Journal of Herpetology, Vol. 18, No. 3, pp. 291-301, 1984

Feeding Ecology of the Lizard, *Uta stansburiana*, in Southeastern New Mexico

TROY L. BEST[1] AND A. L. GENNARO

Llano Estacado Center for Advanced Professional Studies and Research, Natural History Museum, Eastern New Mexico University, Portales, New Mexico 88130, USA

ABSTRACT.—**This study presents the first food habit assessment for the side-blotched lizard (*Uta stansburiana*) in the shinnery oak-mesquite habitat (*Quercus havardii-Prosopis glandulosa*) of southeastern New Mexico. Ants, beetles, true bugs, grasshoppers, and spiders formed the major portion of the diet during the four year study. Discriminant analyses revealed the existence of annual, seasonal (monthly), and sexual variation. Variables separating years were incidental in occurrence; the major food categories occurred consistently between years. Seasonal variation was attributed to temporary changes in abundance of arthropods through the growing season. Sexual variation was pronounced in most samples and may be related to sexual size dimorphism or to behavioral differences related to defense of territories and attraction of mates. The sexual differences in diet may act to reduce intraspecific competition for food resources.**

The feeding ecology of the side-blotched lizard (*Uta stansburiana*) has been studied in several areas of the western United States (e.g., Knowlton and Janes, 1931, 1932; Cole, 1932; Woodbury, 1932; Knowlton and Anthon, 1935; Knowlton and Thomas, 1936; Dixon and Medica, 1966; Milstead and Tinkle, 1969; Parker and Pianka, 1975). Some investigators have found intersexual variation (Parker and Pianka, 1975) while others have found considerable microhabitat (Knowlton and Anthon, 1935; Knowlton and Thomas, 1936) and geographic variation (Parker and Pianka, 1975). Seasonal variation was noted by Cole (1932), Milstead and Tinkle (1969), and Parker and Pianka (1975); annual variation was shown for a Texas population by Tinkle (1967) and Milstead and Tinkle (1969). Best and Polechla (1983) reported some diet data for *U. stansburiana* in their study of *Cnemidophorus gularis* in southeastern New Mexico. In view of the previous studies of food habit variation and because no extensive studies of *Uta* have been conducted in the shinnery oak-mesquite plant association in southeastern New Mexico, the present study was initiated to document the food items consumed in that area, and to examine annual, seasonal (monthly), and sexual variation.

MATERIALS AND METHODS

From 1976 through 1979, 266 *U. stansburiana* were collected approximately 40 km E of Carlsbad in Eddy and Lea Counties, New Mexico (within a 8 km radius of drill hole ERDA 9, SE corner, Sec. 20, T22S, R31E). Specimens were fixed in 10% formalin and stored in 40% isopropyl alcohol. Stomach contents were later removed, placed into individual vials, and identified to family when possible. Arthropod taxonomy presented herein follows Borror et al. (1981).

Discriminant analyses (Nie et al., 1975) were used to statistically distinguish between years, months, and sexes. The discriminating variables used in this study were the numbers of items in each food category found in each of the

[1] Present address: Department of Biology and Museum of Southwestern Biology, The University of New Mexico, Albuquerque, New Mexico 87131, USA.

lizard stomachs. Discriminant analysis attempts to distinguish between groups by forming one or more linear combinations of the discriminating variables. These "discriminant functions" are formed in such a way as to maximize the separation of the groups being compared. In other words, the analyses are able to "discriminate" between years, months, or sexes in the sense of being able to tell them apart. By taking several variables and mathematically combining them, one or more dimensions (discriminant functions) are calculated on which, for example, males are clustered at one end and females at the other. Since the discriminant functions can be thought of as the axes of a geometric space, they can be used to study the spatial relationships among the groups. The weighting of each variable, according to its contribution to the determination of the discriminant function, serves to identify the variables which contribute most to differentiation along the respective function. Once a set of variables is found which provides satisfactory discrimination for cases with known group membership, a check of the adequacy of the discriminant functions can be made. This is accomplished by classifying the original set of cases to see how many are correctly classified by the variables being used. This classification procedure involves the use of a separate linear combination of the discriminating variables for each group. These produce a probability of membership in the respective group; the case is assigned to the group with the highest probability. The percent of "correct" classifications is calculated (by a comparison of the calculated group membership with the known group membership) to give a measure of the adequacy of the use of the variables in distinguishing between groups (years, months, or sexes as in this study).

Two separate data sets were used in the analyses. One contained the number of individuals in each arthropod order. The second included the number of individuals identified to family except where identification was impossible (e.g., unidentified Hymenoptera were entered as Hymenoptera, Formicidae was another character, Chalcidoidea another, etc.). Analyses were conducted using the IBM computer system at the University of New Mexico. Specimens and their stomach contents were deposited in the Eastern New Mexico University Natural History Museum in Portales.

Lizards were collected in a shinnery oak-mesquite association (*Quercus havardii-Prosopis glandulosa*). Although shinnery oak and mesquite did not have the greatest plant density on our study area, they were among the most obvious plant taxa. Extensive vegetation analyses of this non-cultivated region are given in Best and Jackson (1982).

RESULTS

The kinds and numbers of food items in the stomachs of the 266 *U. stansburiana* are presented in Table 1. In addition, one nematode was found in a female collected in June, 1978. Arthropods represented by the highest frequencies of occurrence (number of specimens containing a food category/total number of specimens × 100) were: Hymenoptera, 80%; Coleoptera, 67%; Hemiptera, 46%; Orthoptera, 38%; and Araneae, 32%. These categories were well represented in each of the four annual samples of lizards. Other consistently occurring arthropods were Homoptera, Neuroptera, Lepidoptera, and Diptera. Although the Hymenoptera were represented by at least eight families, there were more than 10 times as many Formicidae as all of the other hymenopterans combined. Their frequency of occurrence was 76% with 1,838 ants being counted. The Coleoptera were more evenly distributed among the 16 families identified, but Carabidae, Scarabaeidae, Tenebrionidae, and Curculionidae each had a 9–11% frequency of occurrence. Other coleopteran families occurred at frequencies <6%. In addi-

TABLE 1. Food items found in the stomachs of 266 *Uta stansburiana* collected from 1976 to 1979 in southeastern New Mexico. Sample sizes are given in parentheses next to the year. Occurrence data are presented as: % of lizards containing the food category (% of the total number of prey items; mean number of prey eaten per lizard eating such prey). There were no empty stomachs.

Food category	1976 (54)	1977 (89)	1978 (64)	1979 (59)	Combined (266)
Arachnida					
Araneae	11.1 (1.2; 1.0)	38.2 (3.1; 1.0)	40.6 (3.3; 1.3)	30.5 (3.7; 1.4)	31.6 (3.0; 1.2)
Acari		10.1 (1.7; 2.2)	9.4 (0.9; 1.5)	5.1 (0.4; 1.0)	6.8 (1.0; 1.8)
Solifugae			1.6 (0.1; 1.0)		0.4 (<0.1; 1.0)
Hexapoda		1.1 (6.7; 77.0)	1.6 (0.1; 1.0)	1.7 (0.1; 1.0)	1.1 (2.4; 26.3)
Collembola (1)[1]		1.1 (0.1; 1.0)	4.7 (0.9; 3.0)		1.5 (0.3; 2.5)
Thysanura (1)		1.1 (0.1; 1.0)	1.6 (0.1; 1.0)		0.8 (0.1; 1.0)
Orthoptera (8)	24.1 (3.0; 1.2)	30.3 (3.1; 1.3)	54.7 (4.1; 1.2)	45.8 (4.2; 1.1)	38.4 (3.6; 1.2)
Dermaptera (1)			3.1 (0.2; 1.0)		0.8 (0.1; 1.0)
Isoptera (1)				1.7 (2.2; 15.0)	0.4 (0.5; 15.0)
Psocoptera (1)		1.1 (0.1; 1.0)			0.4 (<0.1; 1.0)
Thysanoptera (1)		4.5 (0.5; 1.5)			1.5 (0.2; 1.5)
Hemiptera (12)	59.3 (15.2; 2.3)	61.8 (11.9; 2.5)	15.6 (1.9; 1.9)	40.7 (6.7; 2.0)	45.5 (8.3; 2.3)
Homoptera (8)	33.3 (6.1; 1.7)	34.8 (4.4; 1.7)	15.6 (3.0; 3.0)	10.2 (1.0; 1.2)	24.4 (3.5; 1.8)
Neuroptera (2)	0.1 (0.6; 1.0)	6.7 (0.7; 1.3)	6.3 (0.5; 21.3)	11.9 (1.3; 1.3)	7.5 (0.8; 1.3)
Coleoptera (16)	61.1 (15.2; 2.3)	71.9 (13.8; 2.5)	68.8 (9.4; 2.2)	64.4 (10.0; 1.8)	67.3 (11.9; 2.2)
Lepidoptera (4)	13.0 (1.8; 1.3)	31.5 (4.7; 1.9)	23.4 (2.4; 1.6)	27.1 (3.6; 1.6)	24.8 (3.3; 1.7)
Diptera (10)	16.7 (2.0; 1.1)	20.2 (2.4; 1.5)	10.9 (0.7; 1.0)	6.8 (0.6; 1.0)	14.3 (1.4; 1.3)
Hymenoptera (8)	79.6 (54.9; 6.3)	78.7 (46.4; 7.6)	81.3 (70.9; 13.9)	81.4 (66.2; 9.6)	80.1 (59.2; 9.3)
Miscellaneous					
Insect eggs			3.1 (1.8; 29.0)		0.8 (0.5; 9.0)
Lizards		1.1 (0.1; 1.0)			0.4 (<0.1; 1.0)
Plants		2.3 (0.2; 1.0)			0.8 (0.1; 1.0)

[1] Minimum number of families represented.

TABLE 2. Canonical discriminant analyses between years and months based upon stomach contents of *Uta*.

Actual group	N	Predicted group membership				
Years (1976–1979)[1,2]		1976	1977	1978	1979	
1976	54	33 (61.1%)	8 (14.8%)	4 (7.4%)	9 (16.7%)	
1977	89	24 (27.0%)	39 (43.8%)	10 (11.2%)	16 (18.0%)	
1978	64	6 (9.4%)	2 (3.1%)	30 (46.9%)	26 (40.6%)	
1979	59	14 (23.7%)	10 (16.9%)	12 (20.3%)	23 (39.0%)	
Months (1977–1979)[3]		May	June	July	August	
May	31	23 (74.2%)	4 (12.9%)	4 (12.9%)	0	
June	63	19 (30.2%)	21 (33.3%)	16 (25.4%)	7 (11.1%)	
July	67	13 (19.4%)	12 (17.9%)	38 (56.7%)	4 (6.0%)	
August	19	4 (21.1%)	2 (10.5%)	3 (15.8%)	10 (52.6%)	
Months—1977[4]		March	April	May	June	July
March	13	6 (46.2%)	3 (23.1%)	0	2 (15.4%)	2 (15.4%)
April	19	1 (5.3%)	8 (42.1%)	1 (5.3%)	5 (26.3%)	4 (21.1%)
May	8	1 (12.5%)	2 (25.0%)	2 (25.0%)	1 (12.5%)	2 (25.0%)
June	21	0	4 (19.0%)	3 (14.3%)	8 (38.1%)	6 (28.6%)
July	28	1 (3.6%)	1 (3.6%)	3 (10.7%)	8 (28.6%)	15 (53.6%)
Months—1978[5]		May	June	July	August	
May	13	7 (53.8%)	3 (23.1%)	2 (15.4%)	1 (7.7%)	
June	19	2 (10.5%)	11 (57.9%)	6 (31.6%)	0	
July	19	3 (15.8%)	4 (21.1%)	11 (57.9%)	1 (5.3%)	
August	10	0	2 (20.0%)	1 (10.0%)	7 (70.0%)	
Months—1979[6]		May	June	July	August	
May	10	8 (80.0%)	0	2 (20.0%)	0	
June	23	4 (17.4%)	12 (52.2%)	6 (26.1%)	1 (4.3%)	
July	20	5 (25.0%)	2 (10.0%)	12 (60.0%)	1 (5.0%)	
August	9	2 (22.2%)	0	2 (22.2%)	5 (55.6%)	

[1] The data in subsequent footnotes are given as: percent of the specimens that were correctly classified; in decreasing order of importance, the variables accounting for most or all of the differences.
[2] 47.0%; Hemiptera, Collembola, Hymenoptera, Orthoptera, Araneae, Diptera, Lepidoptera, Homoptera, insect eggs, and Thysanoptera.
[3] 51.1%; Hymenoptera, insect eggs, Orthoptera, Hemiptera, Collembola, Araneae, Acari, Coleoptera, Homoptera, and Neuroptera.
[4] 43.8%; Diptera, Hemiptera, Coleoptera, lizards, Thysanura, Psocoptera, Homoptera, and Hymenoptera.
[5] 59.0%; Orthoptera, insect eggs, Hymenoptera, Coleoptera, Acari, Hemiptera, and Diptera.
[6] 59.7%; Hymenoptera, Hemiptera, Neuroptera, Orthoptera, and Diptera.

tion, there was a 36% frequency of unidentified coleopterans (169 individual insects). There were 12 families of Hemiptera—Cydnidae, Scutelleridae, and Lygaeidae being the most common occurring at frequencies ranging from 7–19%, respectively. Orthopterans were predominantly Acrididae (33% frequency); other families were at frequencies <3%. The most common homopteran family was Cicadellidae (11% frequency). Most of the lepidopterans and dipterans were identifiable only to order.

The results of the discriminant analysis between years (sexes combined), using the number of arthropods in each order as characters, are shown in Table 2. Only 47% of the specimens were classified correctly indicating little difference between years. The analysis using all arthropod taxa (orders, suborders, superfamilies, families) classified 85% of the specimens correctly. In decreasing order of importance, the variables separating years were Cydnidae, Scutelleridae, Tenebrionidae, Coleoptera, Carabidae, Sphecidae, and Lygaeidae. Since these categories were represented by small numbers of occurrences, the annual variation was primarily attributable to food categories that were found during only one or two of the four years.

The distributions among the four years for lizards that were incorrectly classified showed some relationships between years (Table 2). The large number of lizards incorrectly classified in 1977 and 1979 were evenly distributed between the other years. For 1976, the few (21 specimens) that were incorrectly placed were distributed evenly between 1977, 1978, and 1979, and for 1978 a large number of incorrectly placed lizards were assigned to 1979. Perhaps, 1979 was an "average" year, 1976 was quite different from 1977, 1978, and 1979, and 1978 and 1979 were more similar to each other than to either 1976 or 1977.

Discriminant analyses were performed between months (May through August) combining data for 1977, 1978, and 1979 (sexes combined). The results are presented in Table 2 and show 51% of the specimens to be correctly classified. Using all arthropod taxa, 70% were classified correctly. Variables contributing the most to the latter classification were Formicidae, Acrididae, insect eggs, Sphecidae, Cydnidae, Coleoptera, Homoptera, and Dictyopharidae. Of these, Formicidae, Acrididae, and Coleoptera occurred most consistently.

When months were considered for individual years, discriminant analyses showed some difference between months for each year (Table 2). Analyses using all arthropod taxa correctly classified 76, 89, and 77% of specimens to month for 1977, 1978, and 1979, respectively. For 1977, variables accounting for most of the differences were Diptera, Dascillidae, Thysanura, lizards, Coleoptera, Homoptera, Cydnidae, and Ichneumonidae. Only Coleoptera and Cydnidae occurred with any regularity in the monthly samples. Thus, the separation of months in 1977 was primarily based upon incidental occurrences. The 1978 data showed greater differences between months than 1977 or 1979. Acrididae, insect eggs, Diptera, Formicidae, Tenebrionidae, Carabidae, and Coccinellidae accounted for the most differences. Acrididae, Formicidae, and Tenebrionidae were well represented in the 1978 data, and there was an 89% correct separation of months. For 1979, variables contributing the most to the differences were Formicidae, Sphecidae, Cleridae, Dic-

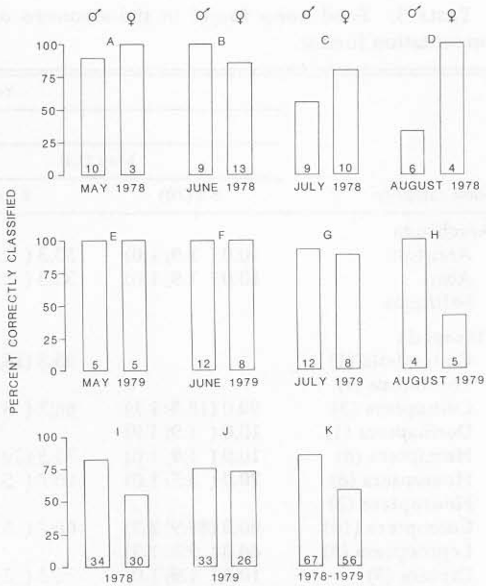

FIG. 1. Discriminant analyses between sexes of *Uta*. The graphs depict the percentages of specimens correctly classified to sex for each analysis. Sample sizes for each sex are presented inside the bar graphs. The data presented below are given as the overall percent of specimens that were classified correctly, and in decreasing order of importance, the variables accounting for most or all of the differences: A) 92.3%, Hymenoptera, Coleoptera, Lepidoptera, Orthoptera; B) 90.9%, Hymenoptera, Araneae, Collembola, Solifugae, Hemiptera; C) 68.4%, Homoptera, Araneae; D) 60.0%, insect eggs; E) 100%, Orthoptera, Hymenoptera, Araneae, Coleoptera; F) 100%, Hymenoptera, Hemiptera, Homoptera, Coleoptera, Araneae, Diptera; G) 90.0%, Hymenoptera, Isoptera, Orthoptera, Neuroptera, Acari; H) 66.7%, Homoptera; I) 70.3%, Hymenoptera, insect eggs, Homoptera, Solifugae; J) 74.6%, Hymenoptera, Acari, Lepidoptera, Araneae, Hexopoda, Orthoptera; K) 73.2%, Hymenoptera, Araneae, Hexapoda, Solifugae, Isoptera.

TABLE 3. Food items found in the stomachs of *Uta* during 1978 and 1979. See Table 1 for data presentation format.

Food category	Year and month of collection			
	1978			
	May (13)		June (22)	
	♂♂ (10)	♀♀ (3)	♂♂ (9)	♀♀ (13)
Arachnida				
Araneae	10.0 (1.9; 1.0)	33.3 (2.5; 1.0)	66.7 (15.2; 1.7)	30.8 (1.2; 1.0)
Acari	10.0 (1.9; 1.0)	33.3 (2.5; 1.0)		15.4 (0.6; 1.0)
Solifugae				7.7 (0.3; 1.0)
Hexapoda				
Collembola (1)		33.3 (15.0; 6.0)		7.7 (0.3; 1.0)
Thysanura (1)			11.1 (1.5; 1.0)	
Orthoptera (3)	90.0 (18.5; 1.1)	66.7 (5.0; 1.0)	66.7 (13.6; 1.5)	61.5 (3.0; 1.3)
Dermaptera (1)	10.0 (1.9; 1.0)			7.7 (0.3; 1.0)
Hemiptera (6)	10.0 (1.9; 1.0)	33.3 (20.0; 8.0)	33.3 (4.6; 1.0)	23.1 (1.5; 1.7)
Homoptera (6)	20.0 (3.7; 1.0)	66.7 (5.0; 1.0)		23.1 (3.6; 4.0)
Neuroptera (2)				7.7 (0.6; 2.0)
Coleoptera (10)	90.0 (38.9; 2.3)	66.7 (5.0; 1.0)	44.4 (7.6; 1.3)	76.9 (7.5; 2.5)
Lepidoptera (3)	40.0 (9.3; 1.3)		33.3 (66.7; 2.0)	30.8 (1.8; 1.5)
Diptera (3)	10.0 (1.9; 1.0)	33.3 (2.5; 1.0)	11.1 (1.5; 1.0)	15.4 (0.6; 1.0)
Hymenoptera (5)	70.0 (20.4; 1.6)	66.7 (42.5; 8.5)	55.6 (47.0; 6.2)	100 (78.8; 20.3)
Miscellaneous				
Insect eggs				
	1979			
	May (10)		June (20)	
	♂♂ (5)	♀♀ (5)	♂♂ (12)	♀♀ (8)
Arachnida				
Araneae		20.0 (2.9; 1.0)	41.7 (10.8; 2.0)	25.0 (2.1; 1.5)
Acari				
Hexapoda			8.3 (1.1; 1.0)	
Orthoptera (3)	40.0 (11.1; 1.0)	80.0 (11.8; 1.0)	41.7 (5.4; 1.0)	75.0 (4.2; 1.0)
Isoptera (1)				
Hemiptera (4)			66.7 (22.6; 2.6)	50.0 (7.8; 2.8)
Homoptera (3)			8.3 (1.1; 1.0)	
Neuroptera (2)			25.0 (5.4; 1.7)	25.0 (1.4; 1.0)
Coleoptera (11)	80.0 (33.3; 1.5)	60.0 (17.7; 2.0)	58.3 (12.9; 1.7)	75.0 (9.9; 2.3)
Lepidoptera (3)		40.0 (8.8; 1.5)	25.0 (4.3; 1.3)	25.0 (3.5; 2.5)
Diptera (2)	20.0 (5.6; 1.0)	20.0 (2.9; 1.0)	16.7 (2.2; 1.0)	
Hymenoptera (4)	80.0 (50.0; 2.3)	80.0 (55.9; 4.8)	66.7 (34.4; 4.0)	100 (71.1; 12.6)

tyopharidae, Chrysopidae, and Lygaeidae. Of these, Formicidae, Sphecidae, and Lygaeidae were the most widely represented in each of the 1979 monthly samples. Their importance in separating months indicated some consistent differences. In summary, there were differences between months for 1977, 1978, and 1979. These differences were most evident when all arthropod taxa were considered.

The sex of each lizard was determined in 1978 and 1979, and discriminant analyses were used to assess sexual variation for these years. Males in the 1978 and 1979 samples were combined and compared with the combined females (Fig. 1K). Of the variables separating sexes, Hymenoptera and Araneae were present in every monthly sample during both years, except for males in May 1979 (Table 3). Along with

TABLE 3. Continued.

Year and month of collection					
1978					
July (19)		August (10)		1978 (64)	
♂♂ (9)	♀♀ (10)	♂♂ (6)	♀♀ (4)	♂♂ (34)	♀♀ (30)
55.6 (3.6; 1.0)	40.0 (4.2; 1.3)	50.0 (3.0; 1.7)	50.0 (5.0; 1.0)	44.1 (4.9; 1.4)	36.7 (2.2; 1.1)
	10.0 (0.8; 1.0)	16.7 (2.4; 4.0)		5.9 (1.2; 2.5)	13.3 (0.8; 1.0)
					3.3 (0.2; 1.0)
		16.7 (0.6; 1.0)		2.9 (0.2; 1.0)	
		16.7 (1.2; 2.0)		2.9 (0.5; 2.0)	6.7 (1.3; 3.5)
				2.9 (0.2; 1.0)	
33.3 (2.1; 1.0)	40.0 (3.3; 1.0)	33.3 (1.2; 1.0)	25.0 (5.0; 2.0)	58.8 (5.6; 1.2)	50.0 (3.4; 1.2)
				2.9 (0.2; 1.0)	3.3 (0.2; 1.0)
11.1 (0.7; 1.0)	10.0 (0.8; 1.0)			14.7 (1.2; 1.0)	16.7 (2.6; 2.8)
	20.0 (1.7; 1.0)	16.7 (4.8; 8.0)		8.8 (2.3; 3.3)	23.3 (3.0; 2.3)
	20.0 (1.7; 1.0)	16.7 (0.6; 1.0)		2.9 (0.2; 1.0)	10.0 (0.8; 1.3)
77.8 (12.8; 2.6)	70.0 (12.5; 2.1)	66.7 (4.2; 1.8)	25.0 (5.0; 2.0)	70.6 (11.9; 2.1)	66.7 (8.2; 2.2)
22.2 (2.1; 1.5)	10.0 (0.8; 1.0)	16.7 (1.8; 3.0)		29.4 (4.0; 1.7)	16.7 (1.3; 1.4)
		16.7 (0.6; 1.0)	25.0 (2.5; 1.0)	8.8 (0.7; 1.0)	13.3 (0.8; 1.0)
77.8 (78.7; 15.9)	90.0 (74.2; 9.9)	83.3 (68.7; 22.8)	75.0 (82.5; 11.0)	70.6 (62.5; 11.1)	90.0 (75.3; 14.9)
		33.3 (10.8; 9.0)		5.9 (4.2; 9.0)	
1979					
July (20)		August (9)		1979 (59)	
♂♂ (12)	♀♀ (9)	♂♂ (4)	♀♀ (5)	♂♂ (33)	♀♀ (26)
41.7 (7.7; 1.2)	22.2 (2.3; 1.0)	25.0 (0.9; 1.0)	40.0 (2.4; 1.5)	33.3 (5.8; 1.6)	26.9 (2.3; 1.3)
16.7 (2.6; 1.0)		25.0 (0.9; 1.0)		9.1 (1.0; 1.0)	
				3.0 (0.3; 1.0)	
41.7 (7.7; 1.2)	11.1 (1.1; 1.0)	50.0 (1.9; 1.0)	20.0 (0.8; 1.0)	42.4 (5.1; 1.1)	46.2 (3.1; 1.0)
	11.1 (16.9; 15.0)				3.9 (3.9; 15.0)
50.0 (9.0; 1.2)	44.4 (6.7; 1.5)	25.0 (0.9; 1.0)	20.0 (0.8; 1.0)	45.5 (9.8; 1.9)	34.6 (4.6; 2.0)
16.7 (2.6; 1.0)	11.1 (1.1; 1.0)		40.0 (2.4; 1.5)	9.1 (1.0; 1.0)	11.5 (1.0; 1.3)
	11.1 (1.1; 1.0)	25.0 (0.9; 1.0)		12.1 (2.0; 1.5)	11.5 (0.8; 1.0)
66.7 (18.0; 1.8)	44.4 (7.9; 1.8)	75.0 (3.8; 1.3)	60.0 (5.6; 2.3)	66.7 (12.2; 1.6)	61.5 (8.7; 2.1)
25.0 (5.1; 1.3)	44.4 (5.6; 1.3)	25.0 (0.9; 1.0)	20.0 (2.4; 3.0)	21.2 (3.1; 1.3)	34.6 (4.1; 1.8)
				9.1 (1.0; 1.0)	3.9 (0.3; 1.0)
66.7 (47.4; 4.6)	66.7 (57.3; 8.5)	100 (89.6; 23.8)	80.0 (85.6; 21.4)	72.7 (58.6; 7.2)	88.5 (71.3; 12.1)

Orthoptera and Coleoptera these two orders were among the most consistently occurring arthropods. Analysis using all arthropod taxa provided 81% correct classifications; Formicidae, Sphecidae, Cicadellidae, Cicindelidae, Asilidae, and Isoptera contributed the most to the differences. Of these, Formicidae was the only consistently occurring taxon throughout both years. Thus, the high percentage of correct classifications was based primarily on incidentally occurring food categories.

Each year was then examined separately. For 1978, 70% of the specimens were correctly classified to sex (Fig. 1I). Of the variables accounting for the differences, Hymenoptera was the only consistently occurring order (Table 3). Considering all arthropod taxa, 81% were correctly classified with Formicidae, Cicadellidae, Fulgoroidea, Araneae, Buprestidae, Lepidoptera, and Berytidae accounting for most of the differences. Formicidae, Araneae, and Lepidoptera were the most consistently occurring food categories. For 1979, 75% of the lizards were correctly classified to sex (Fig. 1J). Except for Acari and Hexapoda, the variables accounting for the differences represented some of the most consistently occurring food categories (Table 3). Ninety-eight percent of the specimens were correctly classified using all arthropod taxa. Variables contributing the most to the differences were Sphecidae, Buprestidae, Cicindelidae, Formicidae, Acari, Tettigoniidae, Acrididae, and Myrmeleontidae. Sphecidae, Formicidae, and Acrididae occurred consistently in the 1979 samples of both sexes. There were more differences between the sexes in 1979 than in 1978.

Subsequent analyses concentrated on the differences between the sexes for the monthly samples during 1978 and 1979. For May 1978, 92% of the specimens were correctly classified to sex (Fig. 1A). The variables accounting for the differences were among the most consistently occurring food categories during 1978 (Table 3). Lepidoptera were found in the stomachs of females only and the other categories were present in both sexes (Table 3). When all arthropod taxa were considered, 92% of the specimens were correctly classified with Curculionidae, Scarabaeidae, Coleoptera, and Thyreocoridae accounting for the differences. Curculionidae occurred in females only and Scarabaeidae, Coleoptera, and Thyreocoridae occurred in males only. For June 1978, 91% of the specimens were correctly classified (Fig. 1B). Of the variables accounting for the differences, Collembola and Solifugae were found in the stomachs of females only, and the other categories were present in both sexes (Table 3). Using all arthropod taxa, 96% of the specimens were correctly classified with Formicidae, Tingidae, Carabidae, Berytidae, Chalcidoidea, Labiidae, Araneae, and Tenebrionidae accounting for the differences. Carabidae, Berytidae, and Labiidae were found only in stomachs of females and the other taxa occurred in both sexes. For July 1978, 68% of the specimens were correctly classified (Fig. 1C). Of the variables accounting for the differences, Homoptera was found in females only and Araneae was present in both sexes (Table 3). Considering all arthropod taxa, 79% were correctly classified with Curculionidae, Buprestidae, Noctuidae, and Vespidae accounting for the differences. These variables occurred in male stomachs only. The analysis for August 1978 correctly classified 60% of the lizards (Fig. 1D). Insect eggs, which accounted for the difference between sexes, were found in male stomachs only (Table 3). Using all arthropod taxa, 70% were correctly classified with Hymenoptera (found in both sexes) accounting for the differences.

For May 1979, specimens were 100% correctly classified to sex (Fig. 1E). Of the variables accounting for the differences, the order Araneae was limited to females; the other categories were found in both sexes (Table 3). When all arthropod taxa were used in the analysis, 100% of the specimens were correctly classified. The variables accounting for the differences were Acrididae, Coccinellidae, Sphecidae, Araneae, and Lepidoptera. Acrididae and Sphecidae occurred in both sexes, Coccinellidae occurred in males only, and Araneae and Lepidoptera occurred in females only. For June 1979, 100% of the specimens were correctly classified (Fig. 1F). Homoptera and Diptera were present in males only and the other variables accounting for the differences were in both sexes (Table 3). Considering all arthropod taxa, 100% of the lizards were correctly classified. The variables accounting for the most differences were Formicidae, Chalcidoidea, Chrysomelidae, Chrysididae, Nitidulidae, Hymenoptera, and Noctuoidea. Formicidae and Chrysididae were found in both sexes; Chalcidoidea, Chrysomelidae, Nitidulidae, and Noctuoidea were found in females only; and Hymenoptera were found in males only (Table 3). For July 1979, 90% of the lizards were correctly classified (Fig. 1G). Of the variables accounting for the differences between sexes, Neuroptera were in females only, Acari were in males only, and the remaining categories were in both sexes (Table 3). Considering all arthropod taxa, 100% of the specimens were correctly classified with Acrididae, Coccinellidae, Formicidae, Tettigoniidae, Cicindelidae, Myrmeleontidae, Sphecidae, and Hymenoptera accounting for the most differences. Formicidae, Sphecidae, and Hymenoptera were represented in the stomachs of both sexes; Acrididae and Coccinellidae were in males only; and Tettigoniidae, Cicindelidae, and Myrmeleontidae were in females only. In August 1979, 67% of the specimens were correctly classified (Fig. 1H). Homoptera, the variable accounting for the difference, were found in males only (Table 3). For all arthropod taxa, 100% were correctly classified with Sphecidae, Coccoidea, Lygaeidae, Acari, Acrididae, and Coleoptera accounting for the differences. Lygaeidae, Acrididae, and Coleoptera occurred in both sexes, Acari were in males only, and Sphecidae and Coccoidea were in females only.

Discussion

In their examination of geographic variation in diet, Parker and Pianka (1975) found that *Uta* consumed the same major food items as found in previous studies. They also found a moderate latitudinal shift in the composition of the diet between their northern and southern samples. Additionally, they observed little difference between northern and southern populations in dietary diversities based upon either numbers or volumes of their various prey categories. Our results were similar to previous studies in that Hymenoptera, Coleoptera, Hemiptera, Orthoptera, and Araneae were among the most abundant food categories. The diversity of food categories found in our specimens (>74 families; Table 1) is as great or greater than any of the previous studies of *Uta*'s food habits. This may indicate that lizards in our study had a greater diversity of food organisms available for consumption, there were varying degrees of expertise in identifying the stomach contents, or different taxonomic levels have been used in identifying the food categories.

Tinkle (1967) and Milstead and Tinkle (1969) noted variation in the annual diet of *Uta* in west Texas. Our findings also indicated annual variation, particularly when we used all arthropod taxa in analyzing the variation. Most of the variables separating years were incidental in occurrence, but the major food categories occurred regularly between years. Therefore, real differences existed, but they were not defined by major food category variation. Lumping arthropods into higher taxa may have reduced the differences between years since food organisms from one year to the next were fairly consistently of the same taxonomic order. Our findings indicated that differences between years were undeniably present. The consistency of major food categories between years also indicated that *Uta* was not a completely opportunistic feeder. The species took certain arthropod taxa very regularly from year to year (i.e., Hymenoptera, Coleoptera, Hemiptera, Orthoptera, and Araneae), and was opportunistic only in the sense of taking other taxa that may fall into the proper size, taste, or behavioral category.

Tinkle (1967) thought *Uta* to be opportunistic because it would feed upon any insect or arachnid of suitable size, Milstead and Tinkle (1969) because of the wide range of foods consumed, and Parker and Pianka (1975) because of the increased volume of termites in their stomachs during swarming as opposed to previous days. We feel these observations support our contention that *Uta* was not completely opportunistic. The species was opportunistic only in the sense that it took foods within its "normal" categories in greater abundance when these foods were in greater abundance. We believe that an opportunistically feeding species is one that takes food as it encounters it, such as is done by coyotes (e.g., Best et al., 1981). The consistency of various food taxa in the diet of *Uta* indicated that some selection must be taking place. We have observed that large numbers of termites and other arthropod taxa were available as food items. However, possibly because of microhabitat, foraging habits, or selection of foods, termites and certain other taxa were rarely found in *Uta*'s stomachs. During times of environmental adversity, we expect that *Uta* would take food species that may not be "preferred" in order to survive.

The presence of seasonal variation in the diet of *Uta* has been briefly addressed by some previous workers. Cole (1932) postulated that the differences between the food items he found in the stomachs of *Uta* and those found by Knowlton and Janes (1931) were probably because of seasonal differences. Tinkle (1967) reported that consistent seasonal changes in diet of west Texas *Uta* were not clearly present, but later Milstead and Tinkle (1969) indicated that there were some seasonal differences in the same populations. Parker and Pianka (1975) were the first to quantify seasonal differences in foods selected by *U. stansburiana*. They found seasonal changes in the size of prey taken by *Uta*, and that the sequence of size variation differed from the northern to southern part of the species' range. Our data clearly show seasonal differences in the kinds and numbers of prey species taken by *Uta* in southeastern New Mexico. Although there were varying degrees of separation between months, differences were persistent in the monthly samples of lizards. This seasonal variation probably reflected the temporary abundance of various arthropods on the study area as the growing seasons progressed. Whitford and Creusere (1977) have shown that in the Chihuahuan desert of south-central New Mexico, the seasonal rainfall pattern as well as total amount of rainfall affect the primary productivity and hence the availability of arthropods as foods for lizards.

Sexual differences in diet of *U. stansburiana* have been examined by Parker and Pianka (1975). They observed that males in their northern samples had slightly more diverse diets than northern females, while southern females took a broader variety of foods than southern males. They also found that in some populations the size of lizards was closely related to the size of foods ingested. For example, their samples from Arizona (these had the greatest sexual size dimorphism), and near El Paso, Texas, showed that females consumed the smallest food items almost exclusively, while males consumed more of the larger food items. Similar sexual differences have been shown for *Anolis* (Schoener, 1967, 1968); they differed dramatically in size and behavior and ate quite different foods. These differences between sexes would act to reduce intersexual competition for food resources—an adaptation that has been known for years in other vertebrates (e.g., birds: Selander, 1966). In addition, Schoener (1977) has shown that the more *Anolis* species in a fauna, the smaller the sexual dimorphism; this also supports the idea of intersexual competition. Somewhat contrary data, however, exist for *Leiocephalus* (Schoener, 1982).

Knopf (1963) found significant sexual size dimorphism in several morphologic characters for *U. stansburiana* in west Texas. Since our New Mexico study area was close to his, we expect that similar sexual size dimorphism occurred in our population. This could at least partially account for the differences in diet we have shown between sexes. That is, sexual differences in size were possibly related to differences in food items taken by each sex. Alternatively, behavior related to defense of territory or courtship may affect feeding strategies or opportunities. Sexual differences in diet may act to reduce intraspecific competition for food in the semi-arid environment of southeastern New Mexico.

Acknowledgments.—We thank J. C. Schaffner, Texas A&M University, and N. Jorgensen, Eastern New Mexico University, for identifying the stomach contents. B. Hoditschek, P. J. Polechla, and numerous other graduate student assistants aided in specimen collection and data preparation. This project received funding as a part of the Los Medaños Waste Isolation Pilot Plant studies by Sandia National Laboratories (Contract No. 13-2097) and Westinghouse Electric Corp. (Subcontract No. WFC-53431-SD). T. L. Yates provided the computer time, Y. Ramsey prepared the figure, L. L. DeVries and C. L. Schooler typed several versions of the paper, S. A. Reza assisted in proofreading, and S. Neuhauser, T. Fritts, and D. J. Hafner critically reviewed the manuscript.

Literature Cited

Best, T. L., B. Hoditschek, and H. H. Thomas. 1981. Foods of coyotes (*Canis latrans*) in Oklahoma. Southwest. Natural. 26:67–69.

———, and D. W. Jackson. 1982. Statistical evaluation of plant density data collected at the Los Medaños site, New Mexico (1978–1980). 374 pp. *In* Braswell, J., and J. S. Hart (eds.), Ecosystem Studies at the Los Medaños Site Eddy County, New Mexico. TME 3141, U.S. Dept. Energy, Albuquerque, New Mexico.

———, and P. J. Polechla. 1983. Foods of the Texas spotted whiptail lizard (*Cnemidophorus gularis*) in New Mexico. Southwest. Natural. 23:376–377.

Borror, D. J., D. M. DeLong, and C. A. Triplehorn. 1981. An introduction to the study of insects. Saunders College Publ., New York. 827 pp.

Cole, A. C., Jr. 1932. Analyses of the stomach contents of two species of Idaho lizards, with special reference to the Formicidae. Ann. Ent. Soc. Amer. 25:638–640.

Dixon, J. R., and P. A. Medica. 1966. Summer food of four species of lizards from the vicinity of White Sands, New Mexico. Los Angeles Co. Mus. Contrib. Sci. 121:1–6.

Knopf, G. N. 1963. Sexual, geographical, and individual variation in three Texas populations of the lizard, *Uta stansburiana stejnegeri.* Amer. Midl. Natural. 70:74–89.

Knowlton, G. F., and E. W. Anthon. 1935. *Uta stansburiana stansburiana* (Baird and Girard). Copeia 1935:183.

———, and M. J. Janes. 1931. Notes on insect food of two Utah lizards. Proc. Utah Acad. Sci. 8:140–142.

———, and ———. 1932. Studies of the food habits of Utah lizards. Ohio J. Sci. 32:467–470.

———, and W. L. Thomas. 1936. Food habits of Skull Valley lizards. Copeia 1936:64–66.

Milstead, W. W., and D. W. Tinkle. 1969. Interrelationships of feeding habits in a population of lizards in southwestern Texas. Amer. Midl. Natural. 81:491–499.

Nie, N. H., C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. H. Bent. 1975. Statistical package for the social sciences (SPSS). McGraw-Hill Book Co., New York. 675 pp.

Parker, W. S., and E. R. Pianka. 1975. Comparative ecology of populations of the lizard *Uta stansburiana.* Copeia 1975:615–632.

Schoener, T. W. 1967. The ecological significance of sexual dimorphism in size in the lizard *Anolis conspersus.* Science 155:474–477.

———. 1968. The *Anolis* lizards of Bimini: Resource partitioning in a complex fauna. Ecology 49:704–726.

———. 1977. Competition and the niche. *In* Gans, C., and D. W. Tinkle (eds.), Biology of the Reptilia, Vol. 7. Pp. 35–136. Academic Press, New York. 720 pp.

———, J. B. Slade, and C. H. Stinson. 1982. Diet and sexual dimorphism in the very catholic lizard genus, *Leiocephalus* of the Bahamas. Oecologia (Berl.) 53:160–169.

Selander, R. K. 1966. Sexual dimorphism and differential niche utilization in birds. Condor 68:113–151.

Tinkle, D. W. 1967. The life and demography of the side-blotched lizard, *Uta stansburiana.* Misc. Publ. Mus. Zool., Univ. Mich. No. 132. 182 pp.

Whitford, W. G., and F. M. Creusere. 1977. Seasonal and yearly fluctuations in Chihuahuan Desert lizard communities. Herpetologica 33: 54–65.

Woodbury, L. A. 1932. Notes on the food habits of three species of lizards from Utah. Copeia 1932:13–16.

Accepted: 5 May 1984.