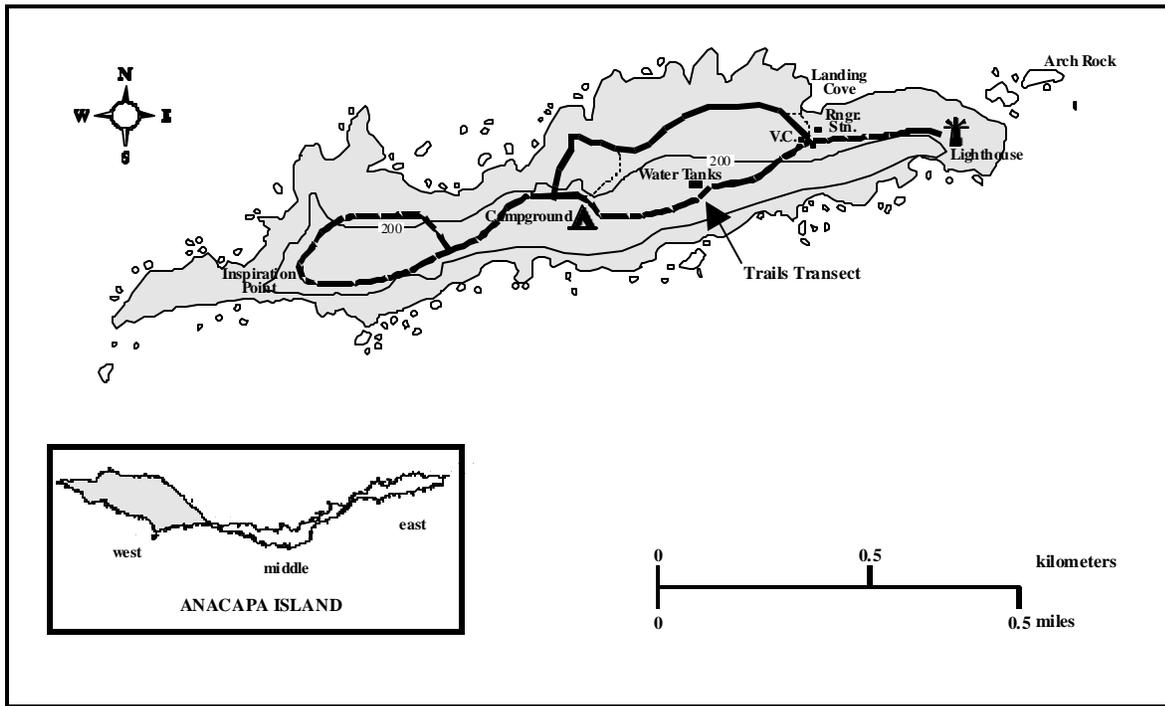


Figure 3. Landbird transects, East Anacapa Island, Channel Islands National Park.

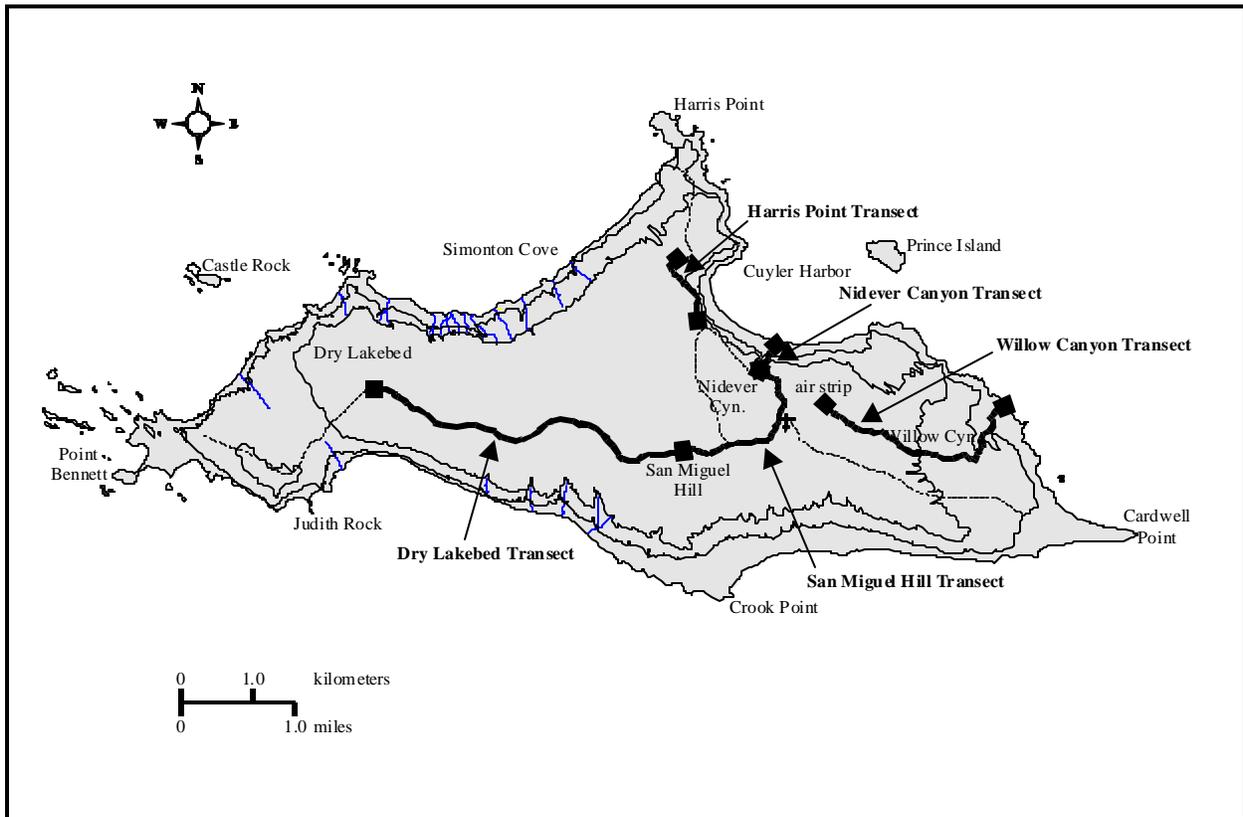


Figure 4. Landbird transect locations, San Miguel Island, Channel Islands National Park.

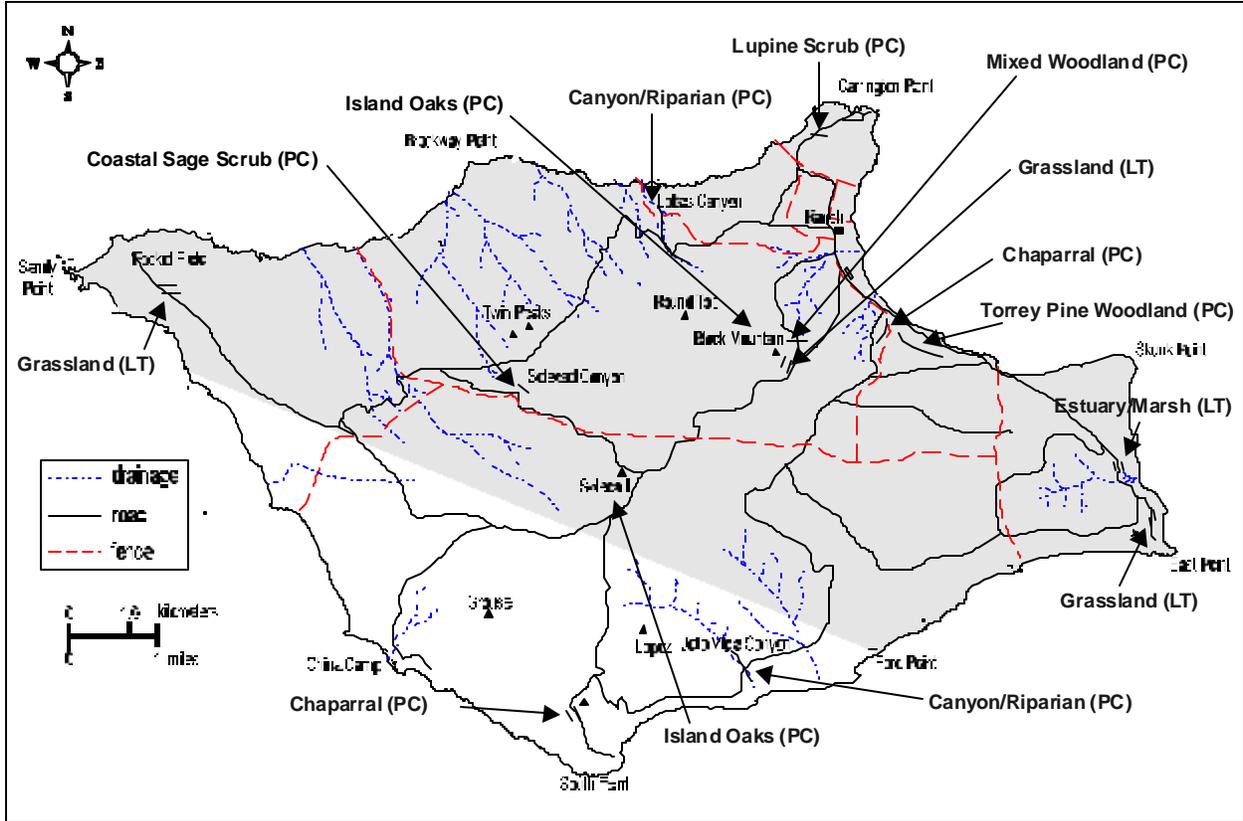


Figure 5. Landbird monitoring sites, Santa Rosa Island, Channel Islands National Park.

RESULTS AND DISCUSSION

Species Observed

A total of 55 species was observed during spring and fall landbird surveys on Santa Barbara, East Anacapa, Santa Rosa and San Miguel Islands (Table 3) (scientific names of landbirds are given in Table 3 and are therefore not mentioned thereafter for those species). The total number of species observed is greater than the number observed in 1993 (47) due to the addition of point-count transects on Santa Rosa Island. The number of species observed in 1994 on Santa Barbara, East Anacapa and San Miguel (31) was less than that observed in 1993.

Twenty-three landbird species were observed on Santa Barbara Island in 1994, compared to 24 in 1993. All landbird species known to breed regularly on Santa Barbara (Jones and Diamond 1980) and observed in 1993 were also observed in 1994. As in the previous year, neither spring nor fall surveys in 1994 recorded Barn Swallows, a regular breeder which arrives after the spring survey period and departs prior to the fall survey period (Sogge et. al 1989). The Loggerhead Shrike, which Jones and Diamond identified as an occasional breeder on Santa Barbara, was not observed on that island in 1993 but was observed during fall surveys in 1994.

The same number of species was recorded on East Anacapa in 1994 as in 1993 (18), though only 1 spring survey was conducted in 1994, compared to 2 the previous year. Chipping Sparrow and Allen's Hummingbird are both regular breeders on Anacapa and were observed in 1993 but not 1994. Jones and Diamond list the Black Phoebe as an occasional

breeder on Anacapa, but the species was only observed in the fall in 1994. The Common Raven is listed as an occasional breeder and was observed in both spring and fall. The Barn Owl, White-throated Swift, (*Aeronautes saxatalis*) and Pacific Slope Flycatcher were reported as regular breeders on Anacapa by Jones and Diamond, but were not recorded on East Anacapa in 1993 or 1994., probably due to lack of suitable habitat for these species on East Anacapa. Similarly, the Mourning Dove, Northern Mockingbird (*Mimus polyglottos*), Loggerhead Shrike, Hutton's Vireo (*Vireo huttoni*) and Rufous-crowned Sparrow (*Aimophila ruficeps*) were listed as occasional breeders on Anacapa but were not recorded in 1993 or 1994. It is possible that these species bred on Middle or West Anacapa Island in 1994, but were not detected on the East Anacapa transects.

A total of 43 species was observed on Santa Rosa Island during spring and fall surveys. Santa Rosa has a richer avifauna than the smaller islands due to its larger size, greater topographic complexity and number of vegetation types. Only three habitat types were surveyed on Santa Rosa this year: Torrey pine, island oak, and riparian. Resident breeders (Super et al., in prep.) not observed in 1994 include White-throated Swift, Northern Mockingbird, European Starling, and Hutton's Vireo.

On San Miguel Island, 22 species were observed in 1994, compared to 27 in 1993. All species listed as regular breeders by Jones and Diamond were observed in 1994, with the exception of the American Kestrel and Barn Owl. The latter were observed, but not during transect monitoring. The Loggerhead Shrike and Lesser Goldfinch were listed as occasional breeders on San Miguel by Jones and Diamond and were observed in 1993, but not in 1994.

Table 3. Landbird species observed during spring and fall landbird surveys, Channel Islands National Park, 1994. Nomenclature from American Ornithologists Union 1983. S = observed on spring surveys, F = observed on fall surveys.

Common Name	Latin Name	SBI	EAI	SRI	SMI
Double-crested Cormorant	<i>Phalacrocorax auritus</i>			F	
American Wigeon	<i>Anas americana</i>			F	
Green-winged Teal	<i>Anas crecca</i>			F	
Ruddy Duck	<i>Oxyura jamaicensis</i>			F	
Cooper's Hawk	<i>Accipiter cooperii</i>		S		
Sharp-shinned Hawk	<i>Accipiter striatus</i>			F	
Golden Eagle	<i>Aquila chrysaetos</i>			F	
Red-tailed Hawk	<i>Buteo jamaicensis</i>		F	S	S,F
Rough-legged Hawk	<i>Buteo lagopus</i>				F
Northern Harrier	<i>Circus cyaneus</i>	S			F
Peregrine Falcon	<i>Falco peregrinus</i>	F	F		
American Kestrel	<i>Falco sparverius</i>	S,F	F	S,F	
California Quail	<i>Callipepla californica</i>			S	
Killdeer	<i>Charadrius vociferus</i>			F	
Black-bellied Plover	<i>Pluvialis squatarola</i>				F
Spotted Sandpiper	<i>Actitis macularia</i>			F	
Sanderling	<i>Calidris alba</i>			F	
Least Sandpiper	<i>Calidris minutilla</i>			F	
Mourning Dove	<i>Zenaidura macroura</i>	F		S,F	
Short-eared Owl	<i>Asio flammeus</i>	S,F			
Burrowing Owl	<i>Athene cunicularia</i>	F			F
Anna's Hummingbird	<i>Calypte anna</i>			F	F
Allen's Hummingbird	<i>Selasphorus sasin</i>			S,F	S,F
Northern Flicker	<i>Colaptes auratus</i>			F	
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>			S	
Black Phoebe	<i>Sayornis nigricans</i>		F	S,F	F
Say's Phoebe	<i>Sayornis saya</i>	F	F	F	F
Horned Lark	<i>Eremophila alpestris</i>	S,F		F	S,F
Cliff Swallow	<i>Hirundo pyrrhonota</i>	S			
Barn Swallow	<i>Hirundo rustica</i>		S	S	S
Common Raven	<i>Corvus corax</i>		S,F	S,F	S,F
Rock Wren	<i>Salpinctes obsoletus</i>	S,F	F	S,F	S,F
Bewick's Wren	<i>Thryomanes bewickii</i>		F	S,F	
House Wren	<i>Troglodytes aedon</i>		F	F	
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	S			
Ruby-crowned Kinglet	<i>Regulus calendula</i>	S		F	F
Hermit Thrush	<i>Catharus guttatus</i>			F	
Varied Thrush	<i>Ixoreus naevius</i>			F	
American Robin	<i>Turdus migratorius</i>			F	
Loggerhead Shrike	<i>Lanius ludovicianus</i>	F		S,F	
European Starling	<i>Sturnus vulgaris</i>	S			F

Common Name	Latin Name	SBI	EAI	SRI	SMI
Yellow-rumped Warbler	<i>Dendroica coronata</i>	S,F	S,F	S,F	F
Townsend's Warbler	<i>Dendroica townsendi</i>			F	
Orange-crowned Warbler	<i>Vermivora celata</i>	S	S,F	S,F	S,F
Dark-eyed Junco	<i>Junco hyemalis</i>	S		F	
Song Sparrow	<i>Melospiza melodia</i>			S,F	S,F
Savannah Sparrow	<i>Passerculus sandwichensis</i>	S,F	S,F		
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>	F	F	S,F	
Chipping Sparrow	<i>Spizella passerina</i>	F		S	
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>			S	S
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	S,F	S,F	S,F	S,F
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>		S,F		
Western Meadowlark	<i>Sturnella neglecta</i>	S,F	S,F	S,F	S,F
Lesser Goldfinch	<i>Carduelis psaltria</i>			S,F	
House Finch	<i>Carpodacus mexicanus</i>	F		S,F	S,F

Detection by Cue Type

Detection by cue type for both the spring and fall sampling periods is presented in Table 4. Ten species were detected in sufficient number during both spring and fall to permit comparison of cue type. Of those 10, four showed significant differences between spring and fall in the proportion of audio versus visual cues. Proportion of audio cues was greater in the spring for Bewick's Wren, Orange-crowned Warbler, Song Sparrow and Western Meadowlark, due to the importance of song and call during breeding. Seasonal differences in detectability can preclude between-season comparisons (Bibby et. al 1992).

Landbird Abundance

Landbird abundance data from spring and fall line transect surveys are presented in Tables 5 and 6, respectively. Abundance data from point counts are presented in Table 7.

Between-site or between-island comparisons are not possible with the raw data, because transect length is not standardized. Transect lengths vary from less than 1 km to greater than 6 km.

Although population trend analysis is not the purpose of this report, it is possible to make general comparisons of the 1994 data with data from 1993, the first year of landbird monitoring at Channel Islands National Park. Island and park totals for spring surveys in both years are presented in Table 8 for 5 relatively abundant breeding species. American Kestrels showed no change between years, Horned Lark observations decreased 37%, Orange-crowned Warbler observations increased 16%, Song Sparrows showed no change, and Western Meadowlark observations increased 16%.

Horned Lark observations decreased on all islands on all transects but one between 1993 and 1994. Western Meadowlark

observations increased on Santa Barbara and San Miguel and decreased slightly on East Anacapa. However, both of these species tend to flock, and some large flocks may have been missed by surveying each transect only once (M. Sogge, personal communication). Thus, changes in abundance estimates for these species may not reflect actual population changes.

Simple line transect counts may best reflect actual population levels for territorial, non-flocking species such as the Orange-crowned Warbler and Song Sparrow. Therefore, interannual comparisons may be more valid for these species. Orange-crowned Warbler observations decreased on Santa Barbara Island, showed no change on East Anacapa, and increased 63% on San Miguel, primarily on the Willow Canyon transect. Orange-crowned Warblers are migratory, and the Channel Islands subspecies (*Vermivora celata sordida*) disperses widely over mainland southern California during the winter (Sogge et al. 1994). Thus, its population may be affected more by habitat and environmental factors on wintering grounds than is the non-migratory San Miguel Island Song Sparrow (*Melospiza melodia micronyx*). If the landbird counts reflect actual densities, then the hazards of migration may account for the apparently greater fluctuation of Orange-crowned Warblers between years, and the relative stability of Song Sparrows.

It is currently not known whether the San Miguel Island population of Song Sparrows fluctuates markedly from year to year. Arcese et. al. (1992) found a small (<300 individuals) insular population of non-migratory Song Sparrows to vary annually 10-fold or more over a 19 year period.

However, the range of annual variation has not been established for the San Miguel Island Song Sparrow population, which is larger. The San Miguel population has been estimated at 980 to 1200 (Collins 1980), and recent density estimates (Sogge and van Riper 1988) suggest the island population to be more in the order of 7,000 to 15,000 individuals. The latter study found overall Song Sparrow densities in appropriate habitat on San Miguel to vary from 7.1 birds/ha in 1985 to 10.0 birds/ha in 1986.

A two-year dataset is inadequate to characterize population trend for Song Sparrows, or any other island species. Moreover, it is not known whether simple line transect counts accurately reflect actual landbird densities on the Channel Islands. Results from this monitoring program should be interpreted with caution until either the relationship with density is established, or at least until a power analysis has been performed on the data to determine resolution of the methods.

Table 4. Percent detection by cue type from landbird surveys, Channel Islands National Park, 1994.

Common Name	Spring				Fall			
	Total	C ¹	S	V	Total	C	S	V
American Kestrel	17	12	0	88	22	0	0	100
Allen's Hummingbird	36	61	0	39	11	64	0	36
Pacific-slope Flycatcher	23	74	4	22				
Black Phoebe	2	0	0	100	17	24	0	76
Horned Lark	121	34	26	40	316	51	0	49
Common Raven	7	29	0	71	27	11	0	89
Rock Wren	6	100	0	0	35	89	0	11
Bewick's Wren*	41	41	54	5	47	66	2	32
Ruby-crowned Kinglet	2	0	0	100	27	22	0	78
European Starling	18	94	0	6	91	0	0	100
Yellow-rumped Warbler	10	10	0	90	118	52	0	48
Orange-crowned Warbler*	100	47	28	25	28	43	0	57
Song Sparrow*	158	22	38	40	134	47	0	53
Savannah Sparrow	15	13	0	87	19	47	0	53
Rufous-sided Towhee	14	50	21	29	26	62	0	38
Chipping Sparrow	43	19	65	16	2	100	0	0
White-crowned Sparrow	49	14	0	86	28	32	0	68
Western Meadowlark*	173	19	49	32	184	17	1	82
House Finch	35	14	49	37	49	53	0	47

¹C = call, S = song, V = visual

* = significant difference between spring and fall for proportion of audio versus visual cues

Table 5. Line transect survey results from Channel Islands National Park, spring 1994. Values are number of birds detected within 100 m of transect midline.

Island Transect ¹	SBI	SBI	SBI	EAI	SMI	SMI	SMI	SMI	SMI
	CAN	SIG	ARC	TRL	WIL	SMH	LAK	HAR	NID
Date	3/16	3/17	3/18	4/13	4/27	4/28	4/28	4/29	4/29
Cooper's Hawk				1					
Red-tailed Hawk									1
Northern Harrier		1							
American Kestrel	5	4	1						
Short-eared Owl	4								
Allen's Hummingbird					19				
Horned Lark		17	9			29	58	8	
Cliff Swallow		4							
Barn Swallow				17	1				
Common Raven				2	1		1		
Rock Wren	1				2	1			
Blue-gray Gnatcatcher	4								
Ruby-crowned Kinglet	2								
European Starling	1		17						
Yellow-rumped Warbler	7			2					
Orange-crowned Warbler	11			15	35	7	7	1	9
Dark-eyed Junco	1								
Song Sparrow					63	28	28	16	9
Savannah Sparrow	1	13		1					
Golden-crowned Sparrow					5				
White-crowned Sparrow	34	5		6	1		2		
Brewer's Blackbird				1					
Western Meadowlark	35	44	27	5	4	12	30	1	
House Finch					15		17		3

¹CAN = Canyons, ARC = Arch Point, SIG = Signal Peak, TRL = Trails, WIL = Willow Canyon, SMH = San Miguel Hill, LAK = Dry Lakebed, HAR = Harris Point, NID = Nidever Canyon

Table 6. Line transect survey results from Channel Islands National Park, fall 1994.
 Values are number of birds detected within 100 m of transect midline.

Island Transect ¹ Date	SBI	SBI	SBI	SBI	EAI	SMI	SMI	SMI	SMI	SRI	SRI
	CAN	ELE	SIG	ARC	TRL	WIL	SMH	HAR	NID	EM1	EM2
	9/28	9/29	9/29	9/30	10/5	10/12	10/13	10/14	10/14	10/27	10/27
Double-crested Cormorant											1
American Wigeon											5
Green-winged Teal											2
Ruddy Duck										6	
Red-tailed Hawk					4		4		2		
Rough-legged Hawk						1					
Northern Harrier							1				
Peregrine Falcon			1	1	1						
American Kestrel	3	2	2	2	1						
Killdeer											2
Black-bellied Plover							140				
Spotted Sandpiper											1
Sanderling										1	
Least Sandpiper											11
Mourning Dove	1										10
Short-eared Owl	1										
Burrowing Owl			1			3					
Anna's Hummingbird						1					
Allen's Hummingbird						6			1		
Black Phoebe					1				1		1
Say's Phoebe	1		1		3	8	4	1	2	1	2
Horned Lark			25	60			12	53		104	
Common Raven					2	8	6	2	4		
Rock Wren	7			1	3	17	3		2		
Bewick's Wren					9						
House Wren					4						
Ruby-crowned Kinglet						2					
Loggerhead Shrike	1										
European Starling								91			
Yellow-rumped Warbler	2			2	62	2	22		1		1
Orange-crowned Warbler					2	5	1	3	4		
Song Sparrow						55	29	25	9		
Savannah Sparrow		10			9						
Rufous-sided Towhee	1				1						
Chipping Sparrow	1		1								
White-crowned Sparrow	1				16	3					1
Brewer's Blackbird					4						
Western Meadowlark	11	9	12	15	47	6	11	9		3	15
House Finch					9	25			5		

¹CAN = Canyons, ARC = Arch Point, SIG = Signal Peak, TRL = Trails, WIL = Willow Canyon, SMH = San Miguel Hill, LAK = Dry Lakebed, HAR = Harris Point, NID = Nidever Canyon, EM = Estuary/Marsh

Table 7. Landbird point count survey results, Channels Islands National Park, 1994. Values are numbers of birds detected within 50 m of point locations.

Island Transect ¹	SRI	SRI	SRI	SRI	SRI
	LOBO	TORR	LOBO	TORR	OAKS
No. of Stations	20	10	20	10	7
Date	4/16	4/17	10/26	10/27	10/28
Sharp-shinned Hawk					1
Red-tailed Hawk	1	1			
American Kestrel	7		4	1	3
California Quail	8				
Mourning Dove	2				
Anna's Hummingbird			1		
Allen's Hummingbird	7	9	4		
Pacific-slope Flycatcher	17	5			
Black Phoebe	2		8	1	1
Say's Phoebe			2		
Horned Lark			62		
Barn Swallow		3			
Common Raven	3		2	1	
Rock Wren	2		2		
Bewick's Wren	31	8	17	9	10
House Wren			3		
Ruby-crowned Kinglet			17	2	6
Hermit Thrush			1	3	1
Varied Thrush			1		1
American Robin					8
Loggerhead Shrike	2		2		
Yellow-rumped Warbler	1		1	13	12
Townsend's Warbler					1
Orange-crowned Warbler	21	1	11		2
Dark-eyed Junco			1		
Song Sparrow	14		14		1
Rufous-sided Towhee	14		10	8	2
Chipping Sparrow	21	18			
Golden-crowned Sparrow	1				
White-crowned Sparrow	1		7		
Western Meadowlark	3		38	1	
Lesser Goldfinch		1	4		
House Finch	9	8	9	1	

¹LOBO = Lobo Canyon, TORR = Torrey Pines, OAKS = Island Oaks

Table 8. Landbird totals by island, spring 1993 and 1994, Channel Islands National Park.

Species	Year	Island			Total
		SBI	EAI	SMI	
American Kestrel	1993	12	1	1	14
	1994	10	0	1	11
Horned Lark	1993	57	136	193	193
	1994	11	95	121	121
Orange-crowned Warbler	1993	21	16	36	73
	1994	11	15	59	85
Song Sparrow	1993			143	
	1994			144	
Western Meadowlark	1993	82	17	37	136
	1994	106	5	47	158

MANAGEMENT RECOMMENDATIONS

Implementation of the landbird monitoring program over the past two years has brought to light several problems regarding the program's design. First, the line transects are not of a standard length; therefore, between-transect and between-island comparisons cannot be made. Second, the transects cross many habitat types and are not linked to any measure of habitat, such as vegetation monitoring transects. As a result, landbird data cannot be grouped and compared by habitat type. Third, the simple count data generated by the program allow no estimate of error or variance. Moreover, the resolution of the methods is unknown. We currently do not know what level of population change can be detected by the methods. Last, although the line transect methods used in this program work well in low vegetation types, they are not currently

used in many other landbird monitoring programs, thus preventing comparison of Channel Islands data with that from other local and regional programs.

I therefore recommend that the Park consider gradually replacing line transects with point counts. The point count method has been adopted as a standard method for monitoring landbirds (Ralph et. al 1993), and point count data are amenable to statistical inference. This will allow the data to be stratified by habitat type, and data can be compared between habitat types and islands.

On the other hand, point count monitoring would necessitate walking off-trail, and it may not be possible to establish sufficient point count stations in each habitat type to adequately characterize bird abundance by habitat type (C. van Riper, personal communication). Time and budget permitting, it may be best to conduct both line transect and point count monitoring for several

seasons so that the two methods may be compared.

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