

Distribution, abundance, and habitat use of Long-billed Curlews in California's Central Valley from broad-scale surveys in 2007 and 2008

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ABSTRACT

The Long-billed Curlew (*Numenius americanus*) is a migrant and winter resident in California's Central Valley, where it concentrates primarily in agricultural lands. Despite recent estimates of the size of the North American breeding population of this at-risk species, little is known about its abundance, concentration sites, and habitat needs at migratory stopovers and wintering areas. To help fill this gap, we coordinated three broad-scale surveys of curlews in the central and southern portions of the Central Valley. Survey totals were 19,063 curlews in 121 flocks in September 2007, 10,183 in 77 flocks in February 2008, and 18,775 in 118 flocks in September 2008. The Solano-Yolo region had consistently high numbers in September, whereas parts of the San Joaquin and Tulare basins were important to curlews in either September or February. On agricultural lands, curlews used mainly alfalfa fields and pastures, which together accounted for 83% to 94% of all birds across surveys. For pasture, curlews predominantly used irrigated pasture in September and native pasture in February. Supplemental surveys in Solano County documented much higher curlew numbers in September than in early or late winter. Lower winter numbers may reflect wider dispersal of curlews after the soaking winter rains enhance the foraging suitability of previously parched grasslands or other habitats. Curlews might also be shifting to Sacramento Valley rice fields after the early fall harvest period, or some may migrate further south to wintering areas in the Imperial Valley or in Mexico. A more complete survey of the entire Central Valley is needed to refine estimates of overall curlew abundance in this region and to better determine the importance of various subregions, particularly the Sacramento Valley, to curlews. More work also is needed to document seasonal movements of curlews, examine local and seasonal variation in habitat use, study the use and persistence of nighttime roosts, and explore ways to maintain and improve curlew wintering habitats while ensuring economic viability of agricultural lands.

The Long-billed Curlew (*Numenius americanus*) is a migrant and winter resident in California's Central Valley, where this large conspicuous shorebird concentrates primarily in agricultural lands. Under the U.S. Shorebird Conservation Plan, the Long-billed Curlew is categorized as a "highly imperiled" species, reflecting population declines, low population size, and threats it faces on the nonbreeding and breeding grounds (Brown et al. 2001). Surveys in 2004 and 2005 estimated the breeding population of the Long-billed Curlew in the United States as 109,533 to 164,515 individuals (Stanley and Skagen 2007) and in North America as 139,252 to 183,231 individuals (Jones et al. 2008). Very little is known, however, about the abundance, concentration sites, and habitat needs of this species at migratory stopovers and wintering areas, where curlews spend about nine months of the year.

With vast expanses of dry and irrigated pastures, alfalfa fields, and post-harvest rice fields, the interior valleys of California, combined, are likely the most important area in the world for Long-billed Curlews during migration and winter. Determining how curlews use habitats during the nonbreeding season is critical to finding ways to protect and enhance agricultural fields and other important habitats they depend on. To meet this need, we coordinated three broad-scale surveys of curlews in a large portion of the Central Valley from September 2007 to September 2008.

Here we summarize the results of the three curlew surveys and discuss overall patterns of abundance, areas of concentration, and habitat use in the central and southern districts of the Central Valley. We provide additional context with supplemental information from the Central Valley and elsewhere in California. Finally, we recommend additional surveys of California's interior valleys to obtain more complete coverage and to assess patterns of curlew concentration and habitat use, which appear to shift seasonally with variation in cropping patterns and enhanced suitability of some habitats after the onset of soaking winter rains.

STUDY AREA AND METHODS

Area Surveyed

The primary study area included all or portions of 12 counties in the Central Valley, from about the City of Sacramento southward. For the purposes of the survey, we divided the agricultural lands of this region into 88 subareas (Figures 1–3), each of which we judged could be covered by an observer from adjoining or internal roads during a half to a full day. To aid in discussing pattern of distribution, we later grouped the 88 subareas into three main subregions: the Sacramento–San Joaquin River Delta region (Delta region, including a small portion of the southern Sacramento Valley), the San Joaquin Basin, and the Tulare Basin (Figures 1–3). To supplement counts on agricultural lands, we also recruited biologists to count curlews

on federal refuges, state wildlife areas, and private wetlands, some of which were in the Sacramento Valley north of the primary study area in agricultural lands.

Survey Protocol

For both agricultural lands and managed wetlands, we instructed observers to conduct an area search—a survey of the entire designated area—with the objectives of recording all the curlews there and identifying the habitats they were using. We provided participants with a road map defining their survey area (or they used their own map for wetlands) and asked them to drive all accessible roads to look for curlews. They were advised that although some curlews would be visible from the car, it would not be possible to see many of them unless they stopped frequently to scan all potentially suitable habitats. We recommended that observers first scan with binoculars, then when seeing curlews, particularly in the distance or in relatively tall vegetation, that they use a spotting scope to count the number of individuals in the flock to obtain the best estimate.

We asked observers to mark the location of all curlew flocks on a map and to record the name of the survey area, date, start and stop times, names of observers, and weather on data sheets provided. For each flock, they also were asked to record the time of the observation, the number of curlews in the flock, the habitat being used, the behavior of the birds, and a verbal description of the location of the flock matching that marked on the map.

Coverage

The three surveys spanned 13–16 September 2007, 1–6 February 2008, and 11–18 September 2008. Coverage of the primary agricultural survey region was incomplete and varied among surveys. On the respective surveys, 58, 67, and 40 observers covered all or a large percentage of suitable habitat within 55, 60, and 41 of the 88 agricultural subareas. Because of limited time to organize the September 2008 survey, we targeted for coverage areas where we found reasonable numbers of curlews on prior surveys and previously unsurveyed areas we judged likely to hold curlews; the latter were mainly in the Tulare Basin of the southern San Joaquin Valley, where overall coverage was limited on the first two surveys (Figures 1–3).

Coverage of managed wetlands was inconsistent. Eighteen observers counted curlews at six state wildlife areas and nine federal refuges in September 2007, ten observers counted curlews at two state wildlife areas and five federal refuges in February 2008, and five observers counted curlews at one state wildlife area, six federal refuges, and two federal waterfowl management areas in September 2008. Likewise, coverage of private wetlands was also incomplete.

Habitat Data

We summarized curlew data with respect to seven major categories of crop or field types in the central and southern Central Valley. We first excluded birds seen only in flight, and hence not associated with any particular habitat, and birds seen at wetlands, ponds, or other water bodies, where they most often were roosting after foraging in unknown habitats. The seven major crop or field types were irrigated pasture, native pasture, alfalfa, other hay crops, various grain crops, tilled or (weedy) fallow fields, and miscellaneous or unidentified crops. Irrigated pasture is actively irrigated in the dry season to provide green forage for grazing and generally is not irrigated in the winter when seasonal rains serve that purpose. Native pasture is not irrigated and, hence, is dry from late spring to early fall and wet intermittently or continuously during the winter rainy season, depending on the extent or duration of precipitation. Although curlews frequently use rice fields (authors' pers. obs.), we did not survey much of this habitat because the vast majority of this crop is grown in the Sacramento Valley, where our survey coverage was minimal.

Supplemental Surveys

To evaluate seasonal patterns of curlew use, we conducted additional surveys encompassing the three South Dixon survey areas (A, B, and C) in Solano County on 15 November 2005, 15 November 2006, 9 February and 6 March 2006, 9–10 February 2007, and 12 July and 5 September 2006. Thus, including the surveys of this area (1 February 2006, 14 September 2007, and 13 September 2008) as part of the three comprehensive surveys described above, we conducted a total of ten surveys of the South Dixon area.

RESULTS

Abundance

Survey totals were 19,063 curlews in 121 flocks in September 2007, 10,183 in 77 flocks in February 2008, and 18,775 in 118 flocks in September 2008 (Table 1). On the respective counts, 15,846 (83%), 8,371 (82%), and 17,117 (91%) curlews were from agricultural survey areas, the remainder from wildlife areas, refuges, and private wetlands.

Repeat surveys of the three South Dixon subareas provided additional information on seasonal abundance patterns of curlews. Total curlew numbers for these three subareas combined were 2,805 individuals on a single July 2006 survey, 5,621–7,253 (average 6,487) on three September surveys, 397 and 1,516 (average 956) on two November surveys, and 297–1,010 (average 544) on four February-to-early-March surveys.

Table 1. Numbers of Long-billed Curlews on three surveys of California's Central Valley in 2007–2008.

Route No.	Route Name	13–16 Sept. 2007		1–6 Feb. 2008		11–18 Sept. 2008	
		No. Birds	No. Flocks	No. Birds	No. Flocks	No. Birds	No. Flocks
Agricultural Areas*							
<i>Delta Area</i>							
D1	Davis-Woodland	803	5	64	5	257	3
D2	Davis South A	14	1	0	0	6	1
D3	Davis South B	2,450	20	0	0	1,023	8
D4	Dixon South A	540	3	0	0	3,310	8
D5	Dixon South B	2,528	17	274	4	3,881	35
D6	Clarksburg South	0	0	5	1	–	–
D7	Dixon South C	2,553	4	23	2	62	2
D8	Ryer Island	0	0	0	0	–	–
D9	Walnut Grove A	0	0	40	0	0	0
D10	Walnut Grove B	220	1	78	3	609	3
D11	Walnut Grove C	0	0	480	1	0	0
D12	Walnut Grove D	0	0	0	0	–	–
D13	Galt-Lodi	0	0	0	0	–	–
D14	Clay-Youngstown	0	0	0	0	–	–
D15	Lockeford	0	0	0	0	–	–
D16	Contra Costa	0	0	245	1	–	–
D17	Tracy-Stockton A	0	0	0	0	–	–
D18	Waterloo	0	0	–	–	–	–
D19	Tracy-Stockton B	88	2	0	0	–	–
D20	Collegeville	0	0	0	0	–	–
D21	South Tracy	0	0	0	0	–	–
D22	Manteca-Ripon	0	0	58	1	–	–
D23	Escalon	0	0	–	–	–	–
<i>San Joaquin Basin</i>							
J1	Westley-Grayson	0	0	0	0	–	–
J3	Riverbank	0	0	0	0	–	–
J4	Oakdale-Empire	0	0	220	1	0	0
J5	Modesto Reservoir	0	0	0	0	–	–
J7	Ceres	16	1	600	2	114	3
J8	Turlock	0	0	455	1	0	0
J9	Turlock Lake	–	–	0	0	–	–
J10	West of Turlock	702	6	524	8	630	6
J11	Newman	363	6	119	1	520	3
J12	Hilmar	907	1	0	0	137	2
J13	Atwater	0	0	0	0	–	–
J14	Snelling	0	0	0	0	–	–

(continued)

Table 1. Numbers of Long-billed Curlews on three surveys of California's Central Valley in 2007–2008 (continued).

Route No.	Route Name	13–16 Sept. 2007		1–6 Feb. 2008		11–18 Sept. 2008	
		No. Birds	No. Flocks	No. Birds	No. Flocks	No. Birds	No. Flocks
J15	Livingston	50	2	6	1	526	5
J16	Los Banos A	226	4	1,480	11	435	7
J17	Los Banos B	762	14	126	1	3	1
J18	Le Grand	0	0	103	1	0	0
J19	Dos Palos	1,420	6	19	1	0	0
J20	Madera West	870	7	1,087	2	38	4
J22	Mendota	–	–	0	0	–	–
J23	Rolling Hills	–	–	0	0	–	–
<i>Tulare Basin</i>							
T 1	Kerman	506	1	622	1	740	3
T 2	Cantua Creek	–	–	0	0	4	1
T 4	Parlier	–	–	0	0	–	–
T 6	Reedley	–	–	0	0	–	–
T 7	S of Five Points	–	–	–	–	215	1
T 11	Huron	–	–	–	–	0	0
T 12	Lemoore-Hanford	–	–	–	–	0	0
T 13	E of Hanford	–	–	–	–	0	0
T 15	Visalia	0	0	–	–	–	–
T 16	N of Kettleman City	–	–	–	–	0	0
T 17	S of Hanford	–	–	–	–	0	0
T 18	Tulare	–	–	–	–	251	3
T 19	Exeter	0	0	–	–	–	–
T 20	Tulare Lakebed	43	1	0	0	–	–
T 21	Stratford-Corcoran	–	–	–	–	0	0
T 22	Waukena	–	–	–	–	0	0
T 23	Woodville	2	1	–	–	–	–
T 24	S of Corcoran	–	–	–	–	5	1
T 25	E of Corcoran	180	2	0	0	325	1
T 26	Porterville	–	–	1,590	5	6	1
T 27	TLDD	–	–	–	–	0	0
T 28	Alpaugh	330	2	–	–	1,650	2
T 29	Pixley	207	5	0	0	2,164	4
T 30	Terra Bella	–	–	0	0	–	–
T 31	Richgrove	0	0	0	0	–	–
T 32	Lost Hills	–	–	9	2	–	–
T 33	Poso Creek	0	0	0	0	206	4
T 34	Famosa	–	–	0	0	–	–

(continued)

Table 1. Numbers of Long-billed Curlews on three surveys of California’s Central Valley in 2007–2008 (continued).

Route No.	Route Name	13–16 Sept. 2007		1–6 Feb. 2008		11–18 Sept. 2008	
		No. Birds	No. Flocks	No. Birds	No. Flocks	No. Birds	No. Flocks
T35	Buttonwillow	–	–	0	0	–	–
T36	Goose Lake	6	1	4	1	–	–
T37	SW of Shafter	0	0	–	–	–	–
T39	Buena Vista Lakebed	0	0	40	1	–	–
T40	W of Bakersfield	0	0	0	0	–	–
T41	Weedpatch	60	1	0	0	0	0
T42	Arvin	–	–	100	1	0	0
Agricultural Subtotal		15,846	114	8,371	59	17,117	112
Sacramento Valley Refuges and Wildlife Areas							
	Federal Refuges	3,204	5	–	–	1,658	6
	Yolo Bypass WA	0	0	0	0	0	0
San Joaquin Valley Refuges, Wildlife Areas, Private Wetlands							
	San Joaquin River NWR	0	0	0	0	–	–
Grasslands Ecological Area							
	Federal Refuges	10	1	785	3	–	–
	State Wildl. Areas	3	1	–	–	–	–
	Private Wetlands	–	–	768	9	–	–
	Mendota WA	0	0	0	0	–	–
	Pixley NWR	0	0	72	2	0	0
	Kern NWR	0	0	187	2	0	0
Wetlands Subtotal		3,217	7	1,812	16	1,658	6
Grand Total		19,063	121	10,183	75	18,775	118

^a Agricultural subareas designated but not covered on any of the three surveys included J2 (Modesto), J6 (Patterson), J21 (Sharon), T3 (Raisin City), T5 (Clovis), T8 (Riverdale), T9 (Dinuba), T10 (Coalinga), T14 (Ivanhoe), and T38 (Rosedale).

Distribution

Curlews were differentially distributed in the study area, with areas of concentration varying among surveys. In September 2007, two general areas held the vast majority of curlews (Table 1, Figure 1): five contiguous subareas in the Delta region in southern Yolo County and (primarily) Solano County held 8,874 curlews (56% of the agricultural total surveywide) and seven contiguous areas in the San Joaquin Basin in southern Stanislaus, Merced, western Madera, and northern Fresno counties held 5,250 curlews (33% of agricultural total). In February 2008, the San Joaquin Basin again had large numbers of curlews, with nine loosely contiguous subareas holding 4,685 curlews (56% of agricultural total); the only other concentration was of 1,590 curlews in one subarea in Tulare County in the Tulare Basin (Table 1, Figure 2). In September 2008, curlews again were concentrated in the Delta region of Solano County, where three subareas held 8,214 curlews (48% of agricultural total), but also in the Tulare Basin, where four subareas held 4,345 curlews (25% of agricultural total; Table 1, Figure 3).

Although wetland areas held substantial numbers of curlews on some surveys (Table 1), these wetlands often serve primarily as roosting areas for curlews foraging in surrounding agricultural fields. On 17 September 2007, about 3,200 curlews were roosting mid-day at Delevan National Wildlife Refuge, and additional observations indicated they were foraging in surrounding rice fields in the morning (Mike Carpenter pers. comm.). Although these observations suggest even larger numbers of curlews are foraging in ricelands, we were unable to survey the very extensive area of rice fields in the Sacramento Valley in which Delevan and other wetland complexes are embedded.

Table 2. Percentage of curlews recorded in various major crop or field types on three surveys in the central and southern Central Valley, 2007 to 2008

	Irrigated Pasture	Native Pasture	Alfalfa	Other Hay	Grain	Tilled or Fallow	Unspecified or Misc. Crop
Sept. 2007	42	4	48	3	0	2	1
Feb. 2008	2	45	36	7	7	3	0
Sept. 2008	21	1	69	1	0	1	9

Habitat Use

Curlews were found primarily in just a few major habitat types in the agricultural landscape of the central and southern Central Valley (Table 2).

We characterized agricultural habitat use for 13,899, 6,104, and 15,465 curlews on the September 2007, February 2008, and September 2008 surveys, respectively. Overall, alfalfa and pastures were the primary habitats used by curlews, together accounting for 83% to 94% of all birds across the three surveys. Alfalfa was the most frequently used crop on the September surveys, and second only to pasture in winter when in the Central Valley alfalfa, a perennial crop, is quasi-dormant and not irrigated or harvested. Pasture was also important on all surveys. Use of irrigated pasture, however, was much greater than that of native pasture on both September surveys, with use of native pasture dominating on the February survey.

DISCUSSION

Abundance, Distribution, and Seasonality

Patterns of distribution and abundance of curlews in the central and southern Central Valley varied substantially among the three broad-scale surveys, and particularly between the two September surveys and the single February survey (Table 1, Figures 1–3). Caution is warranted in interpreting both the patterns of distribution in the context of the entire Central Valley and the estimates of overall abundance in this region, which likely were substantially underestimated, given limited coverage of the Tulare Basin prior to the September 2008 survey and a lack of coverage of most agricultural lands in the Sacramento Valley on any of the surveys.

The overall tally of 10,183 curlews in February 2008 was about 46% fewer than the 19,063 and 18,775 on the September 2007 and 2008 surveys, respectively. This disparity was slightly greater when comparing curlew numbers on just the agricultural survey areas of the central and southern Central Valley, where the total of 8,371 curlews in February 2008 was about 47% to 51% fewer than the 15,846 and 17,117 curlews on the two September surveys, respectively (Table 1). Inconsistent coverage among surveys may explain some of the variation in census totals. Still, the February numbers were much smaller than in September despite higher numbers of observers and coverage of more subareas in February than on either of the September surveys. On these broad-scale surveys, the Solano-Yolo region had consistently high numbers in September, whereas portions of the San Joaquin Basin and the Tulare Basin held substantial numbers of curlews in either September or February.

On multiple, cross-season surveys of the three South Dixon subareas, totals were consistently highest in September, about the driest time of the annual cycle, when curlews are particularly concentrated in irrigated alfalfa fields and irrigated pastures. Much lower numbers on early- and late-winter surveys may reflect much wider dispersal of curlews to habitats outside of Solano County after the soaking winter rains change the foraging suitability of previously parched grasslands or other habitats. Lower numbers of

Figure 1. Distribution and relative abundance of Long-billed Curlews across 88 agricultural subareas of the central and southern Central Valley on a survey in mid-September 2007. Numbers on map correspond to subarea numbering in Table 1 (see also for data on abundance of curlews on state, federal, and private wetlands).

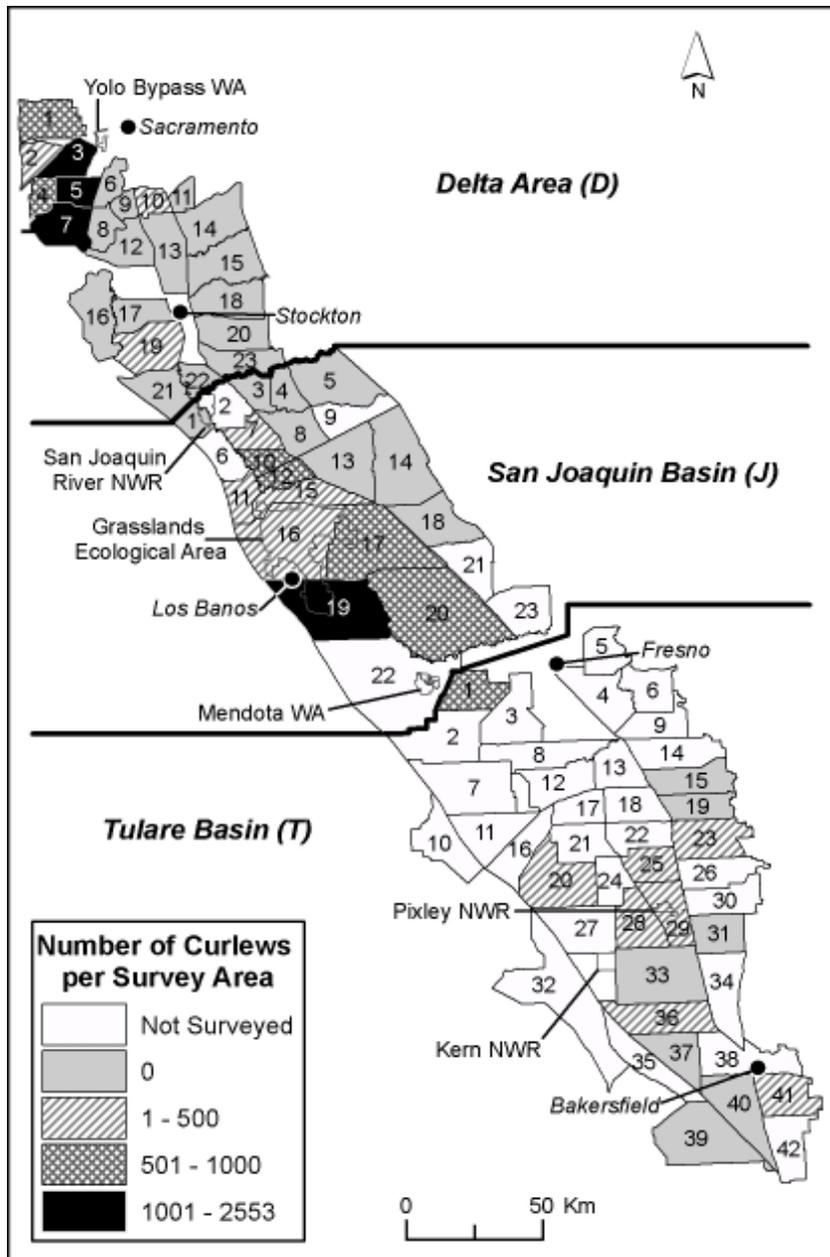


Figure 2. Distribution and relative abundance of Long-billed Curlews across 88 agricultural subareas of the central and southern Central Valley on a survey in early February 2008. Numbers on map correspond to subarea numbering in Table 1 (see also for data on abundance of curlews on state, federal, and private wetlands).

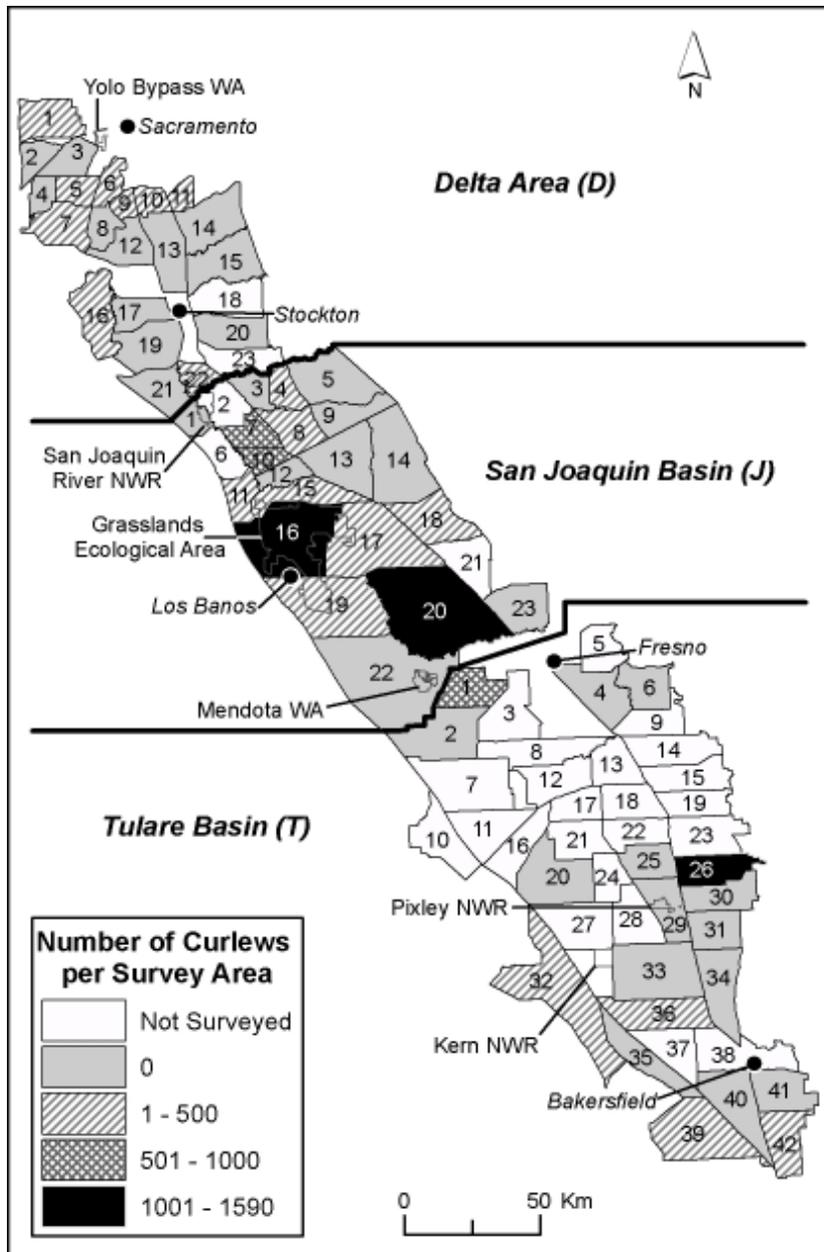
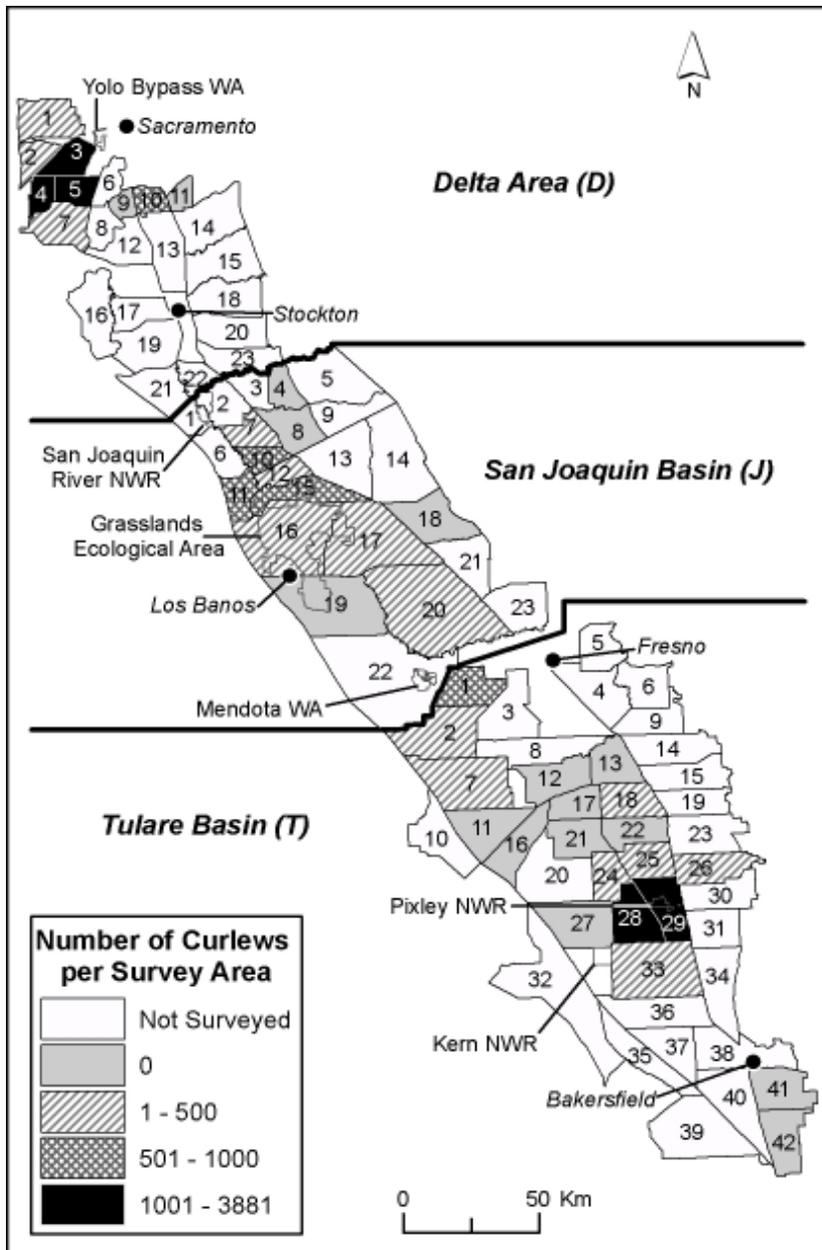


Figure 3. Distribution and relative abundance of Long-billed Curlews across 88 agricultural subareas of the central and southern Central Valley on a survey in mid-September 2008. Numbers on map correspond to subarea numbering in Table 1 (see also for data on abundance of curlews on state, federal, and private wetlands).



curlews in the Solano area in winter also might reflect movement of some curlews into rice fields in the Sacramento Valley after the harvest, which occurs mainly from late August through mid-October, or the migration of some curlews by October to wintering areas south of California. Although mortality surely reduces curlew numbers as the season progresses, this seems likely to account for a very small proportion of the roughly six-fold decrease in curlew numbers in the South Dixon region from September to November, which is before the coldest and rainiest portion of the winter.

In addition to seasonal shifts in curlew use patterns within the Central Valley, it is possible that there is interchange of curlews between that large valley and other smaller valleys within the Coast Ranges to the west. At the Carrizo Plain, San Luis Obispo County, large numbers of curlews typically are not found until after November following periods of rain (Andrea Jones in litt.). For example, 11 observers recorded a total of only 9 curlews on a broad-scale survey of the Carrizo Plain in September 2007, but 1–2 observers counted 763 and 325 curlews at a traditional roost site in the Carrizo Plain at the north end of Soda Lake on 22 January and 5 February 2008, respectively (Sam Fitton and Kathy Sharum in litt.). The largest numbers for that area of which we are aware were reported at that roost on 11 January 2006: 2,200 in the morning and 3,000 that evening (Sam Fitton in litt.). Elsewhere in the Coast Ranges, S. Fitton (in litt.) recorded 174 and 116 curlews at a roost in the Bolsa Valley north of Hollister, San Benito County, on 21 and 23 January 2008, respectively, and 174 curlews at a roost in the San Felipe area near the Santa Clara–San Benito County line on 23 January 2008.

Relative Importance of the Central Valley to Curlews

From late summer to early spring, nonbreeding curlews are distributed widely but locally in the lowlands of California. Important wintering areas in the state besides the Central Valley and Carrizo Plain include the Imperial Valley in the Colorado Desert, various valleys (collectively) within the Coast Ranges, and coastal estuaries, beaches, and plains.

A coordinated survey of various interior valleys in California from 13–16 September 2007, which included the respective survey of the (central and southern) Central Valley reported here, estimated a minimum of 30,000 curlews (Page et al. 2007). Of these, about 65% were in the Central Valley, 35% in the Imperial Valley, and <1% each in the Antelope Valley, San Jacinto Valley, and Carrizo Plain. Observers in the Imperial Valley tallied about 10,000 curlews on this survey and 13,000 on a prior January 2007 survey (Kathy Molina/Natural History Museum of Los Angeles County unpubl. data). Although the numbers recorded for the area covered on our February 2008 survey (Table 1) were lower than the total for the Imperial Valley in January 2007, numbers likely would have been substantially higher if coverage of the Central Valley had been more complete and had included the extensive agricultural lands of the Sacramento Valley.

The available data suggest the number of Long-billed Curlews on the entire California coast in winter is in the low-to-mid thousands. On early winter censuses of shorebirds at all major California estuaries coordinated by PRBO Conservation Science from 1989–1994, curlew totals averaged about 3,000 birds, of which over 50% were at San Francisco Bay (Page et al. 1999, PRBO unpubl. data). Data are lacking for the total number of curlews on coastal beaches or uplands on the coastal slope but collectively are likely smaller than those in coastal estuaries.

The data on numbers of curlews in California in the nonbreeding season reported here are among the few that exist. Therefore, it is not clear if the size of the wintering population is exhibiting any trend. Knowledge of past declines on the breeding grounds, however, suggests that conservation concern is warranted for the Central Valley, where large numbers of curlews congregate in migration and winter.

Future Work

We recommend expansion of the surveys reported here to encompass a broad-scale survey of the entire Central Valley, to obtain a better estimate of overall curlew abundance in this region and a better determination of the importance of various subregions—particularly the Sacramento Valley—to curlews. Because curlews may congregate in large numbers at nighttime roosts, it would be valuable to identify the location and persistence of such roosts and to explore whether roost counts might prove useful in obtaining comprehensive counts or in tracking population trends via periodic counts of curlews at a large sample of roosts. Anecdotal evidence suggests that seasonal changes in cropping patterns in agricultural fields and in the moisture content of soils over the course of the winter rainy season likely cause curlews to shift locations extensively within the Central Valley to exploit optimal foraging conditions. In the future, it would be valuable to better document how patterns of habitat use of curlews in the Central Valley vary locally and seasonally and to explore how this information can best be used to maintain and improve curlew wintering habitats in the Central Valley.

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Announcement

Help count curlews this August!

Volunteers are needed to help count Long-billed Curlews in the Central Valley during the four-day period August 7 and 10, 2009.

The purpose of the surveys is to estimate the total number of migrating and wintering curlews in the interior valleys of California, to identify hot spots of occurrence, and learn more about which types of croplands they prefer. Surveys are conducted by driving routes in pre-determined areas and counting all curlews that can be seen from the road. Surveying areas are sized so that it can be covered by one or two people in four to eight hours of birding.

This will be the fourth survey PRBO and Audubon have run in recent years, and we learn more every time. For the first time ever, we have new areas to cover north of Sacramento. Agricultural fields support large numbers of curlews in the interior valleys of California. Dry and irrigated pastures, alfalfa fields, and post-harvest rice fields appear to be important foraging habitats. We want to learn how much curlews depend on agricultural lands during migration and winter and if the species can cope with future changes in the California farming industry.

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