

# Observer

*Vulnerable songbirds breeding  
in remnant tidal marsh habitat are  
the focus of multifaceted PRBO research  
—and of this special Observer issue.*

▼ *Insights into the health of a threatened ecosystem*

## Tidal Marsh Song Sparrows of San Francisco Bay

### Introduction

*Nadav Nur, PhD*

San Francisco Bay is the largest estuary on the Pacific coast of the United States. Its wetlands provide crucial habitat for a wide range of species. Millions of shorebirds and waterfowl use the estuary and adjacent baylands, either as wintering grounds or as “refueling” areas during fall and spring migrations up and down the Pacific Flyway. In addition, many bird species and other wildlife inhabit San Francisco Bay wetlands *year-round*. A lack of alternative habitats makes them vulnerable, especially the species that depend upon tidal marshes fringing the estuary.

Salt-water marshes—subject to tidal action, marked by extensive networks of sloughs and channels, and characterized by salt-tolerant plants such as pickleweed and gumplant—represent a vital ecosystem. Among their ecological functions, marshes enhance the Bay’s water quality by filtering toxic compounds out of the runoff from surrounding uplands.

In the early nineteenth century, tidal marsh was the dominant habitat type in San Francisco Bay. Its historic acreage has been reduced by about 85%, due to development as well as diking for agriculture and salt evaporation ponds. Even what remains of this habitat today has been severely altered and degraded.

Much of it consists of small remnant habitat patches in a sea of diked or developed baylands. It is often abutted by freeways and shopping centers and sometimes criss-crossed by manmade ditches and power lines.

A number of distinctive organisms have evolved to take advantage of this productive habitat and are *restricted* to it. In San Francisco Bay, these include birds—California Clapper Rail, California Black Rail, Alameda Song Sparrow, San Pablo Song Sparrow, Suisun Song Sparrow, and Saltmarsh Yellowthroat; plants, such as Suisun thistle and soft bird’s-beak; and other wildlife, such as the salt-marsh harvest mouse and San Francisco garter snake.

The effect of extensive habitat loss and degradation has been to put these populations at risk. As a consequence, management agencies and the scientific community have placed a premium on developing programs to conserve remaining populations and restore depleted species, through maintaining and restoring tidal marsh habitat.

Against this backdrop, prbo’s Tidal Marsh Bird Project began in 1996. Its aims are: to provide management agencies with critical information about the status of tidal marsh-dependent species; to guide recovery efforts for these populations; and to establish a



Alameda Song Sparrow

scientific foundation for the design and evaluation of restoration projects.

The Tidal Marsh Bird Project is one component of a larger effort by prbo—our San Francisco Bay Habitat Project—to study, maintain, and sustain the broad array of bird species that depend on the entire mosaic of habitats in the Bay. Our focus ranges from shorebirds feeding on invertebrates in tidal mudflats to cormorants foraging in the open waters of the Bay.

While our tidal marsh work includes all the birds that rely upon this habitat, we have focused much attention on three unique subspecies of nesting Song Sparrows. Studying these birds can be fruitful in advancing the nascent science of restoration. The threats they face—habitat fragmentation, changes in salinity, exposure to pollutants, non-native invasive species, and more—are ones faced by the whole community of tidal marsh fauna. In this *Observer* issue, we summarize some of our recent findings.

Nadav Nur, PhD, is Director of PRBO’s Population Ecology Program.

While all three subspecies face significant threats, the one requiring the most urgent attention is the Alameda Song Sparrow.

## Significant Findings

*Nadav Nur, PhD, and Hildie Spautz*

To provide management agencies with information about the status of tidal marsh-dependent species, and how best to protect and facilitate recovery of their populations, prbo conducts standardized surveys of Song Sparrows each year at over 50 marshes throughout the San Francisco Bay Estuary. Some results to date:

- ◆ Virtually every Bay tidal marsh has one or more pairs of Song Sparrows (Yellowthroats and Black Rails are found in some marshes but not others).
- ◆ There is marked variation in Song Sparrow population density among marshes, even within a sub-region such as San Pablo Bay.
- ◆ In San Francisco Bay marshes, inhabited by the Alameda Song Sparrow, we estimate an average density of 5.2 birds per hectare (100 meters<sup>2</sup>). San Pablo and Suisun Bay marshes, inhabited by the other two subspecies, demonstrate average densities of 14.9 birds per hectare.
- ◆ Habitat characteristics may explain spatial variation in abundance.

Song Sparrows do not appear to respond to vegetation height and density of plant stems (unlike the Marsh Wren and Salt Marsh Yellowthroat). They *do* respond positively to shrub cover, mostly gumplant and coyote brush, and negatively to *Juncus* (rushes).

- ◆ There are strong associations between Song Sparrow density and landscape features. In particular, density is greater in marshes that are larger, not isolated from other marshes, and not adjacent to urban areas. This information is of great value—both to inform current habitat management practice and for prioritizing new acquisition and restoration programs.

Our estimates of density allow us to estimate the total breeding population size for each of the three subspecies: Alameda Song Sparrows,

about 12,000–18,000; Suisun Song Sparrows, 40,000–66,000; San Pablo Song Sparrows, 70,000–85,000. These numbers are greater than previously estimated for San Pablo and Suisun Song Sparrows but similar to previous estimates for the Alameda Song Sparrow. While all three subspecies face significant threats, the subspecies requiring the most urgent attention of management agencies is the Alameda Song Sparrow, which is also the most genetically distinctive subspecies of the group.

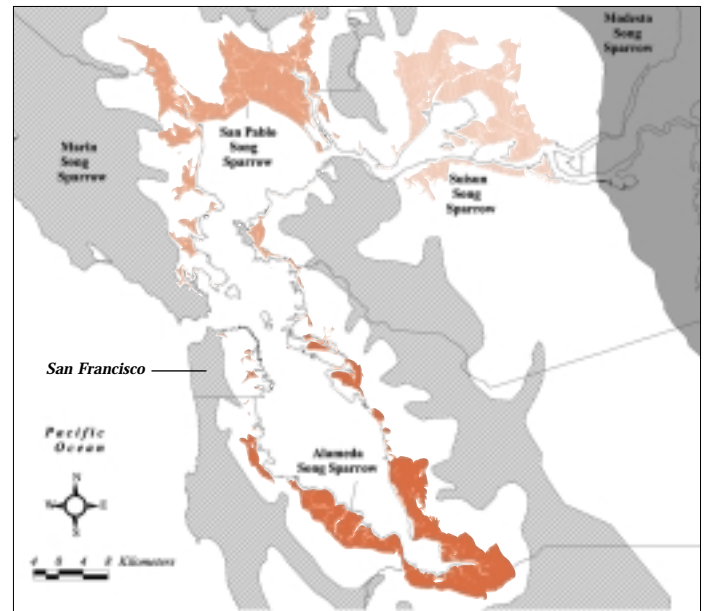
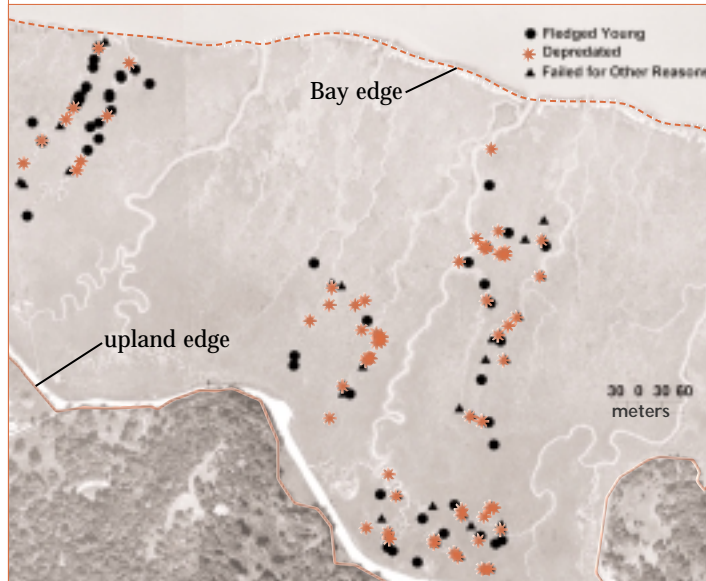


Figure 1. Distribution of three subspecies of tidal marsh Song Sparrows on San Francisco Bay.



**Tidal Marsh Fragmentation: Edge Effects** ◆ Having found nest predation to be a main cause of Song Sparrows' nest failure, we investigated the effects of marsh edge proximity on predation rate and overall nest success. For five San Pablo and Suisun Bay marshes, we looked at the fate of more than 1,800 Song Sparrow nests monitored between 1996 and 2000. Nests located closer to the Bay edge fledged young significantly more often than did nests located closer to upland marshland edges. Our analyses, however, suggest that the edge characteristics of an entire marsh may be more important than the location of nests within a marsh. Landscape-level conservation planning is needed in order to identify conservation/restoration sites most hospitable to Song Sparrows and other marsh-dependent species.—*Diana Stralberg, Geographic Information Systems Specialist, and Yvonne Chan, Seasonal Biologist*

Figure 2. Song Sparrow nests at China Camp State Park (San Pablo Bay) in 1997. Black dots are nests that successfully fledged young. Red stars are nests that were depredated. Black triangles are nests that failed for other reasons.

A growing concern for all wildlife reliant on San Francisco Bay is the accumulation of chemical pollutants in the water, sediments, and food web.

## Contaminants and Nest Success

*Hildie Spautz*

The San Francisco Bay ecosystem is much altered from the one where tidal marsh Song Sparrows evolved, several thousand years ago. A growing concern for all wildlife reliant on San Francisco Bay is the accumulation of chemical pollutants in the water, sediments, and food web. Sources of toxic compounds, especially in the northerly arm, San Pablo Bay, include runoff from agriculture and discharges from industries fringing the Bay.

PRBO's study of Song Sparrows' reproductive success in San Pablo and Suisun Bays has found reproductive rates to be disturbingly low. Predation is a main cause of nest failure. The probability that a nest survives to fledge at least one young averages less than 20% per year; for some marshes, the rate is 10% or less. Nest survival must approach 25% to yield long-term sustainability of the populations. As shown in Figure 3, there is great variability among years and among marshes, and San Pablo Song Sparrows display higher reproductive success than their Suisun neighbors.

Attention now is focused on factors that may contribute to low nest success. Environmental contamination can cause reductions in maternal fertility, increases in embryo and nestling abnormalities, and thin shells. In 1999, PRBO joined a new, collaborative study aimed at designing a monitoring network sensitive enough to provide advance warning, at a cost-efficient scale, of the ecological impacts of contaminants in San Pablo Bay.<sup>1</sup> We have collected Song Sparrow eggs at three San Pablo Bay marshes. Dr. Jay Davis of San Francisco Estuary Institute performs chemical analyses on these and also on Double-crested Cormorant

Right: A PRBO field biologist examines an inactive marsh nest site.



eggs that he collected from nests on the Richmond-San Rafael Bridge. Eggs from 1999 and 2000 have been tested for nine chemical contaminants.

Cormorants' eggs had much higher levels than sparrows' for eight of the nine compounds (e.g., dde, pcbs, and mercury), likely reflecting differences between their ecological niches. Sparrows are restricted to tidal marshes and consume plant material and invertebrates; cormorants, higher on the food-chain, forage for fish in the

cern in avian eggs, and eggs that failed to hatch had selenium levels similar to those of viable eggs, indicating that egg mortality is probably not directly related to higher levels of environmental selenium in parental diets.

In field observation of nests throughout their cycle, we document the proportion of eggs that hatch. We have found no statistically significant differences between tidal marsh nests and those at PRBO's Palomarin Field Station (belonging to the Marin Song Sparrow subspecies), or between San Pablo and Suisun Bay eggs. No detectable pattern of reduced hatchability in Bay marshes at this time is good news!

San Pablo Song Sparrows have higher rates of overall nest success (young that fledge) than Suisun Song Sparrows, due primarily to differences in predation rates. Notably, Marin Song Sparrows at Palomarin show higher nest success than either

San Pablo or Suisun birds.

We aim next to add Suisun and Palomarin birds to our contaminant study, and to evaluate whether regional differences in nest success may be due to broadscale differences in exposure to contaminants.

**Hildie Spautz** is Supervisory Biologist in the Tidal Marsh Project of PRBO's Population Ecology Program.

*This work was made possible by grants from the U.S. Environmental Protection Agency, the Richard Grand Foundation, and the Bernard Osher Foundation.*

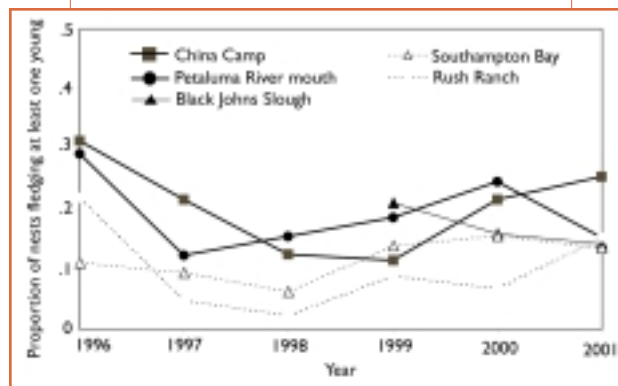


Figure 3. Song Sparrow nest survivorship in San Pablo Bay (solid lines) and Suisun Bay (dotted lines), 1996-2001.

Bay and may bioaccumulate more environmental contaminants.

One chemical that rang a potential warning bell for sparrows was selenium. Concentrations in sparrow eggs were 30% higher than in cormorants, ranging from 2.2 to 4.5 parts per million (ppm) dry weight. However, this is below the 6.0-ppm threshold for con-

<sup>1</sup> Our project, with physical and biological scientists from U.C. Davis and the San Francisco Estuary Institute, is formally called the *San Pablo Bay Network of Environmental Stress Indicators*. Funded by the Environmental Protection Agency, it is part of the National Oceanographic and Atmospheric Administration's *Coastal Intensive Sites Network* (cisnet). The full text of our most recent cisnet report can be found on PRBO's website at [www.prbo.org/tm](http://www.prbo.org/tm).

Ultimately, our results can help shape conservation priorities and restoration efforts.

## Genetic Distinctions

*Yvonne Chan*

**C**radling the Song Sparrow gently in my hand, I worked quickly to record the measurements: back color, bill width, length of wing, tail, and leg. I obtained a small drop of the bird's blood, then released it to flutter off, none the worse for the experience.

It was one of the remarkable four subspecies of Song Sparrow that reside year-round in the Bay Area. Three of these are endemic to tidal salt marshes fringing San Francisco Bay (Figure 2); the fourth inhabits nearby uplands. The tidal marsh subspecies are currently listed as Species of Special Concern in California because of dramatic reduction in their habitat and questions about their long-term viability.

The bird I handled, chocolate brown, was a Suisun Song Sparrow, found only in the brackish marshes of

Suisun Bay. On San Pablo Bay lives the Samuel's Song Sparrow, smaller in size and blackish-olive on the back. The Alameda Song Sparrow in South San Francisco Bay, slightly smaller yet, has a yellowish-grey back color and is the only subspecies with a yellowish wash to the belly. In the coastal sage scrub along the coast and lining fresh-water riparian corridors is the reddish-brown Marin Song Sparrow, intermediate in size between the Suisun and the other two marsh subspecies.

Are these different-looking subspecies *genetically* distinct? Investigating this, I examined genetic markers in small blood samples from over 200 Song Sparrows from nine populations around the Bay. The upland subspecies, the Marin Song Sparrow, is genetically distinct from the tidal marsh populations, even though it nests in an adjacent (but different) habitat.

Among the three tidal marsh subspecies, the Alameda Song Sparrow is the most divergent form, differing from

the other tidal marsh subspecies and from the closest upland subspecies. Samuel's and Suisun Song Sparrows, however, are genetically indistinguishable—and are genetically similar to a population of the Modesto Song Sparrow (a fifth subspecies) on the Cosumnes River!

The Alameda Song Sparrow is genetically the most unique of the three. It is also the subspecies most threatened by habitat destruction, with less than 10% of its original habitat remaining. This highlights the need to prioritize conservation efforts in South San Francisco Bay and provides support for applying for Endangered Species Status for the Alameda Song Sparrow. Ultimately, our results can help shape conservation priorities and restoration efforts.



**Yvonne Chan**, a PRBO Seasonal Biologist, was a 1997-98 Field Supervisor in the Tidal Marsh Project. The research reported here is part of her Masters thesis from the University of British Columbia.

## CALENDAR OF PRBO EVENTS

**PRBO BIRD WALKS** *Morning outings in or near Point Reyes National Seashore, \$5 donation, free to PRBO members.*

Sunday, June 9 ■ **Tidal Marsh.** Visit one of prbo's study sites on northern San Francisco Bay.

Saturday, July 6 ■ **Birds of Redwood Creek.** In riparian habitat near Muir Beach, learn about prbo nest monitoring.

Sunday, August 4 ■ **Coastal Scrub & Riparian Canyons.** At Palomarin Field Station, we look for (and band) fledgling birds.

Sunday, September 1 ■ **Snowy Plovers.** An inside look at prbo efforts to protect and restore a threatened species.

**OF SPECIAL INTEREST** *Please mark your calendar!*

October 10 ■ **2002 Osher Symposium.** Highlighting the achievements of prbo's outstanding intern biologists.

September 21–October 5 ■ **Bird-A-Thon 2002.** Any 24-hour period between these dates. Watch for details in the mail!

December 7 ■ **Bird-A-Thon Awards Dinner.** Annual classic; everyone welcome.

**BIRDING WITH RICH STALLCUP** *Seasonal day trips, advance registration required, \$25.*

August 25 ■ **Abbotts Lagoon.** A great destination for shorebirds, waterfowl, and nearshore ocean bird sightings.

September 22 ■ **Bodega Bay.** Exploring a variety of habitats filled with autumn birds.

October 12 ■ **The Outer Point of Point Reyes.** A search for fall migrants (and vagrants!) and seabirds.

*For more information about PRBO Bird Walks or Birding with Rich Stallcup, call Melissa Pitkin at 415/868-1221, extension 307.*

**PRBO—working to conserve birds, other wildlife & their ecosystems through innovative scientific research & outreach.**

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Benefactor: \$1,000 & more	Sustaining: \$250	Family: \$50	Student &
Sponsor: \$500	Contributing: \$100	Regular: \$35	Senior: \$20

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