California Black Rail (*Laterallus jamaicensis coturniculus*) Distribution and Abundance in Relation to Habitat and Landscape Features in the San Francisco Bay Estuary[1]

Hildie Spautz,[2,3] Nadav Nur,[2] and Diana Stralberg[2]

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Introduction

The majority of California Black Rails (*Laterallus jamaicensis coturniculus*; >90 percent) are found in the tidal salt marshes of the northern San Francisco Bay region, primarily in San Pablo and Suisun Bays (Manolis 1978, Evens et al. 1991). Smaller populations occur in San Francisco Bay, the Outer Coast of Marin County, freshwater marshes in the foothills of the Sierra Nevada, and in the Colorado River Area (Trulio and Evens 2000). Loss of more than 80 percent of historic tidal marsh habitat, as well as habitat fragmentation and degradation have directly and indirectly impacted this and other tidal marsh breeding species (Goals Project 1999). Although there are few historic records of Black Rail presence and abundance in the Bay, recent survey efforts indicate that the species is absent from some marshes in the northern Bay region and that population sizes may be low enough to cause concern (Evens et al. 1991, Nur et al. 1997, Evens and Nur 2002). Due to its small population sizes, the California Black Rail has been listed as a State of California Threatened Species and a Federal Species of Management Concern.

We conducted standardized tape-playback surveys for California Black Rails at 31 tidal salt marshes in San Pablo Bay, Suisun Bay, northern San Francisco Bay and western Marin County, California (*fig. 1*) in 2001 with the aims of: 1) providing the best current information on distribution and abundance of Black Rails; 2) estimating the current population size; 3) comparing our survey results with results of surveys conducted in 1996 and earlier; and 4) identifying vegetation, habitat, and landscape features associated with the presence of Black Rails.

Methods

Dawn surveys were conducted during the breeding season in April and May 2001. Methods followed a standardized tape call-back/response protocol (Evens et al. 1991, Nur et al. 1997). The protocol involved listening passively for 1 minute after arriving at the listening station, then broadcasting tape-recorded Black Rail vocalizations: 1 minute of "grr" calls followed by 0.5 minutes of "ki-ki-krr" calls. The surveyor then listened for another 3.5 minutes for a total of 6 minutes per listening station. We calculated an abundance index for rails at each marsh by dividing the number of rails detected within 50 m of the observer by the sum of the area of marsh within 50 m at each of the points surveyed. We calculated absolute abundance at each site using DISTANCE 3.5 software (Buckland et al. 1993, Thomas et al. 1998). For statistical analysis of predictors of rail presence, we determined presence or absence of rails within 50 m of each survey point.

To examine the effects of local scale habitat characteristics on Black Rails, we collected information on vegetation cover and habitat structure within 50 m of each survey point. Variables included distance to nearest tidal channel and the channel's width; percent cover of channel, open ground and vegetation, and the proportion contributed by each plant species; and at a sample of points within 10 m of the survey point, vegetation height and number of stems at 10 cm intervals from the ground (Nur et al. 1997).

To examine the effects on Black Rails of habitat fragmentation, patch size and patch isolation, we examined the following landscape level variables: marsh size, marsh core area (area > 50 m from marsh edge), perimeter to area ratio, fractal dimension (scale-independent measure of perimeter to area ratio), proportion of marsh area within 250 m, 500 m, 1000 m and 2000 m of survey point; proportion of urban area within these same radii; distance to nearest 25 ha, 50 ha and 100 ha marsh; and distance to nearest marsh edge, upland edge and urban area. We recorded UTM coordinates at each point in the field, using a global positioning unit. We used ArcView GIS 3.2a and extensions (ESRI 2000a),

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[2]PRBO Conservation Science, 4990 Shoreline Highway, Stinson Beach, CA 94970.
[3]Corresponding author: E-mail: hspautz@prbo.org.

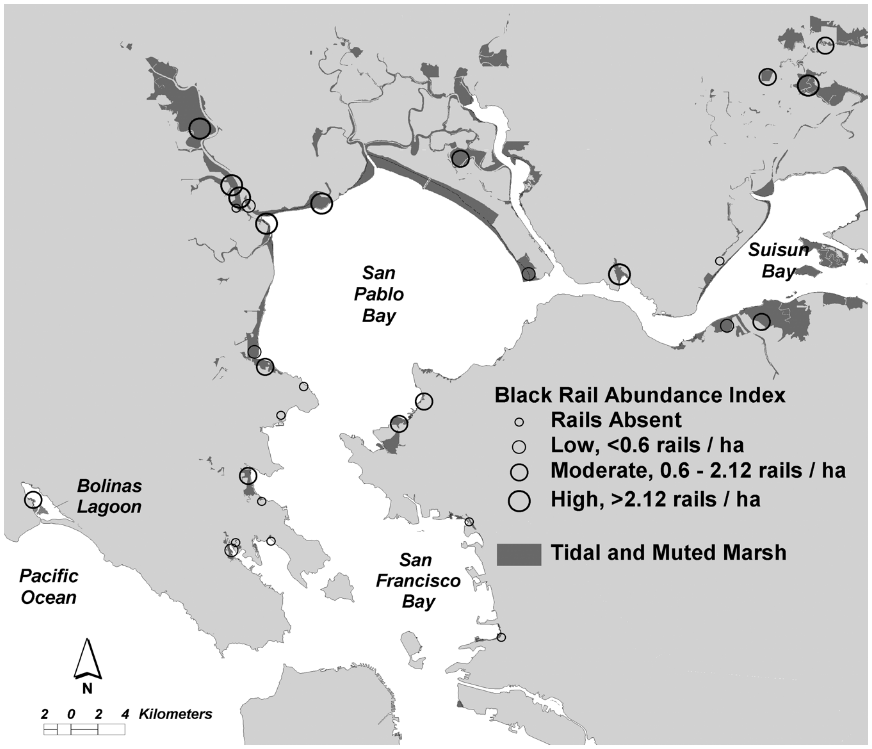

Figure 1— California Black Rail survey sites and abundance indices, 2001.

Spatial Analyst (ESRI 2000b) and Patch Analyst (Rempel 2000) to derive a set of landscape parameters characterizing that point. GIS data for San Francisco Bay habitats were obtained from the San Francisco Estuary Institute's (SFEI) EcoAtlas GIS (version 1.50b4). GIS data for Tomales Bay and Bolinas Lagoon habitats were obtained from the Point Reyes National Seashore. For surrounding uplands, we derived a composite landuse layer for the San Francisco Bay area consisting of the most recent 1:24000 landuse maps from the California Department of Water Resources (1994, 1995, 1999), where available, and 1: 24000 landuse maps from the USGS Mid-continent Ecological Science Center (1996) elsewhere.

We looked for habitat and landscape-level predictors of Black Rail presence using logistic regression (Hosmer and Lemeshow 1989) pooling all survey points across all marshes. We developed separate multi-variable models considering only local habitat variables (vegetation composition and structure) and only landscape level variables, as well as a combined model. In developing each model, we started with all variables showing a correlation of at least 0.80 with rail presence/ absence, and worked in a backwards step-wise fashion, removing variables with significance of $P > 0.05$. All variables retained in the final models had a significance of $P < 0.05$.

Results

Of the ten marshes previously surveyed, abundance indices were lower at nine marshes in 2001 than in 1996 and earlier surveys, and higher in one marsh. Of 21 marshes surveyed for the first time, Black Rails were detected at only nine sites. The absolute density averaged 2.63 (±1.05 se) birds/ha in San Pablo Bay and 3.44 birds/ha (±0.73 se) in Suisun Bay. We estimated that San Pablo Bay had 15,000 Black Rails (range 11,000–19,000 birds, based on the 90 percent confidence interval of mean abundance), the highest Black Rail population in the Bay region in 2001. We estimated there were 12,000 Black Rails in Suisun Bay region (range 6,700 to 17,200) and 280 Black Rails in the outer coast marshes (range 2–606 birds).

At the habitat level, with all variables considered simultaneously, Black Rail detections were positively associated with the density of vegetation below 10 cm in height and with the proportion of pickleweed (*Salicornia virginica*), rushes (*Juncus* spp.), gumplant (*Grindelia stricta*), peppergrass (*Lepidium latifolium*), alkali bulrush (*Scirpus maritimus*) and cattails (*Typha* spp.) within 50 m of each survey point; there was a negative relationship to average vegetation height (*table 1*). At the landscape level, again with all variables considered simultaneously, Black Rail presence was positively related to the amount of marsh in the surrounding 250 m and the size of the core area of the

Table 1-- *Local habitat and landscape level variables associated with California Black Rail presence: logistic regression models.*

Significant local habitat variables[1]	Sign[3]	Significant landscape level variables[2]	Sign[3]
% Cover gumplant (*Grindelia stricta*)	+	Distance to bay or large channel	-
% Cover rush (*Juncus* spp.)	+	Distance to nearest large (100 ha) marsh	-
% Cover peppergrass (*Lepidium latifolium*)	+	Marsh core area (area > 50 m from marsh edge)	+
% Cover pickleweed (*Salicornia virginica*)	+	Marsh peripheral area (total area – core)	-
% Cover alkali bulrush (*Scirpus maritimus*)	+	Area of marsh within 250 m	+
% Cover cattails (*Typha* spp.)	+		
Number of stems under 10 cm (vegetation density)	+		
Vegetation maximum height	-		

[1]All local habitat variables considered simultaneously. Model statistics: Pseudo $R^2 = 0.165$, Log-likelihood ratio statistic = 36.43, df = 8, $P < 0.0001$.
[2]All landscape level variables considered simultaneously. Model statistics: Pseudo $R^2 = 0.067$, Log-likelihood ratio statistic = 16.97, df = 5, $P = 0.0046$.
[3]Sign of logistic regression coefficient.

marsh (interior area of a marsh more than 50 m from a marsh edge); and negatively to the distance to the nearest large (100 ha) marsh and distance to water (*table 1*). When all habitat level and landscape level variables were considered simultaneously in a multi-scale combined model, only the local variables were significant. Thus, Black Rails responded both to local vegetation characteristics and to broader landscape features, but presence or absence at the local scale was better predicted by vegetation characteristics than by landscape characteristics. Our data indicate that Black Rails prefer marshes that are close to water (bay or river), large, away from urban areas, and saline to brackish with a high proportion of *Salicornia*, *Grindelia*, *Scirpus maritimus*, *Juncus*, and *Typha*.

Land managers seeking to acquire existing tidal marsh habitat, or to improve or restore habitat for Black Rails should consider that: (1) large marshes in areas with lower levels of urban development are more likely to benefit Black Rail populations than smaller marsh fragments in urban areas; and (2) management practices that promote dense vegetation, especially that of *Salicornia*, *Grindelia*, and *Scirpus maritimus*, or, in more brackish areas, *Juncus* and *Typha*, should be encouraged.

We recommend nest monitoring of Black Rails in order to better estimate nesting success and the factors that influence it. In particular, information is required to establish whether the marsh habitat preferred by Black Rails is one that promotes successful reproduction and survival.

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