IMPACT OF INVASIVE *SPARTINA ALTERNIFLORA* ON SONG SPARROW AND MARSH WREN POPULATIONS IN SAN FRANCISCO BAY SALT MARSHES

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An exotic cordgrass, *Spartina alterniflora*, is altering the vegetative structure and composition of the San Francisco Bay tidal marsh ecosystem, which has multiple impacts on the Alameda song sparrow (*Melospiza melodia pusillula)*, a resident passerine species that is a California Species of Special Concern. These sparrows are affected not only by the altered habitat, but also by the occupation of this habitat by a potential competitor, the marsh wren (*Cistothorus palustris*). To assess the impact of the *S. alterniflora* invasion on song sparrow and marsh wren populations we 1) located song sparrow nests to observe nesting habitat preferences and nest success and 2) used focal observations of color-banded birds to assess the vegetation composition of each territory and the amount of territory overlap between the two species. Our findings suggest that the changes in salt marsh habitat associated with the invasion of *S. alterniflora* may favor marsh wrens over song sparrows and could eventually result in a decrease in saltmarsh song sparrow populations

Keywords: *Spartina alterniflora*, song sparrow, marsh wren, nest success, territory, competition, San Francisco Bay

Spartina alterniflora, a cordgrass native to the Atlantic and Gulf coasts of North America, was introduced to San Francisco Bay in the early 1970s (Ayres et al. 2004). The exotic cordgrass subsequently hybridized with the native cordgrass, *S. foliosa*, and this hybrid has spread and now covers 793 ha of tidal flat and tidal marsh habitat (Zaremba & McGowan 2004). Native San Francisco Bay tidal salt marshes are characterized by broad expanses of open tidal mudflats, a narrow mid-marsh zone where *S. foliosa* occurs, and a high-marsh zone composed mainly of low-growing *Salicornia* spp. with narrow areas of *Grindelia* that line the meandering tidal channels.

The tall, dense exotic *Spartina* (*S. alterniflora* and/or the hybrid *S. alterniflora x foliosa*) can grow further down the tidal gradient than any native tidal marsh plant species and so is able to colonize open tidal flats. Just as important, however, is that this exotic cordgrass can grow much further up the tidal gradient than the native *S. foliosa* and thus displaces other native plant species in the mid- to high-marsh zones as well (Ayres et al. 1999, Nordby pers. obs.).

The profound changes in habitat structure and composition that accompany the exotic *Spartina* invasion (Callaway and Josselyn 1992) will likely have the greatest impact on species, such as birds, that are wholly dependent on the tidal salt marsh system. The Alameda song sparrows (*Melospiza melodia pusillula*) (Fig. 1), a California Species of Special Concern, resides entirely within the salt marshes in South San Francisco Bay. In a native marsh, this sparrow is the main resident passerine species and occupies territories and nests in *Salicornia* and *Grindelia* near the tidal channels. Another passerine species, the marsh wren (*Cistothorus palustris*) (Fig. 2), that normally occurs in fresh or brackish water marshes on the Pacific Coast, has started to occupy the newly available exotic *Spartina* habitat (Nordby & Cohen, pers. obs.). Marsh wrens are very aggressive and will defend their territories against other birds, even other species, by breaking the eggs in nests that are close to their own territories (Picman 1977).

Fig. 1. Alameda song sparrow (*Melospiza melodia pusillula*). Photo by J. Cully Nordby

To assess the impact of the exotic *Spartina* invasion on song sparrow and marsh wren populations in San Francisco Bay we 1) studied sparrow nesting habitat preferences and nest success and also looked for evidence of the destruction of song sparrow eggs by marsh wrens, and 2) assessed the vegetation composition of sparrow and wren territories as well as the amount of territory overlap between the two species.

Fig. 2. Marsh wren (*Cistothorus palustris*).
Photo by J. Cully Nordby

Song sparrow nest success

During the 2002 and 2003 breeding seasons we followed and observed the fates of 363 nests in 45+ territories across three study sites (Newark, San Leandro and Alameda). Once the fate of a nest had been determined (failed due to predation, failed due to tidal flooding, failed for other reasons, or successful), we recorded the location and vegetation composition of the nest site.

We found that song sparrows did use exotic *Spartina* as nesting habitat, but these nests were much more likely to fail due to tidal flooding than nests placed in native vegetation. As a result, overall nesting success was slightly lower in areas of exotic *Spartina* than in areas of native vegetation (9% vs. 17% respectively). We also found strong evidence of marsh wren destruction of sparrrow eggs, particularly in areas of high marsh wren density (Nordby et al., in prep).

Song sparrow and marsh wren territories

During the 2003 breeding season (from March to August), we conducted two to four focal observations on each color-banded male to map the territory boundaries for the 32 song sparrows and 16 marsh wrens in the two *Spartina*-invaded study sites. Observers used binoculars, a compass, and a range-finder to map bird locations during each one-hour observation period. Observation locations were marked using a GPS unit, bird locations were then calculated and these data were added to ArcView GIS database. The points were used to construct 100% minimum convex polygons of each territory. Using color-infrared aerial photographs, we identified areas of invasive *Spartina* throughout the sites. In ArcView, we combined the layer of *Spartina* vegetation with the layers of marsh wren and song sparrow territory polygons. We then determined the percentage of each territory that was composed of *Spartina* habitat, as well as the amount of overlap between the two species

Although song sparrows did include some exotic *Spartina* habitat in their territories, all but one song sparrow territory included some areas of native salt marsh habitat. The one territory that was entirely covered by *Spartina* actually had a large portion of native pickleweed vegetation underlying the *Spartina* stand. In contrast, marsh wren territories were more highly correlated with exotic *Spartina* habitat and many territories were exclusively composed of the exotic cordgrass. We also found that there was little overlap between the territories of the two species, possibly due to differing habitat preferences (Nordby et al., in prep).

Discussion

These results suggest that the changes in salt marsh habitat associated with the invasion of exotic *Spartina* may favor marsh wrens over song sparrows. While song sparrows are occupying and nesting in the exotic *Spartina*, those that do so may be at a disadvantage. It is possible that song sparrows are being drawn to nesting sites in exotic *Spartina* that are inappropriate because they are too low in elevation relative to the tides. This increase in nest failure due to flooding coupled with an apparent increase in interference competition from marsh wrens may serve to negatively impact saltmarsh song sparrow populations in San Francisco Bay.

However, we do not yet know whether exotic *Spartina* is acting as an 'ecological trap' for song sparrows, where overall reproductive success is reduced. It is also not yet known whether marsh wrens are excluding song sparrows from the *Spartina* habitat or if song sparrows are selecting against those areas for other reasons (e.g., nesting habitat or food resources are limited). Studies to test these hypotheses are ongoing.

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