Central Valley Winter Raptor Survey (2007-2010): Overview and Methods

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RATIONALE AND PURPOSE

The great majority of research conducted on the ecology of birds has focused on the breeding season. For many species, however, and for raptors in particular, understanding habitat use and requirements in the non-breeding winter season may be even more important for conserving viable populations. Post-fledging mortality among raptors is extraordinarily high during their first winter of life, with rates of loss during their first year ranging from 50-80% (Newton 1979, Johnsgard 1990). Even for adult birds, it is crucial to emerge from winter in excellent physical condition to endure the stress of migration to the breeding grounds and to meet the high energy demands of raising young (Bildstein 2006). Thus, the quality of habitat in wintering areas may be as important, or more important, than breeding habitat in maintaining populations for some species.

Christmas Bird Count (CBC) data confirm that California's Central Valley (CV) harbors an extraordinary abundance and diversity of wintering raptors. CBC circles in the CV consistently record numbers that rank among the highest of any area in North America for the White-tailed Kite (*Elanus leucurus*), Northern Harrier (*Circus cyaneus*), Red-tailed Hawk (*Buteo jamaicensis*), and American Kestrel (*Falco sparverius*) (Root 1988, Pandolfino 2006, Pandolfino and Suedkamp-Wells 2009). At least 15 species of diurnal raptors commonly winter in the CV. No other region on the continent, with the possible exception of the coastal plains of Texas, supports a comparable abundance and diversity of wintering raptors. Despite this importance, there have been few studies of winter habitat use by raptors in the CV. All prior studies focused either on a small subset of the CV (Koplin 1973, Warner and Rudd 1975, Wilkinson and Debban 1980, Temeles 1986, Reeves and Smith 2004, Goerrissen 2005), on specific taxa or group of raptors (Erichsen et al. 1996, Smallwood et al. 1996), or on a specific habitat types such as rice (Elphick 2004).

Given the abundance of wintering raptors that use the CV, recent trends in land use are alarming and may have large scale impacts on raptor populations. In the past 30 years, agricultural land in the CV has been urbanized at higher rates than any other region of the United States (Johnson and Hayes 2004, Lubell et al. 2009), and population growth will likely continue well into this century (State of California 2007). During this same period, even more land has been converted from cattle ranching and other relatively passive uses to more intense agricultural practices such as

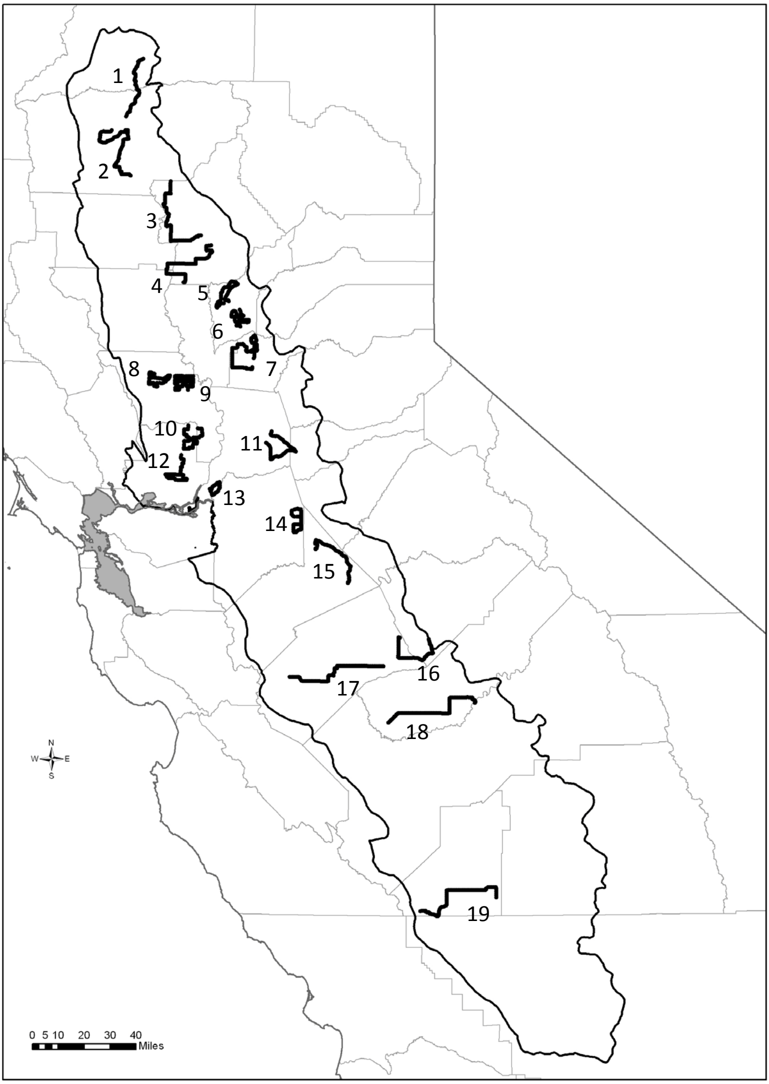

Figure 1. The Central Valley, California, and the 19 survey routes used to assess habitat associations of diurnal wintering raptors, 2007-2010. (1 = Shasta, 2 = Tehama, 3 = Butte North, 4 = Butte South, 5 = Yuba, 6 = Beale, 7 = Lincoln, 8 = Dunnigan Hills, 9 = Woodland, 10 = Davis, 11 = Folsom, 12 = Jepson, 13 = Delta, 14 = Linden, 15 = Oakdale, 16 = LeGrand, 17 = Los Banos, 18 = Madera, 19 = Kings).

vineyards and orchards (California Department of Conservation 2008, Volpe et al. 2010, The Nature Conservancy, unpubl. data). Impacts from this loss of grassland habitat may be responsible for the observed decline of many grassland-associated raptors and other bird species in the CV (Pandolfino 2011).

Because of the significance of winter habitat to raptor population stability, the continental importance of the CV to wintering raptors, and the rapid changes in land use occurring in this region, we felt it was urgent to understand the habitat associations of wintering raptors in the CV. We wanted to assess these associations throughout the CV for most species of wintering raptors, and for all the typical habitat types found in the CV. Clearly, accomplishing such an ambitious goal would not have been possible without employing "citizen science"— utilizing a large group of skilled, dedicated volunteers following a standard protocol over multiple years. The results of this effort have led to two prior publications (Pandolfino et al. 2011a, 2011b), and the other articles in this issue expand on those results to examine topics that encompass effects of riparian elements on raptor habitat associations, raptor behavior, and estimates of raptor populations.

STUDY AREA AND METHODS

Survey Routes and Survey Methodology

We defined the CV as the valley floor up to 300 m above sea level, including a portion of the San Francisco Bay-Delta region in Sacramento, Solano, and San Joaquin Counties. We established 19 roadside survey routes throughout the valley (Figure 1). Routes were not distributed randomly but instead systematically selected to include: 1) broad geographic coverage and representation of all major CV land cover types, 2) roads bisecting mostly open country so birds could be more easily detected, and 3) roads having low to moderate traffic so observers could devote the time needed to detect and identify perched and flying raptors. Average route length was 59 km (range 44-81).

Two volunteer observers conducted each survey, at least one of which had extensive experience at raptor identification. Surveys were conducted monthly (December through February) during three winters from 2007 to 2010. Surveys began at 0800–1000 PST and ended no later than 1500 PST. Observers drove each route in the same direction each time and occasionally stopped to identify birds or allow traffic to pass. Surveys were postponed or interrupted for heavy fog, precipitation, high winds (> 30 kph or Beaufort scale 4) or any condition that limited visibility to less than 500 m.

Observers recorded all raptors seen within 500 m of the survey road and assigned each observation to one of two distance categories: 1) roadside, if the bird was perched immediately along the survey road, or 2) beyond the roadside out to 500 m, including flying and perching birds. This separation allowed assessment of any roadside bias in habitat associations. For each raptor seen, we noted where possible: species, age, sex, behavior (perched or flying), color morph, perch type, side of the road it was seen on, and

Table 1. Numbers and densities of diurnal raptors observed in the Central Valley of California during winter 2007-2010.

			Birds(x100)/block		
			2007-08	2008-09	2009-2010
Species	Obs.	%	X±SE[a]	X±SE	X±SE
Red-tailed Hawk	7950	51%	29 ± 1	27 ± 1	34 ± 1
American Kestrel	3622	23%	13 ± 1	13 ± 1	16 ± 1
Northern Harrier	1396	9.0%	4.9 ± 0.3	4.0 ± 0.3	7.0 ± 0.4
Ferruginous Hawk	630	4.1%	2.4 ± 0.2	2.2 ± 0.2	2.1 ± 0.2
White-tailed Kite	468	3.0%	1.8 ± 0.2	1.5 ± 0.2	1.8 ± 0.2
Red-shouldered Hawk[b]	444	2.9%	—[b]	—	—
Bald Eagle	276	1.8%	1.0 ± 0.2	0.9 ± 0.1	1.0 ± 0.1
Prairie Falcon	232	1.5%	0.7 ± 0.1	0.9 ± 0.1	0.7 ± 0.1
Accipiter spp.[b]	144	0.9%	—[b]	—	—
Rough-legged Hawk	143	0.9%	0.8 ± 0.1	0.5 ± 0.1	0.06 ± 0.03
Golden Eagle[c]	95	0.6%	—[c]	—	—
Merlin[c]	80	0.5%	—[c]	—	—
Peregrine Falcon[c]	33	0.2%	—[c]	—	—
Osprey[c]	33	0.2%	—[c]	—	—

[a] = Mean and standard error
[b] = Excluded from analyses by Pandolfino et al. (2011) because of strong association with woodland areas, which made consistent detection difficult.
[c] = Excluded from analyses in Pandolfino et al. (2011) due to low numbers.

location (nearest 0.1 mi based on odometer readings) from the start of the survey. The bird's behavior and location along the survey route (shortest perpendicular distance from the bird to the road) were recorded at the time when first sighted. Volunteers also recorded the temperature, wind speed (Beaufort Scale estimate) and direction, and cloud cover at the beginning and at the end of each survey.

Habitat Assessment

In order to assign each raptor observation to a specific habitat, we established habitat blocks on both sides of each survey road, beginning

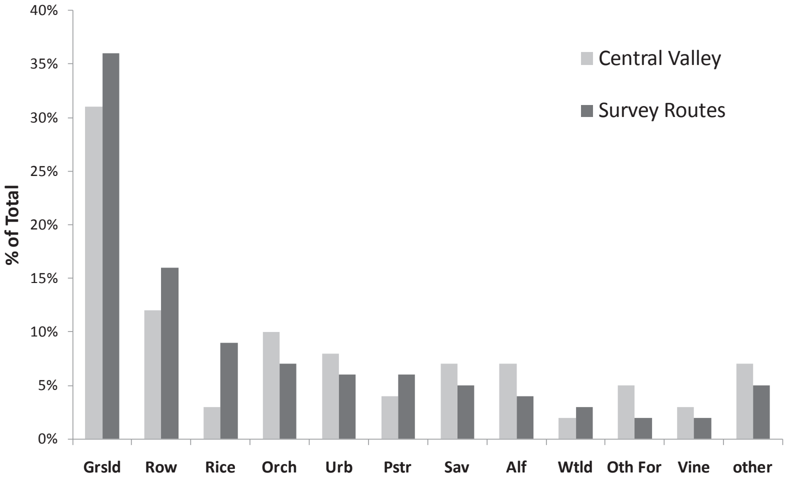

Figure 2. The proportion of habitat types in the CV as a whole and those sampled during our assessment of habitat associations of diurnal raptors wintering in the Central Valley of California, 2007-2010. (Grsld = grassland, Row = row crop, Orch = orchard, Urb = urbanized, Pstr = irrigated pasture, Sav = savannah, Alf = alfalfa, Wtld = wetland, Oth For = other forage, Vine = vineyard).

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from the start of each route. Blocks measured 500 m x 800 m, with one of the 800 m sides abutting the road, and were spaced continuously along the survey route. We recorded UTM coordinates and odometer readings at the center point of the roadside leg of each block. We assigned a dominant habitat type to each block using the habitat categories described below. At the start of each winter survey period we drove each route and noted any changes in dominant habitats in each block. The odometer of the vehicle used for habitat assessment was calibrated to the odometers of each raptor survey vehicle in order to accurately assign raptor observations to the correct habitat block.

Habitat Categories

We assigned a dominant habitat to each block from one of 12 habitat categories. We chose these categories because they best described the dominant land cover types encountered along the routes. The habitats covered were generally representative of the CV as a whole (Figure 2) (California GAP Analysis Project 1998, California Department of Conservation 2008, U.S. Department of Agriculture 2008 and 2009). For planted crops, our assessments did not differentiate the stage of development, which ranged from recently planted to post-harvest stubble. In general, the CV consists of flat, open country, and this was the case in nearly all blocks.

Visibility was limited within a block was only in some areas of oak savannah and mature orchards. The habitat types are described below in order of their relative extent (high to low) within survey routes.

Grassland — Non-irrigated lands dominated by grasses and herbaceous forbs (including areas grazed, ungrazed, and burned) and small amounts of grasslands interspersed with salt-tolerant shrubs (mainly *Atriplex* spp.) in some areas of the San Joaquin Valley. We characterized grassland as ungrazed if the area appeared to have not been grazed for at least a year and the grasses were >15cm tall.

Row crop — Annual crops grown mainly in the spring and summer. Often the crop type was unknown during surveys because many fields had been plowed for winter and consisted of bare dirt.

Rice — Generally consistent with the distribution of this crop in the CV, all routes containing rice were in the southern Sacramento Valley. Most rice is flooded in the winter in the CV (Central Valley Joint Venture 2006). Non-flooded rice fields were either burned or supported dry stubble.

Orchard — Various-aged stands of woody perennial crops such as walnuts, almonds, and apricots.

Urbanized — Areas in which at least 50% of the land area consisted of residential or rural-residential uses or small areas of industrial development or office complexes.

Pasture — Irrigated areas of grasses and other herbaceous species used for grazing but not tilled or harvested (e.g., for hay production).

Savannah — Scattered oaks, mainly blue oak (*Quercus douglasii*), in a grassland matrix with 10-30% tree canopy; most occurred on routes along the eastern edge of the CV.

Alfalfa — Harvested and un-harvested fields of alfalfa at all stages of development.

Wetland — Natural and man-made wetlands.

Other Forage — Hay and winter wheat in a range of growth and management stages from recently planted to post-harvest stubble.

Vineyard — Wine and table grape vineyards of varying ages, with most having typical supporting structures.

Other — A diverse group of uses of limited extent, such as fallow fields, mowed grass, open water, golf courses, oak forests, eucalyptus stands, landfills, and riparian woodland and scrub areas.

SUMMARY OF RESULTS FROM PRIOR PUBLICATIONS

We briefly summarize results from previous publications resulting from this research, as context for the other papers presented in this issue of the Central Valley Bird Club Bulletin.

Results from Wintering Raptor Habitat Use Study

During the three winters encompassing 2007–2010 we recorded 16,033 observations of diurnal raptors in the CV with 15,546 (97%) of these identified to species (Pandolfino et al. 2011a; Table 1). Species densities did not vary significantly between years except for slightly higher densities of Red-tailed Hawks and American Kestrels and dramatically lower densities of Rough-legged Hawk (*Buteo lagopus*) in 2009-2010. Such large between-year fluctuations in the winter abundance of Rough-legged Hawks has been observed frequently across its winter range (Bechard and Swem 2002).

Many species showed positive associations that were statistically significant ("preferred") or significant negative associations ("avoided") with various habitat types. The Ferruginous Hawk (*Buteo regalis*), Rough-legged Hawk, and Prairie Falcon (*Falco mexicanus*) all preferred grasslands and avoided urbanized areas and areas of intense agriculture such as orchards, rice, and row crops. All three of these species occurred in grazed grassland at higher densities than in ungrazed grassland. The White-tailed Kite and Northern Harrier were significantly more abundant in ungrazed than grazed grassland. The kite, harrier, and Bald Eagle (*Haliaeetus leucocephalus*) preferred wetlands, and the harrier and eagle also preferred rice. The kite and harrier also preferred alfalfa and other forage. The Red-tailed Hawk and American Kestrel preferred irrigated pasture and alfalfa and avoided urbanized areas, row crop, orchard, and savannah. American Kestrels showed the strongest preference for alfalfa. Red-tailed Hawks showed the strongest preference for wetlands and rice. When we compared habitat associations between raptors along the roadside and away from the road, we found no significant difference for any species in any habitat with the exception of American Kestrel in rice. Roadside kestrels preferred rice, whereas kestrels away from the road avoided this habitat.

Some of the key conservation implications from this work were:

1) Grassland-associated species were often exclusively associated with that habitat and negatively associated with urbanized areas and intense agricultural uses; these same species appear to prefer grazed over ungrazed grassland;
2) Most wetland-associated species were also associated with rice, suggesting that this habitat serves a wetland surrogate for winter raptors;
3) Alfalfa was important to many raptor species; and
4) Raptors universally avoided urbanized habitats, row crops, vineyards, and orchards—all land uses that are increasing in the CV mostly at the expense of grassland.

Results from Study of Differences in Habitat Selection among Male and Female Kestrels

As noted above, American Kestrels showed positive associations with alfalfa and other forage crops such as hay and winter wheat, as well as grassland, irrigated pasture, and rice. We found that male and female kestrels showed very different habitat associations (Pandolfino et al. 2011b), as has been seen in prior studies of wintering kestrels (Smallwood and Bird 2002 and references therein). Female American Kestrels preferred alfalfa, forage crops, and grassland. In contrast, male American Kestrels preferred only grassland and were less abundant than females in alfalfa, other forage crops, and grassland. Males occurred at higher densities than females in most habitats that were avoided by the species, such as orchards, urbanized areas and oak savannah. Our findings that females seem to occupy higher quality habitats in winter are consistent with observations from elsewhere in North America.

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