HABITAT PREFERENCES OF WINTERING DIURNAL RAPTORS IN THE SACRAMENTO VALLEY

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As slowly reproducing top carnivores, most raptors can be considered potentially endangered (Miller and Botkin 1974). Therefore, accurate data on population trends and their causes, such as pesticide accumulation or habitat alteration, are urgently needed. Olendorff and Kochert (unpublished manuscript) recently stressed the importance of preserving breeding habitat for successful raptor management and conservation. However, considerably less emphasis has been placed on wintering habitat, even though most North American raptors are migratory (Bent 1937, 1938). Relatively little is known about wintering habitat preferences for any raptor species (but see Weller 1964, Schnell 1968 and Koplin 1973); consequently, it is difficult to predict the effects of wintering habitat alterations on raptor populations.

Fifteen diurnal raptors—White-tailed Kite (*Elanus leucurus*), Marsh Hawk (*Circus cyaneus*), American Kestrel (*Falco sparverius*), Merlin (*F. columbarius*), Prairie Falcon (*F. mexicanus*), Peregrine Falcon (*F. peregrinus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*B. lagopus*), Ferruginous Hawk (*B. regalis*) Red-shouldered Hawk (*B. lineatus*), Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*A. cooperii*), Golden Eagle (*Aquila chrysaetos*), Bald Eagle (*Haliaeetus leucocephalus*) and Turkey Vulture (*Cathartes aura*)—winter regularly in or migrate through the Sacramento Valley of California. High winter concentrations of some of these raptors occur locally in the valley. To discover if wintering raptors do have habitat preferences we monitored population fluctuations of all diurnal raptors in two habitats in a portion of the central Sacramento Valley by conducting 18 censuses over 190 days from 26 October 1976 to 2 May 1977.

STUDY AREA AND METHODS

The census area comprises 43 km^2 and its southern boundary is located 4.8 km north of Davis, Yolo County, California. Rotating cultivation of such crops as sugar beets, corn, tomatoes and wheat characterizes the central portion of the valley. At any time during the winter months 25 to 50% of the fields are fallow. The valley floor is flat and treeless except along windbreaks and watercourses or near farmhouses.

A private hunting club maintains 7.7 km² of the study area by flooding intermittently and planting cultivated oats. A local tomato cannery uses 1.3 km² as a spray field for their waste water. We consider the sprayfield to be a separate habitat from the agricultural fields because the composition of its vegetation is more heterogeneous. Watergrass (*Echinochloa crusgalli*) is most common although Prickly Lettuce (*Lactuca serriola*), Lambs-quarters (Chenopodium album), Alkali Mallow (*Sida leprosa*), Common Spikeweed (*Hemizonia pungens*), Curly Dock (*Rumex crispus*) and Yellowstar Thistle (*Centaurea solstitialis*) occur frequently. The cannery fenced and posted this area as a raptor preserve in 1975 and occasionally mows it for hay.

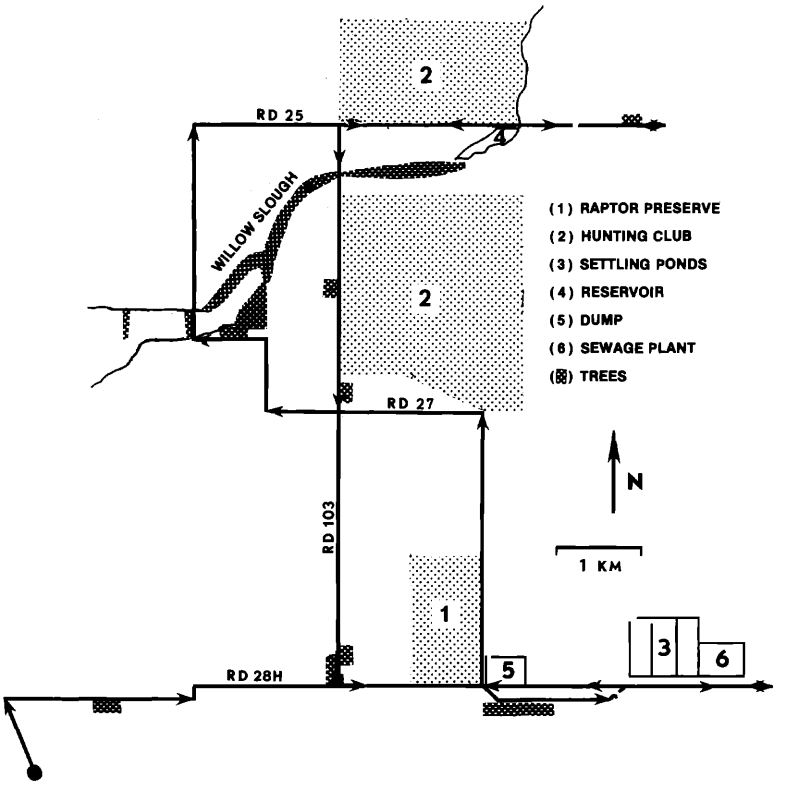


Figure 1. Route driven on each census north of Davis, Yolo County, California. The study area extends 0.8 km on each side of the route; arrows signify direction of travel. The circle denotes the starting point and the square (intersection roads 28H and 103) denotes the ending point.

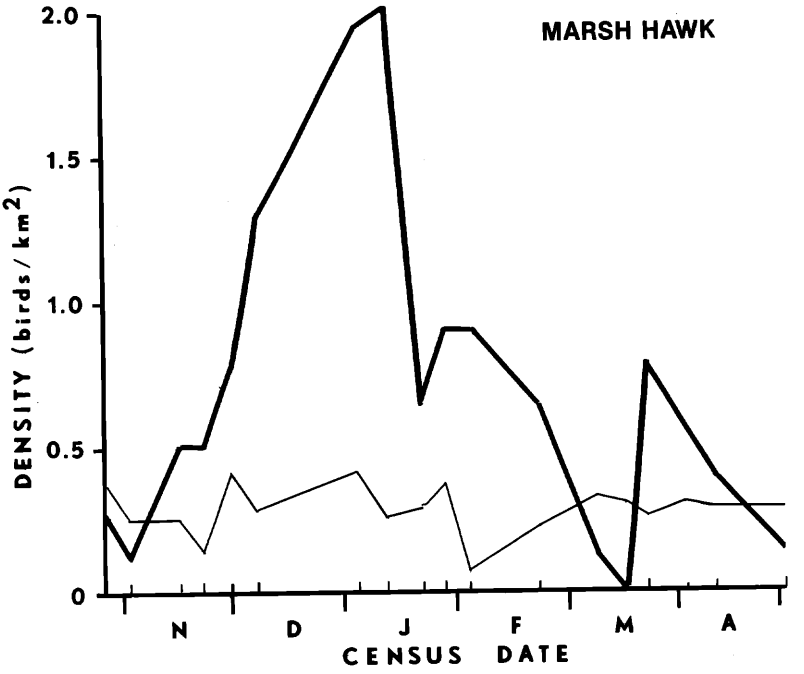
We drove a 37.5 km route (Figure 1) during each census and recorded all raptors seen within 0.8 km of the road. All raptors sighted could be identified to species at this distance using binoculars. These observational limits defined the perimeter of the study area. An average speed of 50 km/hr was maintained for spotting; however, all sightings were verified with our vehicle at a standstill. The location (as well as sex and age when possible) of each raptor sighted was recorded by marking unique symbols for each species' age/sex class at appropriate coordinates on gridded maps of the study area.

Duplication of sighting was uncommon because most birds sighted were perching on telephone poles or sitting on the ground, the census area was large with little overlap, and most censuses lasted approximately 2 hours (mean census time $\pm$ 2 SD was 128 $\pm$ 45 minutes). However, any birds which were suspected to be recounts due to their direction of movement were not counted. Since there are few trees within the study area, most raptors present were probably observed on each census.

We recorded time of day, minimum and maximum wind velocities and ambient temperature before and after each census. Three of the 18 censuses were conducted in the morning, 2 during mid-day and 13 during late afternoon.

RESULTS

Each of the four common resident raptor species showed marked population changes over the study period (Figure 2). If the population increases were due to the influx of wintering populations, then the winter census tallies should nonrandomly increase over the resident population level. We used the mean of all census tallies as an estimate of the resident population level for each species. Then, we determined if the fluctuations were random or nonrandom by comparing individual census tallies for each species within and outside the raptor preserve to each species' estimated local population level. Outside the preserve, Marsh Hawk and White-tailed Kite populations showed nonsignificant changes, whereas Red-tailed Hawk and American Kestrel populations showed marked changes ($p < 0.001$ in each case, chi-squared test for goodness of fit, Sokal and Rohlf 1969). Within the raptor preserve all four species showed significant population changes ($p < 0.001$ for all cases, chi-squared test for goodness of fit). These results indicate that these four resident species have larger wintering than resident populations and suggest that Marsh Hawk and White-tailed Kite wintering populations concentrate in the raptor preserve.


MARSH HAWK
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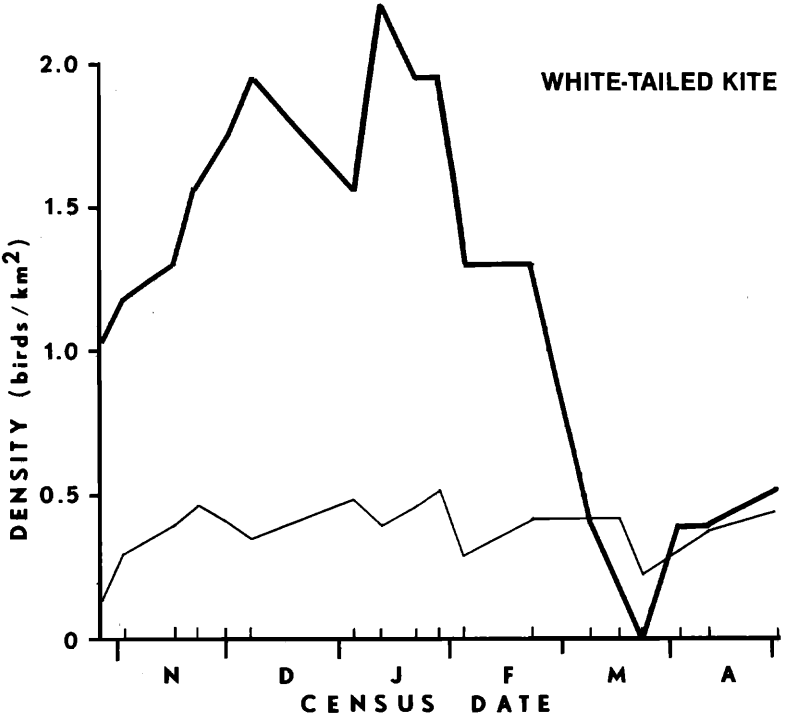
WHITE-TAILED KITE
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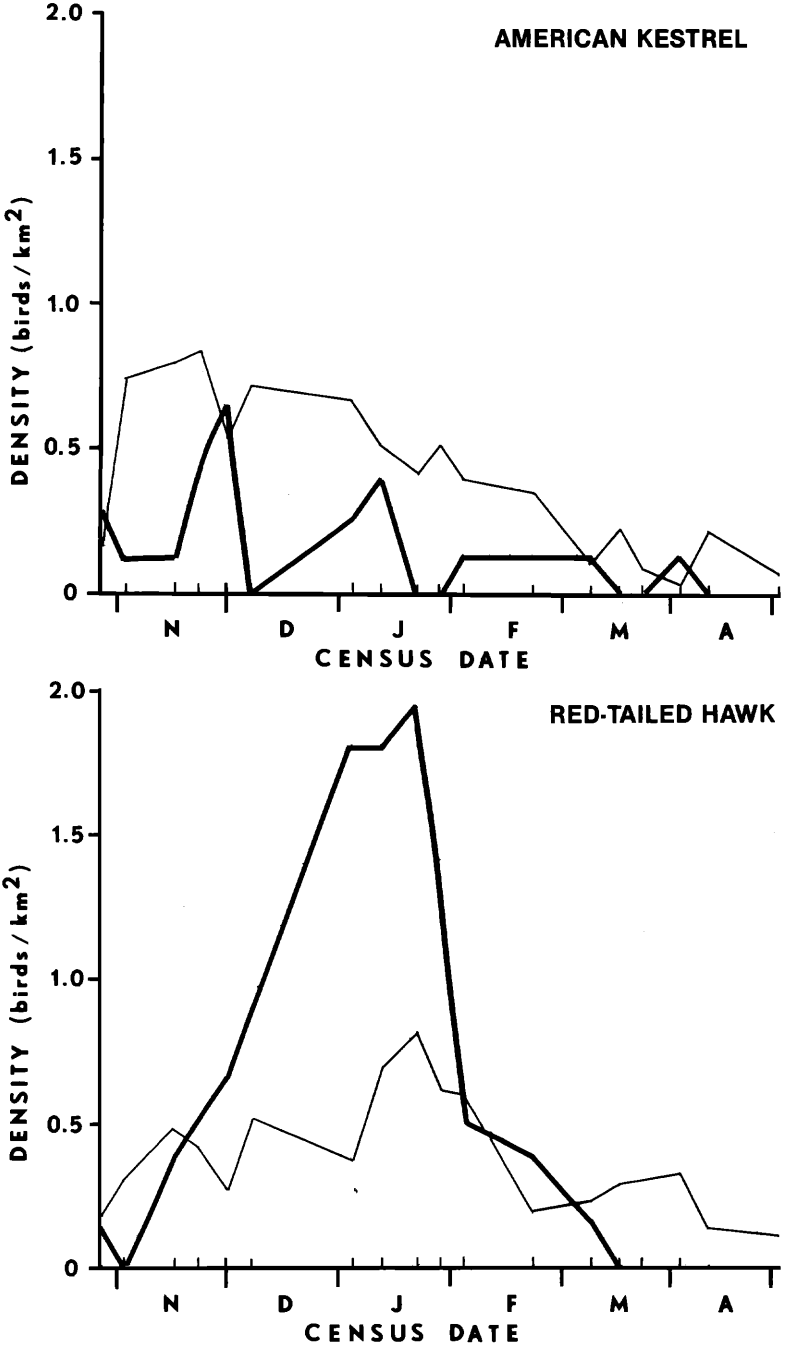

Figure 2. Density fluctuations of the four most common resident diurnal raptors inside the raptor preserve (dark trace) and outside the raptor preserve (light trace). Hash marks above abscissa indicate census dates.

To determine more precisely the habitat preferences of the five winter resident raptors—Red-tailed Hawks, Rough-legged Hawks, Marsh Hawks, White-tailed Kites and American Kestrels—the densities (birds/km^2) of each species within the raptor preserve were compared to densities outside the preserve (cf. Figure 2) with the Wilcoxon test for paired comparisons (Siegel 1956; all probabilities are computed using a one-tailed test). Rough-legged Hawks ($p<0.05$), Marsh Hawks ($p<0.001$) and White-tailed Kites ($p<0.001$) preferentially used the raptor preserve whereas Red-tailed Hawks showed no statistical preference ($p=0.158$) for the raptor preserve over the rest of the study area. American Kestrels showed a statistical avoidance of the preserve ($p<0.001$).

To estimate the effects of weather on our sighting probabilities for each species, we performed Spearman rank correlations (Siegel 1956) between census totals and mean temperature and wind velocity (cf. Figure 3). Marsh Hawk and White-tailed Kite observations were not significantly correlated with wind velocities, whereas Red-tailed Hawk and American Kestrel observations showed significant negative correlations ($r_s=0.57$, $p<0.05$; $r_s=0.59$, $p<0.02$, respectively). American Kestrel observations were not significantly correlated with temperature whereas Marsh Hawk, Red-tailed Hawk and White-tailed Kite observations showed significant positive correlations ($r_s=0.60$, $p<0.02$; $r_s=0.77$, $p<0.001$; $r_s=0.66$, $p<0.01$, respectively).

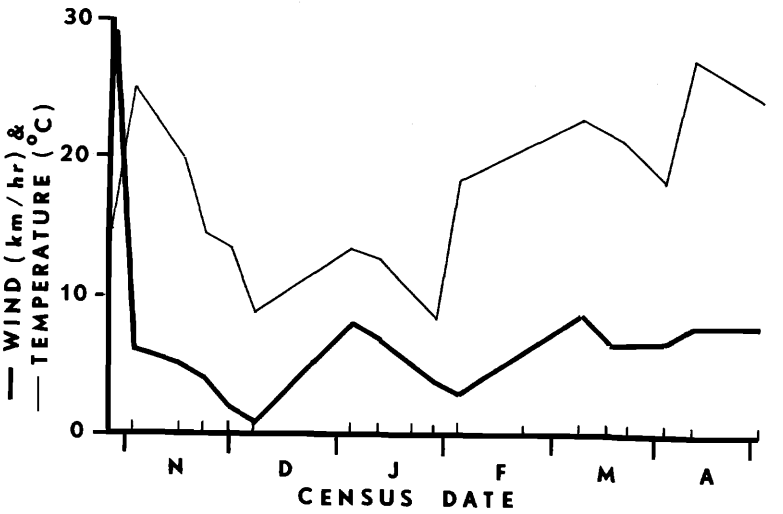

Figure 3. Mean wind and temperature readings for each census, October 1976 to May 1977.

SPECIES ACCOUNTS

Nesting records of each species as well as age/sex information, if known, and dates of observations of uncommon species are presented here. In addition, population status in the study area and the immediate vicinity, based in part on Grinnell and Miller (1944), is included. Status symbols represent transients (T), winter residents (WR), and breeding residents (B).

WHITE-TAILED KITE (WR,B): This species was commonly observed in sugar beet fields south of Road 28H after 1 March. No nest was discovered in the study area although kites were observed there throughout the breeding period.

MARSH HAWK (WR,B): Until 11 March we observed a mean of 5.6 ± 2.9 (± 2 SD) adult males. This relatively low variance suggests that most of the hawks were not transients but winter residents. Unfortunately, first year birds (ventrally buffy to cinnamon without streaking) were not distinguished from adult females (ventrally buffy with streaking) until 22 January. However, most of the winter visitors were either adult females or immatures. A communal roost was used during January within the study area. At least four pairs attempted to nest within the study area, all in sugar beet fields. Three of these pairs contained immature birds. All four nests failed when the beet fields were plowed.

AMERICAN KESTREL (WR,B): Of the 345 kestrels observed through 19 March, 22% were males, 61% were females and 17% were unknown. This relative abundance of females during winter agrees with the findings of Koplin (1973) and Mills (1975, 1976). After 19 March we observed a total of 19 kestrels: 67% males, 22% females and 11% unknown. We believe this reversal in the relative abundances of each sex during early spring is due to the involvement of the females in incubation. A minimum of two kestrel pairs nested in the study area.

MERLIN (T,WR?): A solitary Merlin was seen six times between 12 January and 14 April at one of two locations along road 103 between roads 27 and 25 (cf. Figure 1). On each occasion the falcon resembled an adult male Taiga Merlin (*F. c. columbarius*, Temple 1972).

PRAIRIE FALCON (T): The three sightings occurred on 11 November, 4 January and 22 January at different locations in the study area. Age and sex were not determined on any sighting.

RED-TAILED HAWK (WR,B): Of the 366 sightings, 35% were adults, 30% were immature plumaged and 35% were not aged. No nests were found in the study area. A melanistic bird with jesses was occasionally observed over a period of several months.

ROUGH-LEGGED HAWK (WR): A total of 41 was observed over 15 censuses between 16 November and 6 April. A mean of 2.7 ± 3.6 ($\pm$ 2 SD) hawks were observed on each of these censuses. Twelve Rough-legs, 10 of which were flying in a group, were observed within the study area on 26 February, a noncensus day. One, which was recognizable by plumage pattern and was the last bird to depart, was observed on the same telephone pole regularly over several months.

FERRUGINOUS HAWK (T): All six were observed during five censuses between 30 November and 23 February. We have no evidence that any bird remained in the study area for longer than one week.

RED-SHOULDERED HAWK (T,B): Solitary birds were observed on 22 and 28 January, and two were observed on 4 February. All sightings were of immature plumaged birds.

SWAINSON'S HAWK (*Buteo swainsoni;* T,B): Two were observed on 6 April, 10 on 14 April and one on 2 May. Fourteen were reported near the study area in mid-April.

Three were observed in the study area on 28 May and also on 22 July. At least one pair attempted to nest within the study area.
SHARP-SHINNED HAWK (T): An adult was observed in the orchard south of Willow Slough on 22 January.
GOLDEN EAGLE (T): A first-year bird (white in wings and tail) was observed flying southeast on 19 March just north of the raptor preserve. A Rough-legged Hawk stooped at the eagle for several minutes.
TURKEY VULTURE (T): Two vultures were observed on 11 March, one on 25 March and two on 14 April. All sightings were of soaring birds.
SHORT-EARED OWL (*Asio flammeus;* WR,B): Although not entered in our census tallies, these owls were seen occasionally at dusk. All sightings were either in the raptor preserve or in the sugar beet fields south of road 28H. We suspect that the owls communally roosted on the raptor preserve on some occasions. A high of 20 was seen over the raptor preserve on 23 January, a noncensus day. At least one pair nested in the sugar beet fields south of road 28H because a fledgling (presumably dead from starvation) was found there within a week after the fields were plowed.
BURROWING OWL (*Athene cunicularia;* WR,B): This owl also was not censused regularly, but at least two pairs nested within the study area. One nest had seven and the other had five fledglings.

DISCUSSION AND CONCLUSIONS

Most wintering raptors in the central Sacramento Valley arrive between October and November (Bent 1937, 1938). These birds leave between March and April although each species may show some variation. Since our data extend from late October until early May, we believe that we have accurate tallies of all winter residents. However, we may have missed a few early fall migrants.

Several of the correlations we discovered between species numbers and either temperature or wind velocity indicate that these two environmental factors influence raptor movements directly or indirectly via the behavior of prey species. The correlations between Marsh Hawk, Red-tailed Hawk and White-tailed Kite census totals and ambient temperature suggest that these species either move locally, migrate or become less detectable during periods of cold weather. The absence of a correlation between American Kestrel numbers and temperature suggests that American Kestrels do not move in response to temperature. This result is expected because these falcons do not rely on thermals to forage. Correlations between Red-tailed Hawk and American Kestrel census totals and wind velocity suggest that these two species also respond to high winds by moving locally and/or become less detectable by perching in protected locations. This interpretation agrees with our casual observations. When the wind was strong (approximately 20 km/hr or stronger), Red-tailed Hawks and American Kestrels almost always were observed perching, whereas Marsh Hawks and White-tailed Kites often were foraging.

Since Marsh Hawks, Rough-legged Hawks and White-tailed Kites preferentially frequented the raptor preserve during the day (and

probably Short-eared Owls did so at dawn and dusk), one or more foods sources may be commonly used by these raptors. All of these species are known to prey on the California Vole (*Microtus californicus;* Craighead and Craighead 1956, Brown and Amadon 1968, Warner and Rudd 1975). Krebs (1966) states that California Voles tend to thrive under irrigated agricultural conditions. Since the raptor preserve is frequently sprayed with waste water, grasses and herbs are usually growing and provide abundant rodent food.

Water Pipits (*Anthus spinoletta*), Brewer's Blackbirds (*Euhpagus cyanocephalus*), Killdeer (*Charadrius vociferus*) and Savannah Sparrows (*Passerculus sandwichensis*) occur frequently and abundantly in the preserve and may provide alternate food sources. Marsh Hawks and Short-eared Owls commonly take avian prey of this size (Craighead and Craighead 1956, Page and Whitacre 1975).

The unusually dry winter of 1976-77 may have caused a reduction in bird and rodent populations in agricultural fields, thereby intensifying raptor congregation at the preserve. In a normal rainfall year, the preserve might be used less frequently. However, on 22 December 1977 more than 15 White-tailed Kites, 6 Rough-legged Hawks and many Red-tailed Hawks and Marsh Hawks were observed on the preserve even though 1977-78 was an above normal rainfall year. These figures are comparable to our census tallies of the previous year, hence the drought may not have had a significant effect. Of course, such an interpretation must be considered with caution because effects of a drought on raptor populations may take several years to disappear.

Three of the central Sacramento Valley winter resident diurnal raptors (Rough-legged Hawk, Marsh Hawk and White-tailed Kite) preferentially frequent the raptor preserve. Recognition of this preference is important because alteration, such as plowing, of preferred winter habitats can cause local movements of raptor populations and may create critical energetic demands if prey is not abundant in nearby areas. We believe that a raptor preserve, such as the sprayfield in our study area, is an effective management area for those species which frequent it, insuring suitable winter habitat for those species in addition to providing an excellent opportunity to view relatively uncommon birds in high concentrations.

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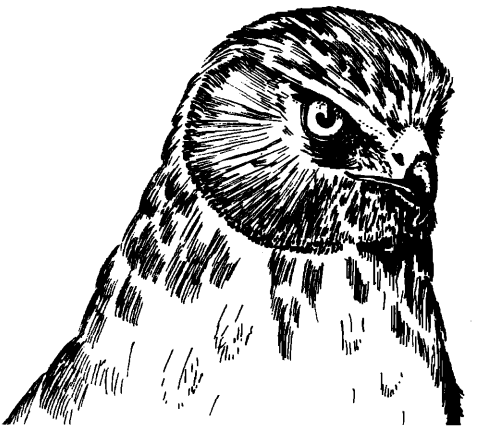

Sketch by Cameron Barrows