Conserving San Francisco Bay’s Waterbirds: three decades in a rapidly changing landscape

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ABSTRACT

The San Francisco Bay estuary provides critical habitat for over one million waterbirds annually. Although the landscape has been altered for well over a century by increasing levels of urbanization, and by the historic establishment of evaporator ponds for salt production, it remains heavily used by waterbirds. The area also hosts the west coast’s largest tidal wetlands restoration project; the South Bay Salt Pond Restoration Project is implementing a plan to convert thousands of acres of salt ponds into tidal and managed wetland habitat. While the restoration to tidal marsh will increase habitat for many species, it also will reduce the overall habitat available for waterbirds. Through adaptive management, the Project is committed to maintaining historic levels of waterbirds in this landscape. To inform these efforts, the USFWS, San Francisco Bay Bird Observatory, USGS and UC Davis have partnered to assess changes in bird population levels and community composition for nine waterbird guilds. Data collected during the early 1980s were compared with current data to identify significant changes that have occurred over 30 years. We identified significant increases in populations for some guilds, such as gulls, and declines at all or some locations for other guilds such as divers, terns and grebes. We provide recommendations for the Project’s development and for future adaptive management to ensure abundant and diverse waterbird communities.

METHODS

Data Collection
Modern Ground Surveys:
• Counted waterbirds from the nearest drivable levee
• Used spotting scopes and binoculars
• Years: 2006 – 2012

Modern Aerial Surveys:
• Counted waterfowl from fixed-wing aircraft
• Years: 2006 – 2012 selected to match ground counts

Historical Waterbird Surveys:
• Counted waterbirds from fixed-wing aircraft
• This dataset was found by USFWS personnel as a set of hand-written data-sheets in a box, 20 years after data were collected.
• Entered datasets into a database and verified collection methods with original observers
• Years: 1981 – 1986

Data selection/pond & species matching for model development
• We paired waterfowl ground and aerial survey data collected on the same day at the same pond. Paired surveys were conducted in the following years: 2006-2012.
• Only waterfowl were included because the modern aerial survey does not record shorebirds.
• We removed any observations where the difference between predicted and observed counts were in the top 5 percentile (i.e. outliers). We did this to reduce the influence of data points where movement of birds was likely to have occurred.

Statistical Model Development
• We developed a model to convert aerial to ground counts
• We used a generalized linear model framework with a quasipoisson distribution
• Variables included species identity and numbers of birds counted in ground and aerial surveys of ponds.
• Observations where the aerial or ground count was zero and the paired aerial or ground count was nonzero were removed under the assumption that they represented movement of birds rather than differences in visibility.
• Application of model to historic waterbird surveys
• We used the model to convert the historical aerial waterbird abundance values into estimated ground abundance values.
• We used bootstrap methods to calculate a 95% prediction interval for the calculated ground survey counts

RESULTS

The historical aerial and ground bird surveys were compared to identify significant changes in bird population levels and community composition for nine waterbird guilds. Data collected during the early 1980s were compared with current data to identify significant changes that have occurred over 30 years. We identified significant increases in populations for some guilds, such as gulls, and declines at all or some locations for other guilds such as divers, terns and grebes. We provide recommendations for the Project’s development and for future adaptive management to ensure abundant and diverse waterbird communities.

DISCUSSION

• We identified increases in populations for some guilds, such as gulls, dabblers, and shorebirds, and declines at all or some locations for other guilds such as divers, terns and grebes.
• Changes in bird numbers are likely the result of changes in pond management and habitat availability:
  • Restoration of tidal influence to salt production ponds
  • Changes in the remaining salt production ponds
  • Management for wildlife
• Changes in landscape- and flyway-level populations need to be considered as well.
• Recommendations for the project’s development and for future adaptive management to ensure abundant and diverse waterbird communities:
  • Manage ponds at a variety of water levels and salinities, across the landscape.
  • Provide for isolated roosting habitat near foraging habitat. For example, provide insular levees adjacent to mudflats for shorebirds.
  • Monitor management actions and the effects on waterbird use of ponds.
• Use the locally collected data in the larger context of populations of birds in the Pacific Flyway to determine benefits for and impacts on local waterbirds.
• Recognize that not all ponds are created equal in the eyes of waterbirds. Careful management decisions need to be made when restoring ponds to tidal marsh or when attempting to manage them for specific species or guilds.

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Table 2: Changes in average abundance of birds over all seasons, relative to 1980s counts. Positive values indicate increases since the 1980s; negative values indicate decreases. Percent change is calculated as the difference divided by average abundance from the 1980s, multiplied by 100%.

Table 1: Components of the model to convert aerial counts to ground counts. Model selection indicated that RUDU was the only species that was significantly different from other species.

Figure 1: Modern aerial and ground data used to calculate a correction factor to be applied to historical aerial counts. The dashed line shows the ground count if no correction is applied.