PREY OF THE WHITE-TAILED KITE IN CENTRAL CHILE AND ITS RELATION TO THE HUNTING HABITAT

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ABSTRACT.—Between November 1973 and January 1974 we collected 702 pellets of White-tailed Kites (*Elanus lecurus*) in two areas of central Chile differing in their vegetation physiognomy (disturbed versus undisturbed). We compared the diversity, age structure, and mean prey size of items found in pellets from both sites. There were noticeable differences in the diversity of prey consumed by kites in the two areas. The smallest prey taken was the house mouse (17 g), the largest, juvenile norway rats (160 g); these figures represent 5.6–52.9% of Chilean kites' weight (302.2 g). Mean size of prey taken in the disturbed site was about 25% smaller than in the undisturbed area. White-tailed Kites were much more abundant in disturbed areas, in spite of the relatively smaller prey-size distribution available. We propose that disturbed habitats generated by human activities are more profitable to the kites in terms of greater prey abundance, higher prey vulnerability, or both. *Received 24 July 1979, accepted 12 October 1979.*

THE White-tailed Kite (*Elanus leucurus*) is a common Falconiform species in open or widely cleared lowlands, sparsely wooded savannas, and marshes in extensive areas of the southern United States, Middle America, and South America to Argentina and Chile (Eisenmann 1971, Blake 1977). In Chile, it is abundant between latitudes 30°S and 40°S (Johnson 1965). Its ecology is well known in North America (Waian and Stendall 1970, Waian 1973, Warner and Rudd 1974) but not in South America (e.g. Haverschmidt 1968, Ffrench 1973). Knowledge of the biology of the White-tailed Kite in Chile was sparse and mostly anecdotal (Housse 1935, Johnson 1965, Greer and Bullock 1966) until recently, when Meserve (1977) published a quantitative study on its feeding habits. That author worked 56 km north of Santiago, near Polpaico (33°10'S, 70°54'W, 550 m elevation), in an area "alternatively used for dry pasture or with irrigation for corn and vegetable crops." He found that 76.5% of total prey consisted of the rodent species *Akodon olivaceus,* with *Mus musculus* accounting for 20.2% of prey consumed.

In this paper we report the prey of the White-tailed Kite in two physiognomically different areas near Santiago and compare the diversity, age structure, and mean prey size of items found in kite pellets.

STUDY AREA AND METHODS

We studied the food habits of the White-tailed Kite in both Pudahuel (33°26'S, 70°47'W, 15 km west of Santiago, 475 m elevation) and La Dehesa (33°21'S, 70°32'W, 20 km east of Santiago, 875 m elevation). The first site is a very disturbed lowland used for agricultural practices (mainly for cultivation of alfalfa), surrounded by extensive swampy areas and, at the time of our study, by a garbage dump. In contrast, the second site is a rather dry area on the outskirts of Cordillera de los Andes, with relatively undisturbed

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patches of the original shrub vegetation (Thrower and Bradbury 1977), now mainly used as pasture land and for cultivation of alfalfa.

We collected 551 kite pellets at Pudahuel during January 1974 and 151 pellets at La Dehesa from November 1973 through January 1974. At the latter site kites were comparatively less numerous. We identified rodent prey to the species level and distinguished juveniles from adults based on the degree of tooth wear and comparisons with the reference collection of the Museo Nacional de Historia Natural of Chile. We distinguished these age classes in order to evaluate a possible bias of the White-tailed Kite to eat only juveniles of some large rodent species. This also allowed us to calculate more accurately the mean prey size (MPS) consumed by the kite populations in the two study areas. MPS is the grand mean obtained by summing the products of the numbers of individual prey times their size (either adult or juvenile) and dividing by the total number of prey in the pellets (n). Mean weights of adult prey are given by Glanz (1977) or, in the case of *M. musculus* and *Rattus norvegicus*, provided by the Curator of Mammals of MNHN of Chile. We assumed mean weight of juveniles to be half that of adults. N is the minimal number of prey in the pellets, as estimated by half the number of jaws found. In order to characterize dimensions of castings for the two kite populations, we measured length, width, and dry weight of pellets from both Pudahuel (n = 404) and La Dehesa (n = 136). Statistical differences in MPS and dimension of pellets between the two study sites were analyzed by the weighted-variances t-test (Sokal and Rohlf 1969).

RESULTS

As reported by Meserve (1977) in Polpaico, the main prey of White-tailed Kites in Pudahuel are rodents, with birds accounting for a negligible fraction of prey consumed (Table 1). Similarly, as in Polpaico, the crepuscular rodents *M. musculus* and *A. olivaceus* (Glanz 1977, Meserve 1977, Jaksić and Yáñez 1979) comprise an important fraction of the diet of this kite population. Even though *M. musculus* occurs in the Pudahuel sample in about the same proportion as in the Polpaico sample, however, *A. olivaceus* is half as abundant in the first sample as compared to the latter (see Meserve 1977). This fact is associated with the high incidence of *Oryzomys longicaudatus* in the sample from Pudahuel. This is unexpected, because *O. longicaudatus* has been reported to be strictly nocturnal (Fulk 1975, Glanz 1977) while the White-tailed Kite has been described as an "obligate diurnal predator" (Waian and Stendall 1970, Meserve 1977). A likely explanation is that by the end of 1973 a rodent plague occurred in northern and central Chile that involved primarily *O. longicaudatus* (Péfaur et al. 1979). By that time this species was commonly seen in daylight hours and therefore became an available prey for diurnal raptors. The numbers of the presumably crepuscular *R. norvegicus* (its activity pattern in Chile is unknown) are small in comparison to other rodent prey but are expected, as they are abundant in the adjacent swampy and garbage areas. Only juvenile *R. norvegicus* are preyed upon by the White-tailed Kite; this could be related to the difficulty of killing and handling such large-sized prey as adult *R. norvegicus* (320 g).

Results from La Dehesa (Table 1) are rather divergent in comparison to those at Pudahuel and Polpaico (Meserve 1977). The synanthropic rodents *M. musculus* and *R. norvegicus* were not found in the pellets and were also absent from the general area (Jaksić and Yáñez 1978). Instead, three new rodent species appeared in the pellets: the diurnal *Octodon degus,* the crepuscular *Akodon longipilis,* and the nocturnal *Phyllotis darwini* (Glanz 1977). *Octodon degus* is the most abundant species on the outskirts of the Santiagan Andes (Le Boulengé and Fuentes 1978, Jaksić and Yáñez 1978, Yáñez and Jaksić 1978) but is rarely preyed upon by the White-tailed Kite. Meserve (1977) has interpreted this phenomenon as the result of the "degu's strong social organization and well-defined predator warning calls." Other central Chile predators, such as foxes (*Dusicyon culpaeus* and *D. griseus*) and the Harris'

TABLE 1. Prey of the White-tailed Kite in two localities of central Chile. Vernacular names are reported by Jaksić and Yáñez (1979); weights are taken mainly from Glanz (1977); J = juvenile individuals, A = adults.

Prey species	Weight (g)	Pudahuel J	Pudahuel A	Pudahuel Total	Pudahuel %	La Dehesa J	La Dehesa A	La Dehesa Total	La Dehesa %
Mammals									
Rodents	—	—	—	(698)	(97.2)	—	—	(148)	(98.0)
Akodon longipilis	76	—	—	—	—	3	12	15	9.9
Akodon olivaceus	40	66	187	253	35.2	11	41	52	34.5
Mus musculus	17	59	114	173	24.1	—	—	—	—
Octodon degus	230	—	—	—	—	13	—	13	8.6
Oryzomys longicaudatus	45	49	150	199	27.7	2	54	56	37.1
Phyllotis darwini	66	—	—	—	—	1	1	2	1.3
Rattus norvegicus	320	37	—	37	5.2	—	—	—	—
Unidentified	—	—	—	36	5.0	—	—	10	6.6
Birds									
Unidentified	—	—	—	20	2.8	—	—	3	2.0
Total prey	—	—	—	718	100.0	—	—	151	100.0
Pellets examined	—	—	—	551	—	—	—	136	—

Hawk (*Parabuteo unicinctus*) however, consume large numbers of these rodents (Fuentes and Jaksić 1979; Jaksić et al. 1979a, b), thus suggesting that other factors could be restricting predation by the White-tailed Kite upon *O. degus*. As seen in Table 1, consumption of this species is exclusively of juveniles (similar to the case of *R. norvegicus*). Hence, it is not unlikely that the adult-sized *O. degus* (230 g) are too large to be killed or handled by the kite, thus explaining their small occurrence in pellets. *Akodon longipilis* and *P. darwini* are known to be present in areas close to La Dehesa (Jaksić and Yáñez 1978). The crepuscular *A. longipilis* is also more numerous in kite pellets as compared to the nocturnal *P. darwini* (Fulk 1975, Glanz 1977).

Mean prey size (MPS) taken by White-tailed Kites in Pudahuel (n = 662) is significantly larger than in La Dehesa (n = 138) at the 0.001 level. Figures in Pudahuel and La Dehesa are: 37.78 ± 2.52 g ($\bar{x}$ ± 2 SE) and 50.40 ± 4.14 g, respectively. Because the availability of *A. olivaceus* and *O. longicaudatus* in the two study sites was probably similar (2 × 2 contingency table with Yates' correction; $\chi^2 = 2.133$, $P > 0.14$), the smaller MPS in Pudahuel is likely to be due to the greater incidence of the smaller-sized *M. musculus* in the kites' diet in this area (see Table 1).

In spite of the larger prey items consumed by White-tailed Kites in La Dehesa, their pellets are not significantly longer, wider, nor heavier than those from the Pudahuel population. Respective figures ($\bar{x}$ ± 2 SE) are: 32.76 ± 0.60 vs. 32.68 ± 1.21 mm long; 24.67 ± 0.47 vs. 24.40 ± 0.67 mm wide; and 1.60 ± 0.07 vs. 1.59 ± 0.12 g weight. These results strongly suggest that pellet size of the White-tailed Kite is dependent on physiological factors that are not responsive to the size of individual prey consumed but most likely to some critical level of biomass in the stomach.

DISCUSSION

As shown, the selection of a hunting habitat by the White-tailed Kite determines both the rodent species composition and abundance in its diet. This could be due to the strong patterns of habitat selection exhibited by central Chile rodents (Greer

1965, Fulk 1975, Glanz 1977, Meserve and Glanz 1978), which most probably affect their relative abundance in different habitat types.

On the other hand, given a certain habitat, it does not seem likely that kites select their prey on a taxonomic basis but rather on a cost-benefit trade-off that takes into consideration the energetic reward attained with the capture of differently sized prey items. Because the smallest rodent prey in central Chile is *M. musculus* and it appears in an important fraction of pellets examined, it is possible that the minimum body size that renders an energetically positive balance for the kites would be around 17 g (Table 1). An upper limit to prey size seems to be around 160 g (juvenile *R. norvegicus*) and could be related to the difficulty of killing and handling larger-sized prey (the White-tailed Kite in central Chile has been reported not to eat its prey on the ground but to carry it first to its perch; see Housse 1935, Johnson 1965). The weights recorded for three central Chile kites were 270, 317, and 319.5 g (average = 302.2); hence, the lower and upper limits of prey size are between 5.6–52.9% of kites' weight.

Calculation of mean prey size (MPS) based on the data of Meserve (1977), assuming individuals of *R. norvegicus* to be juvenile, gives an average figure of 37.0 g ± 1.2 (2 SE, n = 761). Statistical comparison of this MPS with those obtained in Pudahuel and La Dehesa shows a nonsignificant difference between Polpaico-Pudahuel but a highly significant difference between Polpaico-La Dehesa MPS's (Scheffé test, see Sokal and Rohlf 1969). Because Polpaico and Pudahuel are comparable in the intensity of human activities and strongly contrast with the less disturbed area of La Dehesa, it is reasonable to infer that agricultural practices drastically alter the rodent species composition and abundance in the field and, hence, the MPS available for predators. In this particular case, disturbed areas appear less rewarding for kites, as reflected in the smaller MPS. Interestingly, kite populations are noticeably more numerous in these areas than in other less disturbed places (Meserve 1977, Schlatter pers. obs.). This phenomenon could be accounted for by at least two factors (or a combination of both): (1) higher vulnerability of prey in the disturbed areas, which may render it more profitable to hunt in those areas, and (2) higher prey abundance. We have no data to estimate the importance of the first factor, but, because shrub cover is smaller in disturbed places, it is likely that rodents living there are more vulnerable to the White-tailed Kite. Concerning the second factor, unpublished results by Jaksić et al. tend to support the contention. A quarterly year-round comparison of rodent abundances in two adjacent patches in an area near La Dehesa showed that rodents were always more numerous in the disturbed patch than in the undisturbed one. Figures in terms of individuals trapped per effort unit (trap-night) were: 0.078, 0.026, 0.037, 0.085 (disturbed area), and 0.008, 0.004, 0.003, 0.011 (undisturbed area), for corresponding seasons. Thus, it is likely that the White-tailed Kite in central Chile prefers to hunt in disturbed places, where MPS is relatively small but prey are fairly abundant (and perhaps more vulnerable), than in undisturbed places with higher MPS but lower prey abundance.

In sum, the situation exhibited by the White-tailed Kite in central Chile could be one of the rare cases of a wild bird species surviving best in association with highly disturbed areas generated by human activities such as agriculture. A similar conclusion was reached by Warner and Rudd (1974) in California.

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