Food Habits and Prey Specificity of the Common Barn Owl in Ohio[1]

BRUCE A. COLVIN, Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403
E. BRUCE MCLEAN, Department of Biology, John Carroll University, Cleveland, OH 44118

ABSTRACT. **Pellets from common barn owls (*Tyto alba*) were collected in 1976 and 1979-1981 from seven different locations in Ohio, yielding 14 distinct samples. A total of 12,589 prey items, including 21 mammal species, was identified. The meadow vole (*Microtus pennsylvanicus*) was 63.9% of all prey and 75.7% of all biomass of mammalian prey. Two species, the meadow vole and short-tailed shrew (*Blarina brevicauda*), accounted for 84.1% of total prey and 87.8% of biomass of mammalian prey. Birds constituted only 1.5% of total prey. Mean weight of Norway rats (*Rattus norvegicus*) taken by owls was 59.1 g; the mode was 42.5 g, suggesting selection of small rats since adult rats weigh 200-500 g. Comparison of prey among samples showed a high degree of similarity. The diet of common barn owls can be described as highly stereotyped and restrictive; thus, barn owl foraging behavior should be considered when evaluating habitat requirements and prey resources appropriate for maintenance of barn owl populations.**

OHIO J. SCI. 86 (1) 076-080, 1986

INTRODUCTION

Numerous food habits studies have been conducted on most species of owls in North America, including the common barn owl (*Tyto alba*) (Errington 1932, Wallace 1948, Smith et al. 1972, Marti 1973). The regurgitation of pellets containing bone material from ingested prey has made such studies relatively easy to perform. Although analysis of barn owl prey in Ohio has been done (Stupka 1931, Phillips 1951, Dexter 1978), studies based on pellets collected in the past 20 years are limited. The lack of recent analysis of barn owl prey is not due to disinterest in the species, but rather to a drastic decline in the barn owl population of Ohio (and the Midwest) over the past 30 years (Stewart 1980, Colvin 1985).

Pellet analyses have provided substantial data on the natural history of the barn owl. Food habits studies can provide the foundation for additional investigations, besides documenting the existence of certain prey species within the owl's range, its capability to take such prey, and relative abundance of prey species in the owl's diet. In particular, these studies may be used in the process of evaluating habitat requirements (Colvin et al. 1984), predator-prey interactions (Otteni et al. 1972, Marti 1974), secondary poisoning hazards (Hegdal and Blaskiewicz 1984), or the use of owls as biological control agents (Lenton 1980).

In this study, we analyzed barn owl food habits in Ohio, and compared barn owl diets among different collection locations and times. Because the barn owl currently is a rare species in Ohio (Smith et al. 1973), information on the restrictiveness of its diet may be used in evaluating habitat components supportive of barn owl populations.

METHODS AND MATERIALS

Barn owl pellets were collected from seven locations in Ohio (Table 1). Although owls nested in a chimney at one site (A) in south-central Ohio, pellets collected there were only from roost sites on the farmstead. Pellet collections at site A were made in January 1976, and January, May, August, and November 1979. At all other

[1]Manuscript received 31 May 1985 and in revised form 13 December 1985 (#85-21).

sites (B-G) in north-central Ohio, owls nested in nest boxes. Pellet collections consisted of all material inside the boxes and any pellets found in barns or silos on the farmsteads. These collections were made during the spring and summer 1979-1981.

Pellet material was bagged, labeled in the field, and returned to the laboratory where it was frozen to kill associated invertebrates. All pellet material was picked apart by hand. Unbroken pellets were examined individually, since Razcynski and Ruprecht (1974) observed that the mixing of bones of one individual in two successive pellets is rare. Prey species were separated; each was then sorted to form as many sets of skull, with left and right mandibles, as possible. These, along with all incomplete skeletal sets (skull, left or right mandible), were counted as individuals. Broken pellets, and the large quantities of compacted pellet material from nest boxes, were examined in mass in the same manner.

Mammalian prey were identified to species from skulls or mandibles, except in the case of *Peromyscus* spp. mandibles, which were identified to genus. Birds were not identified to species. The number of each species encountered in the pellet material was recorded for each collection period (year) among the seven collection sites, resulting in 14 pellet samples (Table 1).

The number of each mammal species taken was converted to percentage of diet biomass in order to evaluate the use of each prey species in the diet of the owl. Individual average weight for each species (Table 2) was based most often on Ohio trapping data. However, some weights were based on values cited in the literature (Burt and Grossenheider 1964, Gottschang 1981); others were estimated by comparison of mandibles from owl pellets to animals of known weight of the same species. Mean weight of Norway rats (*R. norvegicus*) taken by owls was calculated according to Morris (1979).

Prey composition was compared among pellet samples with a similarity index of resource use overlap (May 1975);

$$O_{xy} = \frac{\Sigma X_i Y_i}{\sqrt{(\Sigma X_i^2 \Sigma Y_i^2)}}$$

where X_i and Y_i equal the relative abundance of species i in sample X and sample Y. Values may range from 0 to 1, with 1 being most similar. Comparison of all 14 samples with every other sample yielded 91 indices.

RESULTS

A total of 12,589 prey, including 21 mammal species, was identified (Table 1). Meadow vole (*M. pennsylvanicus*) was the principal prey item in all 14 samples, ranging from 54.6 to 84.3% of the prey in each collection period. It constituted 63.9% of all prey examined and 75.7% of the biomass of mammalian prey (Table 2). Short-tailed shrew (*B. brevicauda*) was the second most common prey item in all pellet samples and constituted 20.2% of all prey examined. Meadow vole, short-tailed shrew, *Peromyscus* spp., meadow jumping mouse (*Zapus hudsonius*), masked shrew (*Sorex cinereus*), and moles accounted for 96.8% of total prey; 97.3% of the biomass of mammalian prey. Most *Peromyscus* identified to species were deer mice (*Peromyscus maniculatus bairdii*).

Ten of the mammalian species each represented less than 0.1% of total prey and accumulatively, only 0.3% of the prey total (Table 1). Birds represented only 1.5% of all prey items taken by barn owls.

Norway rats taken as prey ranged from 24.4-371.0 g, with a mean weight of 59.1 g and mode of 42.5 g (N = 158 mandibles). The few large prey in the samples, such as eastern cottontail (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), and muskrat (*Ondatra zibethicus*), were all immature individuals (Table 2).

TABLE 1

Results of barn owl pellet analysis in Ohio. Numbers of each prey species are given for each site and collection period. Site A was in Ross County, site B in Holmes County, and sites C-G in Wayne County.

	Pellet Collections															
	Site A		Site B		Site C		Site D		Site E		Site F			Site G	Total	
Prey	1976 #	1979 #	1979 #	1980 #	1979 #	1980 #	1979 #	1980 #	1979 #	1980 #	1979 #	1980 #	1981 #	1980 #	#	%
Microtus pennsylvanicus	240	1087	296	622	216	260	1027	462	138	338	743	964	1048	609	8050	63.9
Blarina brevicauda	32	407	77	116	65	64	203	139	56	54	376	432	463	54	2538	20.2
Peromyscus spp. (Total)	18	134	7	45	6	22	33	51	7	23	50	115	94	22	627	5.0
Peromyscus leucopus	7	38	1	1	—	1	8	2	—	4	2	3	7	—	(74)	(0.6)
Peromyscus maniculatus	4	47	—	1	—	—	1	8	3	6	2	22	22	3	(119)	(0.9)
Peromyscus spp.	7	49	6	43	6	21	24	41	4	13	46	90	65	19	(434)	(3.4)
Zapus hudsonius	2	102	33	21	10	6	41	18	8	7	82	118	60	11	519	4.1
Condylura cristata	—	—	5	10	7	5	42	17	1	18	33	20	41	8	207	1.6
Parascalops breweri	—	1	8	9	1	5	15	13	2	13	22	15	27	5	136	1.1
Sorex cinereus	—	—	1	1	3	1	11	39	—	2	6	23	19	—	106	0.8
Rattus norvegicus	4	8	3	7	2	1	37	6	—	6	6	16	2	4	102	0.8
Mus musculus	—	18	1	2	2	2	5	2	3	1	4	11	7	—	58	0.5
Sylvilagus floridanus	—	—	—	—	—	—	—	2	—	—	—	14	1	—	17	0.1
Mustela nivalis	—	1	—	1	—	—	4	2	—	—	1	—	—	—	9	<0.1
Microtus ochrogaster	1	7	—	—	—	—	—	—	—	—	—	—	—	—	8	<0.1
Cryptotis parva	1	4	—	—	—	—	—	—	—	—	—	3	—	—	8	<0.1
Eptesicus fuscus	—	—	—	—	—	—	—	1	—	—	4	—	1	1	7	<0.1
Tamias striatus	—	—	—	—	—	—	1	—	—	—	—	3	1	—	5	<0.1
Synaptomys cooperi	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	<0.1
Didelphis virginiana	—	—	—	—	—	—	—	1	—	—	1	—	—	—	2	<0.1
Sorex fumeus	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	<0.1
Ondatra zibethicus	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	<0.1
Scalopus aquaticus	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	<0.1
Birds	3	29	4	4	—	6	14	23	—	7	24	29	34	8	185	1.5
Total	303	1799	435	838	312	372	1434	776	215	469	1352	1764	1798	722	12,589	

TABLE 2

Biomass of mammalian prey taken by common barn owls in Ohio.

Prey	Individual average weight (g)*	Total biomass (kg)	Percentage of biomass
Microtus pennsylvanicus	35.2[a]	283.36	75.8
Blarina brevicauda	17.8[a]	45.18	12.1
Peromyscus spp.	18.1[a]	11.35	3.0
Zapus hudsonius	17.5[a]	9.08	2.4
Condylura cristata	43.2[a]	8.94	2.4
Rattus norvegicus	59.1[c]	6.03	1.6
Parascalops breweri	40.0[b]	5.44	1.5
Sylvilagus floridanus	89.3[d]	1.52	0.4
Mus musculus	17.4[a]	1.01	0.3
Mustela nivalis	48.8[a]	0.44	0.1
Tamias striatus	80.5[d]	0.40	0.1
Sorex cinereus	3.8[a]	0.40	0.1
Microtus ochrogaster	30.0[b]	0.24	<0.1
Didelphis virginiana	110.0[d]	0.22	<0.1
Eptesicus fuscus	17.0[a]	0.12	<0.1
Ondatra zibethicus	120.0[b]	0.12	<0.1
Scalopus aquaticus	95.0[d]	0.10	<0.1
Cryptotis parva	6.0[b]	0.05	<0.1
Synaptomys cooperi	27.0[b]	0.05	<0.1
Sorex fumeus	6.5[b]	<0.01	<0.1

*Legend: a = calculated from trapping data; b = estimated from literature and mandible size; c = calculated according to Morris (1979); d = estimated by mandible comparison (owl prey versus animals of known weight).

Barn owl prey was highly similar among all collection sites and times. Similarity values ranged from 0.92 to 0.99, with 62 of 91 values 0.98 or greater.

DISCUSSION

The high proportion of meadow vole found in the pellets analyzed in this study is comparable to many other studies of barn owl food habits in North America (Pearson and Pearson 1947, Wallace 1948, Smith et al. 1972, Dexter 1978) and Europe (Glue 1974, Buckley and Goldsmith 1975). Although we documented 21 different mammalian species in the pellet analysis, meadow vole accounted for 75.7% of all biomass of mammalian prey and was the most common prey item in all pellet collections. After meadow vole, the relative abundance of short-tailed shrew, *Peromyscus* spp., and meadow jumping mouse in pellet material was also comparable to that found by Wallace (1948) in Michigan and Dexter (1978) in Ohio. Wallace (1948) observed that *Blarina* and *Peromyscus* are preyed upon more heavily by barn owls when microtine populations decline. Additionally, Goszczynski (1981) reported that the proportion of voles in the diet of barn owls in Poland changes only slightly and rarely drops below 50%, and that insectivores are the main buffer food.

All three species of moles (*Condylura cristata, Parascalops breweri, Scalopus aquaticus*) found in Ohio were observed in owl diets. They totaled 2.7% of all prey, and 3.9% of the biomass of mammalian prey taken by owls. Giger (1965) recorded the occurrence of the Townsend mole (*Scapanus townsendii*) and Pacific mole (*S. orarius*) in the diet of the barn owl. Cunningham (1979) also found the star-nosed mole in the diet of this species. Giger (1965) suggested that because moles rarely move on the surface of the ground, they are seldom captured by barn owls. The exception is from May through July when a considerable increase in their surface movements, attributed to dispersal of juveniles, takes place. Therefore we believe that the presence of mole remains in our samples is largely due to the timing of pellet collections, with barn owl nesting in May, June, and July.

Murids made up only a small percentage of the total prey (1.3%) and biomass of mammalian prey (1.9%) observed in the diet; they also comprise a relatively small portion of the diet of barn owls elsewhere in North America. The Norway rat and house mouse (*Mus musculus*) can be commensal on farmsteads (Jackson 1982) and, therefore, are often assumed to be captured there by barn owls. However, analysis and marking of rodent populations available to barn owls in New Jersey have shown that both murid species also can occur in feral populations away from farmsteads, and that commensal rodents comprise an extremely small portion of the barn owl diet (Colvin 1984).

Several uncommon or rare prey species were represented in our samples of barn owl prey. Their low occurrence as prey may be a function of inappropriate body size, limited habitat overlap with barn owl foraging habitat, low abundance in the environment, or foraging behavior directed towards other prey species. Two prey species of particular interest were the eastern chipmunk (*Tamias striatus*) and Virginia opossum, neither of which are found in previous accounts of barn owl prey. Chipmunk remains were found in four different pellet samples collected from three different sites (Table 1). We believe that, because barn owls are highly nocturnal in North America (Wallace 1948, Colvin et al. 1984) and eastern chipmunks are diurnal (Burt and Grossenheider 1964), these prey were probably taken at dusk or dawn. The two opossums taken were both of pre-weaning age, based on mandible size and dentition (Petrides 1949), and therefore were probably taken by owls after they were lost

from their mother. Colvin (unpubl.) also found a similar-sized opossum skull in a barn owl pellet in New Jersey. Other uncommon prey items included bats, which also have been noted as barn owl prey (Trautman 1940, Dexter 1978, Ruprecht 1979), and one immature muskrat, which compares to one muskrat each found by Pearson and Pearson (1947), Marti (1974), and Dawe et al. (1978).

The small portion of the barn owl diet that consisted of birds was consistent with the majority of the studies of barn owl food habits in North America. Although a strong adherence to a mammalian (non-avian) diet is reflected in numerous studies of barn owl prey, some deviation has been documented. For example, Carpenter and Fall (1967) found that barn owl pellets collected near a red-winged blackbird (*Agelaius phoeniceus*) breeding area in Ohio showed seasonal changes in the number of blackbirds taken as prey. This reached a high of 37% of the diet (N = 79 prey items) during the massive concentrations of blackbirds that occur in September. However, Errington (1932) noted a continued adherence to a mammalian diet by barn owls, even under winter circumstances of stress and available avian prey. In addition, Marti and Wagner (1985) found 77 dead barn owls during the winter of 1981-1982 in northern Utah. These deaths were attributed to starvation resulting from very cold weather and deep snow cover that could interfere with capture of small mammalian prey, especially voles.

The barn owl is a bird of open country (Stewart 1952). Commonly they range 2-3 km from nest sites to forage in grassland habitats, and up to 8 km from the nest site to roost during the day (Colvin 1984, Hegdal and Blaskiewicz 1984). They intercept grass habitats at night more often than by chance alone (Colvin 1984). This use of grassland habitats for foraging is reflected in the diet of the barn owl in Ohio. Meadow vole, deer mouse, and meadow jumping mouse are restricted largely to grassland habitats. Likewise, most species recorded as prey (i.e., short-tailed shrew, star-nosed mole, hairy-tailed mole, and masked shrew) are also characteristic of, or frequently found in, grassland and wet meadow habitats in Ohio (Gottschang 1981). The proportion of various habitats (e.g., woodland, cropland, meadow, residential), and thus available prey, varied within 3 km of each of the seven nest sites studied, and during the various time intervals in which pellets were collected. Yet, the diet of the barn owl (two species accounting for >84% of total prey and >87% of the biomass of mammalian prey) was highly restricted and stereotyped.

The size of prey taken by barn owls illustrated selection for mammals of a particular size. Adult Norway rats weigh 200-500 g (Jackson 1982); Norway rats trapped on New Jersey farmsteads had an average individual weight of 200 g (Colvin 1984). However, the mean weight of Norway rats taken by owls in the present study was 59.1 g. Colvin (1984) described selection of small Norway rats by barn owls and found that the mean and mode weights of rats taken by owls in New Jersey were 85.6 and 42.5 g, respectively. Morris (1979) also found that selection for small rats occurred, and calculated a mean weight of 66.5 g. That the barn owl is capable of capturing larger rats is indicated by the weight range of prey items (Table 2); however, the mode weight of 42.5 g for rats taken by this species in Ohio is probably a good indicator of the particular prey size selected by the barn owl. Star-nosed and hairy-tailed moles, and particularly meadow voles, fall into a similar size class as the Norway rats selected as prey. Marti (1974) calculated that the mean weight of prey taken by barn owls in Colorado was 46 g, whereas Colvin (1984) calculated a mean weight of 38 g for New Jersey barn owls. The average weight per mammalian prey item in Ohio was 30 g.

Although the upper size range of selected prey may be assessed from Norway rat data, it is difficult to as readily assess the lower range. However, some lower limit of prey size can be predicted, at least as a function of smallness of prey and the physical capability of the owl in prey capture.

Colvin (1984) found that although smaller prey such as the white-footed mouse ($\bar{X}$ wt = 19 g) and house mouse ($\bar{X}$ wt = 16 g), were far more abundant in the environment than voles ($\bar{X}$ wt = 40 g), they were taken by barn owls in New Jersey in far fewer numbers than would occur by chance alone. Fast and Ambrose (1976), in an artificial situation, also found that barn owls selected meadow voles over white-footed mice.

Marti and Hogue (1979) found that the common screech-owl (*Otus asio*) selected prey by size. They stated that predators that detect and capture prey individually must do so efficiently. Energy obtained from large prey may not compensate for energy spent in capture, whereas energy obtained from small prey may not compensate for energy spent in searching. Colvin and Spaulding (1983) found that short-eared owls (*Asio flammeus*) selected the meadow vole over the deer mouse, and suggested that hunting for larger prey was more energy efficient. Barrett and Mackey (1975) found that American kestrels (*Falco sparverius*) also selected the meadow vole over the deer mouse, and related the behavior to energy-efficient foraging.

The selective foraging behavior of the barn owl has also been described as energy efficient and a result of natural selection strongly favoring a life-history strategy that emphasizes energy investment in reproduction (Colvin et al. 1984). This life-history strategy (r-selected in comparison to other raptors) apparently has been favored because of an oscillating prey population (microtines) combined with high juvenile mortality and short adult life in the barn owl (Colvin 1984). The number and distribution of barn owl nests, and annual productivity per nest, has been related to the availability of vole resources (Colvin 1984). Of 33 barn owl nests that were documented in Ohio during 1979-1982, all were found in areas with grassland (i.e., vole) habitat.

The existence of particular prey resources (i.e., voles) must be considered as a factor limiting the maintenance and distribution of common barn owl populations in Ohio. Prey species found in grassland habitats, particularly the meadow vole, consistently dominated prey analysis in this and other studies. The impact on barn owl populations of grassland habitat loss because of changing agricultural practices and reduction in farmland, and the availability of appropriate prey resources to support a breeding barn owl population, should be evaluated when considering management of this species.

ACKNOWLEDGMENTS. We wish to thank William B. Jackson and John T. Rotenberry for their comments during the preparation of this manuscript, Paciencia P. Milan and Steven M. Takacs for helping

with portions of the pellet analysis, and John E. Staab for outstanding assistance in the collection of pellet material. This research was funded by grants from ICI Americas Inc., and the Ohio Biological Survey.

LITERATURE CITED

Barrett, G. W. and C. V. Mackey 1975 Prey selection and caloric ingestion rate of captive American kestrels. Wilson Bull. 87: 514-519.

Buckley, J. and J. G. Goldsmith 1975 The prey of the barn owl (*Tyto alba alba*) in East Norfolk. Mammal Rev. 5: 13-16.

Burt, W. H. and R. P. Grossenheider 1964 A field guide to the mammals. Houghton Mifflin Co., Boston, Massachusetts 284 p.

Carpenter, M. L. and M. W. Fall 1967 The barn owl as a red-winged blackbird predator in northwestern Ohio. Ohio J. Sci. 67: 317-318.

Colvin, B. A. 1985 Common barn owl population decline in Ohio and the relationship to agricultural trends. J. Field Ornithol. 56: 224-235.

——— 1984 Barn owl foraging behavior and secondary poisoning hazard from rodenticide use on farms. Unpubl. Ph.D. dissert., Bowling Green State Univ., Bowling Green, Ohio 326 p.

———, P. L. Hegdal, and W. J. Jackson 1984 A comprehensive approach to research and management of common barn owl populations. *In*: W. McComb (ed.), Proc. Workshop on Manage. of Nongame Species and Ecological Communities. Univ. Kentucky, Lexington, pp. 270-282.

——— and S. R. Spaulding 1983. Winter foraging behavior of short-eared owls (*Asio flammeus*) in Ohio. Am. Midl. Nat. 110: 124-128.

Cunningham, H. N., Jr. 1979 Barn owls feeding on star-nosed moles. Proc. Penn. Acad. Sci. 53: 169-171.

Dawe, N. K., C. S. Runyan, and R. McKelsey 1978 Seasonal food habits of the barn owl (*Tyto alba*) on the Alaksen National Wildlife Area, British Columbia. Can. Field-Nat. 92: 151-155.

Dexter, R. W. 1978 Mammals utilized as food by owls in reference to the local fauna of northeastern Ohio. Kirtlandia 24: 1-6.

Errington, P. L. 1932 Food habits of southern Wisconsin raptors. Part 1. Owls. Condor 34: 176-186.

Fast, S. J. and H. W. Ambrose, III 1976 Prey preference and hunting habitat selection in the barn owl. Am. Midl. Nat. 96: 503-507.

Giger, R. D. 1965 Surface activity of moles as indicated by remains in barn owl pellets. Murrelet 46: 32-36.

Glue, D. E. 1974 Food of the barn owl in Britain and Ireland. Bird Study 21: 200-210.

Goszczynski, J. 1981 Comparative analysis of food of owls in agrocenoses, Ekol. Pol. 29: 431-439.

Gottschang, J. L. 1981 A guide to the mammals of Ohio. Ohio State Univ. Press, Columbus. 176 p.

Hegdal, P. L. and R. W. Blaskiewicz 1984 Evaluation of the potential hazard to barn owls of Talon (brodifacoum bait) used to control rats and house mice. Environm. Toxicol. Chem. 3: 167-179.

Jackson, W. B. 1982 Norway rats and allies. *In*: J. A. Chapman and G. A. Feldhamer (eds.), Wild mammals of North America. Johns Hopkins Univ. Press, Baltimore, pp. 270-282.

Lenton, G. M. 1980 The ecology of barn owls (*Tyto alba*) in the Malay Peninsula with reference to their use in rodent control. Unpubl. Ph.D. dissert., Univ. Malaya, Kuala Lumpur. 253 p.

Marti, C. D. 1973 Ten years of barn owl prey data from a Colorado nest site. Wilson Bull. 85: 85-86.

——— 1974 Feeding ecology of four sympatric owls. Condor 76: 45-61.

——— and J. G. Hogue 1979 Selection of prey by size in screech owls. Auk 96: 319-327.

——— and P. W. Wagner 1985 Winter mortality in common barn owls and its effect on population density and reproduction. Condor 87: 111-115.

May, R. M. 1975 Some notes on estimating the competition matrix, α. Ecology 56: 737-741.

Morris, P. 1979 Rats in the diet of the barn owl (*Tyto alba*). J. Zool. Proc. Zool. Soc. Lond. 189: 540-545.

Otteni, L. C., E. Bolen, and C. Cottam 1972 Predator-prey relationships and reproduction of the barn owl in southern Texas. Wilson Bull. 84: 434-448.

Pearson, O. P. and A. K. Pearson 1947 Owl predation in Pennsylvania with notes on the small mammals of Delaware County. J. Mammal. 28: 137-147.

Petrides, G. A. 1949 Sex and age determination in the opossum. J. Mammal. 30: 364-378.

Phillips, R. S. 1951 Food of the barn owl, *Tyto alba pratincola,* in Hancock County, Ohio. Auk 68: 239-241.

Raczynski, J. and A. L. Ruprecht 1974 The effect of digestion on the osteological composition of owl pellets. Acta Ornithol. 14: 25-38.

Ruprecht, A. L. 1979 Bats (Chiroptera) as constituents of the food of barn owl (*Tyto alba*) in Poland. Ibis 121: 489-494.

Smith, D. G., C. R. Wilson, and H. H. Frost 1972 Seasonal habits of barn owls in Utah. Great Basin Nat. 32: 229-234.

Smith, H. G., R. K. Burnard, E. E. Good, and J. M. Keener 1973 Rare and endangered vertebrates of Ohio. Ohio J. Sci. 73: 257-271.

Stewart, P. A. 1952 Dispersal, breeding behavior, and longevity of banded barn owls in North America. Auk 69: 227-245.

——— 1980 Population trends of barn owls in North America. Am. Birds 34: 698-700.

Stupka, A. 1931 Dietary habits of barn owls in Ohio. Ohio J. Sci. 31: 263.

Trautman, M. B. 1940 The birds of Buckeye Lake, Ohio. Misc. Publ. Mus. Zoo., Univ. Michigan Press, Ann Arbor. 466 p.

Wallace, G. J. 1948 The barn owl in Michigan. Its distribution, natural history, and food habits. Mich. State Coll. Ag. Exp. Sta. Tech. Bull. No. 208. 61 p.