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Analysis of Regurgitated Short-Eared Owl (*Asio flammeus*) Pellets from the Roth Prairie, Arkansas County Arkansas

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frequencies are seemingly related to the severe drought of the summer and early fall of 1980. Prolonged drought conditions were noticeably detrimental to populations of small rodents and decreasing water level tended to concentrate fish populations. Crayfish seem to represent a buffer food item available during periods when other prey are less available. During periods of normal rainfall (1981-82) mink opportunistically utilized a wide range of available prey. Mustelids, due at least in part to their elongate bodies, incur substantial energy costs during foraging activities (Brown and Lasiewski, 1972). Opportunistic feeding by mink maximizes utilization of available, but possibly patchy, resources.

Comparison by sexes of prey utilization revealed interesting differences. During the winter of 1980-81, females utilized mammalian prey at a significantly higher rate (41.7%) than did males (19.4%) (Figure 2). Utilization of mammalian prey by females was also higher during the winter of 1981-82 (females, 56.0%; males 48.4%). Males, on the other hand, utilized fish to a somewhat greater extent than did females (Figure 2). Other prey were utilized at varying low rates and apparently reflected opportunism as no trend was established.

The high frequencies of mammalian prey (mainly small rodents) in the diet of females over the two years may relate to sexual dimorphism in the body size of mink and to its presumed role in feeding. According to Moors (1980), female mustelids consistently consume more small rodents than males. This concept is supported by Erlinge's report (1979). In which rodents were staple prey of female stoats (*Mustela nivalis*), even when small rodent densities were low. Food habit differences, then, may be attributed to differences in the foraging strategies of the sexes. Males, being larger, have longer limbs permitting greater mobility (Moors, 1980). Presumably, greater mobility is translatable into greater proficiency in catching fish. In addition, the larger size of males should permit the utilization of a wider range of acceptable and catchable prey items (Wilson, 1975). The smaller size of female mink could be advantageous for foraging in rodent runs. It is not yet known if the amount of dietary overlap (between sexes) is significant in terms of intraspecific competition and/or population regulation.

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ANALYSIS OF REGURGITATED SHORT-EARED OWL (*ASIO FLAMMEUS*) PELLETS FROM THE ROTH PRAIRIE, ARKANSAS COUNTY, ARKANSAS

The short-eared owl (*Asio flammeus*) is one of the most cosmopolitan of raptors, as it is found on every continent except Australia (Bent, 1938). In its habits, it prefers prairies, marshes, other campestrine habitats, and even forests. This species is somewhat diurnal and can frequently be seen hunting during the day. In hunting, the short-eared owl adopts the same habits as the harrier, or marsh hawk (*Circus cyaneus*).

Three recent food habit studies of owls and other raptors from northeast Arkansas have been reported (Hanebrink et al., 1979; Paige et al., 1979; Harris and Hanebrink, 1980), however these did not deal extensively with the short-eared owl. Black (1933) first reported the occurrence of short-eared owls in northwest Arkansas, but little research has been devoted to this species in Arkansas. As the amount of suitable habitat dwindles, due to expanded agricultural practice, and as greater emphasis is placed on biological control mechanisms, information on the feeding habits of Arkansas raptors is needed. The food habits of short-eared owls elsewhere have been studied through pellet analysis (Cahn and Kemp, 1930; Errington, 1932).

Ninety regurgitated pellets measuring 2.8 to 6.7 cm in length were collected on 28 February 1980 from known roosting sites of short-eared owls on the Roth Prairie. Several short-eared owls were observed as they flushed from shallow depressions in the prairie as it was burnt for management purposes. Of owl species occurring in Arkansas, only *A. flammeus* roosts on the ground.

Roth Prairie in Arkansas County, is one of the few surviving remnants of the Grand Prairie Grassland. Its biology and location have been of interest to individuals concerned with prairie preservations in Arkansas. The study site is characterized by lush growths of grasses and abundant spring flowers. The area appears to be wetter than most other Grand Prairie remnants as witnessed by its high production of hay. Big Bluestem

General Notes

(*Andropogon gerardi*), Little Bluestem (*Andropogon scoparius*), and Indian Grass (*Sorghastrum nutans*) are strongly dominant, while Broom Sedge (*Andropogon virginicus*) and other disturbance species are relatively scarce. Forb species are not abundant due to fire suppression in recent years but probably would return in good numbers if prescribed burnings were carried out (Foti, 1974).

Owl pellets were examined and prey items identified with the aid of a 10X Bausch and Lomb dissection microscope. Identifications were aided by various published field guides and keys, an unpublished key to skulls of Arkansas mammals, avian and mammal collections housed at Arkansas State University, and a reference collection of dorsal guard hair of Arkansas mammals. Prey items were tabulated by species and percent occurrences were calculated. A total of 105 food items was recovered, including 16 taxa.

Birds represented the main prey of short-eared owls (Table 1) with a total percent occurrence of 50.5. Species included the common grackle (*Quiscalus quiscula*) at 10.5%, red-winged blackbird (*Agelaius phoeniceus*) at 8.6%, horned lark (*Ermophila alpestris*) at 6.7%, starling (*Sturnus vulgaris*) at 6.7%, eastern meadowlark (*Sturnella magna*) at 6.7%, white-throated sparrow (*Zonotrichia albicollis*) at 3.8%, brown-headed cowbird (*Molothrus ater*) at 1.9%, and unidentifiable bird remains at 5.7%.

Mammalian prey totaled 44.8 percent of the pellet remains (Table 2). Rodents collectively represented 32.4% of the remains and included prairie voles (*Microtus ochrogaster*) at 13.3%, fulvous harvest mice (*Reithrodontomys fulvescens*) at 8.6%, hispid cotton rats (*Sigmodon hispidus*) at 5.7% and deer mice (*Peromyscus maniculatus*) at 4.8%. Insectivores were represented by a single species, the short-tailed shrew (*Blarina carolinensis*) at 7.6%. Lagomorphs also were represented by a single species, the cottontail rabbit (*Sylvilagus floridanus*) at 4.8%.

Remaining prey items are illustrated in Table 3. Coleopterans represented 2.9% of the total prey and snakes with keeled scales, possibly garter or ribbon snakes (*Thamnophis* spp.) represented the remaining items at 1.9%.

The high frequency of birds in the diet of the short-eared owls may correlate with dense populations of migrant birds during the winter. Blackbirds (Icteridae) can be seen frequently in large numbers as they over-winter across Arkansas. Errington (1932) stated that short-eared owls appear to show a distinct preference for small mammals. However, Munro (1918) observed short-eared owls feeding on migrant birds as they rested along sand bars after crossing Lake Ontario, although small mammals were plentiful. Logically migrants could be more easily obtained as they rested after long periodic flights. Boyd and Shriner (1954) stated that the availability of prey would probably determine the kind and amount consumed. Migrant bird species in Arkansas, especially over-wintering blackbirds, would be available and abundant. The periodic resting and feeding habits of blackbirds would make them susceptible to predation, in this case, by short-eared owls. Results of this study are not meant to suggest short-eared owls roosting on the Roth Prairie during the winter months of 1980 were selecting and utilizing birds over mammals as major prey. To the contrary, short-eared owls appear to be opportunistic as evidenced by the wide range of prey consumed. Prey were taken according to availability, abundance, and susceptibility and at minimum energy expenditure to the raptor.

Table 1. Avian prey items of short-eared owls roosting in the Roth Prairie, Arkansas County, Arkansas, expressed as the number of prey items taken and percent occurrence.

Prey Species	Species Occurrence (53 Total)	Percent Occurrence
Common Grackle	11	10.5
Red-wing Blackbird	9	8.6
Horned Lark	7	6.7
Starling	7	6.7
Eastern Meadowlark	7	6.7
Brown-headed Cowbird	2	1.9
White-throated Sparrow	4	3.8
Unidentifiable Bird Remains	6	5.7
	Total	50.5

Table 2. Mammalian prey items of short-eared owls roosting in the Roth Prairie, Arkansas County, Arkansas, expressed as the number of prey items taken and percent occurrence.

Prey Species	Species Occurrence (47 total)	Percent Occurrence
<i>Microtus ochrogaster</i>	14	13.3
<i>Reithrodontomys fulvescens</i>	9	8.6
<i>Blarina carolinensis</i>	8	7.6
<i>Sigmodon hispidus</i>	6	5.7
<i>Peromyscus maniculatus</i>	5	4.8
<i>Sylvilagus floridanus</i>	5	4.8
	Total	44.8

Table 3. Remaining prey items of short-eared owls roosting in the Roth Prairie, Arkansas County, Arkansas, expressed as the number of prey items taken and percentage occurrence.

Prey Species	Prey Item Occurrence (3 total)	Percent Occurrence
Coleoptera (Beetles)	3	2.9
Snakes with Keeled Scales	2	1.9

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A LOCATIONAL ANALYSIS OF RECREATIONAL SUBDIVISIONS IN THE UNITED STATES

The selling of rural real estate as it exists today began in the 1950's with the appearance of large companies, primarily resort land developments, that sold lots in Florida and the desert southwest by mail. Their practices have changed as the corporations evolved schemes to tap a broader market for rural property (Stroud, 1978). Thousands of corporations are a part of the interstate, or installment, land sales industry and range in size from one or two people to giant enterprises (Paulson, 1972).

Comprehensive data on the land development industry is sketchy at best and often difficult to obtain. Much of the research has been only peripherally related to recreational land development and has not analyzed the extent of or the implications associated with these developments. A three volume manuscript (Allen et al., 1976), a relatively recent government document (American Society of Planning Officials, 1976), the work of Richard Ragatz (1970), a private consultant in vacation housing, and the Office of Interstate Land Sales Registration, Department of Housing and Urban Development (U. S. Dept. of Housing and Urban Development, 1981), provide the most useful information.

The office of Interstate Land Sales Registration, which requires developers involved in interstate commerce to register and make full disclosure, has published a Catalogue Report providing the number of large scale operations in the United States. Useful information was also obtained from personal interviews with land development officials on the Cumberland Plateau in Tennessee, in Arkansas, and in Texas.

Much of the serious impact of development can be traced to two major factors: 1) the location of the development, and 2) the developmental standards used by project officials. The most glaring environmental problems result when fragile environments are selected for development.

Recreational subdivisions total more than 19,000 in the United States and are found primarily in five states, with 76.7 percent of all lots subdivided in only 10 states. Since many of these subdivisions are small and the primary emphasis in this investigation is with the impact of large-scale recreation subdivisions, this research analyzes the resort developments of 405 hectares or more.

A dot map portrays the location of each of the 707 large recreational subdivisions (Figure). Very strong clusterings are revealed. Florida has an incredibly high density with 145 large projects concentrated in central and southern portions of the state. Other strong concentrations occur in Colorado south and west of Denver along the Front Range of the Rockies, in several counties in Texas near Austin and Houston, and across the desert southwest. California has sizable concentrations as does northeastern Pennsylvania within the Pocono Mountains.

A number of important variables influence the location of these large scale land development operations. The most important include: 1) accessibility, 2) the availability of large tracts of relatively inexpensive land, 3) nearness to urban centers of population, and 4) an absence of local and regional land use plans and regulations that might hamper land development operations. (Pers. Comm. by Land developers in Tennessee, Arkansas, and west Texas, 1973, 1975, and 1981).

The relationship between interstate highways and the location of major recreational subdivisions was considered. This examination showed developments, in many instances, to be located along or near major transportation arteries with only two percent more than 160 kilometers from an interstate.

The availability of large tracts of relatively inexpensive land is important to the success of land development operations. Lee and Collier Counties in Florida emerged after the depression with huge inventories of land still intact and one land development company acquired more than 149,850 hectares during the 1950's. Some of the early purchases were made for around \$40.00 per hectare (Carter, 1974). Similar acquisitions have been made across the country.

Nearness of recreational subdivisions to urban centers with populations of 500,000 or more was tested. Only 264 are more than 160 kilometers from urban centers, with 217 of the more remote projects located in the western United States. When the counties within which large developments are located were examined, it was found that only 13 had populations of 500,000 or more, 37 counties had 80 percent or more of their populations living in urban places, and 96 counties were within standard metropolitan statistical areas. Although statistics reflect the preference of developers to locate in a rural setting where land use regulations and controls are lacking, 98 percent of the subdivisions are within 160 kilometers of an interstate and 63 percent are within 160 kilometers of large metropolitan areas.

The recreational land development boom caught many rural governments by surprise and with no controls over land use. A survey taken by the American Society of Planning Officials of one-third of the nation's counties revealed that only 41 percent of the non-metropolitan counties (less than 100,000 population) had zoning regulations. The figure for metropolitan counties was 55 percent (American Society for Planning Officials, 1976).

The large land developments studied here produce numerous environmental problems. These problems are caused by an enormous network of roads, poor water resource planning and management, inadequate open space, and disregard for fragile environments. When developers ignore local environmental constraints and roads remain unpaved, the area may become susceptible to dust storms, flash floods, and pollution of water resources from erosion and siltation. Inadequate water resource management may result in pollution of surface water from siltation, pollution of shallow aquifers from the widespread use of septic tanks, and the depletion of ground water resources if withdrawal exceeds recharge. Adequate open space improves not only the aesthetic quality of the development but could help preserve the natural drainage network of streams, fragile environments, and hazardous areas by allowing them to remain undeveloped (Allen et al., 1976).

Extreme clustering has accompanied recreational subdivision activity and has created and accentuated several problems. Impact of these activities could be reduced dramatically if developers were required to operate within existing environmental constraints.