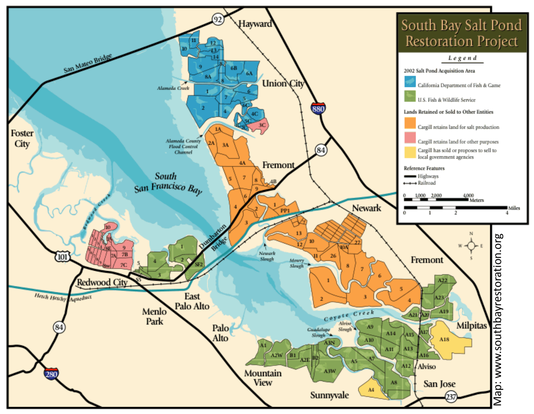
Conserving San Francisco Bay's Waterbirds: three decades in a rapidly changing landscape

Vanessa Tobias[1], Catherine Burns[2], Cheryl Strong[3], Orien Richmond[4], Jill Demers[2], John Takekawa[5], and Emilio Laca[1]

[1]UC Davis Department of Plant Sciences, [2]San Francisco Bay Bird Observatory, [3]Don Edwards San Francisco Bay National Wildlife Refuge, [4]Refuges Inventory & Monitoring Program, [5]USGS Western Ecological Research Center. Contact email: vtobias@ucdavis.edu

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 datasheets into a database and verified collection methods with original observers
- Years: 1981 – 1986

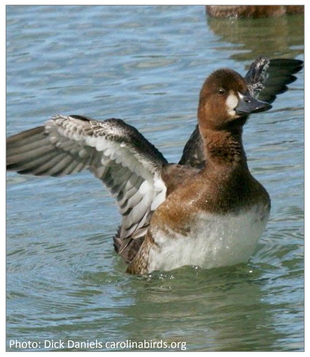


Photo: Dick Daniels carolinabirds.org

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.

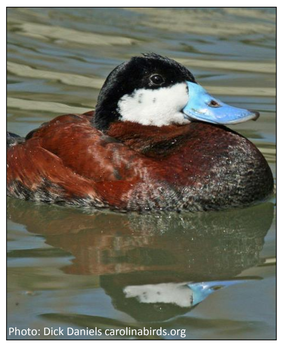


Photo: Dick Daniels carolinabirds.org

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

ACKNOWLEDGEMENTS

Paul Kelly and Roy Lowe confirmed historical waterbird methods. Paul Kelly, Roy Lowe, & Tom Harvey collected the historical waterbird dataset.
Josh Scullen (SFBBO) summarized bird counts and created maps.
Nicole Athearn (USGS), Christina Donehower (SFBBO), and Caitlin Nilsen (SFBBO) coordinated and performed ground counts.
Funding for this project was provided by USFWS Region 8 Inventory & Monitoring Program.

RESULTS

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.

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.

	Estimate	Std. Error	t-value	Pr(>|t|)
Intercept	4.94691	0.10878	45.48	< 0.0001
log(aerial count)	0.87771	0.03997	21.96	< 0.0001
Species = RUDU	1.74392	0.15766	11.06	< 0.0001
log(aerial)*RUDU	-0.55606	0.06436	-8.64	< 0.0001

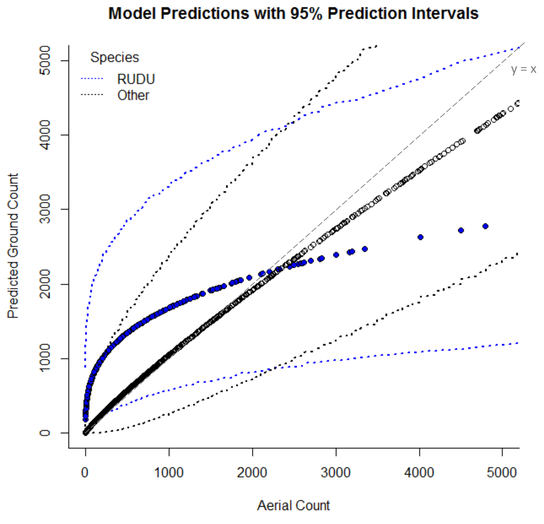


Figure 2: Calculated historical ground counts generated by the statistical model in figure 1, using the historical waterbird dataset for the aerial counts.

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%.

	Complex	Dabblers	Divers	Eared Grebes	Fish eaters	Gulls	Herons and egrets	Phalaropes	Shorebirds	Terns	ALL guilds
Difference	Alviso	13314	74	-544	141	6748	51	154	5113	86	25138
	Eden Landing	2307	-12303	79	-202	-647	-141	131	20197	-140	9280
	Mowry	-801	-2581	-3054	-2093	4962	5	79	-1557	-69	-5109
	Newark	-4790	-6572	-714	-217	161	91	92	-5849	8	-17790
	Ravenswood	-987	-2681	-32	-10	-2476	12	-40	-1967	-5	-8184
	ALL	9043	-24063	-4266	-2380	8749	17	417	15937	-120	3334
% Change	Alviso	111.3	0.4	-30.5	7.8	119.2	19.9	5935.9	31.9	24.7	44.5
	Eden Landing	123.7	-73.3	102.3	-28.5	-51.2	-51.8	70.5	117.6	-38.8	24.0
	Mowry	-51.7	-88.4	-69.3	-95.3	246.3	75.1	369.0	-29.1	-79.8	-27.5
	Newark	-65.4	-78.1	-32.0	-35.3	6.4	1712.4	53.0	-33.5	6.5	-45.8
	Ravenswood	-83.5	-85.9	-61.0	-31.5	-93.5	6178.9	-81.1	-17.4	-27.7	-44.5
	ALL	37.9	-48.3	-49.9	-44.5	61.9	3.2	96.2	23.7	-12.9	2.0

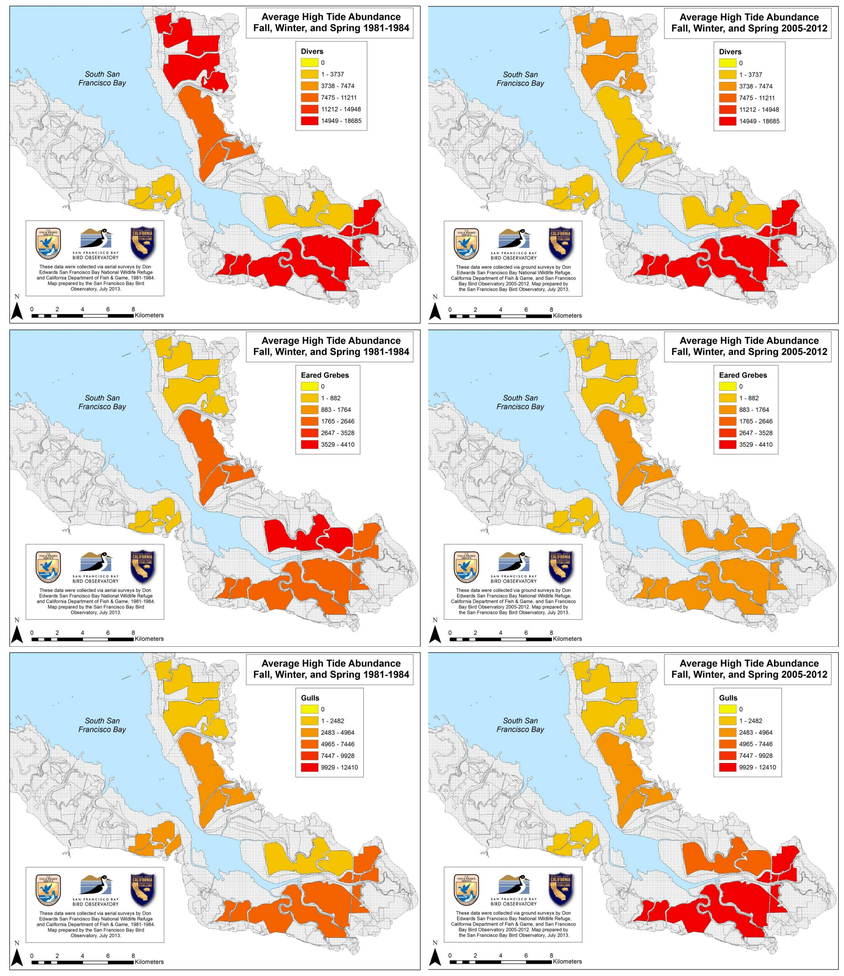


Figure 3: Selected maps comparing historical (left panels) and modern (right panels) average abundance of various guilds in South Bay Salt Ponds. Values represent the average number of birds in a guild expected for a survey in any season.

DISCUSSION

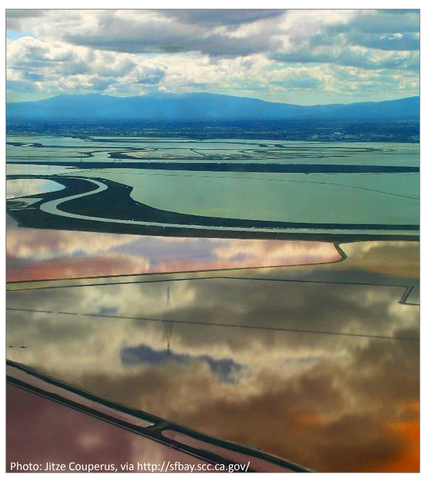


Photo: Jitze Couperus, via http://sfbay.scc.ca.gov/

- 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.