CENTRAL DELTA WATER AGENCY

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NOV 0 3 2015

Re: BDCP/California Water Fix
RDEIR/SDEIS
DJN Sr. Part Three

Our comments regarding the above are being submitted in multiple parts.

Adverse impacts to Delta Water Quality Violate Anti-Degradation Policies and The Delta Reform Act and Are Avoidable by Elimination of Isolated Delta Conveyance

Adverse impacts to Delta Water Quality result both from operation of the isolated conveyance alternatives and from the habitat mitigation and so-called restoration projects.

The reported resulting increases in EC in Tables EC-8A and EC-8B show that average EC for a 5 year drought period will increase at Prisoner's Point in February from 6% to 7% in March from 20% to 30% and April from 17% to 26%, and in September from 12% to 14%. For agriculture in the central Delta this is significant adverse impact. Salt accumulation in the soil during periods of drought is aggravated by the lack of rain, and due to the soil and groundwater conditions increasing leaching fractions is not feasible. Elimination of exceedences of the WQCP objective will not eliminate the degradation and given the historic application of emergency authority to circumvent WQCP objectives during drought it is unlikely that even the objective would limit operation of any isolated conveyance during drought. Compliance with water quality objectives rather than avoidance of degradation assumes that the objectives avoid significant harm. There is no supporting analysis for such assumption. The analysis of effects ignores the adverse impact to water quality from conservation measures due to increased salinity intrusion from increase of the tidal prism, shortening the path for intrusion and increased evaporative losses. Degradation is the result of the desire to increase exports and is inconsistent with the Delta Reform Act requirements to honor the statutory and water right priorities, enhance Delta agricultural values, reduce reliance on the Delta and make the Delta water supply more reliable.

The determination that the effects on boron concentrations are less than significant ignores the adverse impact associated with accumulation in the Delta soils, especially during drought conditions.

Table BO-5 shows significant interior Delta increases in concentration of boron in both the full year and drought year averages with some monthly increases as high as 37%. The analysis ignores the impact of increased evaporative losses and the result reduced assimulative capacity due to the conservation measures. The resulting degradation violates the policies against degradation as well as the Delta Reform Act.

The determination that there is no available mitigation to address the significant adverse impacts from increases in methyl mercury concentration measures is the result of the desire to export water that is not surplus to the needs of the Delta and other areas of origin. Operation and improvement of the through Delta conveyance coupled with reduction of exports to provide sufficient to protect fish would avoid the need for conservation measures which increase methyl mercury. As set forth in previous comments, the assumed benefits from the proposed conservation measures some of which increase methyl mercury are not supportable.

The increase in pathogens resulting from the conservation measures is determined not to be significant because it is localized and public access can be prevented. Preclusion of Public Access to tidal wetlands requires a control structure disconnect from the navigable water and control of trespass even with such a disconnect is uncertain. Additionally, the confinement of the increased pathogens to isolated areas is impossible with tidal wetlands and uncertain with floodplain inundation.

Microcystis is already a significant health hazard in the Delta to recreational users and animals, and the Delta is a source of drinking water to export and local users. Isolated conveyance will remove substantial quantities of the good quality Sacramento River water from passing through the interior of the Delta to the export pumps near Byron. This will reduce velocities in some areas and increase residence time. Elimination of the flushing action and dilution from the cross-delta flow will increase residence time in many locations and increase the concentration of constituents contributing to algal blooms. Water temperature and clarity increases could also result. Further investigation and implementation of operational measures to manage residence time is clearly not a good faith effort to fully consider all reasonable alternatives. The most obvious of which is to eliminate isolated conveyance, provide adequate flushing flows and export only water which is truly surplus.

The microcystis effects from conservation measures could certainly be mitigated by eliminating those which create the problem. The impacts to fish which the conservation measures are intended to mitigate can be mitigated with water flow and other measures including the reduction of export of water which is not truly surplus and sensitivity as to when to run the export pumps.

RECIRC2650

The BDCP/Water Fix Fails to Provide Good Faith Consideration of Impacts, Alternatives and Mitigation Relating to Waterfowl Including Those of International Importance In The Pacific Flyway

The Delta is an important wintering ground for waterfowl of the Pacific Flyway including Sandhill Cranes. The routing for alternatives 4A, 2A and 5A pass through the heart of the wintering grounds for such waterfowl. The fourteen years of construction activity and presence of electrical transmission lines will result in short and long term adverse impacts. Suggested avoidance and minimization measures and mitigation has not been demonstrated to be adequate. Landuse in the Delta primary zone is highly restricted and much of the land is not suitable for vineyards and orchards. The lands are already available habitat. The mitigating effect of so-called compensation for the loss of foraging and nesting habitat has not been demonstrated.

The analysis does not appear to have adequately considered impacts to Sandhill Cranes in other Delta areas, including Bouldin Island, Mandeville Island and others. The proposed tunnel material disposal site on Bouldin Island will greatly impact Sandhill Crane winter foraging habitat on the island for 14 years or more. See Figure 4 on Exhibit 30-1.

The tunnel construction disturbance and electric transmission lines crossing Mandeville Island and others will adversely impact migrating waterfowl, including Sandhill Cranes during the winter and will adversely impact important wetland nesting areas. See Table 2 of Exhibit 30-2. Mandeville Island contains the multi-thousand acres of wetland and waterfowl management areas of the Tuscany Research Institute, which have not been considered. See Exhibits 30-2 and 30-3.

The presence of electrical transmission lines in the existing wintering areas is not adequately offset by actions in other areas since the obligation for such avoidance of take of special status species is already an obligation.

Alternative tunnel locations away from the important waterfowl wintering and nesting areas in the Delta have not been considered. Tunnel locations such as beneath the I-5 and 205 highways or easterly would greatly reduce the adverse impacts to waterfowl including Sandhill Cranes.

With such alternatives, impacts to roads and agriculture lands could be reduced. The need for additional electrical transmission lines could also be reduced. Improvement of conveyance through the existing Delta channels coupled with a limitation on exports to truly surplus water consistent with the mandates of law is also an alternative not given objective consideration.

Sea Level Rise Assumptions Used In The analysis Fail to examine A Sufficient Range of Possibilities Including the Possibility of No Increase In The Rate of Increase And Possible Decline

Attached hereto is Exhibit 31 which shows that the rate of sea level rise at the Golden Gate has declined.

Very truly yours

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Manager and Co-Counsel

DISTRIBUTION, ABUNDANCE, AND MIGRATION TIMING OF GREATER AND LESSER SANDHILL CRANES WINTERING IN THE SACRAMENTO-SAN JOAQUIN RIVER DELTA REGION OF CALIFORNIA

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Abstract: The Sacramento-San Joaquin River Delta region of California (hereafter, Delta region) is an important wintering region for the Central Valley Population of greater sandhill cranes (*Grus canadensis tabida*) and lesser sandhill cranes (*G. c. canadensis*), but basic information about the ecology of these birds is lacking to design a biologically sound conservation strategy. During the winters of 2007-08 and 2008-09, we conducted roost counts, roadside surveys, aerial surveys, and tracked radio-marked birds to define the geographic area used by sandhill cranes in the Delta region, document migration chronology, and estimate subspecies-specific abundance. Radio-marked sandhill cranes arrived in our study area beginning 3 October, most arrived in mid-October, and the last radio-marked sandhill crane arrived on 10 December. Departure dates ranged from 15 January to 13 March. Mean arrival and departure dates were similar between subspecies. From mid-December through early-February in 2007-2008, the Delta population ranged from 20,000 to 27,000 sandhill cranes. Abundance varied at the main roost sites during winter because sandhill cranes responded to changes in water conditions. Sandhill cranes used an area of approximately 1,500 km^2 for foraging. Estimated peak abundance in the Delta region was more than half the total number counted on recent Pacific Flyway midwinter surveys, indicating the Delta region is a key area for efforts in conservation and recovery of wintering sandhill cranes in California. Based on arrival dates, flooding of sandhill crane roost sites should be staggered with some sites flooded in early September and most sites flooded by early October. Maintained flooding through mid-March would provide essential roosting habitat until most birds have departed the Delta region on spring migration.

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Key words: abundance, California, *Grus canadensis*, migration chronology, Sacramento Delta, sandhill cranes, San Joaquin Delta.

California's Central Valley is an important wintering region for sandhill cranes (*Grus canadensis*), both for the Central Valley Population of greater sandhill crane (*G. c. tabida*, hereafter referred to as greaters) and the Pacific Flyway Population of lesser sandhill crane (*G. c. canadensis*, hereafter referred to as lessers) (Pacific Flyway Council 1983, 1997). Sandhill cranes are patchily distributed in the Central Valley using areas where agricultural practices appear to meet their ecological needs and undisturbed roost sites are available (e.g., Pogson and Lindstedt 1991). The Sacramento-San Joaquin Delta region of California (hereafter Delta region) is a major wintering site for sandhill cranes in the Central Valley, and is particularly important for greaters (Pogson and Lindstedt 1991), listed as threatened in California (CDFW 2013).

Because of the importance of the Delta region for wintering sandhill cranes, agencies and conservation groups have acquired, enhanced, and managed lands for use by sandhill cranes. Most of this activity has centered on 5 major roost complexes in the Delta region; the Isenberg Sandhill Crane Reserve owned by California Department of Fish and Wildlife (CDFW), Stone Lakes National Wildlife Refuge (NWR) and San Joaquin River NWR owned by U.S. Fish and Wildlife Service (USFWS), Cosumnes River Preserve, established by The Nature Conservancy (TNC) in partnership with the Bureau of Land Management (BLM) and with multiple agency ownerships, and the more recent acquisition of Staten Island by TNC. All these properties include a portion of habitat managed to provide winter roost sites for sandhill cranes.

Periodic monitoring has confirmed sandhill cranes

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are using all areas currently managed for roost habitat (Pogson and Lindstedt 1991, Ivey and Herziger 2003), but basic information about the timing of use and subspecies composition are lacking. Moreover, no annual surveys are conducted to estimate crane abundance and define their distribution in the Delta region. Such basic information is necessary for proper sandhill crane management in the face of new environmental threats. For example, the recent spread of West Nile virus into California has caused landowners and managers to reduce the amount of shallow, standing water that might support mosquitoes during summer and early fall (e.g., CDFW 2007). Data on the timing of arrival and expected abundance over time at key roost sites in fall will provide the information needed to justify the timing and size of flooded roost sites to maintain sandhill crane use on traditional sites.

Our study addresses key questions about the abundance and distribution of sandhill cranes that winter in the California's Sacramento-San Joaquin Delta. Specifically, we quantify the timing of arrival, residence time, and timing of departure at major roost sites, track changes in roost use from fall through winter, estimate subspecies specific sandhill crane abundance, and define the distribution of sandhill crane occurrence in the Delta region during winter. When combined with information on habitat use and individual movements, this information will be critical for the development of biologically sound conservation plans for sandhill cranes wintering in the Delta region.

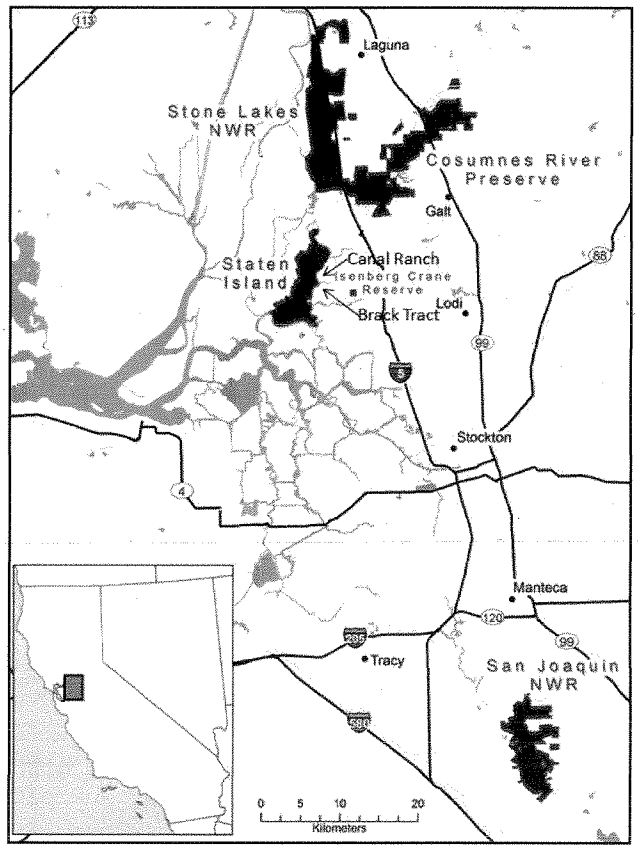

Figure 1. Map of the Sacramento-San Joaquin Delta and the San Joaquin River National Wildlife Refuge where distribution, abundance, and arrival and departure dates of greater and lesser sandhill cranes were studied, 2007-2009. Grey areas are waterways.

STUDY AREA

Our study focused on the Delta region but we also collected some information on sandhill crane abundance in the San Joaquin NWR region (Fig. 1). Our study concentrated specifically on several properties managed to provide night roost sites for sandhill cranes that subsequently support most of the sandhill cranes that winter in the Delta region (Pogson and Lindstedt 1991, Ivey and Herziger 2003), including Staten Island, Canal Ranch, Cosumnes River Preserve, Brack Tract, and Stone Lakes NWR. The study area was primarily rural agricultural landscapes bordered by urban communities. Agricultural land uses included field and silage corn, fall-planted (winter) wheat, rice, alfalfa, irrigated pasture, dairies, vineyards and orchards. The area also contained tracts of oak savannah and floodplain wetlands along the Cosumnes and Mokelumne rivers. The San Joaquin NWR region (located in Stanislaus County, approximately 12 km west of Modesto) includes the refuge and private croplands similar to the Delta region.

METHODS

Capture, Radio-marking, and Tracking

We captured and radio-marked a total of 33 greaters, 44 lessers, and 1 Canadian sandhill crane (*G. c. rowani;* identified morphologically, hereafter referred to as Canadian) on wintering, spring staging, and breeding areas. We captured 33 greaters and 28 lessers using rocket nets baited with corn (Urbanek et al. 1991) and noose lines (Hereford et al. 2000) at Staten Island or Cosumnes Preserve between 17 October 2007 and 27

February 2008. Additionally, to increase our sample of marked birds, we used rocket nets to capture 6 lessers on a spring staging site (Ladd Marsh Wildlife Management Area) near LaGrande, Oregon, in April 2008 and used noose lines to capture 10 lessers on their breeding grounds near Homer, Alaska, in August 2008.

For each sandhill crane captured, we determined subspecies based on morphological differences (Johnson and Stewart 1973). We marked each individual with a U.S. Geological Survey aluminum leg band and a unique combination of color bands. Finally, we radio-marked each sandhill crane with a VHF transmitter (Sirtrack, Hawkes Bay, New Zealand, Model AVL6171) that was mounted to a tarsal band (Krapu and Brandt 2001). Transmitters weighed approximately 30 g (<1% of body mass), had a life expectancy of 730 days, and were equipped with a mortality sensor. The 10 birds captured in Alaska were marked with platform terminal (satellite) transmitters mounted to a tarsal band. All birds were released at their capture site within an hour after capture.

We attempted to locate each radio-marked sandhill crane daily, from October through mid-March, using hand-held 3-element Yagi antennas and a truck-mounted null-peak antenna system (Balkenbush and Hallett 1988, Samuel and Fuller 1996); however, our relocation rate averaged every 2 days, varied by individual, and primarily depended on sandhill crane movement within our study area. We used a Global Positioning System (GPS) linked to a computer system to enter bird identification number, local site name, truck location, date, time, and bird bearings from multiple locations. We used Program Locate III (Pacer Computing, Tatamagouche, NS, Canada) to triangulate locations (Nams 2005). We conducted 7 aerial searches (Gilmer et al. 1981) over the 2 winters of our study of areas throughout central California to locate sandhill cranes that left the Delta region. During aerial surveys, we also mapped locations that looked suitable as sandhill crane night roosts.

Our handling of sandhill cranes was conducted under the guidelines of the Oregon State University Animal Care and Use Committee (project #3605) to ensure methods were in compliance with the Animal Welfare Act and United States Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training policies. Sandhill cranes were captured under CDFW permit SC-803070-02 and U.S. Geological Survey federal banding permit MB#21142.

Migration Chronology

We used telemetry information from our radio-marked sandhill cranes to characterize fall migration arrival and spring migration departure dates relative to our study area during fall 2008 and spring 2009. We defined arrival date as the first date each sandhill crane was found during fall in the study area and departure date as the last date they were detected in late winter. We calculated the number of days our marked sandhill cranes were at our study sites in the Delta region (i.e., winter residency period) from our telemetry records by totaling days that individuals were found at our study sites in the Delta region. We used the Student's *t*-test to assess if either mean arrival date in fall of 2008 or departure date in spring of 2009 differed by subspecies.

Sandhill Crane Abundance

Roost counts.—We conducted biweekly counts of sandhill cranes at the 5 major night roost complexes in the our study area (Staten Island, Brack Tract, Canal Ranch Tract, Cosumnes River Preserve, and Stone Lakes NWR) between 5 October 2007 and 27 February 2008 to document seasonal patterns of abundance and estimate peak sandhill crane population size in the Delta region. We also conducted roost counts at the San Joaquin River NWR monthly during October 2007 through February 2008. We conducted each count over a period of 2 or 3 days but all sites within each roost complex were counted on the same night or morning. We conducted surveys by stationing observers with binoculars at key locations around a roost complex to count all sandhill cranes as they flew into a roost site at sunset or during early morning before they left their roost. We did not have permission to survey the Canal Ranch roost complex on 3 December, so we report estimates only for 3 dates with complete roost count data.

Aerial surveys.—To generate an unbiased estimate of abundance that included a measure of precision, we conducted aerial surveys (e.g., Caughley 1977, Dugger et al. 2005) on 14 and 28 January and 5 February 2008. We first partitioned the study area into high and low density survey blocks based on our understanding of roost site distribution and relative sandhill crane abundance (Ivey and Herziger 2003). In the Delta region, we created 3 high density survey blocks centered on the major roost complexes at Stone Lakes

NWR, Staten Island and adjacent Brack Tract and Canal Ranch, and the Cosumnes River Preserve. The remainder of the Delta region was classified as a low density survey block. In the San Joaquin NWR region, we identified 1 high density block associated with San Joaquin NWR that was imbedded in a larger, low density, block. We partitioned each survey block into a series of 1-km-wide survey strips oriented north-south. We stratified our sample effort by survey block size and randomly selected (without replacement) a sample of transects to survey within each block, adding transects until the total transect area equaled or exceeded 10% of the total block area. We used the same set of transects for each survey.

We conducted surveys from a fixed-wing aircraft flying 300 m above the ground and at a speed of 160 km/hr. We used markers on the aircraft window to identify transect boundaries, and 2 observers counted sandhill cranes out each side of the aircraft while the pilot flew a line down the middle of each survey strip.

For each survey, we estimated sandhill crane abundance as (Caughley 1977):

$$\hat{Y} = RZ$$

where Z = area of total census

R = average density per unit area = $\Sigma y_{ji}/\Sigma z_i$

where y_{ji} = total sandhill cranes j counted on transect i

z_i = area of transect i

variance was calculated as:

$$[N(N-n)/n(n-1)]/(\Sigma y2 + R2\,\Sigma z2 - 2R\,\Sigma yz)$$

We estimated abundance separately for high and low density survey blocks then combined the 2 estimates for an estimate of total population size for each survey. We estimated abundance for the Delta and San Joaquin River NWR regions separately, and provide totals for these 2 regions.

Abundance by subspecies.—Because we could not identify sandhill cranes to subspecies during roost counts or aerial surveys, we conducted roadside surveys at the Cosumnes River Preserve, Staten Island, and Brack Tract to differentiate the subspecies and estimate the relative abundance of greaters and lessers in the Delta region. Counts by roadside surveys were conducted biweekly by 2 experienced observers during morning feeding periods (0700-1000 hr) from early October through mid-February in 2007-08 and 2008-09. We counted all flocks from vehicles using binoculars and spotting scopes and assigned all sandhill cranes observed as greaters or lessers using morphological characteristics described by Drewien and Bizeau (1974): 1) greaters are approximately 25-33% taller and more massive; 2) greaters are lighter gray in late fall and winter; 3) greaters have longer and more massive bills in relation to head length; and, 4) greaters have sloping foreheads in comparison to lessers which have rounded foreheads. A few sandhill cranes appeared intermediate in size and were likely Canadians. Our abundance estimates for greaters probably included a few Canadians, but because only 1 of the 60 sandhill cranes that we captured had the morphological measurements of a Canadian (see Johnson and Stewart 1973), this source of bias is likely very low.

We used the estimate of the ratio of greaters to lessers derived from roadside surveys to calculate subspecies-specific abundance for 4 roost count dates (3, 17, 31 December 2007 and 14 January 2008). We could not conduct a roadside survey at the Cosumnes River Preserve on 17 December because of poor road conditions; therefore, we took the mean proportion of the roadside surveys for dates immediately before and after 17 December as our estimate to estimate subspecies proportions for that roost count data. Based on the arrival and departure dates of our radio-marked sandhill cranes, our 3 December to 14 January survey interval occurred after all sandhill cranes had arrived and ended before any birds had departed for spring migration. This interval included the period previously known to support peak numbers of greaters in the Delta region (Pogson and Lindstedt 1991). To adjust the total roost count data, we used the proportion estimate generated from the roadside survey that was closest to the roost count date. Finally, because sandhill crane abundance varied by roost complex, we generated proportion estimates (of greaters to lessers) separately for each roost complex and applied that ratio to estimate the number of greaters and lessers at each roost. To derive relative abundances for roosts where we did not have roadside surveys we used proportions from the next nearest roost area: for Stone Lakes NWR we applied the estimate from the Cosumnes River Preserve; and for Canal Ranch we applied the estimate averaged from Staten Island and Brack Tract. We then summed estimates from each roost to arrive at the total. We did not have data on subspecies proportions for the San Joaquin NWR region because no roadside surveys were conducted there. We report values as mean ± SE.

Sandhill Crane Distribution

We plotted all locations for radio-marked sandhill cranes on a map of the study area. We supplemented that data with observations of flocks seen from the ground and air during our searches for radio-marked birds. We combined these data sets to generate a map of sandhill crane distribution as well as roost locations in the Delta region.

RESULTS

Migration Chronology

Sandhill cranes were reported arriving in our study area as early as 6 September 2007 (M. Ackerman, personal communication), and 9 September 2008 (B. Tadman, personal communication). In 2008 we detected the first radio-marked lesser on 3 October, and the first radio-marked greater on 4 October. Peak arrival occurred slightly earlier for greaters than lessers in 2008 (Fig. 2); however, the average arrival date was similar ($t = 1.22$, $P = 0.23$) between radio-marked greaters (13 Oct ± 2 days) and radio-marked lessers (17 Oct ± 3 days). The average departure date was also similar ($t = 1.03$; $P = 0.30$), for greaters (25 Feb ± 1 days) and lessers (22 Feb ± 2 days) (Fig. 2). Lessers began departing the study area earlier yet some lingered longer in the Delta region than the greaters (latest departure 13 March versus 7 March, respectively). Winter residency was 22% longer for greaters (130 ± 7 days) than for lessers (107 ± 4 days; $t = 2.78$, $P < 0.01$).

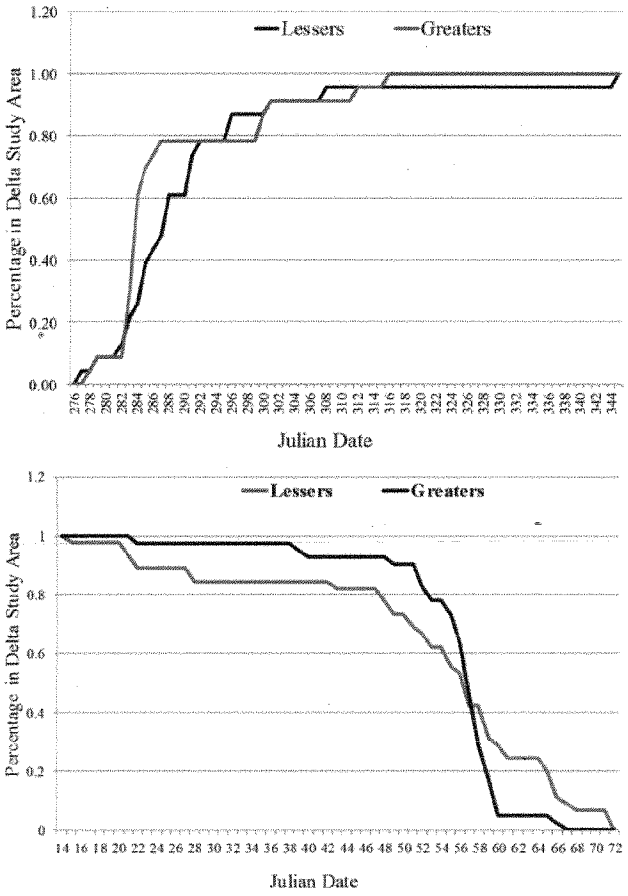

Figure 2. Chronology of arrival in fall 2008 (top) and departure in spring 2009 (bottom) of radio-marked greater and lesser sandhill cranes to the Sacramento-San Joaquin Delta, 2008. The lines represent the proportion of radio-marked birds on the study area at each date. Julian date 276 is 2 October, date 344 is 10 December, date 14 is 14 January, date 66 is 7 March, and date 72 is 12 March.

Abundance

Roost counts.—The total number of roosting sandhill cranes in the Delta region increased from a low of 6,421 (5 Nov 2007) to a high of 27,213 (11 Feb 2008, Fig. 3). The season mean was 15,037 ± 4,529. Table 1 shows the largest average abundance was recorded at Brack Tract roost complex (7,423 ± 2,129) followed by Staten Island (4,898 ± 1,045), Canal Ranch (4,095 ± 1,425), Cosumnes River Preserve (1,539 ± 339), and Stone Lakes NWR (345 ± 40). Early in the season, most sandhill cranes roosted at Staten Island, however as winter progressed sandhill cranes shifted to Brack Tract and by end of winter most sandhill cranes were roosting in the Brack Tract roost complex. Peak counts recorded at each site included 24,487 at Brack Tract, 10,995 at Staten Island, 7,215 at Canal Ranch, 4,347 at Cosumnes River Preserve, and 598 at Stone Lakes NWR (Table 1). Counts for San Joaquin River NWR averaged 2,310 (± 132), and peaked at 2,895 in February (Table 1).

Aerial surveys.—Based on aerial surveys conducted in 2008, we estimated 19,183 ± 1,500 (95% CI: 16,243-22,123; Coefficient of Variation [CV]: 0.07) sandhill cranes in the combined Delta and San Joaquin NWR regions on 14 January, 9,028 ± 769 (95% CI: 7,520-10,535; CV: 0.01) on 28 January and 21,125 ± 1,903 (95% CI: 17,395-24,855; CV: 0.09) on 5 February. Estimates for the Delta region during those same 3 surveys were 15,687 ± 843 (95% CI: 14,214-17,519; CV: 0.05), 8,086 ± 724 (95% CI: 7,362-8,810; CV:

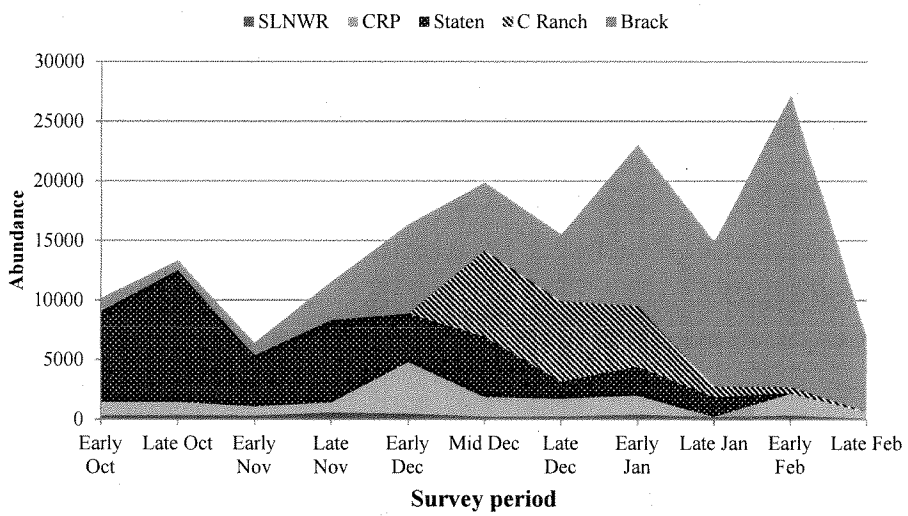

Figure 3. Counts of sandhill cranes (all subspecies combined) at all major roosts sites (Brack Tract, Canal [C] Ranch, Staten Island, Cosumnes River Preserve [CRP], and Stone Lakes National Wildlife Refuge [SLNWR]) in the Sacramento-San Joaquin Delta, California, as determined from evening roost counts conducted every 2 weeks during the winter 2007-08.

0.09), and 18,405 ± 1,795 (95% CI:14,886-21,923; CV: 0.10), while estimates for the San Joaquin River NWR region during those 3 surveys were 3,496 ± 657 (95% CI: 2,208-4,783; CV: 0.18), 942 ± 45 (95% CI: 853-1,030; CV: 0.05), and 2,720 ± 108 (95% CI: 2,508-2,932; CV: 0.04), respectively. In the Delta region, only a few sandhill cranes were observed south of Highway 12 or west of Isleton where we did not conduct roost count surveys, therefore our roost counts included a high percentage of the total Delta region population.

Table 1. Roost count comparisons of sandhill cranes at all major roost sites (Brack Tract [BT], Canal Ranch [CR], Cosumnes River Preserve [CRP], Staten Island [SI], and Stone Lakes National Wildlife Refuge [SLNWR]) in the Sacramento-San Joaquin Delta region and the San Joaquin National Wildlife Refuge, (SJNWR) California, fall-winter 2007-08.

Week	BT	CR	CRP	SI	SLNWR	SJNWR
08 Oct	1,132	-[a]	1,105	7,565	362	-[d]
22 Oct	852	-[a]	1,137	10,995	358	-[d]
05 Nov	1,083	-[a]	775	4,230	333	-[d]
19 Nov	3,255	-[a]	850	6,846	598	2,537
03 Dec	7,540	-[b]	4,347	3,986	506	-[d]
17 Dec	5,706	7215	1,650	5,041	251	2,264
31 Dec	5,605	6758	1,504	1,397	261	-[d]
14 Jan	13,551	5064	1,621	2,403	417	-[d]
28 Jan	12,140	915	-[c]	1,622	230	2,895
11 Feb	24,487	525	1,834	-[a]	367	-[d]
25 Feb	6,306	-[a]	564	-[a]	113	2,484
Average	7,423	4,095	1,539	4,898	345	

[a] Roost site was dry.
[b] Did not have permission to survey.
[c] Roads were too wet to survey.
[d] Did not survey on these dates.

Abundance by subspecies.—The proportion of sandhill cranes that we identified as greaters during roadside surveys varied from 1.0% to 80.4% with higher proportions of greaters generally observed at the Cosumnes River Preserve than other areas (Table 2). We estimated that the number of greaters roosting in the Delta Region ranged from 2,166 to 6,866, while the number of lessers ranged from 12,867 to 17,690 (Table 3).

Distribution

Sandhill cranes were found primarily in Sacramento and San Joaquin counties, but also in east Yolo, Solano, and Contra Costa counties (Fig. 4). This area includes both the Central Delta and Cosumnes and Stone Lakes areas, and is approximately 1,500 km^2, bounded on the west by the Sacramento River and the Deep Water Ship Channel, on the north by Elk Grove and South Sacramento, on the south by Highway 4 to Stockton and on the east by Lodi, Galt, and rural communities of Herald and Wilton. This area includes the Cosumnes River floodplain (below Wilton), the Mokelumne River floodplain (below Galt), the Sacramento River floodplain (below Freeport), and the Delta tracts and islands which lie east of the Deep Water Ship Channel, east of the Sacramento River channel

Table 2. Proportion of greater (G) and lesser (L) sandhill cranes observed during 4 roadside surveys of feeding fields around 3 major roost complexes in the Sacramento-San Joaquin Delta, California, during winter 2007-08. "*n*" indicates the total number of cranes observed during surveys at all 3 sites.

		Roost complex					
		Brack		Cosumnes		Staten Island	
Week	*n*	G	L	G	L	G	L
3 Dec 2007	5,180	0.014	0.986	0.182	0.818	0.083	0.917
17 Dec 2007	3,788	0.074	0.926			0.065	0.935
31 Dec 2007	5,416	0.093	0.907	0.783	0.217	0.093	0.917
14 Jan 2008	8,152	0.678	0.322	0.804	0.196	0.014	0.986

between Rio Vista and Antioch, north of Highway 4, and west of Interstate Highway 5.

DISCUSSION

Migration Chronology

Sandhill cranes first arrived in our Delta region study area during the first week of September, earlier than the third week of September as reported by Pogson and Lindstedt (1991) in the mid-1980s. The difference may be due to changes in cropping practices that have benefited sandhill cranes. For example, at Staten Island before the mid-1980s, corn harvest was not begun until mid-September and continued to November. With more corn planted due to the falling price of wheat, the start date for harvest was moved up in order to harvest the entire crop early. Earlier crop harvesting has permitted earlier flooding of harvested fields to serve as roost sites on the island (J. Shanks, personal communication). Possibly some sandhill cranes learned that resources are

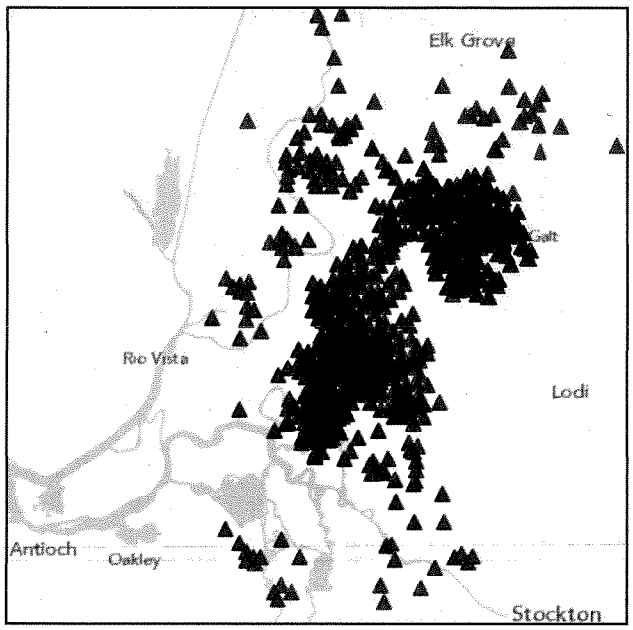

Figure 4. Distribution of greater (black triangles) and lesser sandhill crane (grey triangles) winter foraging locations in the Sacramento-San Joaquin Delta, California, winters 2007-08 and 2008-09, as determined by locations of radio-marked cranes from ground and air surveys.

available earlier in the Delta region and therefore arrived from migration earlier than they had in the past. Also, the earlier arrival might be attributed to an increasing population of greater sandhill cranes since the mid-1980s (see Littlefield 2002) or because the breeding population has expanded southward in the Sierra Nevada to locations that are shorter migration distances from the Delta region (see Ivey and Herziger 2001).

Despite the earlier initial arrival dates of some birds, only a small number of sandhill cranes were present

Table 3. Abundance of greater (G) and lesser (L) sandhill cranes at 5 roost complexes (Brack Tract, Cosumnes River, Staten Island, Canal Ranch, and Stone Lakes NWR) in Sacramento-San Joaquin Delta, California, on 3 dates during winter 2007-08.

	Date					
	17 Dec		31 Dec		14 Jan	
Roost	G	L	G	L	G	L
Brack Tract	422	5,284	521	5,084	3,444	10,107
Cosumnes River	792	858	1,173	331	1,297	324
Staten Island	328	4,713	130	1,267	34	2,369
Canal Ranch	503	6,712	630	6,128	1,757	3,307
Stone Lakes NWR	121	130	204	57	335	83
Total	**2,166**	**17,697**	**2,658**	**12,867**	**6,867**	**16,190**

in September. Our radio-marked birds arrived about 1 month later in October coincident with the arrival of large numbers of sandhill cranes into the region. Despite the considerable difference in the length of migration between subspecies (see Pacific Flyway Council 1983, 1997), the arrival chronology of our radio-marked lessers and greaters was similar. These subspecies flocks occasionally share fall staging areas and their movements south may be synchronized by favorable weather conditions for migration to the Central Valley. Arrival dates for lessers to the Delta region were very similar to mean arrival times for lessers to wintering areas in Texas (Krapu et al. 2011), despite the fact that lessers wintering in California use different migration routes and staging areas than birds wintering in Texas (Petrula and Rothe 2005, Krapu et al. 2011).

During our study, sandhill cranes used roosts throughout our study area into early March, much later than reported by Pogson and Lindstedt (1991), who noted sandhill cranes departed Brack Tract, Staten Island, and Canal Ranch in late January. We attribute this difference to changes in management that currently maintains roosts for sandhill cranes later during winter. The general chronology of spring departure was similar for both subspecies. However, lessers tended to begin their departure earlier than greaters but finished departing after the all greaters had left.

Abundance

During mid-winter surveys in the Pacific Flyway in 2008 and 2009, 51,981 and 49,238 sandhill cranes were counted, respectively (Collins and Trost 2010). A comparison of our results with previous work in the Delta region suggests the total abundance of sandhill cranes in the Delta region has increased since the 1980s. Previous aerial counts ranged from 3,380 during 1983-1989 (CDFW, unpublished data) to 17,030 in the late 1990s (Ducks Unlimited, unpublished data) and 11,625 in 2000-2001 (CDFW, unpublished data). Roost count and aerial survey data are not directly comparable, but it is likely that the sandhill crane population in the Delta region is higher today than in the 1980s. The highest estimate from our aerial surveys was similar to the estimate from the air in the late 1990s; however, our methods differed because previous surveys were assumed to be complete counts while our estimates were generated using sampling statistics.

Our population estimates from aerial surveys were relatively precise, with coefficients of variation ranging from 5 to 10% during all but 1 survey. This precision indicates that an aerial-based survey for sandhill cranes in the Delta may be a valid method to estimate their population size or at least derive an index of population size. Such a survey would have to be coupled with ground surveys to derive the percentage of the total population comprised of greaters and lessers. The aerial survey estimates were consistently smaller than the abundance estimates from roost counts (on average 37% less), and the roost count estimates were well above the 95% confidence limits for the aerial survey. Given the large discrepancy, additional work is needed to determine the more accurate method of surveying cranes, but aerial surveys may provide a precise index of crane abundance.

The increase in sandhill crane numbers in the Delta region since the 1980s reflects an overall increase in sandhill cranes in the Pacific Flyway from counts of 10,000 in the 1980s to counts of over 50,000 in recent years (Collins and Trost 2010). A comparison of peak counts for the Delta region relative to the total sandhill crane population in the Pacific Flyway indicates about one-third of all sandhill cranes that wintered in the Pacific Flyway used the Delta region during the 1980s. Our peak roost count of >27,000 sandhill cranes in mid-February indicates that more than half of all sandhill cranes in the Pacific Flyway may currently use the Delta region, so both the absolute and relative importance of this region for wintering sandhill cranes has increased since the 1980s. The increase of sandhill cranes in the Delta region could reflect improved roosting and foraging conditions in the Delta region from the conservation efforts of the past 3 decades or could be the result of habitat loss and degradation elsewhere which would force the sandhill cranes to increase their presence in the Delta region.

Roost count data indicate that the population of sandhill cranes using the Delta region increased from October through mid-February. Pogson and Lindstedt (1991) noted a similar pattern for greaters during the 1980s. However, our radio-marked greaters had all arrived in the Delta region by the end of November and lessers had all arrived by early December. Furthermore, movement data indicate that once greaters arrived in the Delta region they were relatively sedentary (Ivey et al. 2011). This discrepancy between increases in roost counts and movement data may be because our telemetry results were based on a relatively few

individuals and may not have encompassed movement trends of the population.

Previous to this study only a few population estimates were made of greaters and lessers wintering in the Central Valley or the Delta region. Pogson and Lindstedt (1991) estimated 6,800 "large cranes" wintered in the Central Valley in 1983 and 1984, while Littlefield (2002) estimated that 6,000 greaters wintered in the Sacramento Valley during the early 1990s. Both estimates apparently combined greaters with the Canadian subspecies which are more common in the Sacramento Valley (G. Ivey, personal observation) so their counts are likely biased high. Using roost counts and roadside surveys to allocate total count data to subspecies, our estimate for the number of greaters using the Delta region ranged from 2,166 to 6,800. The maximum number of greaters counted during a single set of roadside surveys in the Delta region was 1,786. Our estimate of 6,800 is likely biased high because in January large flocks of lessers were using Brack Tract for roosting while foraging to the south in areas not covered by our roadside surveys; therefore greaters were over-estimated in our roadside survey proportions. The number of sandhill cranes using Brack Tract during the feeding count in January 2008 was less than 3% of the number roosting, further suggesting our estimates of proportions might be biased. In comparison, our roadside surveys counted 24% and 41% of birds roosting at Brack Tract in mid and late December. Therefore, we think that the true number of greaters in the Delta region was between 2,000 and 3,000 birds, which is a significant portion of the Central Valley Population. Additional work to develop a more precise survey methodology, including using random sampling of subspecies composition of foraging flocks from ground surveys to assess subspecies composition, and possibly including distance sampling with aerial surveys (see Ridgway 2010), is needed to accurately estimate the population size of each subspecies of sandhill crane wintering in California's Central Valley.

The changing distribution of sandhill cranes among roost complexes in the Delta region was likely in response to changes in roost site conditions. Managers at Staten Island began flooding roost sites relatively early in fall during both years of our study, which attracted early arriving sandhill cranes. As winter proceeded additional roost sites at Brack Tract and Canal Ranch were flooded both years, and sandhill cranes spread out to take advantage of these sites. By mid-winter during both years, managers at Staten Island began drying several large roosts which likely induced birds to shift their roosting to nearby Brack Tract. At the Cosumnes River Preserve, roost sites remained available throughout winter and sandhill crane numbers were relatively stable there the entire season. This pattern of habitat use suggests the abundance and distribution of sandhill cranes in the Delta region can be influenced by changing the distribution of their roosts.

In addition to responding to habitat changes, the proportion of greaters to lessers differed by habitat areas. Greaters were proportionately more abundant in the Cosumnes River Preserve and Stone Lakes NWR and lessers dominated in the Central Delta. Reasons for this pattern are not clear but may be related to a preference by lessers for alfalfa (see Ivey et al. 2011) which is widely grown in the Central Delta and rarer near the Cosumnes River Preserve and Stone Lakes Refuge. Differences in proportions of the subspecies may have been due to difference in physical characteristics of roosts that favored or constrained use by 1 subspecies compared to the other. Greaters are also socially dominant over lessers (G. Ivey, unpublished data), which may have allowed them to dominate proportional use of the Cosumnes River preserve which grew rice, a food resource preferred by both subspecies (Ivey et al. 2011).

Distribution

In comparing our data to that from a 1980s study reported in Pogson and Lindstedt (1991), the winter range for sandhill cranes in the Delta region has decreased. While development of conservation areas such as Cosumnes River Preserve and Stone Lakes NWR has improved habitat conditions for wintering sandhill cranes, significant loss of foraging habitat has occurred over the past 3 decades on private lands in the region (primarily from conversion to vineyards) and such losses are continuing (see Littlefield and Ivey 2000). Within their Delta region winter range, large areas of habitat have been lost primarily due to conversions to incompatible crops (e.g., vineyards and orchards) and to the expansion of the cities of Elk Grove and Galt. Most noticeable has been the increase in grape vineyards, but in more recent years other incompatible crops such as turf farms, olives, and blueberries have further reduced compatible foraging area (Littlefield and Ivey 2000). For example, between 2003 and 2007, approximately

335 ha of cropland used regularly by sandhill cranes at Canal Ranch was converted to olive trees (G. Ivey, personal observation). If such habitat losses continue, this could further influence sandhill crane use of the Delta region and possibly limit the regional carrying capacity for sandhill crane populations in the future.

MANAGEMENT IMPLICATIONS

Based on arrival dates, flooding of some sites managed for crane roosting should begin slowly in early September and managers should provide larger areas for roosting cranes by early October. Maintaining flooded roosts until mid-March when most birds leave the Delta region for spring migration would provide roosting habitat throughout their wintering period. For areas specifically managed for the welfare of greaters (e.g., Staten Island) our data suggests that maintenance of roost sites through the first week of March would be beneficial, based on departure times for greaters. Our estimates for the population of greaters using the Delta region represent a significant percentage of the total population. Therefore, this region should be considered a key area for efforts in conservation and recovery of this listed subspecies.

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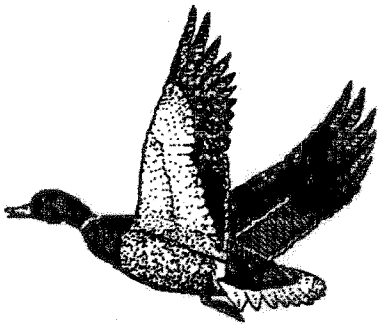
MANDEVILLE ISLAND BIOLOGICAL SURVEYS

FINAL REPORT - 1993



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MANDEVILLE ISLAND BIOLOGICAL SURVEYS

EXECUTIVE SUMMARY

Biological surveys were conducted to determine the abundance and distribution of wildlife occurring on Mandeville Island. These surveys began in April 1992 and continued into June 1993. Results of these evaluations will be used to help guide habitat restoration efforts and measure changes in wildlife populations and habitats resulting from future management.

Evaluations focused on breeding and wintering waterfowl populations, ring-necked pheasant populations, avian communities within different habitat types, migrating shorebirds, and carnivorous mammals. Baseline information on the vegetative characteristics of existing habitats were also collected.

Mallard and cinnamon teal were the two prevalent duck species observed during waterfowl breeding pair surveys. A peak estimate of 560 mallards and 40 cinnamon teal was made in April 1992. In 1993, surveys yielded an average of 609 mallards and 97 cinnamon teal throughout the breeding season. Other species encountered during pair surveys included, pintail, gadwall, wigeon, shoveler and green-winged teal. In addition to breeding birds, 51 mallard and 3 cinnamon teal broods were seen during the 1992 and 1993 nesting seasons.

Wintering waterfowl numbers were acquired by California Department of Fish and Game biologists using a small fixed wing airplane from September - January 1992-93. We also performed 4 complete ground counts from January - March 1993. Waterfowl numbers peaked in November when almost 80,000 ducks, geese and swans were present.

Pheasant "crow counts" were performed in April and May 1992-93 to establish breeding population indices and a comparative base for pheasant populations. Peak crow counts occurred in the third week of April during both years. During this period 28 calls per station were recorded in 1992 and 60 calls per station were recorded in 1993.

General surveys on the Island confirmed the presence of 110 avian species. Surveys were also conducted to measure avian density and diversity within six habitat types on Mandeville Island. The greatest species diversity occurred in willow wetland habitats. This habitat supported 41 of the 68 species observed and accounted for the highest densities for 19 of the bird species. The asparagus habitat exhibited the lowest species diversity and densities. Other habitat types surveyed included the permanent water of Connection Slough, seasonal wetlands found in Camp 7 and a road side strip through cultivated and set-aside land. Seasonal use of all habitats was greatest during the winter period. A total of 18 species of shorebirds and wading birds were seen through the study period. Of these 18 species, 6 are common nesters on the Island.

Trends in carnivorous mammal populations were measured by comparing individual animal visitation rates to scent-stations on a monthly basis. The scent-stations were operated in July and September 1992 and April-June 1993. During this five month period raccoons (25%) and striped skunks (23%) had the highest average visitation rates. Other predators visiting scent-stations were : Coyotes (17%), mink, opossum, and gray fox (all less than 5 percent).

Photo points were located at various key areas on Mandeville Island to record changes in vegetative structure on a seasonal basis. We also measured vegetation composition and estimated seed production of watergrass and smartweed in an agricultural wetland. This sampled field yielded approximately 1,050 pounds of seed per acre and contained a total of 8 different moist-soil plant species.

Biological surveys conducted on Mandeville Island indicate that an impressive array of wildlife can co-exist with successful agricultural operations. However, the enhancement of existing habitats and creation of new wetlands could greatly improve wildlife values on the Island. The fertile peat soils predominantly found on Delta Islands provide an excellent base for these efforts. Cooperative ventures between private land managers in the Delta and various resource agencies are necessary if waterfowl and other wildlife populations are to reach desired levels established by the Central Valley Habitat Joint Venture of the North American Waterfowl Management Plan.

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MANDEVILLE ISLAND BIOLOGICAL SURVEYS

Final Report - 1993

INTRODUCTION

The Sacramento-San Joaquin Delta has been identified as a high priority area for wetland restoration by the Central Valley Habitat Joint Venture, a component of the North American Waterfowl Management Plan. Proper management of water and vegetation in newly created wetlands is necessary to maximize the success of restoration efforts. Wetland restoration and habitat management typically occur without regard for existing wildlife values, thus, measurement of accomplishments are illusive. Baseline biological surveys can prove indispensable in assisting habitat managers by providing a measurement of the distribution and abundance of species and capability to predict wildlife response to various management strategies. In addition, future performance of similar evaluations allow wetland managers to monitor and adjust progress of habitat and restoration projects to assure maximum benefits are provided to wildlife.

Located in the heart of the Sacramento-San Joaquin Delta, Mandeville Island has initiated a progressive wetland restoration and habitat management program coincident with successful agricultural operations. Biological surveys were designed to determine the relative abundance and distribution of wildlife occurring in both agricultural and natural habitats found on the Island. These surveys were conducted from April 1992 - June 1993. Final results presented herein provide baseline data which will help guide future habitat restoration efforts on Mandeville Island.

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SURVEY METHODS

Breeding Waterfowl - Early morning waterfowl breeding pair surveys were performed four times from 21 April to 19 June 1992 and six times from 3 March to 24 May 1993. Waterfowl within .2 km of either side of the vehicle were counted while driving an established route (.40 km wide X 29 km long) designed to include a representative cross section of habitat types found on the Island (Figure 1). All ducks were recorded as pairs, single drakes, single hens, or groups for each species. As the nesting season progressed, the route effectively served as a brood survey. Location, date, time, species, brood size and age (Gollop and Marshall 1954) were recorded when broods were encountered. Duck broods seen during other surveys on the Island were also recorded.

In early May 1992, waterfowl counts were conducted using three different modes of transport: fixed-wing aircraft, a helicopter and a ground vehicle. The purpose of these counts was to compare the accuracy and costs associated with the different techniques and determine which method is most suitable for future Mandeville Island waterfowl surveys. Counts were conducted within one day of each other to minimize biases resulting from birds leaving or entering the survey area. Connection Slough and the main north-south canal on the Island comprised this experimental survey route (Figure 2).

Wintering Waterfowl - Wintering waterfowl numbers on Mandeville Island were recorded during 5 aerial and 4 ground surveys from September 1992 through March 1993. Aerial surveys were conducted by California Department of Fish and Game (CDFG) biologists using a small fixed-wing aircraft. Ground surveys were conducted by CWA biologists using All Terrain Cycles (ATC).

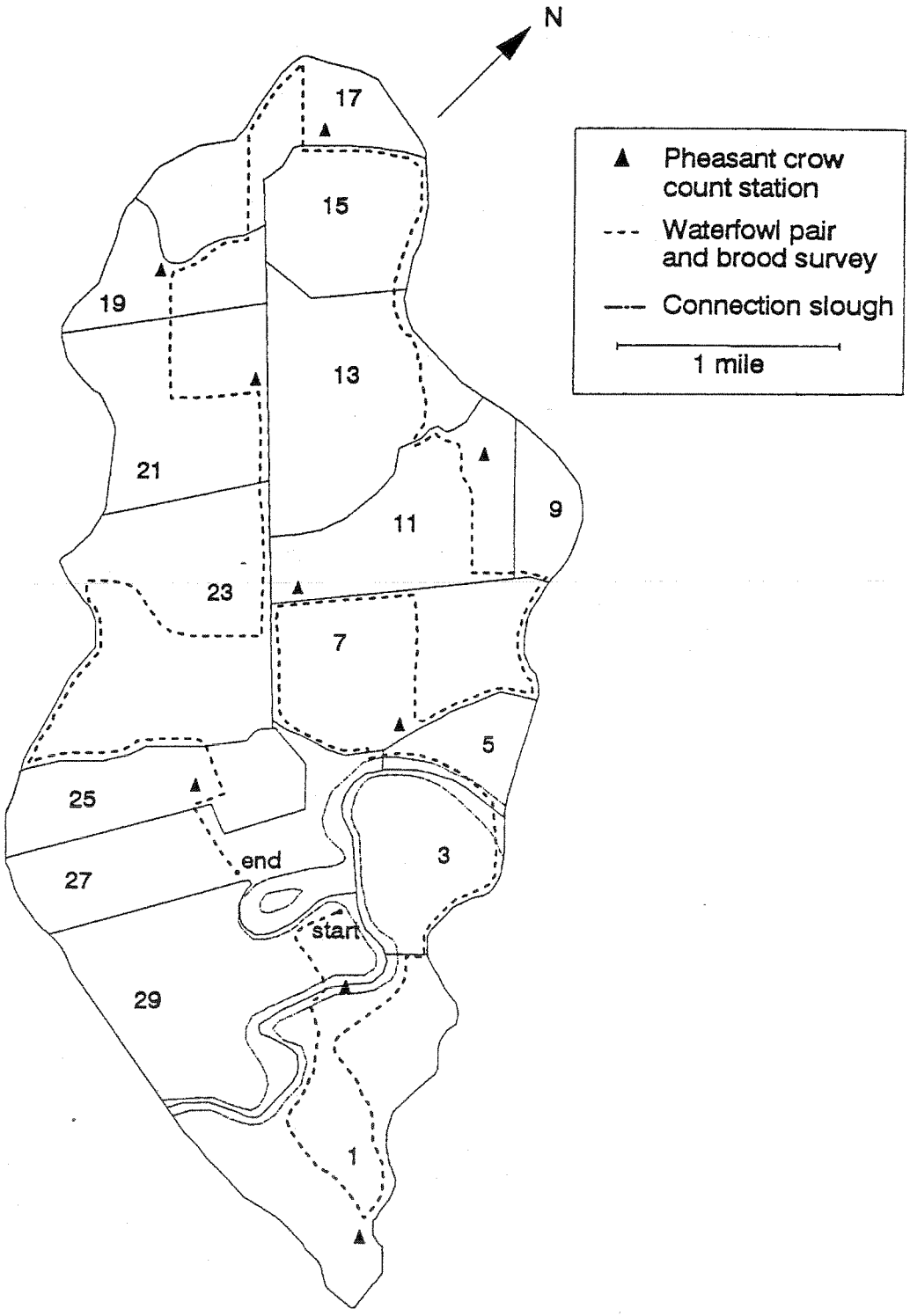

Figure 1. Survey routes used to monitor waterfowl and pheasant breeding populations on Mandeville Island, April 1992. (Numbers denote camps)

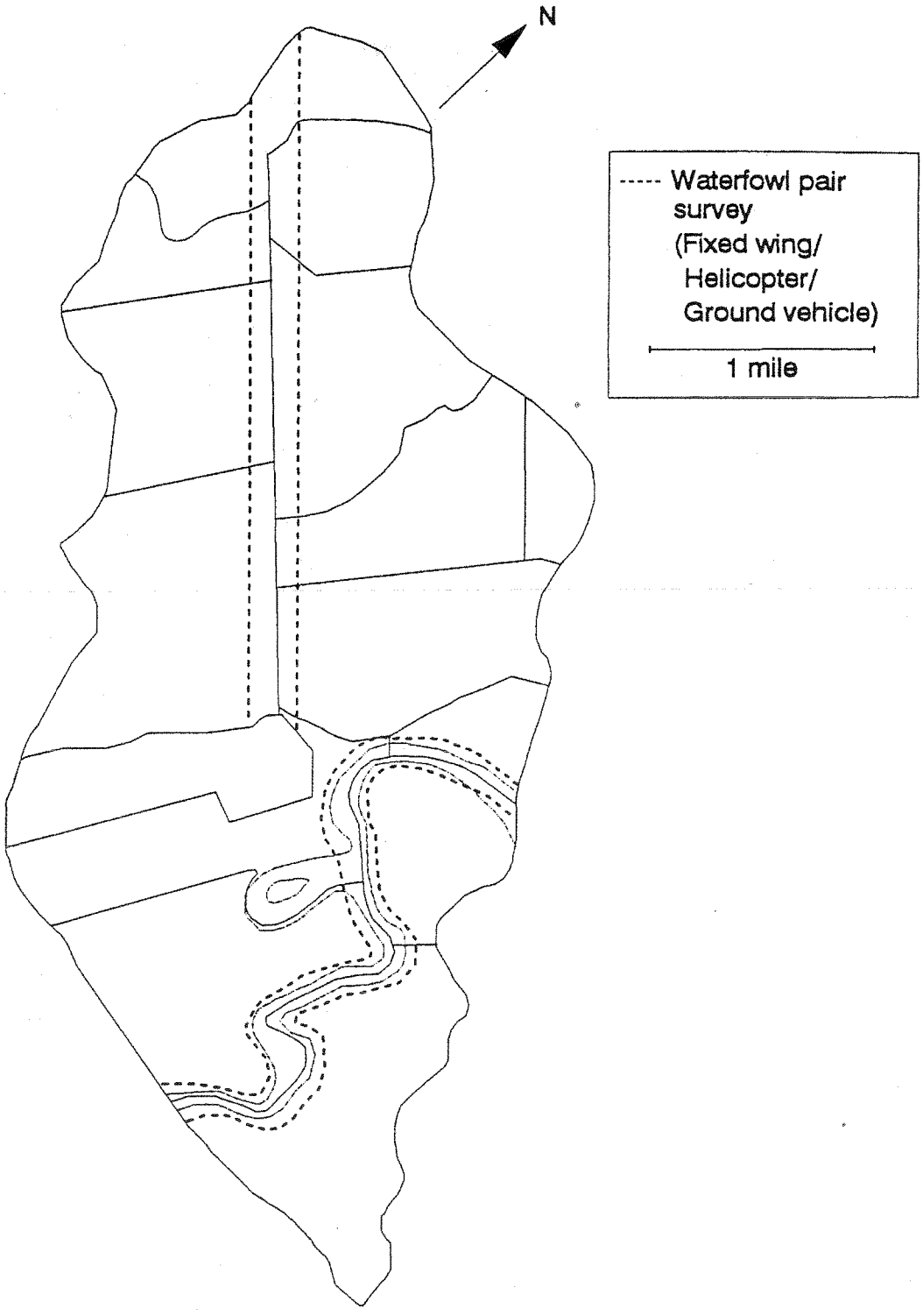

Figure 2. Waterfowl breeding population survey route used to determine air-ground visibility rates on Mandeville Island, May 1992.

Wintering Mallard Food Habits - Mallard food habits were investigated by analyzing the gizzard and esophageal contents of hunter collected ducks from November through January 1992 - 93. Mallards were shot on Mandeville Island primarily in the morning (95% of sample) and gizzards and esophagi were removed and frozen approximately one hour after hunters returned from the field.

Foods from gizzard and esophageal samples were sorted and identified using published references (Martin 1954, Martin and Barkley 1961, Delorit 1970, Merrit and Cummins 1984). Food items found in each esophagi were measured by volumetric displacement (Swanson and Bartonek 1970, Swanson et al. 1974) using 10 ml and 25 ml graduated cylinders. Volumetric measurements of individual food items were expressed as an average of volumetric percentages or aggregate percent volume (c.f. Swanson et al. 1974). Samples containing food items displacing less than .05 ml were considered trace and not included in analyses of aggregate percent volume. However, these data were included to obtain percent occurrence. Data for gizzard contents were summarized by percent occurrence.

Ring-necked Pheasant - "Crow count" surveys were conducted to obtain an index of the pheasant population on Mandeville Island. In 1992, crow count surveys were conducted in late April and early May. Surveys in 1993 began on 7 April and continued bi-weekly through the end of May. Sampling procedures were similar to those used by state and federal wildlife areas (the California Department of Fish and Game (1958). A total of nine listening stations were spaced approximately .75 - 1.0 miles apart on the Island. Surveys were conducted in the morning, usually at or before sunrise. Rooster calls were recorded at each station during two, 2-minute periods in 1992 and one, 2-minute period in 1993. Upon completion of each morning count, totals were averaged between stations. Procedures were designed so that they can be repeated and used to measure annual trends on Mandeville Island and to compare with other pheasant population data from other areas.

Avian Communities - The presence of different bird species was obtained from fortuitous observations throughout the survey period. In addition, transect routes were established to measure relative abundance among different upland and wetland habitats found on Mandeville Island, and to determine seasonal trends in distribution and abundance. In 1992, six transects were traversed on two consecutive days every week during the postbreeding or summer period (7 July - 15 August) (Figure 3). Each transect was .9 to 1.5 km long and was comprised of 6-10 listening stations at 150 m intervals. On arrival at each station we waited one minute to compensate for our disturbance and allow bird activity in the plot to return to normal. All birds detected either audibly or visually within 50 m of each listening station were recorded. This was repeated for exactly 5 minutes at each listening station. Birds flying over the plots were also recorded, but only those birds observed foraging (primarily swallows) were used in data analyses. In 1993, the same transect locations were used, however, rather than using listening stations, the entire transect length was walked at a slow steady pace and all birds detected within 50 m of the transect line were recorded. Using this "fixed width" transect method, plot size increased (transect area ranged from .05 km^2 to .08 km^2 in 1992, and .09 km^2 to .15 km^2 in 1993) and the number of undetected birds was reduced because flushing birds were recorded. This method was repeated on 6 different occasions throughout the winter and spring 1993. Density figures were derived for each species by totaling the number of birds detected (for each species) and dividing by the area of the transect.

Specific habitat type for each transect surveyed included: 1) seasonal wetland (camp 7, Figure 1) - the center of the Island is composed primarily of watergrass, smartweed and various tall perennial and annual upland grasses; 2) seasonal/willow wetland (camp 15) - located towards the northern end of the Island is dominated by robust stands of willow/cattail growth; 3) agricultural wetland (camp 1) - located in the southeastern tip of the Island and composed of planted corn, volunteer stands of smartweed, watergrass, and pigweed; 4) a commercially grown agricultural crop (camp 27) - located on the south side of the Island containing only asparagus; 5) Connection

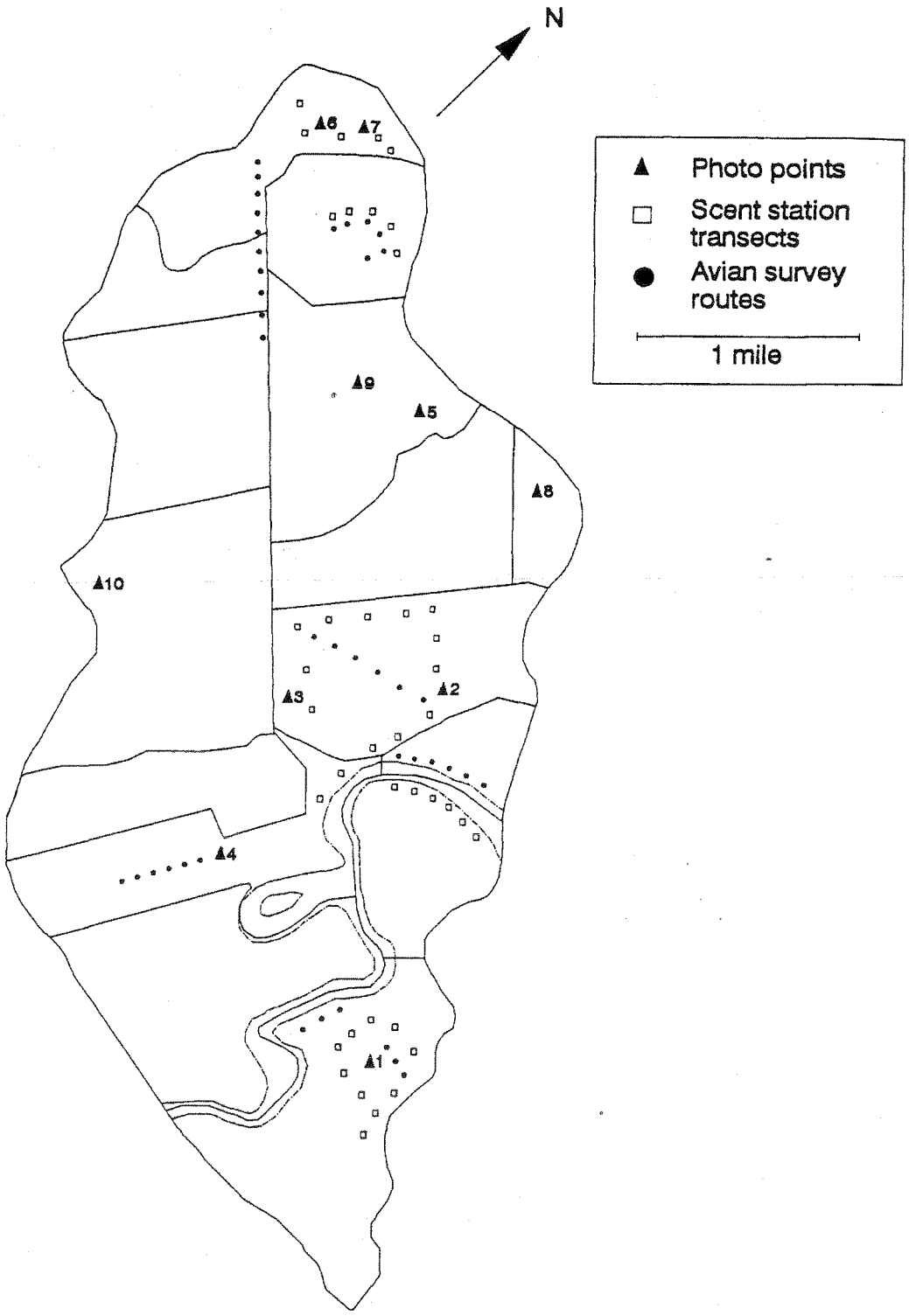

Figure 3. Wildlife and vegetation survey routes established on Mandeville Island, 1992.

Slough - a permanent wetland that bisects the Island and is dominated by tules, cattail and various forbs and grasses; and 6) a road side strip that passes through corn, grapes and set-side agricultural land.

Shorebirds - Shorebirds were recorded coincident with the waterfowl pair and brood surveys throughout the reporting period. A supplemental shorebird count during August 1992 was conducted in conjunction with the Point Reyes Bird Observatory (PRBO) fall shorebird migrational survey. Observers recorded species and number of shorebirds that were concentrated on Mandeville Island's few remaining natural wetlands.

Carnivorous Mammals - Carnivorous mammal population trends were measured monthly by comparing individual animal visitation rates to scent stations. Four scent station transects were established on 8 July 1992 and were checked one night per month (c.f. Roughton and Sweeny 1982, Conner et al. 1983). Transects were 2.7 km long and consisted of ten scent stations at .3 km intervals. Scent stations consisted of a circle of finely sifted peat/sand 1.0 meter in diameter with a centrally placed scent disk (plaster disk saturated with fatty acid scent). Scent stations were activated during the afternoon and checked for tracks the following morning.

An animal visit was defined as the presence of one or more tracks of a species per station (Conner et al. 1983). Visitation rates were expressed as the percentage of stations per transect visited by a species during the sample period. Mammalian species monitored during these surveys included: striped skunk (Mephitus mephitus), raccoon (Procyon lotor), mink (Mustela vison), opossum (Didelphus virginianus), coyote (Canis latrans), and gray fox (Urocyon cinereoargenteus).

It was logistically impossible to have transects covering the entire area of Mandeville Island, so an effort was made to distribute the routes systematically so that major habitat types would be sampled (Figure 3). Transects were established along levee and secondary dirt roads bordering seasonally flooded wetlands (one area

dominated by moist soil plants and another dominated by dense willow/cattail growth), an agricultural wetland section (camp one), and the permanent wetland found in Connection Slough.

VEGETATION SURVEYS

Baseline information on the vegetative characteristics of existing habitats was collected on the Island. Specific habitat parameters evaluated included seasonal changes in the habitat, and an estimation of seed production and percent vegetation cover by species in a sample of an agricultural wetland.

Photo Points - A total of ten photo points were located at various key areas on the Island to monitor changes in vegetative structure on a seasonal basis. These stations were established on 10 July (Figure 3). Two photos per station were taken, a close-up photo and a wide view photo. These photos can be used to monitor habitat changes that result from wetland development and various management strategies in the future.

Information collected when taking photographs at these stations included a detailed description of the location, date, time of day, compass direction, and comments on the vegetation and wildlife use of the selected area. Also, dates of management activities (ie. discing, burning, water regime, etc.) were noted.

Seed Production and Vegetation Composition of Common Moist-soil Food Plants- Seed production was estimated on a small field consisting of agricultural wetland habitat using a recently developed technique (c.f. Laubhan and Fredrickson 1992). Samples were collected at ten separate plots (plot size = .0625-m^2) spaced at 50 m intervals on a straight line transect through a representative section of the field. Plant height, seed head size and number of seed heads were recorded for individual plants of watergrass and smartweed occurring in the ten plots. The regression equation developed by Laubhan and Fredrickson (1992) was used to estimate the total weight of available seeds in the sampled field.

Plant species composition was estimated for the wetland using the same ten plot locations as noted above, however the plot size was increased to 1 m^2. Ocular estimates of percent cover were made for each species occurring in each plot. These numbers were then added and divided by the total number of plots to estimate average percent cover of each plant species for the entire field.

RESULTS/DISCUSSION

Breeding Waterfowl - The pair survey route used to estimate breeding waterfowl populations covered approximately 10.4 km^2 or 50% of Mandeville Island (Figure 1). Mallards and cinnamon teal were most numerous, but occasionally gadwall, pintail, northern shoveler, green-winged teal and wigeon were observed. In 1992, the first pair survey yielded an estimate of 620 breeding mallards and 44 cinnamon teal on the Island. Subsequent surveys showed a marked decrease in breeding activity, and only 3 mallard pairs observed on June 19. A total of six breeding pair surveys conducted in 1993 yielded an average of 670 breeding mallards and 103 cinnamon teal on the Island (Table 1). Breeding mallard pairs peaked in the third week of March when over 1,700 ducks were observed.

A total of 26 mallard broods and one cinnamon teal brood were seen in 1992. In 1993, 25 mallard and 2 cinnamon teal broods were seen during the breeding season. Due to time constraints, brood surveys ceased on 16 June 1993. Average brood size for Class I (1 - 18 days old) and Class II ducklings (19 - 42 days old) was 5 and average brood size for Class III (43 - 55 days old) was 6 ducklings. Habitats most commonly used by broods on the Island included; the main north-south canal adjacent to Camps 7, 19, and 23 (48% of observations), the permanent wetland comprising Connection Slough (30% of observations) and the permanent wetland comprising the club house pond (11% of observations). The newly created seasonal marsh in Camp 13 also provided summer water for several mallard broods.

Table 1. Breeding waterfowl totals estimated from breeding pair surveys on Mandeville Island, 1992 and 1993.

	Date of Survey, 1992				
Species	21 April	13 May	28 May	19 June	$\bar{X}$
Mallard	620	184	74	12	223
Cinnamon Teal	44	12	4	0	15

	Date of Survey, 1993						
Species	3 Mar	23 Mar	13 Apr	21 Apr	4 May	24 May	$\bar{X}$
Mallard	328	1708	284	196	1416	86	670
Cinnamon Teal	320	84	88	116	0	8	103
Pintail	4	28	4	4	4	0	7
Shoveler	0	36	40	8	4	0	15
Wigeon	20	8	16	0	0	0	7
Gadwall	12	20	12	4	0	0	48
Green-winged Teal	48[1]	32	12	64	8	0	27

[1] Includes 4 blue-winged teal.

The earliest brood in 1992 seen was on April 21 and contained only 3 Class 1A ducklings (< one week old). The latest brood observations in 1992 occurred in July when two class 1 broods were seen. This depicts the protracted waterfowl breeding season found in California. In 1993, the first broods were observed on 5 May. On this date, 3 Class I broods averaging 7 ducklings were recorded. The vast network of irrigation ditches found on the Island likely supported more broods than were seen. However, the thick vegetation and steep banks associated with the ditches created a very difficult habitat to census.

During the first week of May 1992, three different survey methods were used to determine air-ground visibility rates and determine the best method to estimate the breeding waterfowl population on Mandeville Island. A pre-determined route - (independent of the above mentioned pair survey) was flown by CDFG biologists using a small fixed-wing aircraft (Figure 2). CWA biologists then repeated this route by helicopter and on the ground so differences in visibility could be compared among the techniques. As expected, the helicopter survey resulted in twice as many ducks as the fixed-wing survey. The observer performing the ground survey counted 2.70 and 1.35 times as many ducks as the fixed-wing and helicopter surveys, respectively. Visibility rates are critical for accurately estimating the breeding waterfowl population on the Island, and may be used as correction factors on future aerial surveys.

Wintering Waterfowl - Over 2,300 acres of flooded habitat were available for migrating waterfowl and other waterbirds on Mandeville Island during the winter of 1992 - 93. In addition, approximately 1,000 acres of harvested asparagus were irrigated in December and January providing a vast shallow water wetland.

A total of 5 aerial waterfowl surveys were conducted by the CDFG from September 1992 through January 1993. Ground surveys were performed by CWA biologists on 4 dates extending through the period of January 21 - March 3, 1993. Nineteen different species of waterfowl were observed using Mandeville Island habitats during the fall and winter. Peak waterfowl use occurred during the first week of

November, when approximately 78,000 ducks (including > 59,000 pintail), geese and swans were counted (Table 2).

Although large numbers of mallards were recorded during surveys (both aerial and ground), estimates are likely conservative. Mallards on Mandeville Island used the densely vegetated moist-soil impoundment in Camp 7 extensively, as well as the tree lined willow wetland habitats. Owing to the dense nature of both habitat types, accurate population estimates were hard to achieve. Conversely, pintail and wigeon most commonly utilized the flooded corn stubble and similar open water habitat on the Island, resulting in increased visibility and likely more reliable estimates.

While duck numbers decreased substantially by the third week of January, snow geese, Ross' geese and white-fronted geese numbers increased. White-fronted geese were not observed on the Island until the first week of January and snow/Ross' geese were not recorded in large numbers until the first week of February. Over 1,400 white-fronted geese and 15,000 snow and Ross' geese were observed using the harvested corn fields on the Island during the first week of February. At that time, water was being drawn off all harvested corn and agricultural wetland habitats.

Mallard Food Habits - A total of 106 gizzards and 56 esophagi contained adequate quantities of food items for analyses. Plant seeds and miscellaneous vegetative parts (i.e., grasses and tubers) comprised almost 98% of the mallard diet during fall and winter 1992-93 (Table 3).

The most important food item consumed by mallards during this period was corn (Zea mays). Corn was found in 34% of the gizzards and 40% of the esophagi. More importantly however, corn comprised almost 70% (by volume) of the mallards diet. By comparison, smartweed (Polygonum spp.) occurred in 63% of the gizzards and 57% of the esophagi yet comprised only 0.9% (by volume) of the diet (Table 3). Other important plant seeds found included watergrass (Echinochloa crusgalli), pigweed

Table 2. Waterfowl and sandhill crane totals recorded during aerial and ground surveys of Mandeville Island Fall/Winter 1992-93.

	Date of Survey								
	Aerial[1]					Ground			
Species	14 Sept 1992	20 Oct 1992	28 Oct 1992	4 Nov 1992	4 Jan 1993	21 Jan 1993	3 Feb 1993	11 Feb 1993	3 Mar 1993
Mallard	10,000	3,610	25,000	13,750	18,355	4,813	14,559	13,664	5,119
Northern Pintail	18,000	2,000	0	59,060	29,775	296	60	150	83
American Wigeon	0	0	0	5,020	3,060	109	1,002	1,004	0
Gadwall	0	0	0	0	270	225	200	358	70
Northern Shoveler	75	5	0	0	1,645	60	597	290	204
Wood Duck	0	0	0	0	0	4	119	44	0
Green-winged Teal	1,500	450	0	0	3,170	117	38	97	158
Cinnamon Teal	0	0	0	0	0	49	41	247	498
Ring-necked Duck	0	0	0	0	0	18	7	62	0
Canvasback	0	0	0	0	10	0	0	8	0
Ruddy Duck	0	0	0	0	0	1	0	0	0
Bufflehead	0	0	0	0	0	0	0	2	0
Lesser Scaup	0	0	0	0	0	0	4	0	0
Common Goldeneye	0	0	0	0	0	0	4	2	0
Blue-winged Teal	0	0	0	0	0	0	0	0	4
White-fronted Goose	0	0	0	30	235	77	1,401	164	1,430
Snow Goose	0	0	0	1	0	0	10,000	0	12,300
Ross' Goose	0	0	0	0	0	0	1,502	0	0
Canada Goose	0	0	0	30	205	211	132	9	6
Tundra Swan	0	0	0	220	1,425	396	127	140	0
Coot	0	0	0	10	140	451	246	730	60
Sandhill Crane	0	0	35	6	80	99	0	271	0

[1] Aerial surveys performed by California Department of Fish and Game Biologists.

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Table 3. Esophageal and gizzard contents of hunter collected mallards on Mandeville Island, November - January 1992-93.

Food Item	Gizzard (n=106)	Esophagus (n=56)	
	Percent Occurence[1]	Percent Occurence	Aggregate Percent[2]
Seeds			
Corn	34	40	69.4
Rice	1	1	3.3
Wheat	1	1	tr[3]
Milo	2	-	-
Melon	4	-	-
Smartweed spp.	63	57	0.9
Watergrass	31	26	12.7
Pigweed	17	12	3.4
Bidens spp.	1	4	tr
Bulrush spp.	8	7	tr
Johnson grass	16	21	4.2
Mustard	-	1	tr
Swamp timothy	-	1	tr
Other seeds	16	3	tr
Misc. Vegetation			
Unk. grasses	1	4	tr
Unk. tubers	3	5	3.9
Total plant	100	100	97.8
Animal Matter			
Coleoptera	3	5	tr
Diptera	-	1	tr
Amphipoda	-	4	0.5
Isopoda	-	4	1.4
Total animal	3	5	1.9

[1] Percent occurence = number of mallards consuming a food item ÷ number of mallards in the sample.

[2] Aggregate percent volume = volume of food item ÷ volume of all food items determined for each mallard, then averaged over all mallards.

[3] tr = food items displacing < 0.05ml.

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(Amaranthus spp.), Johnson grass (Sorghum halapense) and bulrush (Scirpus spp.) (Table 3). In addition, 19 different plant seeds were found (of these 12 were unidentifiable) in low percentages. Unidentified seeds were found in only fifteen individuals; and each unidentified seed generally occurred in no more than two ducks. The diet of one mallard consisted of over 90% (by volume) plant tubers, suggesting the importance of this food item.

Animal matter in the mallard's diet consisted primarily of scuds (Amphipoda) and pill bugs (Isopoda). Although coleopterans (beetles) and dipterans (flies) were present, their numbers were insignificant.

Ring-necked Pheasants - Rooster calls were counted from nine stations on two separate days, once during April and again in May 1992. Due to logistical problems, counts were not performed as early in the morning as should be to obtain optimal results. On 21 April two observers counted an average 28 calls per station. Due to a 15-20 mph increase in wind speed during counts on this day, only those data from the first two stations were used for analysis (survey protocol stipulates that counts not be made if winds exceed 10 mph). The second survey was conducted on 7 May and yielded a much lower crow count of 7 calls per station. High winds again, were undoubtedly a factor in the low number of pheasants heard.

In 1993, all crow counts were conducted at least one half hour before sunrise and completed within an hour after sunrise. Earlier counts resulted in far less wind disturbance and coincided with peak rooster crowing activity. A total of four counts were performed during April and May. Overall rooster calls averaged 46 per station through the survey period. An obvious peak in crowing activity occurred during the third week in April (Figure 4). On this date an average 60 rooster calls were recorded per station. The fourth count was completed on 28 May with an average of 22 calls per station recorded.

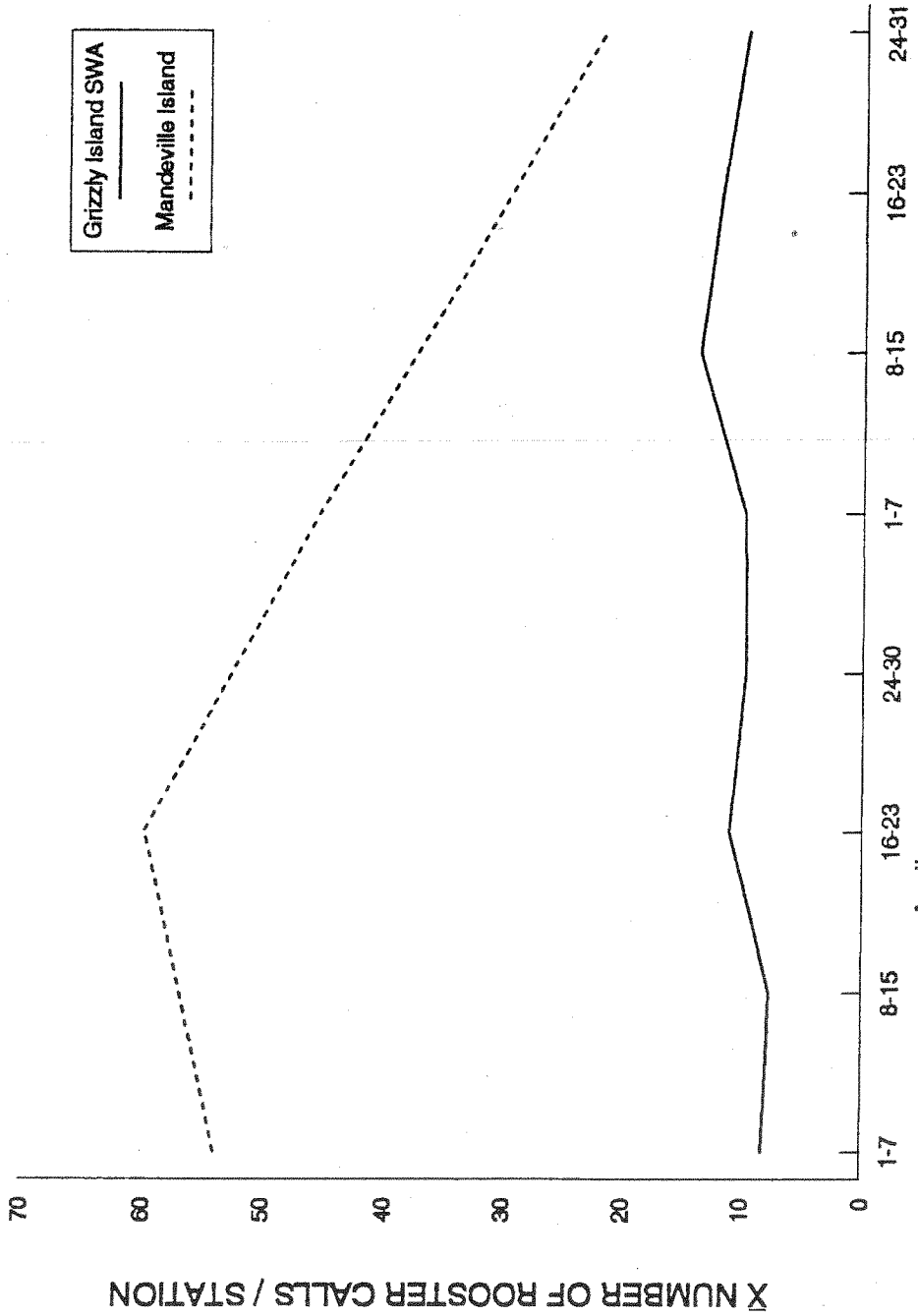

Figure 4. Mean number of ring-necked pheasant rooster calls at nine listening stations on Mandeville Island and 20 listening stations on Grizzly Island State Wildlife Area, 1993.

A comparison of Delta pheasant populations can made with the Grizzly Island State Wildlife Area which lies approximately 30 km west of Mandeville Island. During pheasant surveys conducted on the Grizzly Island Wildlife Area in 1990, peak number of crow calls were recorded during the first week of April. Observers on Grizzly Island recorded an average of 20 calls per station on their first survey (3 April 1990) and measured a 50% decrease in rooster crowing activity through their last count on 3 May 1990. Results from surveys conducted in 1993 using the same listening stations at Grizzly Island indicated a much lower average of 10 calls per station. An early small peak in crowing activity occurred in the third week of April, as on Mandeville Island (Figure 4). A second peak occurred much later, however. During the second week of May a total of 14 calls per station were recorded.

Avian Communities - General surveys on Mandeville Island confirmed the presence of 110 species of birds. Included in this total were 20 species of waterfowl, and 11 species of birds of prey. A complete list of birds seen on the Island appears in Appendix A.

We measured avian densities and diversity within six distinct habitat types on Mandeville Island during summer 1992 and winter - spring 1993. A total of 68 different species were observed during surveys. Density of birds detected (per square kilometer) in all habitat types can be found in Appendix B.

Three species of swallow (barn, cliff and tree) were commonly seen foraging in all habitats. During summer 1992 surveys however, swallow species were combined and analyzed as a group. Other species recorded in all six habitats were the song sparrow, ring-necked pheasant, western meadowlark, and house finch.

Seasonal changes in avian diversity on Mandeville Island indicated that the winter period supported the greatest number of species (Figure 5). Migrating waterfowl and small passerines comprised the majority of birds recorded during this period. The greatest diversity of wintering birds occurred in agricultural wetlands (28 species

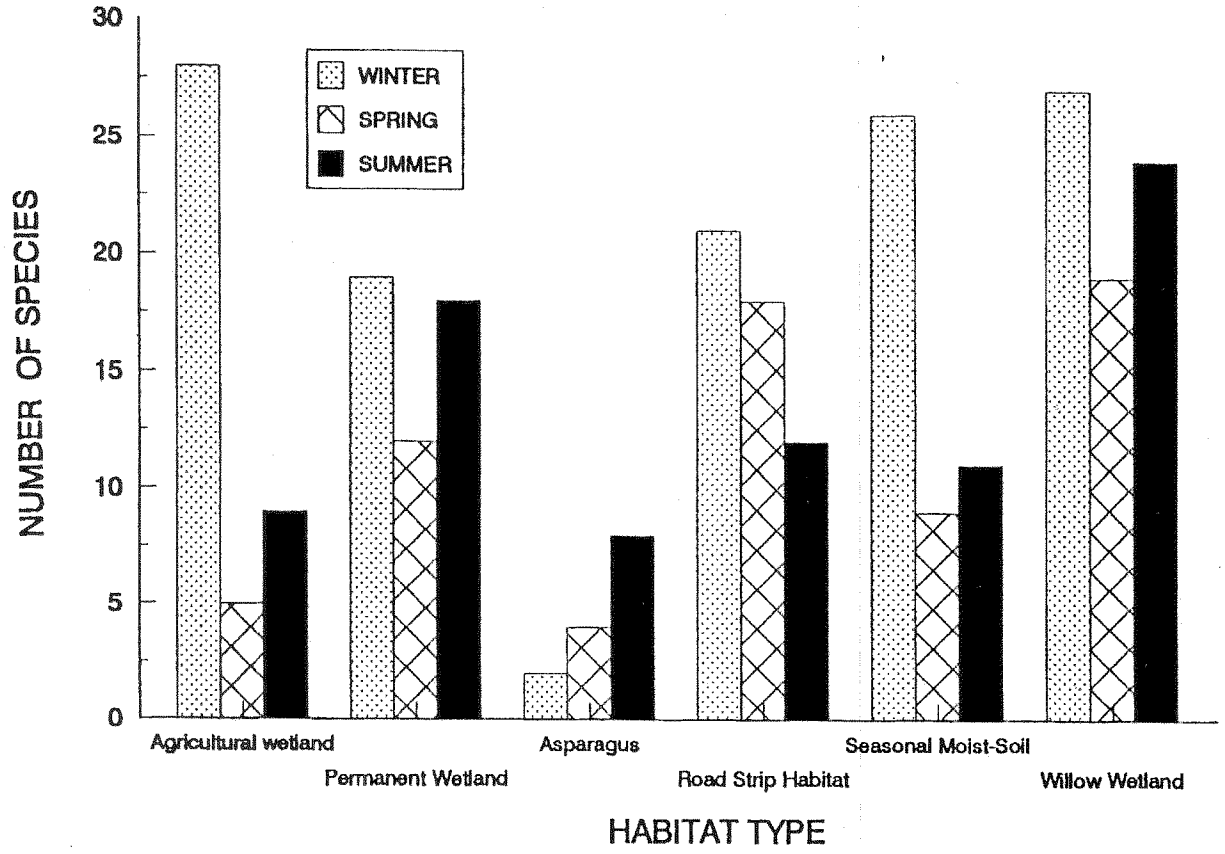

Figure 5. Seasonal changes in avian diversity within 6 different habitat types on Mandeville Island, Summer 1992 and Winter - Spring 1993.

observed), willow wetlands (27 species observed) and the seasonal moist-soil wetland (26 species observed). A total of 11 and 12 different species of waterfowl were recorded in the seasonal moist-soil and agricultural wetlands, respectively, whereas the willow wetlands supported primarily small passerines during this period (Appendix B). Number of species detected decreased among all habitats surveyed through the spring and summer periods (Figure 5).

The greatest overall species diversity occurred in the willow wetland habitat found in camps 15 and 17. This habitat supported 41 of the 68 species observed (including ten species not found in any other habitat) and accounted for the highest densities for 19 of the bird species (Appendix B). The lowest overall species diversity and bird densities occurred in cultivated asparagus fields. Only song sparrows and swallows were observed in high numbers within this habitat. Horned larks and western meadowlarks, species that prefer open fields and forage on the ground, were most commonly seen in asparagus fields. American pipits were also seen exclusively in this habitat (Appendix B).

The seasonal moist-soil wetland and road strip habitats contained the second highest number of species observed during surveys. Density figures were the highest in the seasonal moist-soil wetland for common yellow-throats (74 birds/km^2), swallows (1,654 birds/km^2) black-shouldered kite (15 birds/km^2) and nine different species of waterfowl (Appendix B). The survey conducted along road strip habitats yielded the highest densities for white-crowned sparrows (280 birds/km^2), golden-crowned sparrows (118 birds/km^2) and ring-necked pheasants (63 birds/km^2).

Agricultural wetlands supported the greatest number of species among all habitats during the winter period, but its importance dropped considerably after water was drawn off fields in February. Number of species using this habitat decreased from 28 in the winter to only 5 during spring surveys. Highest densities were recorded for song sparrows (548 birds /km^2), coot (589 birds/km^2), wood ducks (441 birds/km^2) green-winged teal (148 birds/km^2), ring-necked duck (26 birds/km^2) and lesser scaup (11 birds/km^2) (Appendix B).

Connection Slough, a permanent wetland meandering through the southeastern portion of the Island, maintained a fairly constant number of species throughout the survey period (Figure 5). Its densely vegetated edges and small wooded sections provided excellent cover for a total of 31 different bird species. The highest densities of house finch (707 birds/km^2), rufous-sided towhees (206 birds/km^2), marsh wrens (118 birds/km^2) and yellow warblers (8 birds/km^2) were found along this slough.

Shorebirds and Wading birds - A total of 18 species of shorebirds and wading birds were seen on Mandeville Island between April - June 1992-93 (Appendix A). Of these 18 species, 6 are known to nest on Mandeville and other Islands in the Delta (Appendix A). On 17 August shorebirds were counted to supplement the PRBO Pacific Flyway Fall migrational survey. While actual wetland acreage was limited at this time, substantial numbers of dowitchers and Caspian terns were present. Six additional species were also seen during this count (Appendix A).

Carnivorous Mammals - Carnivorous mammals were inventoried, and trends in population abundance were measured by comparing individual animal visitation rates to scent-stations associated with different habitats. Scent-stations were operated in July and September 1992 and April - May 1993 (Figure 6). The overall mean monthly scent-station visitation rate by raccoons and striped skunks for the 5 month period was 25% and 23%, respectively. Coyotes had the next highest mean monthly visitation rate of 17%. Mink, fox and opossum all had mean monthly visitation rates of less than 5 percent.

The various wetland habitats associated with the scent-station transects and the timing of their flood-up and draw down, appear to have influenced visitation rates by different mammals. Monthly visitation rates by raccoons were highest in the seasonal moist-soil wetland (mean = 33%) and the permanent wetland of Connection Slough (mean = 24%). Visitation rates peaked during April in both habitats (Figure 6). Conversely, the two transects through the willow wetland and the agricultural wetland yielded substantially lower mean visitation rates of 18% and 20% , respectively. By

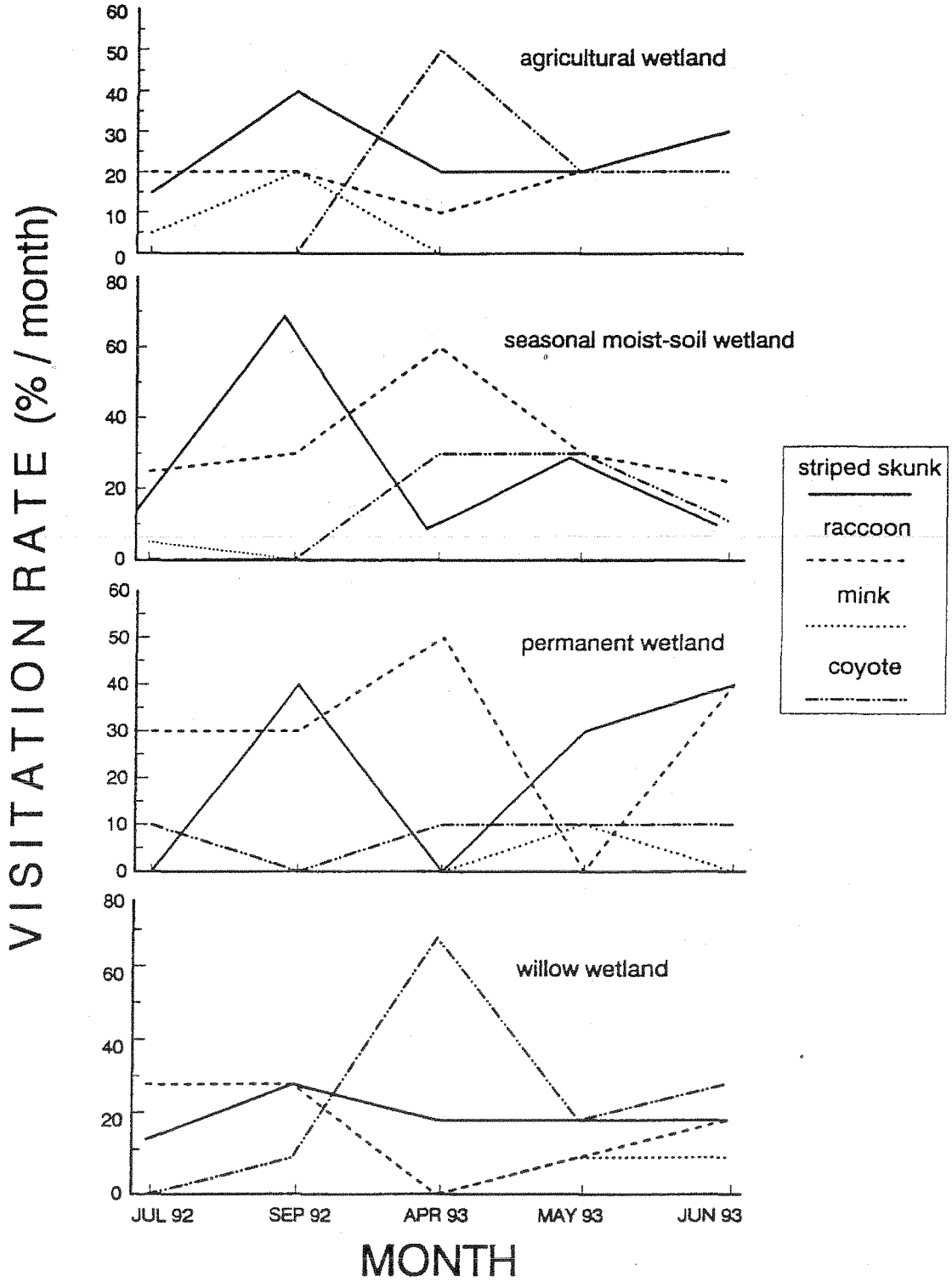

Figure 6. Monthly scent station visitation rates for striped skunk, raccoon, mink and coyote with associated habitat types on Mandeville Island, 1992-93.

April, water had been drawn off the willow and agricultural wetlands, and visitation rates for raccoons dropped to 0 and 10%, respectively. At this time, the moist-soil impoundment and Connection Slough were the primary wetlands on the Island. It is difficult to compare species-specific visitation rates between habitat types because physical differences (i.e. road distribution, vegetation density) may affect animal movements and seasonal shifts from upland habitats to wetlands have been observed for raccoons (Sumner and Hill 1980).

A decrease in visitation rates for coyotes during the May - June period, was likely a result of the denning and rearing of young. Progulske (1982) found total daily movements are usually quite minimal for adult gray foxes during this period. Similar patterns were also observed for raccoons.

Significant changes in habitat occurred through the July - September period as fields were prepared for the annual arrival of wintering waterfowl and other migratory birds. Primary habitats affected included fields managed as agricultural wetlands and moist-soil wetland. Wide strips were mowed and wetlands were flooded in order to provide feeding habitat for the early migrants. Four out of the 6 mammalian species monitored by these stations showed overall increased visitation rates during September. Striped skunks had the greatest increase (15% in July, 70% in September), especially on the transect running adjacent to the recently flooded moist-soil unit in Camp 7 (Figure 6). Only opossums and coyotes did not exhibit an increase in visitation rate during this period.

When wetlands were flooded carnivorous mammals probably shifted to levees and other roads, thereby increasing the probability of encountering our stations. Also, the population increase observed during the latter survey may have been attributable to dispersal of juveniles and possibly an increase in daily movements of adults.

Vegetation Surveys

Photo stations - Following is a brief description of the vegetative composition for each photo station on Mandeville Island. Photo point locations can be found on Figure 3.

1) Agricultural wetland: This station is dominated by tall (6.5' - 7') stalks of corn grown in 6 consecutive lines interspersed by an additional 6 lines of volunteer stands of natural (moist-soil) food plants. The predominant moist-soil plants found intermixed in this plot consisted of smartweed, watergrass and redroot pigweed (Amaranth). The plants ranged in height from 2.5' -3'.

2) Seasonal marsh: This station contained a very robust stand of smartweed averaging greater than 3' tall. A smaller percentage of aster and horseweed is also present.

3) Reverse cycle marsh: This unique wetland serves a dual management purpose. Maintaining water in this marsh until August provides the locally produced ducks with brood water and migrating shorebirds a location to feed and loaf. Flooding these cells during the growing season also controls Johnson grass, a nuisance to many farmers in the Delta. The vegetation at this station consisted primarily of dying Johnson grass and immature stands of watergrass.

4) Commercial agricultural crop: Asparagus is grown on approximately 900 acres at Mandeville Island. This station is focused on a section which depicts the "clean farming" style necessary to produce this crop.

5) Pothole Complex: This newly created wetland was flooded in June 1992 and produced an abundance of moist-soil food plants. Dominant plant types include watergrass and smartweed growing taller than 3 feet throughout the pond.

6) Agricultural set-aside: Although the field was recently disced, small patches of cattail and a large clump of willows were still standing in the field.

7) Willow wetland: The vegetation composition at this station includes dense clumps of cattail, watergrass and smartweed surrounded by a forest of willow trees.

8) Managed pheasant habitat: This field was recently disced and plowed. Future management activities include planting a food plot of milo and a variety of upland grasses for nesting cover.

9) Semi-permanent marsh: Flooded throughout the summer, this wetland provided excellent waterfowl pair and brood habitat during the nesting season. In addition,

seeds of watergrass, smartweed and other important waterfowl food plants will be available during the fall and winter months.

10) Commercial agricultural crop: This station is an example of the corn crop on Mandeville Island. After harvest in November, this habitat will be flooded for the benefit of waterfowl and other wildlife.

Seed Production and Vegetation Composition of Common Moist-soil Food Plants-

The combined amount of seed produced by watergrass and smartweed in our sample of agricultural wetland habitat averaged approximately 1,050 pounds per acre (Table 4). Although smartweed and watergrass were the most common species found in the field (excluding the planted corn), watergrass was especially abundant in this unit, occurring in 100% of the sample plots. Smartweed occurred in only 30% of the samples. We also measured the plant species composition in the sampled field. A total of 8 different species were documented (Table 5).

Table 4. Estimation of seed production for watergrass and smartweed on an 8 acre sample of an agricultural wetland on Mandeville Island, August 1992.

Plot	Species	# of Seed Heads	Plant Height (m)	Seed Head Diameter (cm)	Seed Head Height (cm)	lb/acre *
1	Watergrass	1	0.80	4	16	427
1	Smartweed	21	1.00	-	-	320
2	Watergrass	4	1.60	6	16	900
2	Smartweed	4	0.50	-	-	61
3	Watergrass	6	2.00	10	18	1331
4	Watergrass	13	1.80	7	16	1135
5	Watergrass	13	1.40	7	16	1000
6	Watergrass	12	1.80	10	17	1476
7	Watergrass	4	1.30	4	14	706
8	Watergrass	8	1.80	11	15	1323
9	Watergrass	12	1.50	5	15	905
10	Watergrass	9	1.30	5	15	770
10	Smartweed	9	1.00	-	-	137

Average Estimated Weight

Plant	lb/ac	lb/unit	% Freq
Watergrass	997.3	7978.4	100.0
Smartweed	51.8	414.4	30.0
Total	1049.1	8392.8	

* Determined by using the regression equation developed by Laubhan and Fredrickson, (1992).

Table 5. Species composition of moist-soil plants found in a sample of an agricultural wetland on Mandeville Island, August 1992.

Common Name	Scientific Name	Mean Percent Cover
Watergrass	*Echinochloa crussgalli*	95.0
Smartweed	*Polygonum lapathifolium*	7.3
Crab grass	*Digitaria sanguinalis*	7.0
Nut sedge	*Cyperus sp.*	3.6
Fat hen	*Atriplex patula*	2.0
Johnson grass	*Sorghum halepense*	1.0
Beggerticks	*Bidens sp.*	0.5
Rabbitfoot grass	*Polypogon monspeliensis*	0.4

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Appendix A

Appendix A. Birds seen on Mandeville Island during surveys performed April - June 1992-93. * Indicates birds seen during PRBO Pacific Flyway Fall migrational survey (total number seen).

Common name	Abundance	Seasonality	Probable breeding
PODICIPEDIDAE			
Pied-billed grebe	Common	Resident	
PELICANIDAE			
White pelican (25)	Common	Migrant	
PHALACROCORACIDAE			
Double-crested cormorant	Common	Migrant	
ARDEIDAE			
Great blue heron (3)	Common	Resident	
Green-backed heron	Common	Resident	
Great egret	Common	Resident	
Snowy egret	Common	Resident	
Black-crowned night heron	Common	Resident	Nesting
American bittern	Common	Migrant	
THRESKIORNITHIDAE			
White-faced ibis	Uncommon	Migrant	
GRUIDAE			
Sandhill crane	Common	Migrant	
ANATIDAE			
Tundra swan	Common	Migrant	
Canada goose	Common	Resident	Nesting
Cackling Canada goose	Common	Migrant	
Greater white-fronted goose	Common	Migrant	
Snow goose	Common	Migrant	
Ross' goose	Uncommon	Migrant	
Mallard	Common	Resident	Nesting
Gadwall	Uncommon	Resident	
Canvasback	Uncommon	Migrant	
Pintail	Common	Resident	Nesting
Green-winged teal	Common	Migrant	
Cinnamon teal	Common	Resident	Nesting
American wigeon	Common	Migrant	
Northern shoveler	Common	Migrant	
Wood duck	Common	Resident	Nesting
Ruddy duck	Common	Migrant	

Appendix A. Birds seen on Mandeville Island during surveys performed April - June 1992-93. * Indicates birds seen during PRBO Pacific Flyway Fall migrational survey (total number seen).

	Common name	Abundance	Seasonality	Probable breeding
	Ring-necked duck	Common	Migrant	
	Common Goldeneye	Occasional	Migrant	
	Lesser Scaup	Occasional	Migrant	
	Blue-winged Teal	Rare	Migrant	
	RALLIDAE			
	Virginia rail	Common	Migrant	
	Sora rail	Common	Migrant	
	Common moorhen	Common	Resident	Nesting
	American coot	Common	Resident	Nesting
	RECURVIROSTRIDAE			
	American avocet	Common	Migrant	
*	Black-necked stilt (32)	Common	Resident	
	CHARADRIIDAE			
	Killdeer (5)	Common	Resident	
	SCOLOPACIDAE			
	Common snipe	Common	Migrant	
	Greater yellowlegs	Common	Migrant	
	Western sandpiper (3)	Common	Migrant	
	Wilson's phalarope (2)	Uncommon	Migrant	
	Long-billed dowitcher (151)	Common	Migrant	
	LARIDAE			
	Western gull	Common	Resident	
	California gull	Common	Migrant	
	Forster's tern	Common	Migrant	
*	Caspian tern (215)	Common	Migrant	
	CATHARTIDAE			
	Turkey vulture	Common	Resident	
	ACCIPITRIDAE			
	Black-shouldered kite	Common	Resident	
	Sharp-shinned hawk	Common	Resident	
	Cooper's hawk	Occasional	Resident	
	Red-tailed hawk	Common	Resident	
	Red-shouldered hawk	Common	Migrant	

Appendix A. Birds seen on Mandeville Island during surveys performed April - June 1992-93. * Indicates birds seen during PRBO Pacific Flyway Fall migrational survey (total number seen).

Common name	Abundance	Seasonality	Probable breeding
Northern harrier	Common	Resident	
FALCONIDAE			
Prairie falcon	Uncommon	Resident	
American kestrel	Common	Resident	
PHASIANIDAE			
California quail	Common	Resident	Nesting
Ring-necked pheasant	Common	Resident	Nesting
Wild turkey	Common	Resident	
COLUMBIDAE			
Rock dove	Common	Resident	Nesting
Mouring dove	Common	Resident	Nesting
TYTONIDAE			
Barn owl	Common	Resident	Nesting
STRIGIDAE			
Great horned owl	Common	Resident	Nesting
ALCEDINIDAE			
Belted kingfisher	Common	Resident	
PICIDAE			
Common flicker	Common	Resident	
Downy woodpecker	Common	Migrant	
Hairy woodpecker	Common	Migrant	
TYRANNIDAE			
Western kingbird	Common	Migrant	
Ash-throated flycatcher	Occasional	Migrant	
Black phoebe	Common	Resident	Nesting
ALUADIDAE			
Horned lark	Common	Resident	
HIRUNDINIDAE			
Barn swallow	Common	Resident	Nesting
Cliff swallow	Occasional	Resident	Nesting
Tree swallow	Occasional	Migrant	

Appendix A. Birds seen on Mandeville Island during surveys performed April - June 1992-93. * Indicates birds seen during PRBO Pacific Flyway Fall migrational survey (total number seen).

Common name	Abundance	Seasonality	Probable breeding
Bank swallow	Common	Migrant	
CORVIDAE			
Scrub jay	Common	Resident	
Common crow	Common	Resident	
MUSCICAPIDAE			
American robin	Common	Resident	
Western bluebird	Common	Resident	
Wrentit	Common	Resident	
AEGITHALIDAE			
Bushtit	Common	Resident	
TROGLODYTIDAE			
Bewick's wren	Common	Resident	
Marsh wren	Common	Resident	Nesting
LANIIDAE			
Loggerhead shrike	Common	Resident	
MIMIDAE			
Mockingbird	Common	Resident	
MOTACILLIDAE			
American pipit	Common	Resident	Nesting
STURNIDAE			
European starling	Common	Resident	Nesting
EMBERIZIDAE			
Yellow warbler	Common	Migrant	
Yellow-rumped warbler	Common	Migrant	
Common yellowthroat	Common	Migrant	
Yellow-breasted chat	Common	Migrant	
Western Meadowlark	Common	Resident	Nesting
Yellow-headed blackbird	Common	Resident	
Red-winged blackbird	Common	Resident	Nesting
Tricolored blackbird	Common	Resident	

Appendix A. Birds seen on Mandeville Island during surveys performed April - June 1992-93. * Indicates birds seen during PRBO Pacific Flyway Fall migrational survey (total number seen).

Common name	Abundance	Seasonality	Probable breeding
Brewer's blackbird	Common	Resident	Nesting
Northern oriole	Common	Resident	Nesting
Brown-headed cowbird	Common	Resident	Nesting
Black-headed grosbeak	Common	Migrant	
Blue grosbeak	Common	Migrant	
Rufous-sided towee	Common	Resident	
Brown towee	Common	Resident	
Dark-eyed junco	Common	Migrant	
White-crowned sparrow	Common	Resident	
Golden-crowned sparrow	Common	Resident	
Song sparrow	Common	Resident	
PASSERIDAE			
House sparrow	Common	Resident	Nesting
FRINGILLIDAE			
Purple finch	Common	Resident	
House finch	Common	Resident	
American goldfinch	Common	Migrant	

Appendix B

Appendix B. Density of birds detected per square kilometer in willow wetland habitat on Mandeville Island, summer 1992 and winter-spring 1993.

	Survey Period		
Species	Summer	Winter	Spring
Mallard	0	22	2
Cinnamon Teal	0	9	9
Coot	0	4	0
Common snipe	0	2	0
Red-tailed hawk	0	2	0
Ring-necked pheasant	15	40	13
California quail	0	27	0
Mourning dove	47	2	11
Barn swallow	0	0	2
Swallow sp.[1]	202	0	0
Tree swallow	0	0	27
Northern flicker	2	2	0
Hairy woodpecker	0	2	0
Downy woodpecker	34	0	0
Ash-throated flycatcher	2	0	0
Scrub jay	11	0	0
Black phoebe	2	7	2
Western meadowlark	0	29	0
Bushtit	47	0	27
American crow	30	9	45
Raven	0	2	0
Bewick's wren	4	0	0
Wrentit	2	0	0
Marsh wren	0	13	0
American robin	2	7	2
Mocking bird	0	2	0
Vireo sp.[2]	4	0	0
Common yellowthroat	4	7	9
Yellow-breasted chat	8	0	0
Yellow-rumped warbler	0	76	20
Black-headed grosbeak	19	0	0
Blue grosbeak	53	0	0
Song sparrow	23	109	38
Golden-crowned sparrow	0	87	0
White-crowned sparrow	0	107	2
Brown-headed cowbird	11	0	0
Brewers blackbird	0	0	2
Red-winged blackbird	25	64	29
Northern oriole	6	0	0
Rufous-sided towhee	200	16	16
Brown towhee	0	5	0
Dark-eyed junco	0	31	0
House finch	306	22	162
American goldfinch	89	0	13

[1] Swallow sp. includes several unidentified species of swallow.
[2] Vireo sp. includes several unidentified species of vireo.

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Appendix B. Density of birds detected per square kilometer in road strip habitats on Mandeville Island, summer 1992 and winter-spring 1993.

Species	Survey Period		
	Summer	Winter	Spring
Great blue heron	0	2	0
Mallard	0	4	20
Cinnamon teal	0	0	18
Gadwall	0	0	4
Common snipe	0	2	2
Killdeer	0	2	0
Red-tailed hawk	0	2	0
American kestrel	0	2	0
Ring-necked pheasant	55	18	16
Mourning dove	3	0	9
Tree swallow	0	0	4
Barn swallow	0	0	2
Swallow sp.[1]	178	0	0
Belted kingfisher	0	0	2
Northern flicker	0	2	0
Black phoebe	0	2	0
Western meadowlark	0	2	0
American crow	0	2	4
Marsh wren	0	7	0
American robin	0	2	0
Mocking bird	0	0	2
Common yellowthroat	1	5	7
Yellow-rumped warbler	0	2	0
Blue grosbeak	1	0	0
Song sparrow	47	54	71
Golden-crowned sparrow	0	118	9
White-crowned sparrow	0	280	16
Brown-headed cowbird	6	0	0
Brewer's blackbird	1	0	0
Red-winged blackbird	6	80	55
Rufous-sided towhee	3	0	0
Dark-eyed junco	0	7	0
House finch	908	358	85
American goldfinch	9	0	2

[1] Swallow sp. includes several unidentified species of swallow.

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Appendix B. Density of birds detected per square kilometer in cultivated asparagus on Mandeville Island, summer 1992 and winter-spring 1993.

Species	Survey Period		
	Summer	Winter	Spring
Ring-necked pheasant	2	0	0
Swallow sp.[1]	117	0	0
Horned lark	11	0	22
Western meadowlark	15	0	4
Bewick's wren	6	0	0
Marsh wren	4	0	0
American pipit	0	44	4
Song sparrow	121	0	11
Brown-headed cowbird	2	0	0
House finch	0	33	0

[1] Swallow sp. includes several unidentified species of swallow.

Appendix B. Density of birds detected per square kilometer in permanent wetland habitat on Mandeville Island, summer 1992 and winter-spring 1993.

Species	Survey Period		
	Summer	Winter	Spring
American bittern	0	4	0
Mallard	0	152	4
Cinnamon teal	0	15	0
Red-tailed hawk	0	4	4
Sharp-shinned hawk	0	4	0
Ring-necked pheasant	2	48	26
Mourning dove	8	0	7
Tree swallow	0	0	4
Swallow sp.[1]	401	0	0
Northern flicker	0	7	0
Downy woodpecker	2	0	0
Scrub jay	4	0	0
Black phoebe	2	4	0
Horned lark	0	0	4
Western meadowlark	0	144	0
Common bushtit	2	0	0
American crow	2	0	0
Marsh wren	70	118	111
American robin	6	48	0
Yellow warbler	8	0	0
Common yellowthroat	68	7	4
Yellow-rumped warbler	0	11	0
Blue grosbeak	8	0	0
Song sparrow	397	107	130
Golden-crowned sparrow	0	145	0
White-crowned sparrow	0	41	0
Brewer's blackbird	91	0	0
Red-winged blackbird	0	3,111	11
Rufous-sided towhee	206	15	0
House finch	251	707	52
American goldfinch	36	0	15

[1] Swallow sp. includes several unidentified species of swallow.

Appendix B. Density of birds detected per square kilometer in agricultural wetland habitat on Mandeville Island, summer 1992 and winter-spring 1993.

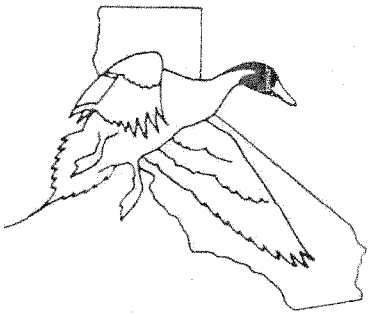
Species	Survey Period		
	Summer	Winter	Spring
White-fronted goose	0	78	0
Snow goose	0	7	0
Tundra swan	0	52	0
Mallard	0	4,955	0
Northern pintail	0	37	0
Wood duck	0	441	0
Cinnamon teal	0	174	0
Northern shoveler	0	304	0
Green-winged teal	0	148	0
Ring-necked duck	0	26	0
American wigeon	0	7	0
Lesser scaup	0	11	0
Coot	0	589	0
Black-shouldered kite	0	7	0
Red-tailed hawk	0	11	0
Ring-necked pheasant	0	63	7
Mourning dove	2	96	0
Swallow sp.[1]	19	0	0
Northern flicker	0	7	0
Black phoebe	0	7	0
Western meadowlark	0	89	4
American robin	0	4	0
Common yellowthroat	23	0	0
Yellow-rumped warbler	0	33	0
Blue grosbeak	2	0	0
Song sparrow	144	548	48
Golden-crowned sparrow	0	45	0
White-crowned sparrow	0	52	0
Red-winged black bird	36	8,855	115
Brewer's blackbird	132	0	0
Rufous-sided towhee	4	30	4
House finch	4	33	0

[1] Swallow sp. includes several unidentified species of swallow.

Appendix B. Density of birds detected per square kilometer in seasonal wetland habitat on Mandeville Island, summer 1992 and winter-spring 1993.

Species	Survey Period		
	Summer	Winter	Spring
American bittern	0	7	0
Canada goose	0	115	0
White-fronted goose	0	230	0
Tundra swan	0	419	0
Mallard	0	39,537	19
Northern pintail	0	67	0
Green-winged teal	0	37	0
American wigeon	0	3,822	0
Gadwall	0	755	0
Cinnamon teal	0	267	0
Northern shoveler	0	615	0
Coot	0	356	0
Common snipe	0	15	0
American avocet	0	0	7
Black-shouldered kite	0	15	0
Red-tailed hawk	0	7	0
Sharp-shinned hawk	0	4	0
Coopers hawk	0	4	0
Ring-necked pheasant	17	16	29
Mourning dove	11	0	0
Tree swallow	0	0	4
Swallow sp.[1]	1,654	0	0
Horned lark	2	0	4
Western meadowlark	6	4	0
Marsh wren	11	44	0
Common yellowthroat	74	0	8
Song sparrow	285	119	89
Golden-crowned sparrow	0	4	0
White-crowned sparrow	0	4	0
Brewer's blackbird	74	7	0
Red-winged blackbird	0	15	11
House finch	17	37	11
American goldfinch	21	0	0

[1] Swallow sp. includes several unidentified species of swallow.



CALIFORNIA WATERFOWL ASSOCIATION

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"Preserving California's waterfowl, wetlands, and outdoor heritage... since 1945."

August 12, 1993

Anthony Marnell
4495 South Polaris
Las Vegas, NV 89103

Dear Tony:

Enclosed is the Mandeville Island Biological Surveys Final Report. Dan Loughman and Bob Hawkins have done a great job on the report. I believe the information provided therein will assist you with your future habitat management endeavors on Mandeville Island. If you have any questions, feel free to contact me. Thank you for your support of the California Waterfowl Association.

Sincerely,

M. Robert McLandress, Ph.D
Director of Waterfowl and Wetlands Programs

MRM:cm

cc: Chuck Dennis w/enc.

TUSCANY
RESEARCH INSTITUTE

A NON-PROFIT FOUNDATION DEDICATED TO THE RESTORATION, PROTECTION AND MANAGEMENT OF WETLANDS FOR BIOLOGICAL AND RECREATIONAL PURPOSES IN AN ENVIRONMENTALLY AESTHETIC WAY

RECIRC2650

EXHIBIT 30-3

Balance and Eco System

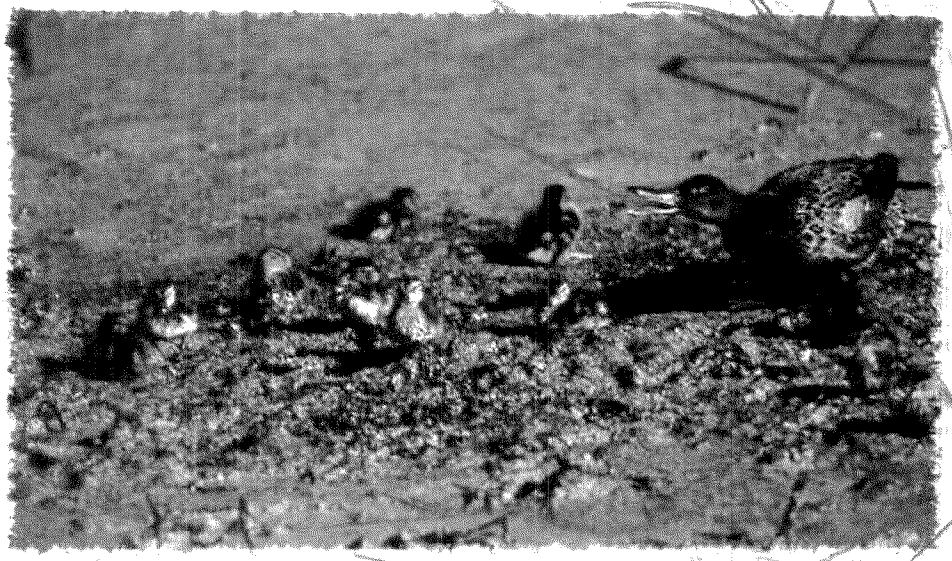
Tuscany Research Institute's ("TRI") efforts focus on the development of environments that are capable of sustaining the ecosystem in which they participate.

Our priority is to bring balance to the targeted area by creating a system that is beneficial to humans, nature, wildlife and agricultural practice.

Tuscany Research Institute's focus is to conserve high priority areas for wetland and nesting restoration. Through experience and expertise, our team is capable of identifying the biological needs of the ecosystem at hand. Once these areas are targeted, an extensive evaluation is done to first determine the restoration plan and then secondly, determine the management plan.

Our responsibility all the while is to bring balance to the specific area, making it possible for all participants in the ecosystem at hand to participate together.

When environmental and biological needs are satisfied and balance is restored, Tuscany Research Institute has achieved its goal by creating ecosystems that not only survive, but also thrive.



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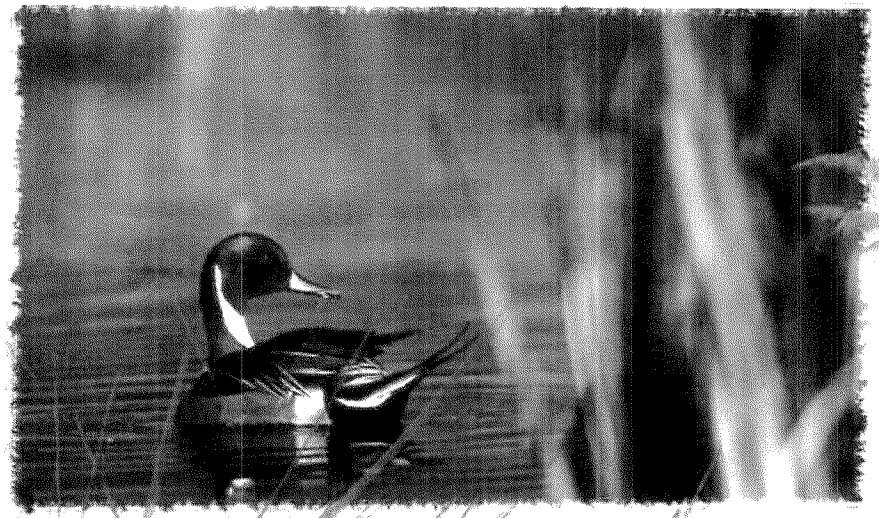
Leader in Research



1999 - Tuscany Research Institute placed itself in a leading role in waterfowl research when it awarded Ducks Unlimited an unprecedented $1 million dollar grant to document pintail migration patterns in the Pacific Flyway and serve as the foundation in "Discovery for Recovery: An International Pintail Initiative." This program is designed to expand the scientific research of pintail migration, nesting patterns and changes in habitat. The program will reach 29 million acres of habitat that is vital to the pintail's life cycle. It is the goal of the Institute to further the knowledge about this treasured bird and support its recovery.

2003 - TRI again pledged another $1 million dollar grant to partner with Ducks Unlimited and initiated "The Pintail Initiative: A Race Against Time." This program is dedicated to protecting nesting land in Canada's Prairie Pothole Region.

2004 - TRI participated in a partnership with the California Waterfowl Association to support the Mallard Legacy Program, pledging a $500,000 grant.

2004 - TRI participated in a partnership with Delta Waterfowl Foundation to support the Delta's Milk River Ridge pintail breeding ecology project.

2004 - Chairman Anthony A. Marnell II is invited to sit on the Board of Directors for Wetland America Trust.

History and Awards

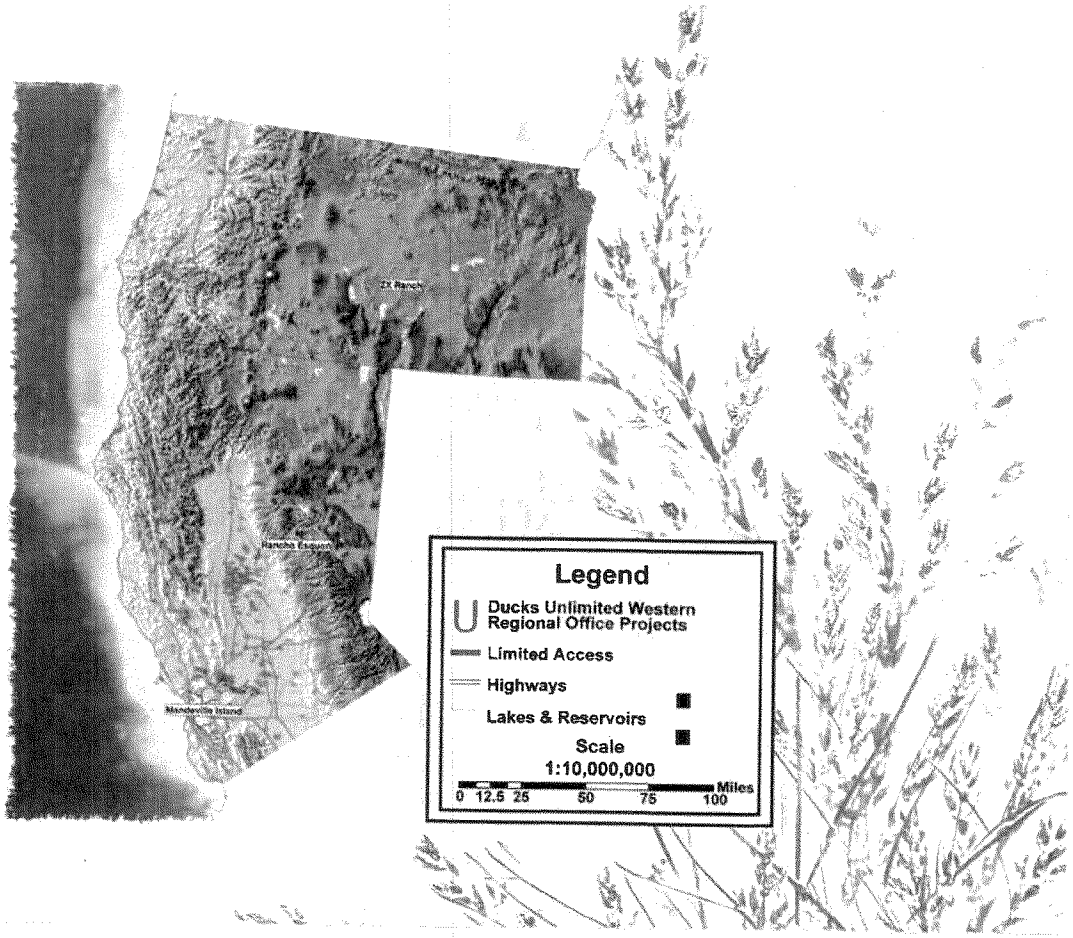
1988 - TRI is established as a 501(C)(3)
1993 - TRI receives a gift of 1,251 acres on Mandeville Island
1994 - TRI receives a gift of 2,620 acres on Mandeville Island
1996 - "The Mallard" is produced by California Waterfowl Association as a documentary video of the activities on Mandeville Island
1996 - Anthony A. Marnell II receives the "Starker Leopold" award for exceptional stewardship of wildlife habitat
1997 - California Waterfowl Association sites article "Mandeville Island Demonstrates State-of-the-Art Waterfowl Management"
1998 - State of California Senate Resolution commends Anthony A. Marnell II for his work and dedication to the restoration of wetlands
1999 - TRI awards grant to Ducks Unlimited for $1 million dollars for "Discovery for Recovery: An International Pintail Initiative"
2002 - TRI receives a gift of 678 acres on Mandeville Island
2003 - TRI receives the "Dennis G. Raveling Award" awarded by California Waterfowl Association for vital contributions to waterfowl research
2003 - TRI awards grant to Ducks Unlimited for $1 million dollars for "The Pintail Initiative : A Race Against Time"
2004 - TRI awards grant to Delta Waterfowl Foundation for the "Milk River Ridge Pintail Project"
2004 - TRI awards grant to California Waterfowl Association for the "Mallard Legacy Program"
2004 - Chairman, Anthony A. Marnell II accepts position on Wetland America Trust, Board of Directors

MANDEVILLE ISLAND

With its largest project on Mandeville Island in California, Tuscany Research Institute has developed the concept of managing an ecosystem. By balancing the needs of nesting and migrating waterfowl with the need to rotate land use, setting aside land that will sustain long-term habitat and agricultural use. Mandeville Island has been acclaimed as a world-class waterfowl habitat.

Through selective field flooding, rotating land uses, varying ground cover and alternating food plants, TRI has significantly benefited the quality and quantity of waterfowl in the San Joaquin Delta area and the Pacific Flyway.

Mandeville Island has been recognized for demonstrating this State-of-the-Art Waterfowl Management. Chuck Dennis, Field Manager for TRI, has been accredited for creating the best hunting area in the Delta. In 1989 the Board adapted his land management practices on a full scale implementation plan across the entire 5200 acres that comprise Mandeville Island. California Fish and Game surveys continually indicate that more than half of all of the waterfowl in the Delta make use of Mandeville Island throughout the migration annually.



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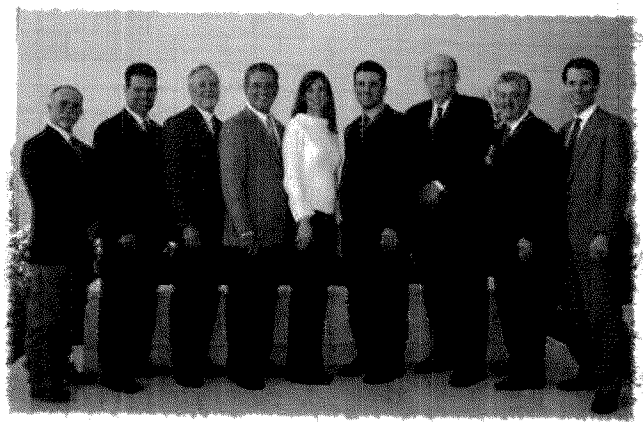


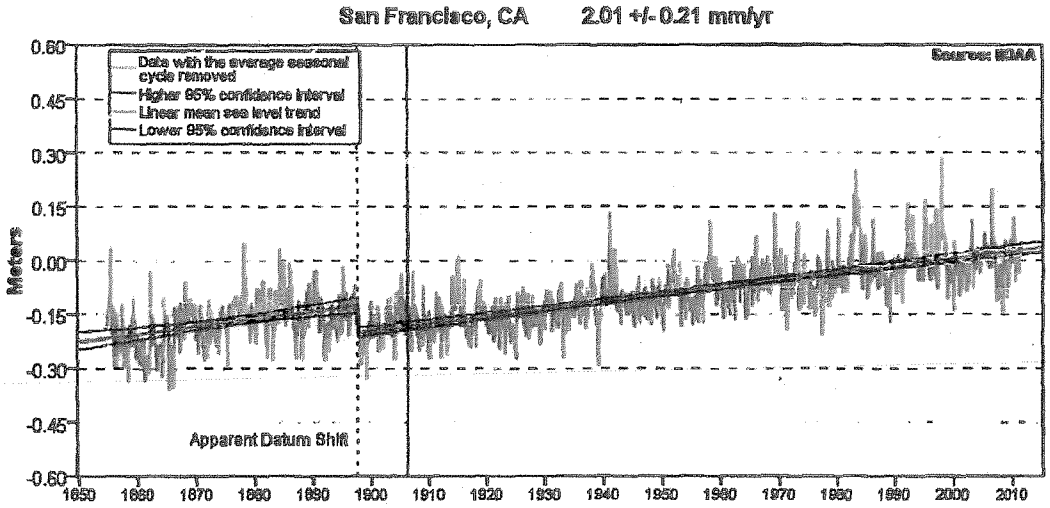
sea level trends

Alabama
Alaska
California
Connecticut
Delaware
Florida
Georgia
Hawaii
Louisiana
Maine
Maryland
Massachusetts
New Jersey
New York
North Carolina
Oregon
Pennsylvania
Rhode Island
South Carolina
Texas
Virginia
Washington
Washington DC
Island Stations

Global Stations

main page

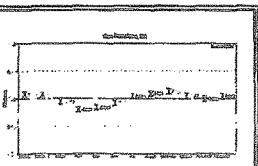
Mean Sea Level Trend
9414290 San Francisco, California

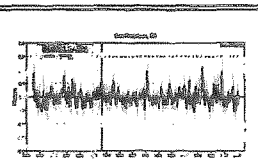


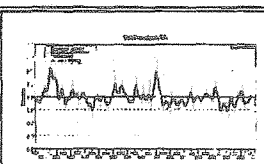
The mean sea level trend is 2.01 millimeters/year with a 95% confidence interval of +/- 0.21 mm/yr based on monthly mean sea level data from 1897 to 2008 which is equivalent to a change of 0.66 feet in 100 years.

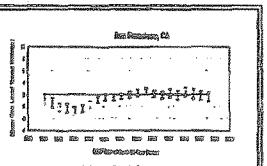
The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS. The calculated trends for all stations are available as a table in millimeters/year or a table in feet/century (0.3 meters = 1 foot).

If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data.


Average seasonal cycle


Interannual variation for all data


Interannual variation since 1980


Variation of 50-year mean sea level trends

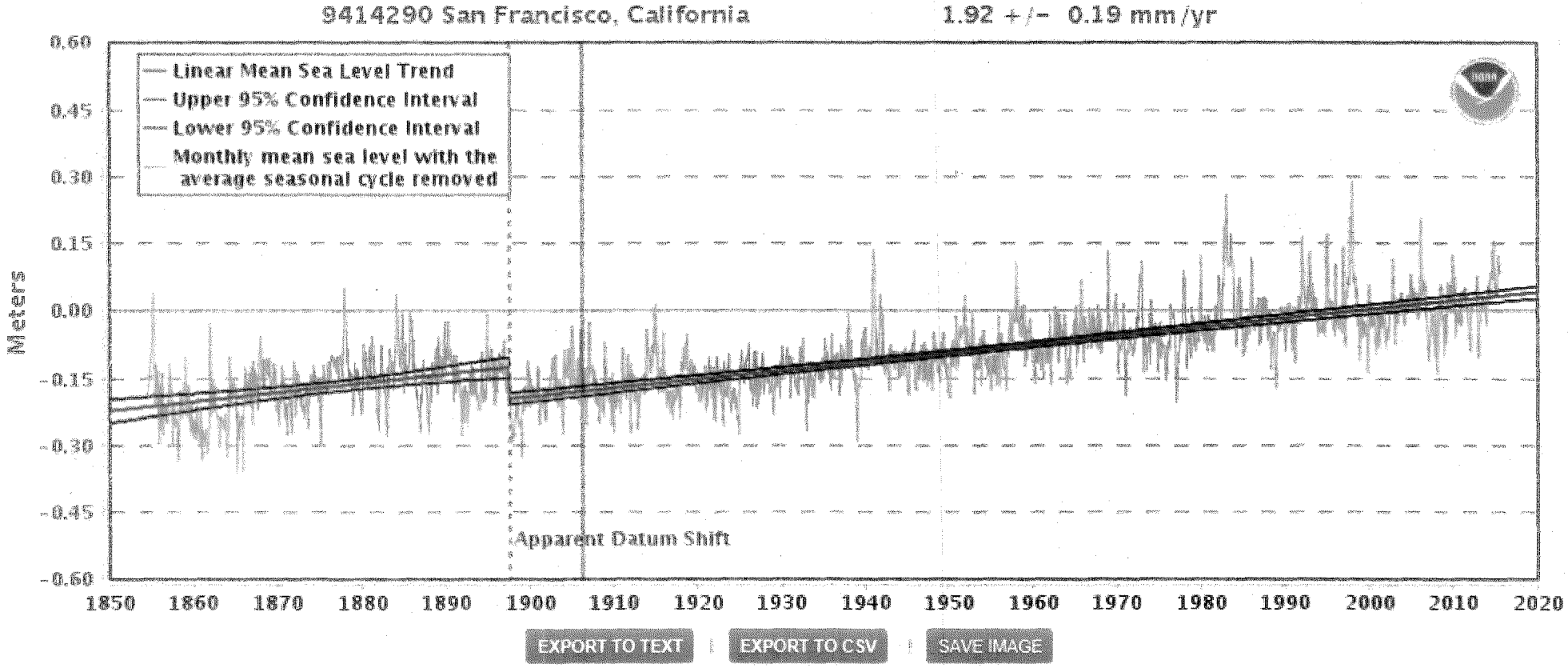
Frequently Asked Questions:

What is Sea Level?
Why does Sea Level change over time?
What does Sea Level have to do with Climate?

Back to Sea Levels Online

EXHIBIT 31

Mean Sea Level Trend
9414290 San Francisco, California



EXPORT TO TEXT | EXPORT TO CSV | SAVE IMAGE

The mean sea level trend is 1.92 millimeters/year with a 95% confidence interval of +/- 0.19 mm/yr based on monthly mean sea level data from 1897 to 2014 which is equivalent to a change of 0.63 feet in 100 years.

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