FOOD HABITS OF A WHITE-TAILED KITE POPULATION IN CENTRAL CHILE

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The White-tailed Kite (*Elanus leucurus*) is a common resident of agricultural areas and coastal plains in Colombia, Venezuela, Surinam, Brazil and southern South America. In Chile, it is a conspicuous raptor, ranging from 30° to 40° S latitude (Johnson 1965). Although two subspecies are sometimes recognized, *E. l. leucurus* and *E. l. majusculus* (Eisenmann 1971), the appearance and behavior of the two forms are virtually indistinguishable. Much interest has centered on the White-tailed Kite in North America due to its remarkable recovery from low population levels in the 1940's; it has also apparently extended its range into Central America in recent years (Eisenmann 1971). The food habits of this species have been much studied in North America, but have received little attention in South America.

This paper reports the results of a 14-month study of White-tailed Kites conducted on a 26-ha study area near the town of Polpaico, 56 km N of Santiago and 6 km W of the Pan American Highway (Santiago Province, Chile). The elevation is approximately 550 m and mean annual precipitation is 295 mm. The area is located in the northern Central Valley of Chile and is alternately used for dry pasture or with irrigation for corn and vegetable crops. In the open fields and along edges, tall acacia trees (*Acacia caven*) and willows (*Salix chilensis*) are common and are frequently used for perching and nesting by kites.

The climate in central Chile is typically Mediterranean with wet winters and dry summers. Kites are most conspicuous soon after the winter rains begin (April–May); then large numbers congregate along highways and cutover fields. Kites in southern Chile move north in the central valley during winter months (May and June) and concentrate in the Santiago area (A. W. Johnson, pers. comm.). Although winter roosts have not been reported as in California (e.g., Morgan 1948, Dixon et al. 1957, Waian and Stendell 1970), the high concentration of kites along the Pan American highway during the winter months suggests that communal roosts exist there also. Johnson (1965) reported that kites in Chile breed in September and October. However, evidence of exceptionally early nesting was indicated by the discovery of a dead juvenile on the study site in June 1974. During winter months, I saw a maximum of four individuals on the study area; during most other months, only one pair was present during pellet collections.

About once a month between April 1973 and May 1974, I searched the study area for kite pellets. On two occasions (May 1973 and June 1974) I trapped small mammals in order to determine the occurrence and relative abundance of potential prey species. Kite pellets were soaked in a 0.5 N solution potassium hydroxide to separate bones and teeth from the fur. Teeth and palates were used to identify prey species and quantitative estimates were based on minimum number of individuals represented by at least one complete cheek or mandible tooth row. Individuals represented by two or fewer teeth were not counted. It has been generally recognized that hawks eat less roughage than owls and digest bones more thoroughly, making their pellets less useful in determining food habits (Errington 1930, Glading et al. 1943). Waian (1973) showed that kite pellets are closer to those

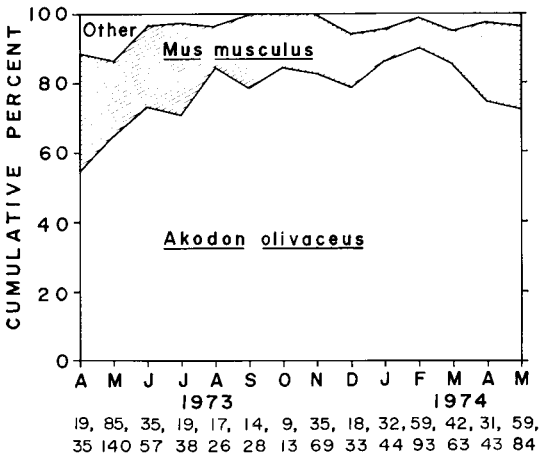

FIGURE 1. Cumulate percent of prey individuals in the pellets of White-tailed Kites in central Chile from April 1973 through May 1974. Figures under month indicate number of pellets (top row) and number of prey individuals (bottom row) for that month.

of owls than hawks in accurately reflecting food habits. Kites, like owls, frequently ingest prey whole or at least cranial elements, facilitating identification. Various skeletal characters have been previously used to identify and quantify prey items in kite pellets (e.g. Dixon et al. 1957, Stendell and Myers 1973, Waian 1973, Stendell 1972).

The results of the pellet analysis are presented in Figure 1. While 44.9% of the pellets had only one prey item, 47.2% had two or more items. The remaining 7.9% contained only fur and of these, 8% also contained insects (grasshoppers) while another 8% had feathers (together, 1.3% of the total pellets). More than three quarters (76.5%) of the prey of kites in this locality consisted of *Akodon o. olivaceus*, the olivaceous field mouse, including members of all age classes. The proportion of *Akodon* in the monthly diets varied from 54.3% during April and May 1973 (late fall, early winter) to 90.3% during February 1974 (summer). The second most common prey item was the house mouse (*Mus musculus*) which made up 20.2% of the total diet and varied from a maximum of 34.3% during April 1973 to 8.6% during February 1974 (Fig. 1). Other prey species included the Norway rat (*Rattus norvegicus*) (1.2% of the total diet), the long-tailed rice mouse (*Oryzomys l. longicaudatus*) (0.8% of the total diet), the long-haired olivaceous field mouse (*Akodon l. longipilis*) (0.7% of the total diet) and unidentified rodents (0.7% of the total diet). Only *Mus musculus* was caught during trapping on the study area, but carcasses of *Akodon olivaceus* were occasionally found on the ground where they may have been dropped by kites during feeding. *Akodon olivaceus* is the most common rodent of the adjacent native matorral community dominated by sclerophyllous shrubs (W. Glanz, pers. comm.).

The temporal variation in prey proportions found here parallels the findings of Stendell (1972) in which the proportion of the primary prey of White-tailed Kites in the San Francisco Bay Area, *Microtus californicus*, was highest during summer months and lowest during winter months. Conversely, the proportion of the second most important prey, *Mus musculus*, was highest in winter months and lowest in

TABLE 1. Prey composition for nine food studies of the White-tailed Kite in California and Chile.

Locality	Primary prey	% Total prey	Secondary prey	% Total prey	Total no. pellets	Source
Los Angeles Co., Ca.	*Mus musculus*	83.3	*M. californicus*	10.8	74	Bond 1942
Orange Co., Ca.	*Mus musculus*	85.2	*M. californicus*	12.7	131	T. St. John, unpubl.
Santa Barbara Co., Ca.	*M. californicus*	72.1	*Mus musculus*	4.7	1,197	Waian 1973
San Francisco Bay, Ca.	*M. californicus*	74.9	*Mus musculus*	20.9	5,463	Stendell 1972
Santa Cruz Co., Ca.	*M. californicus*	88.1	*R. megalotis*	9.5	214	Hawbecker 1940
Monterey Co., Ca.	*M. californicus*	86.5	*Thomomys bottae*	8.7	166	Stendell & Myers 1973
San Diego Co., Ca.	*M. californicus*	66.3	*Mus musculus*	23.8	144	Dixon et al. 1957
Santa Barbara Co., Ca.	*M. californicus*	47.2	*Mus musculus*	34.8	544	Waian & Stendell 1970
Santiago Prov., Chile	*A. olivaceus*	76.5	*Mus musculus*	20.2	474	This study

summer. These findings are repeated in Chile with *Akodon olivaceus* making up the greatest proportion during the South American spring through fall months and the lowest proportion during winter months, while *Mus musculus* proportions are greatest in winter months.

Akodon olivaceus is endemic to Chile, but closely related species occur on both sides of the Andes (Osgood 1943). It is a medium-sized cricetid rodent (mean weight 29.2 gm, unpubl. data), smaller than *Microtus californicus* (mean weight 41.2 gm, Stendell 1972) and, like the latter species, largely diurnal (Pearson 1959, Fulk 1975). A number of other similar-sized rodent species including *Akodon longipilis, Oryzomys longicaudatus* and *Phyllotis darwini*, the leaf-eared mouse, are also common in the kites' range, but are primarily nocturnal (Fulk 1975, unpubl. data). The latter species appears more often in the pellets of nocturnal predators such as Barn Owls (*Tyto alba*) and Short-eared Owls (*Asio flammeus*) which were present in the study area (Fulk 1976). Analysis of 23 pellets of the American Kestrel (*Falco sparverius*), a common raptor of central Chile, showed only three had rodents (all *A. olivaceus*) while the rest contained insects or feathers. Thus, the characterization of the White-tailed Kite as an "obligate diurnal predator" (Waian and Stendell 1970) is supported for both North and South American populations.

A comparison of this and previous studies on kite food habits is presented in Table 1. The few studies on South American kites are rarely more specific in describing their diets beyond stating that they include small mammals, lizards, snakes, and insects such as grasshoppers (e.g. Johnson 1965, ffrench 1973). Haverschmidt (1962) described the contents of a small number of pellets which consisted of marsh rats (*Holochilus brasiliensis*) and cane mice (*Zygodontomys microtinus*). To this were added cotton rats (*Sigmodon alstoni*) for the general food habits of Surinam kites (Haverschmidt 1968). R. Schlatter (pers. comm.) reports that kites in southern Chile take the same rodent species indicated in this study, but in different proportions. This study and previous ones in North America show a recurrent trend for kites to specialize on one predominant prey item (Table 1). Stendell (1972) suggested that kites in California have specific search images for *Microtus*. When *Mus* are the primary food, kites may not be able to nest successfully since this rodent is considerably smaller and provides less energy per prey item. In the two studies in which *Mus* were the primary food (Table 1), one was a winter communal roost (T. St. John) while the second involved a nonbreeding group of kites (Bond 1942). However, *Microtus* is not always present within the geographic range of White-tailed Kites and in other areas, alternative prey are taken (i.e. *Akodon* in Chile, *Holochilus* and *Zygodontomys* in Surinam). The prerequisites for feeding primarily on a particular prey appear to include diurnal activity, a minimum body size (as small as *Akodon*, 29 gm, but usually larger than *Mus*, 12–13 gm), and probably some minimum abundance in the kite's habitat. Surprisingly, even though kites in South America and California occasionally utilize large prey of 200 gm or more such as *Rattus* (Stendell 1972, this study) and *Holochilus* (Haverschmidt 1962), they did not utilize the most common diurnal Chilean rodent, the degu (*Octodon degus*, about 150–250 gm). This may be related to the degu's strong social organization and well-defined predator warning calls (R. E. Martin, pers. comm.).

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FOOD OF NESTLING TRICOLORED BLACKBIRDS

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Information on the food of nestling Tricolored Blackbirds (*Agelaius tricolor*), a colonial breeding species largely endemic to California, has been recorded for only a few scattered colonies and not in much detail. Tyler (1907) reported that adult Tricolored Blackbirds at a colony near Fresno, Fresno Co., gathered a "short, heavy worm" to feed their young. A few years later at a colony near Rancho Dos Rios, Stanislaus Co., Mailliard (1914) reported that milk-stage barley was "much prized as a food for the young," but he found that the stomachs of adults contained "mostly insects of several sorts (not determined), grasshoppers being largely in evidence." More recently, Payne (1969) stated that several hundred food items of nestlings from colonies near East Park Reservoir, Colusa Co., were almost entirely animal matter, one-half of which (by weight) consisted of grasshoppers; he listed other food items but did not quantify those observations.

During the breeding seasons of 1971, 1972, and 1975, we examined the stomach contents of Tricolored Blackbird nestlings from several locations within the Central Valley of California. This paper summarizes the foods of the nestlings we sampled, examines the relative importance of certain foods at different colonies, looks at the day-to-day variation of some foods at the same colony, and presents observations on the foraging behavior of adults.

METHODS

We collected 272 Tricolored Blackbird nestlings from 10 breeding colonies (nine locations) within the Central Valley: (1) Clay—1.6 km N Clay, Sacramento Co.; (2) Orland—4.8 km SW Orland, Glenn Co.; (3) Afton—3.2 km S Afton, Glenn Co.; (4) Angle Road—3.2 km ENE Herald, Sacramento Co.; (5) Butte Sink—8.0 km N Meridian, Sutter Co.; (6) Pig Farm—14.4 km SW Modesto, Stanislaus Co.; (7) Knights Landing—3.2 km N Knights Landing, Yolo Co.; (8) Folsom—2.4 km S Folsom, Sacramento Co.; and (9) Herald—0.8 km ENE Herald (table 1).

In 1971 and 1972, nestlings were taken throughout each colony at 5 ± 1 days of age, around midday (between 11:00 and 13:00), and were frozen until examination. In 1975, nestlings were collected from each colony at 3, 6, and 9 days of age, around midday, immediately injected with a 10% formalin solution, and frozen until examination. The contents of each stomach (gizzard and proventriculus) plus the negligible amount of food found in the esophagus were washed, assigned a number, air-dried on blotter paper, and examined under low magnification. Each food item was identified, segregated, and its percentage of the total volume was estimated visually. The aggregate percentage volumes (Martin et al. 1946) of selected major food items were compared among locations, and among days at the same location by single-classification analyses of variance (ANOVA) on arcsin-transformed data. Means were compared using the least significant difference (Steel and Torrie 1960); $P < 0.05$ was considered significant. Neff (1937), Orians (1961), Payne (1969), and DeHaven et al. (1975) present more complete data on breeding colony characteristics and Central Valley habitats.

In 1975 we injected 10% formalin into nestlings to prevent possible post-mortem digestion of soft food items (Dillery 1965). However, we could not detect any visual differences in the degree of preservation of food items from injected and noninjected nestlings, and the percentage volume of soft and hard food items did not differ significantly between the two types of nestlings (ANOVA; $P > 0.10$; $F = 2.54$