Black-necked Stilt (*Himantopus mexicanus*) Space Use and Site Fidelity in the San Francisco Bay Estuary: Toward Predicting Shorebird Response to Salt Pond Conversions

BY

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THESIS

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INTRODUCTION

BACKGROUND

The research described in this thesis is one component of a larger research program, which is being carried out by a collaborative team from the U.S. Geological Survey, the Point Reyes Bird Observatory (PRBO), and the San Francisco Bay Bird Observatory, among others. The broad objectives of the larger research program are to: 1) assess habitat use and population dynamics of waterbirds in the San Francisco Bay estuary, and 2) identify determinants of their habitat use and population status. The research presented here focuses on one species of shorebird, the Black-necked Stilt (*Himantopus mexicanus*; hereafter stilt). The stilt is one of only four shorebird species that regularly breeds in wetlands of the estuary and is investigated here as a representative of the "surface feeder" foraging guild (Takekawa et al. 2001). It is one of several shorebird species that are dependent on diked wetlands of the estuary throughout the annual and tidal cycles.

In addition to the research described in this thesis, researchers have begun to explore some of the objectives mentioned above. Research on the potential affects of wetlands restoration of salt ponds on waterbirds in the North Bay has been completed (Takekawa et al. 2000, Takekawa et al. 2001), and Warnock et al. (in press) examined the effects of tide cycle, pond salinity, and pond area on bird use of South Bay salt ponds. Key results from this thesis, and from other projects in the larger research program, will be used to support the development of predictive models of habitat alterations in the region. These will provide means for estimating the population level effects, on

shorebirds and other important species in the region, of potential changes to major habitat types in the estuary.

There are many species of conservation concern in the San Francisco Bay estuary, including several federally threatened and endangered species, such as the Western Snowy Plover (*Charadrius alexandrinus nivosus*), the California Clapper Rail (*Rallus longirostris obsoletus*), and the Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*), Substantial portions of other species of concern rely on the estuary during a portion or throughout the year (e.g. Table 1). To date, much conservation focus in the region has centered on species that rely on natural tidal salt marsh habitats, which have been reduced substantially since the early 1800s. To recover populations of species dependent on tidal marsh habitats, recent wetlands planning efforts for the estuary propose conversion of thousands of hectares of salt ponds to tidal salt marsh habitat (Goals Project 1999, Steere and Schaefer 2001). Less conservation focus has centered on species that may be adversely affected by such habitat restorations, including shorebirds, whose populations have likely benefited from the conversion of natural tidal salt marsh to commercial salt ponds (Harvey et al. 1992). If managers are to make fully informed decisions regarding the extent and location of habitat restorations (as well as other potential land use changes), impacts on all species of concern in the estuary should be accounted for in the decision-making process.

Studies of shorebirds in the estuary have largely focused on broad-scale abundance and distribution patterns (Stenzel et al. in press), and seasonal abundance patterns and species composition at individual sites or in specific habitats (Storer 1951, Recher 1966, Holway 1990, Swarth et al. 1982, Harvey et al. 1988, USFWS unpubl. data,

Warnock et al. in press). Except for a few species, including Marbled Godwit (*Limosa fedoa*), Willet (*Catoptrophorus semipalmatus*), Long-billed Dowitcher (*Limnodromus scolopaceus*), Western Sandpiper (*Calidris mauri*), and American Avocet (*Recurvirostra americana*) (Luther 1968, Kelly and Cogswell 1979, Warnock and Takekawa 1995, 1996; PRBO unpubl. data), only cursory information is available on habitat preferences and landscape and ecosystem variables that determine habitat selection within the estuary. Furthermore, except for a few studies (Hamilton 1975, Gill 1977, Page and Stenzel 1981, Harvey et al. 1988, PRBO unpubl. data), the estuary's importance to and use by breeding shorebirds has not been well documented.

The research described here focused on the Black-necked Stilt, an abundant, yet poorly studied, species in the California coastal environment. The San Francisco Bay estuary is one of the northernmost sites in the stilt's breeding range on the Pacific Coast (Robinson et al. 1999) and is one of the most important sites for stilts along the Pacific Coast during all seasons (Page et al. 1999, PRBO unpubl. data). Indeed, Page et al. (1999) found 90% of stilts wintering in the estuary on surveys of all major wetlands of the contiguous U.S. Pacific coast (Table 1). The estuary is considered a priority area for maintaining and potentially increasing stilt breeding numbers in the Southern Pacific Region of the U.S. (Page and Shuford 2000). The Southern Pacific Region (most of California) is one of only 4 regions out of 11 in the U.S. highly important to stilts during breeding, and one of only 2 regions highly important during all seasons (Brown et al. 2001).

Previous research on the breeding behavior of stilts in other regions has provided information on natal philopatry, site tenacity, age of first breeding, pair formation,

parental sex roles, and anti-predator behavior (Sordahl 1982, 1984, 1990; James 1991, 1995). In the San Francisco Bay estuary, Hamilton (1975) completed a comparison of stilts and avocets that included many aspects of behavior from maintenance to nesting. A separate research focus has been on the effects of contaminants, particularly selenium, on stilt breeding success (Ohlendorf et al. 1989, Williams et al. 1989).

This thesis is organized as follows. In the next section, I provide an overview of the relative importance of habitats to shorebirds in coastal estuaries, particularly in the San Francisco Bay estuary. I also describe some of the shorebird conservation goals and strategies that have been suggested to maintain or enhance shorebird populations in the estuary.

In order to achieve the general shorebird population goals for the estuary described in the next section, or to effectively implement any conservation strategies for shorebirds, a better understanding of the ecological and demographic parameters that affect population dynamics in the estuary is required. This thesis focuses on two key ecological parameters for the Black-necked Stilt in the estuary: space requirements and site fidelity. Information on the space requirements of shorebird species, especially as a function of the amount and configuration of different habitat types, will be important for estimating the population size the estuary would be able to support under different wetland restoration scenarios. Information on site fidelity and selection may provide clues to differences in reproductive success in different habitat types, further aiding our ability to predict the impacts of habitat alterations in the region.

Chapter 1 addresses the space requirements of stilts in the estuary. In this chapter, I present results of a study on breeding and post-breeding ecology of stilts in the North

and South Bays of the San Francisco Bay estuary during the summer and fall of 1999. We used radio-telemetry data to examine space use and movement patterns by stilts breeding in the estuary, quantifying home range size, daily distance moved, dispersal from capture site, and degree of clustering of activity. We examined differences in these variables by sex, region, and capture site. Previous space use research on stilts has been on long-distance movements in the Pacific Flyway (Robinson and Oring 1996). Stilts are known to be strongly territorial during breeding and winter (Hamilton 1975, Engilis et al. 1998, Robinson et al. 1999), but area requirements for breeding and post-breeding stilts have not previously been quantified.

Chapter 2 addresses site fidelity of stilts in the region. In this chapter, I present results of a study that used re-sight data from color-marked stilts to examine winter site use and breeding site fidelity by stilts and to estimate residency status of stilts in the estuary. Previous studies of stilt breeding site fidelity have been conducted in small study reas and were based on limited data (Sordahl 1984, James 1995).

I conclude by summarizing the main findings of the studies in Chapter 1 and Chapter 2, and discussing management implications and future research for stilts in the estuary. I also discuss how the findings of this thesis, combined with the broader research program mentioned above, can be used to help predict the impact of potential wetland restoration scenarios on the capacity of the estuary to support populations of concern.

CHAPTER 1 - SPACE USE BY BREEDING AND POST-BREEDING BLACK-NECKED STILTS IN THE SAN FRANCISCO BAY ESTUARY

by

Catherine Hickey, Nils Warnock, and John Takekawa

ABSTRACT

We examined space use of wetlands by the Black-necked Stilt in the North and South Bay regions of the San Francisco Bay estuary, California. We radio-marked 59 breeding stilts and tracked them for up to four months. We found no significant difference in fixed-kernel home range size by sex and region of the estuary (North and South Bays). We did find differences in home range size and maximum distance traveled by capture site. Overall, individual stilts used an area of approximately 360 ha, and remained within an average of 4.5 km from their capture sites. Only three of the stilts moved between North and South Bays (all north to south), traveling 65-72 km from their capture sites. Daily movement patterns changed through the study period, varying by region. We used cluster analysis to calculate number of focal areas for individual stilts and found that overall space requirements were larger for stilts with multiple centers of activity. An understanding of space and habitat requirements of stilts will aid wetland managers in providing habitat for breeding and post-breeding stilts, contributing to the management of regional populations of the species.

CHAPTER 2 - BREEDING SITE FIDELITY AND WINTER SITE USE BY BLACK-NECKED STILTS IN THE SAN FRANCISCO BAY ESTUARY

by

Catherine Hickey and Nils Warnock

ABSTRACT

We examined breeding site fidelity and winter site use by the Black-necked Stilt in the San Francisco Bay estuary, California. We color-marked 60 breeding stilts, of which we radio-marked 59. We tracked the radioed stilts using telemetry for up to four months, and recorded observations of banded stilts during the subsequent winter and breeding season. Twenty-three of 26 stilts captured in the North Bay and all of the 33 stilts captured in the South Bay stayed in their region for the duration of their individual tracking periods. Re-sighting data indicated that a minimum of 23% of the breeding stilts tracked in our study resided in the estuary through the following winter and at least 20% bred in the estuary during the consecutive breeding season. Breeding site fidelity was higher for stilts captured in the South Bay (35%) than for stilts captured in the North Bay (0%). Stilts exhibited a range of 0 to 42% return rates among capture sites the following year. Stilts from at least four of the five South Bay capture breeding sites wintered in South Bay salt ponds. An understanding of site selection and fidelity by stilts in the estuary will help predict how pending changes to wetland habitats within the estuary may affect regional populations of the species.