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Distribution of California Black Rails in the Sierra Nevada foothills

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ABSTRACT. California Black Rails *(Laterallus jamaicensis coturniculus)* have a disjunct and poorly understood distribution. After a new population was discovered in Yuba County in 1994, we conducted call playback surveys from 1994 to 2006 in the Sierra foothills and Sacramento Valley region to determine the distribution and residency of Black Rails, estimate densities, and obtain estimates of site occupancy and detection probability. We found Black Rails in 164 small, widely scattered marshes distributed along the lower western slopes of the Sierra Nevada foothills from just northeast of Chico (Butte County) to Rocklin (Placer County). Marshes were surrounded by unsuitable habitat, creating a patchy or metapopulation structure. We observed Black Rails nesting and found that they are year-round residents. Assuming perfect detectability, we estimated a mean density of 1.78 rails/ha. Assuming a detection probability of 0.5, this estimate increases to a mean density of 3.55 rails/ha. The probability of detecting occupancy with a single call playback survey at a marsh was high ($\bar{x} = 0.84$), and the estimated proportion of marshes occupied (across all years) was 0.58. Irrigation ditches were the primary water source for 75% of the marshes with Black Rails. Our results indicate that Black Rails are more widespread in the Sierra foothills than previously known, and the foothills distribution appears to be discontinuous with populations in the San Francisco Bay-Delta Estuary. Occupancy surveys may be an improved method for monitoring population trends of this secretive marsh bird where habitat patches are highly fragmented.

SINOPSIS. **Distribución de *Laterallus jamaicensis coturniculus* en el piedemonte de la Sierra Nevada**

El Ralido Negro Californiano *(Laterallus jamaicensis coturniculus)* tiene una distribución disjunta y poco conocida. Después de que una nueva población fue descubierta en el Condado de Yuba en 1994, nosotros realizamos censos usando playback desde 1994 hasta 2006 en el piedemonte de la Sierra y en la región del valle de Sacramento para determinar la distribución y residencia del Ralido Negro, estimar densidades y obtener estimativos de ocupación de sitios y probabilidades de detección. Encontramos Ralido Negro en 164 pequeños humedales altamente dispersos distribuidos a lo largo de las parte bajas de los flancos occidentales del piedemonte de la Sierra Nevada desde el noreste del Chico (Condado de Butte) hasta Rocklin (Condado de Placer). Los humedales estaban rodeados por hábitat inapropiado, creando así una estructura en parches o metapoblación. Observamos Ralido Negro anidado y encontramos que son residentes durante todo el año. Asumiendo una detectabilidad perfecta, nosotros estimamos una densidad promedio de 1.78 ralidos ha^{-1}. Si asumimos una probabilidad de detección de 0.5, este estimativo incrementa la densidad promedio a 3.55 ralidos ha^{-1}. La probabilidad de ocupación de un solo llamado de playback durante los censos en los humedales fue alta ($\bar{x} = 0.84$), y la proporción estimada de los humedales ocupados (a lo largo del año) fue 0.58. Los canales de irrigación fueron los principales proveedores de agua para el 75% de los humedales que contenían Ralido Negro. Nuestros resultados indican que el Ralido Negro están dispersas en el piedemonte de la Sierra Nevada más de lo que se conocida previamente y la distribución del piedemonte parece ser discontinua con poblaciones en el estuario del delta de la bahía de San Francisco. Los censos de ocupación puede ser un mejoramiento del método para montorear tendencias de poblaciones de esta ave enigmática de los humedales en donde la distribución de los parches del hábitat es altamente fragmentada.

Key words: avian metapopulation, Black Rail, freshwater marsh, Laterallus *jamaicensis coturniculus*, occupancy, Sierra foothills

California Black Rails (*Laterallus jamaicensis coturniculus;* hereafter "Black Rails") are rare and secretive marsh birds with a disjunct and poorly understood distribution. Through the mid 1940s, Black Rails were only thought to breed in coastal marshes of southern California in San Diego and San Bernadino counties (Stephens 1909, Huey 1916, Walker 1941,

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Grinnell and Miller 1944). Subsequent surveys confirmed the presence of breeding populations in the San Francisco Bay-Delta Estuary and occurrences in three outer coastal marshes (Manolis 1978, Evens et al. 1991). In 1969, Snider (1969) documented the first inland population along the lower Colorado River and Salton Trough. Black Rails have also been recorded in northern Baja California (Wilbur 1987, Erickson et al. 1992). In 1994, Aigner et al. (1995) discovered a Black Rail population in the Sierra Nevada foothills, extending the known breeding range 115 km north of the Sacramento-San Joaquin Delta. Prior to 1994, there was a single record in the Sacramento Valley region of a dead Black Rail found at Gray Lodge Wildlife Area (Baldridge and Chandik 1969). There have been several studies on the distribution and status of Black Rails in the San Francisco Bay-Delta Estuary and southern California and Arizona (Manolis 1978, Evens et al. 1991, Evens and Nur 2002, Conway and Sulzman 2007), but little is known about the distribution and abundance of Black Rails in the Sacramento Valley and Sierra foothills. Thus, our objectives were to determine the distribution and residency status of California Black Rails, estimate their densities, and obtain estimates of site occupancy and detection probability.

METHODS

We surveyed 411 marsh sites in 14 counties (Butte, Colusa, El Dorado, Glenn, Lake, Nevada, Placer, Sacramento, San Joaquin, Solano, Sutter, Tehama, Yolo, and Yuba) in the Sierra Nevada foothills and portions of the Sacramento Valley in California (Fig. 1). We delineated a core study area (Fig. 1) made up of 343 marsh sites in Butte, Nevada, and Yuba counties. We selected candidate marsh sites using U.S. Geological Survey topographic quad maps, aerial photographs, U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps, and encountered many sites opportunistically during field surveys. On NWI maps, we targeted palustrine emergent persistent wetlands and focused on two water regimes, semipermanently flooded and saturated/semipermanent/seasonal (Cowardin et al. 1979), which were the most consistent with previous descriptions of Black Rail habitat (Repking and Ohmart 1977, Flores and Eddleman 1995). We also surveyed additional palustrine emergent persistent wetland types that were less likely to provide habitat for rails, including temporarily flooded, saturated, seasonally flooded, seasonally flooded/saturated, intermittently exposed, and permanently flooded (Cowardin et al. 1979). We attempted to survey all potential sites identified in our core study area, but were sometimes unable to access marshes on private lands.

We conducted surveys for Black Rails from 1994 to 2006 in four phases: (1) broad-scale spring and summer occupancy surveys from 1994 to 1997 to determine distributional limits, (2) winter occupancy surveys from 1994 to 1999 in the core study area (Fig. 1) to determine year-round residency, (3) spring and winter surveys from 1998 to 1999 in the core study area to estimate density, and (4) repeated summer occupancy surveys from 2002 to 2006 in the core study area to estimate the probability of detecting occupancy and the proportion of occupied sites. From 1994 to 1997, we conducted broad-scale occupancy surveys using call-playback surveys (Evens et al. 1991, Legare et al. 1999, Spear et al. 1999, Conway et al. 2004). We conducted most surveys from 1 March 1997 to 5 November 1997. For occupancy surveys, we visited marshes in the 2-h intervals after civil sunrise and prior to civil sunset. We selected an initial station in suitable rail habitat and commenced the playback sequence, consisting of the *"kic-kic-kerr"* (hereafter *kkk*) and *"grr"* vocalizations of California Black Rails (Eddleman et al. 1994) played on portable recorders (Model TCS-580V; Sony, Tokyo, Japan) amplified through a small speaker (Mini-Amplifier-Speaker, Cat. No. 277–1008C, RadioShack, Ft. Worth, Texas), and broadcast at 81–85 dB measured at 1 m from the speaker. The playback sequence consisted of 2 min of silent listening, two sets of *kkk* calls lasting 30 s each followed by 30 s of listening between sets, two sets of *grr* calls lasting 30 s each followed by 30 s of listening between sets, and 2 min of silent listening. This protocol is similar to that used for other playback surveys of Black Rails (Repking and Ohmart 1977, Flores and Eddleman 1995, Legare et al. 1999). If we did not detect a Black Rail at the first station, we walked 40–50 m further into suitable habitat and repeated the playback sequence. Occupancy surveys ended at a site either when we detected one or more rails, or when we had surveyed the entire marsh. We

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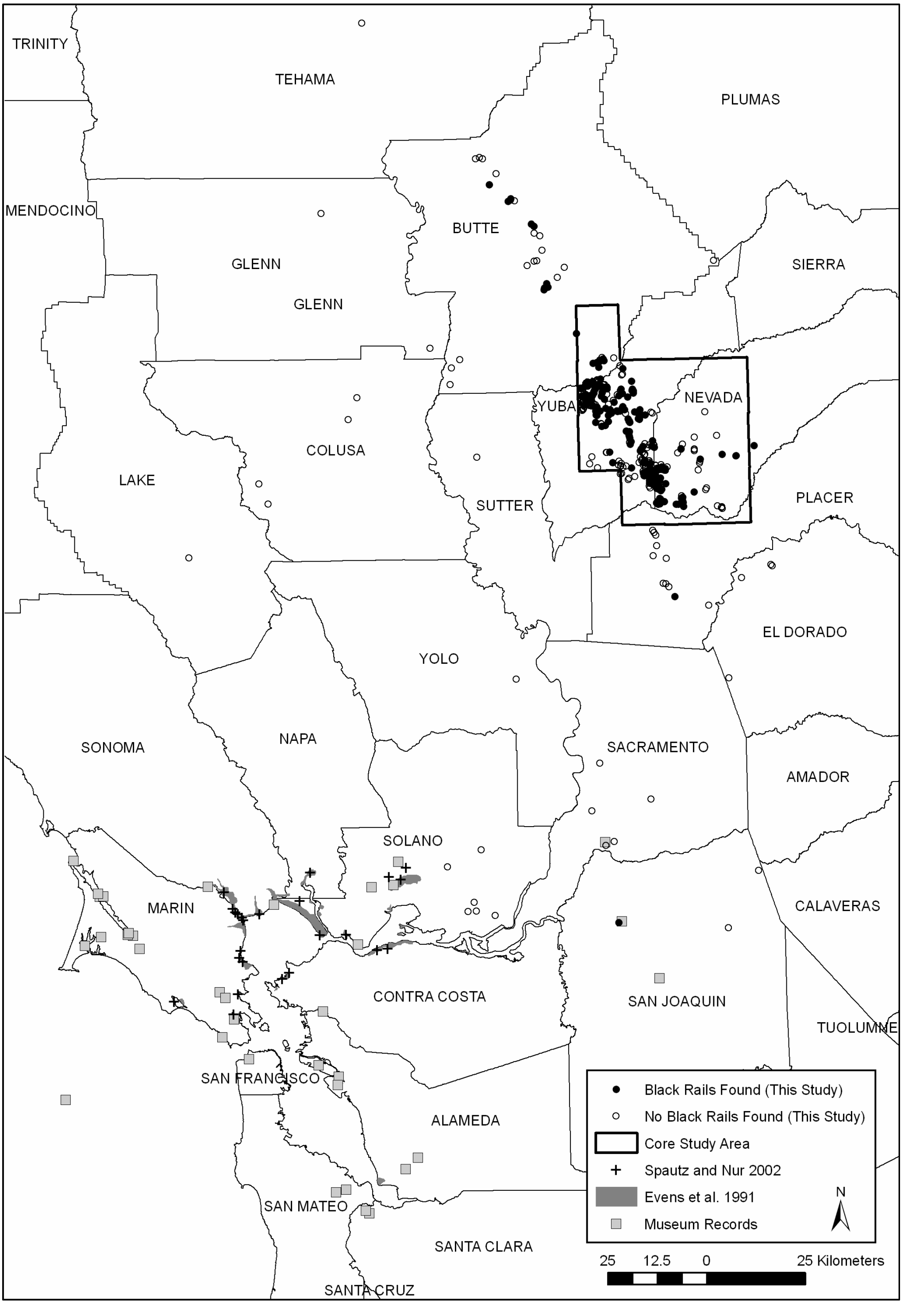

Fig. 1. Occurrence records for California Black Rails from summer surveys conducted 1994–2006 (this study) and records obtained from museums, Evens et al. (1991), and Spautz and Nur (2002).

did not conduct surveys during periods of rain or when wind speed exceeded 25 km/h.

From 1 November to 28 February 1994–1999, we conducted occupancy surveys to determine winter residency at between 5 and 42 marshes in the core study area (Fig. 1) where Black Rails had been detected during the preceding spring or summer. We conducted occupancy surveys using call playback as described above.

We used call-playback surveys to estimate Black Rail density at 38 marshes in the core study area in the early spring (1 April–11 May) and late spring/summer (13 May–31 July) of 1998, and at a subset of 32 marshes in the winter (1 December–15 January) of 1998–1999. We calculated Black Rail density as the total number of birds, N, divided by the area surveyed, A. Because the total number of birds in an area is unknown, we estimated it using a fixed-radius circular plot method similar to that of Evens and Nur (2002). In each marsh we randomly located between 2 and 12, 30-m radius circular plots, separated by at least 100 m. We determined the number of plots by marsh size. We played Black Rail vocalizations at the center of each plot using an identical procedure to the occupancy surveys, except that the initial silent listening period was 1.5 min instead of 2 min. We recorded the total number of Black Rails responding within 30 m of the observer at each plot, and considered all calls originating from one compass direction to be a single bird unless we heard two calls simultaneously. We considered calls from different compass directions ($>30^\circ$ apart) and separated by at least 20 m to be different birds.

In the absence of data on the probability of detecting individual birds (p_i), we estimated abundance at each plot under two different assumptions: (1) $p_i = 1$ (complete detectability), thus yielding a lower-bound estimate of abundance, and (2) $p_i = 0.5$ based on findings by Legare (1999). In response to playback, Black Rails often move before vocalizing (Legare et al. 1999) so the true survey area is unknown. Evens and Nur (2002) added a correction of 6.2 m to the radius of their circular plots, increasing the effective survey area to 0.412 ha, to account for birds moving toward the playback source. Legare et al. (1999) found comparable movement distances for Eastern Black Rails *(Laterallus jamaicensis jamaicensis)*, with males moving an average of 9.5 ± 1.3 m toward the playback source before vocalizing, and females an average of 4.9 ± 1.3 m. We only counted responses within 30 m of the observer and added a correction of 7 m to the radius of the circular plots, roughly equal to the average movement distances noted by Legare et al. (1999), increasing the effective survey area to 0.43 ha per plot. Because some of our marsh sites were narrow and linear, we adjusted the effective plot areas to exclude non-Black Rail habitat. We divided the number of Black Rails detected within 30 m at all plots in a marsh *(n)* by the total effective area surveyed *(a)* to calculate the number of Black Rails per hectare. For calculations that incorporated detection probability, the density index was calculated as $n(1/p_i)/a$.

From 2002 to 2006, we conducted repeated summer occupancy surveys and rapid habitat assessments at marshes in the core study area. We visited each marsh up to five times in 2002 and up to three times from 2003 to 2006 using a removal design (MacKenzie et al. 2006) where, in each year, we did not revisit a site after we detected Black Rails. We conducted call playback surveys for Black Rails (as described above) from 30 min before civil sunrise until 210 min after civil sunrise and from 180 min before civil sunset until 30 min after civil sunset from 1 June to 31 August. Before collecting habitat data, we defined the boundary of each marsh using a multiparameter method described in the U.S. Army Corps of Engineers' Wetlands Delineation Manual (Environmental Laboratory 1987). At each site, we recorded the water sources, categorized each wetland using a hydrogeomorphic classification system (Brinson and Malvarez 2002), and identified dominant plant species. Water source categories included groundwater discharge (springs) and surface or near-surface inflows (deliberate irrigation, irrigation leaks, or streams). The geomorphic setting categories were depression, fluvial, fringe, and slope (Brinson and Malvarez 2002).

We obtained information on marsh area, elevation, and slope using a Geographical Information System (GIS) consisting of a polygon layer of wetland sites, aerial photographs, Ikonos satellite imagery, and 10-m resolution digital elevation models (DEMs) from the U.S. Geological Survey. We mapped marsh boundaries by walking the perimeter of each wetland using a backpack Trimble GPS unit capable of determining three-dimensional positions with 0.5 m accuracy. We excluded large areas of open water and areas with nonemergent vegetation from marsh areas using ESRI's ArcGIS program. We obtained elevation and slope values from DEMs. We calculated marsh fractal dimension, an index of shape complexity, using the algorithm from McGarigal et al. (2002).

We obtained georeferenced museum records of Black Rails from the Museum of Vertebrate Zoology at the University of California at Berkeley, the California Academy of Sciences, and The Field Museum of Chicago. On 8 October 2007, we accessed additional locality records through the ORNIS data portal (http://ornisnet.org) at the Canadian Museum of Nature in Ottawa and the Museum of Zoology at the University of Michigan. Several institutions had Black Rail specimens that were not georeferenced when we accessed ORNIS, including the American Museum of Natural History, Delaware Museum of Natural History, Smithsonian National Museum of Natural History, Western Foundation of Vertebrate Zoology, and the United States National Museum. We did not include these records.

We ran single-species, single-season occupancy models in Program PRESENCE (ver. 2.0; Hines 2006) to estimate the probability of detecting occupancy and the proportion of occupied sites using the presence-absence data collected during the summer (June–August) in 2002–2006. Following the occupancy modeling approach outlined by MacKenzie et al. (2006), we estimated the probability of detecting at least one Black Rail during a single survey (the survey-specific probability of detecting occupancy, p) and the proportion of marshes occupied by at least one Black Rail (Ψ). We calculated model parameters in Program PRESENCE using maximum likelihood estimation. This approach assumes that sites were closed to emigration and immigration during the survey season. We considered this assumption to be valid during the breeding season (roughly March–July; Eddleman et al. 1994), but it may be violated by some unknown level of adult or natal postbreeding dispersal, particularly in August. We calculated the probability of detecting occupancy at a site after x replicate surveys (p^*) as $(1-(1-p)^x)$. We used a Kruskal-Wallis (H) test to compare mean densities among early spring, late spring/summer and winter periods in Systat 11 (Systat Software Inc. 2004). Unless otherwise specified, values are presented as means ± SE.

RESULTS

Distribution, residency, and density. We found Black Rails at 164 of 410 marshes (40%) along the lower western slopes of the Sierra Nevada foothills (Fig. 1), including 103 marshes in Yuba County, 38 in Nevada County, 21 in Butte County, 1 in Placer County, and 1 in San Joaquin County. We found Black Rails at 19 marshes on the eastern edge of the Sacramento Valley floor and, except for one detection in San Joaquin County, the rest were in the Sierra foothills. We found no Black Rails in Colusa, El Dorado, Glenn, Lake, Sacramento, Solano, Sutter, Tehama, or Yolo counties.

Black Rails appeared to be year-round residents in the Sierra foothills. During winter surveys, we detected rails at 83% of marshes that had been occupied during the preceding spring or summer (Table 1). We found a nest with five nestlings on 18 May 1998, and observed a chick-sized Black Rail vocalizing with a nearby adult on 20 May 1999.

We detected an average of 0.55 Black Rails per plot (Table 2). Black Rail density averaged 1.78 rails/ha under the assumption of complete detectability, and 3.55 rails/ha assuming an individual detection probability of 0.5 (Table 2). Density did not differ among early spring, late spring/summer, and winter surveys ($H_2 = 0.41$, $P = 0.81$).

Table 1. Winter (1 November–28 February) occupancy of sites that had been occupied by Black Rails during the preceding spring or summer[a].

	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999
Marshes surveyed *(N)*	5	12	7	12	42
Marshes with California Black Rails	5	11	7	9	33
Naïve proportion of marshes occupied	1.0	0.92	1.0	0.75	0.75

[a]The naïve estimate does not account for an imperfect probability of detection.

Table 2. Estimates (means ± SE) of Black Rail densities based on playback surveys conducted in 1998–1999.

Season	Marshes surveyed	Number of plots	Rails/plot	Rails/ha ($p_i = 1$)[a]	Rails/ha ($p_i = 0.5$)[b]
Early spring	38	183	0.57 ± 0.08	1.84 ± 0.25	3.68 ± 0.50
Late spring/summer	38	183	0.54 ± 0.09	1.81 ± 0.30	3.61 ± 0.60
Winter	32	154	0.55 ± 0.08	1.67 ± 0.20	3.35 ± 0.41

[a]Density estimates were calculated from the total number of rails detected at each site divided by the effective survey area. Only rail detections within 30 m of each plot center were counted. The effective survey radius was adjusted to 37 m (max. 0.43 ha per plot) to account for the movement of rails toward the playback source. The effective survey area at each plot was further adjusted to exclude nonrail habitat. The detection probability (p_i) for an individual rail was assumed to be 1.
[b]Same as above, except the detection probability (p_i) for an individual rail was assumed to be 0.5.

Detection probability and occupancy. The estimated survey-specific probability of detecting occupancy ranged from 0.78 to 0.89 from 2002 to 2006 (Table 3), and the average probability of detecting occupancy at a site after multiple visits (3 or 5) was 0.99. Given such a high probability of detecting occupancy, it is no surprise that the average naïve proportion of marshes occupied (0.57) was nearly identical to the estimated proportion of marshes occupied (across all years) corrected for imperfect detection (0.58).

Attributes of marshes with Black Rails. Marshes with Black Rails were typically small, gently sloped sites ($\bar{x} = 3.63 \pm 0.18$ degrees) at elevations between 33 and 790 m asl ($\bar{x} = 156 \pm 10$ m asl; Fig. 3). Occupied sites averaged 1.31 ± 0.16 ha (range = 0.07–13.99 ha), with a median marsh area of 0.67 ha. Most sites had simple perimeters with fractal dimensions averaging 1.21 ± 0.01. Approximately two-thirds of the marshes with Black Rails were on private land and one-third on public land (Fig. 2).

Irrigation water was the most common water source for marshes with Black Rails. Intentional irrigation water inputs were the primary water source for 63% of marshes and 12% were fed primarily by irrigation water from unintentional ditch leaks. Other water sources included natural springs (21%) and streams (3%). Slope (49%) was the most common geomorphic setting of marshes with Black Rails, followed by fluvial (21%), depression (20%), and fringe (10%). Marshes were densely vegetated and dominated by a wide range of emergent plant species, including *Typha latifolia, T. domingensis, Juncus effusus, J. balticus*, *Scirpus acutus, Paspalum dilatatum, Epilobium ciliatum, Leersia oryzoides,* and *Eleocharis macrostachya.*

DISCUSSION

Distribution, residency, and density. Black Rails in the Sierra foothills and Sacramento Valley formed an apparently disjunct distribution from the nearest populations in the Sacramento-San Joaquin Delta and comprised a resident, breeding population. This is consistent with the view that California Black Rails are nonmigratory (Eddleman et al. 1994). We rarely found Black Rails in marshes >350 m asl,

Table 3. Results of Black Rail occupancy surveys conducted over five summers (1 June–31 August 2002–2006) in Butte, Nevada, and Yuba counties, California[a].

	2002	2003	2004	2005	2006	All years (95% CI)
Maximum number of visits to each marsh *(x)*	5	3	3	3	3	n/a
Marshes surveyed	109	126	131	169	195	209
Marshes with rails	69	70	69	90	115	147
Survey-specific prob. of detecting occupancy *(p)*	0.78	0.87	0.89	0.85	0.82	0.84 (0.80, 0.87)
Prob. of detecting occupancy after *x* visits (p^*)	0.99	0.99	0.99	0.99	0.99	0.99
Naïve proportion of marshes occupied	0.63	0.56	0.53	0.53	0.59	0.57 (0.53, 0.61)
Estimated proportion of marshes occupied	0.66	0.56	0.53	0.54	0.59	0.58 (0.53, 0.63)

[a]The naïve estimate does not account for an imperfect probability of detection.

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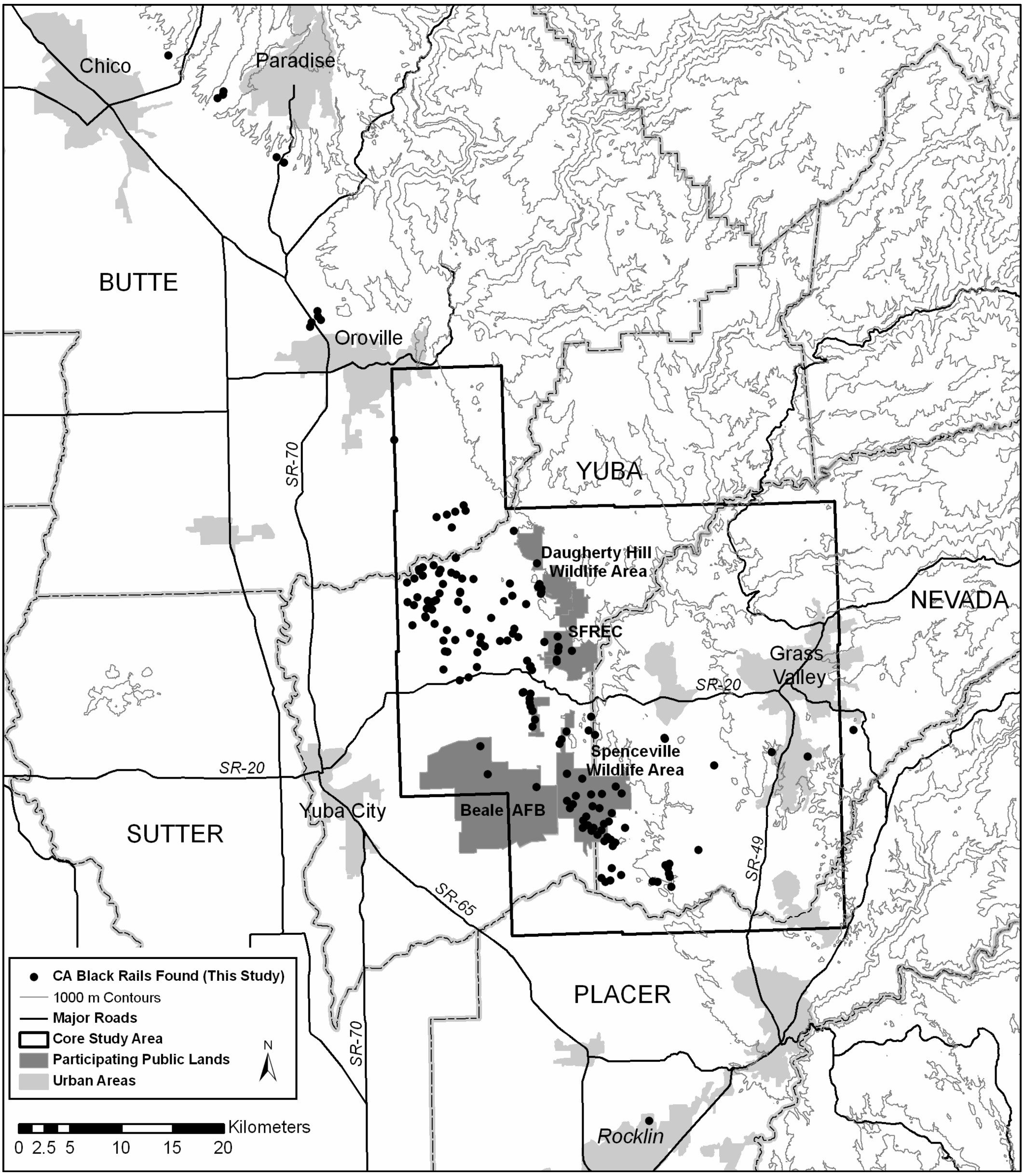

Fig. 2. California Black Rail occurrence records in the Sierra Nevada foothills, 1994–2006.

probably due to freezing winter temperatures above this elevation. We located Black Rails in 19 marshes on the eastern edge of the Sacramento Valley, but none in marshes in interior areas of the Valley floor.

Black Rails in the Sierra foothills may be recent colonists, a long-established disjunct population, or a relict population from a once continuous distribution that may have linked extensive freshwater marshes in the Sacramento Valley to the Sacramento-San Joaquin Delta. The Central Valley lost an estimated 1.4 million hectares (~86.4%) of wetlands from the 1850s to the mid 1980s due to the diking and draining of marshes for conversion to agriculture (Frayers et al. 1989, Hundley 1992). Much of

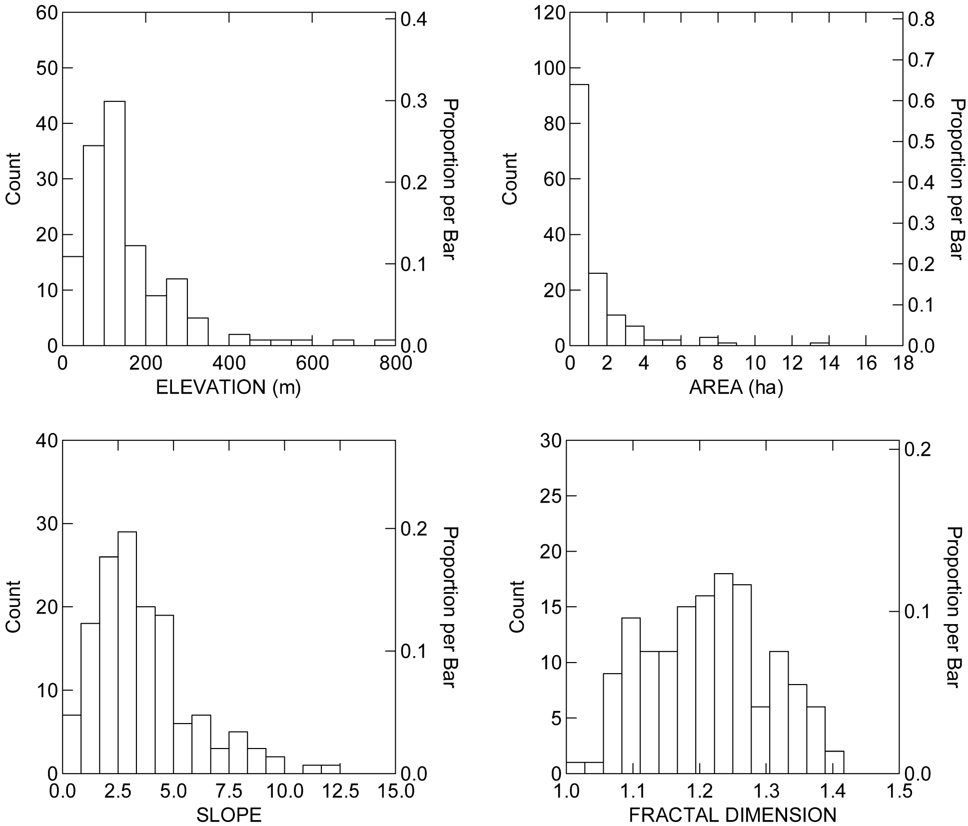

Fig. 3. Histograms of elevation, area, slope, and fractal dimension for marshes occupied by Black Rails from 2002–2006 ($N = 147$).

the 152,970 ha of wetlands that remain are managed for rice or waterfowl habitat (Frayers et al. 1989) that require water level fluctuations and disturbance of vegetation (Cross and Vohs 1988, Hill et al. 1992) and make them less suitable for Black Rails. In contrast, the Sierra foothills now have more wetland habitat than was present naturally due to construction of irrigation canals (Hundley 1992) that supply water to marshes via intentional watering, unintentional runoff from irrigated pastures, or leaks.

The main challenges in estimating Black Rail density are accounting for individual detection probability that may vary with sex, breeding status, time of day, weather, season, and distance from playback source (Legare et al. 1999, Spear et al. 1999, Conway et al. 2004), and determining the effective area surveyed. Evens and Nur (2002) used the program DISTANCE (Buckland et al. 1993) to estimate individual detection probability and density using fixed-radius plot surveys. However, Black Rails violate two important assumptions of the distance sampling approach: (1) rails move toward a playback source prior to responding vocally (Legare et al. 1999) and so are not detected at their initial location, and (2) distance estimates are imprecise because they are estimated from auditory cues. For these reasons, we did not use the distance sampling approach for estimating the density of Black Rails. Detections of rails within a fixed radius from a playback source can be compared between sites as an index of relative abundance, but estimates of absolute density derived from playback surveys should be interpreted with caution.

Regardless of the estimation approach used, the number of rails in the Sierra foothills is likely smaller than the San Francisco Bay population. Based on the product of the lower-bound density estimate (1.78 rails/ha) and the total area of the marshes that we mapped (413 ha), the population size would be 734 Black Rails (95% CI: 613, 856) in the core study area. Based on the product of the density estimate with an assumed individual detection probability of 0.5 (3.55 rails/ha) and the total area of mapped marshes, the population size would be 1466 Black Rails (95% CI: 1226, 1711) in the core study area. The total potential Black Rail habitat in the Sierra foothills is unknown, but the generally small size and scattered distribution of marsh habitats in the Sierra foothills suggests that the bulk of the California Black Rail population is likely confined to the much larger, continuous tidal marshes in the San Francisco Bay estuary, where previous investigators have estimated the population to be between 8173 and 14,589 rails (Evens et al. 1991, Evens and Nur 2002).

Detection probability and occupancy. We found that playback surveys were effective for determining site occupancy. Determining site occupancy required less effort than estimating density because we could end surveys after the first detection. The overall proportion of occupied sites varied little among years, suggesting a stable population from 2002 to 2006. However, turnover was common each year, as some sites went locally extinct and others were colonized (unpubl. data). This suggests that Black Rails occur as a metapopulation in the Sierra foothills. We observed several cases of rapid colonization within 1 yr of marsh creation, suggesting that habitat restoration may be a viable option for conserving Black Rails in the foothills. Given the increased effort required and inherent difficulties in estimating rail density, occupancy surveys may be a preferred option for monitoring rail population trends in places with highly fragmented habitat patches, as in our study area.

Attributes of marshes with Black Rails. Marshes that support Black Rails in the Sierra foothills are distributed in a large number of relatively small, discrete patches separated by unsuitable habitat. Irrigation water was the most common water source for marshes with Black Rails, and irrigation practices will likely play an important role in determining the extent and quality of Black Rail habitat available in the Sierra foothills in the future. In southern California, the All-American and Coachella canals provide water to seep marshes that support Black Rails (Evens et al. 1991, Hinojosa-Huerta et al. 2002, Conway and Sulzman 2007). Sections of the Coachella Canal south of Niland were lined to reduce water loss, resulting in loss of wetland habitat that had previously supported Black Rails (Evens et al. 1991). Water agencies in the Sierra foothills face similar pressures to improve the efficiency of delivery systems, and such improvements could lead to the loss of wetland acreage or degradation of existing Black Rail habitat.

Conclusions. Black Rails have a wider distribution in the Sierra foothills than previously known. Black Rails were found throughout small wetlands in the foothills of Yuba, Nevada, and Butte counties, but not in the central floor of the Sacramento Valley. We suggest that occupancy surveys may be a suitable method for monitoring population trends of these rails over large spatial scales, particularly where habitat patches are highly fragmented as in the Sierra foothills. Continued research is needed to characterize the full extent of the distribution, determine the relationship of the foothills population to the nearest populations in the Delta, and identify the environmental factors that drive occupancy and turnover dynamics of this rare marsh bird.

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