FACTORS INFLUENCING NESTING SUCCESS OF BURROWING OWLS IN SOUTHEASTERN IDAHO

Richard S. Gleason[1,2] and Donald R. Johnson[1]

Abstract.— A burrowing owl (*Athene cunicularia*) population nesting on the Idaho National Engineering Laboratory (INEL) in southeastern Idaho utilized burrows excavated by badgers (*Taxidea taxus*) or natural cavities in lava flows as nesting sites. The size of the population was small (N = 13–14 pairs) in relation to the number of available nesting sites, suggesting that factors other than burrow availability limited this population. Rodents and Jerusalem crickets (*Stenopelmatus fuscus*) represented the primary prey utilized during the nesting season. This population demonstrated both a numerical (brood size) and functional (dietary) response to a decrease in the density of three species of rodents on the INEL during a drought in 1977.

Because of the ease with which active nest sites can be discovered and the diet monitored, burrowing owls are suitable subjects for a study of the relationships of nest site and prey availability to nesting success. In this paper we discuss the effects of nest site and prey availability on the reproductive success of a burrowing owl population, basing our conclusions on counts of emerging broods.

Methods

Field work was conducted on and immediately adjacent to the Idaho National Engineering Laboratory (INEL) from 21 May to 3 August 1976 and from 10 May to 1 October 1977. About 80% of the site is covered by big sagebrush (*Artemisia tridentata*) or Douglas rabbitbrush (*Chrysothamnus viscidiflorus*). The understory vegetation consists of wheatgrasses (*Agropyron* spp.), bottlebrush squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*). Winterfat (*Ceratoides lanata*) and saltbushes (*Atriplex* spp.) occur on moderately saline soils in mixed or relatively pure stands (Harniss and West 1973). Several former sagebrush sites in the southern portion of the reserve have been seeded to crested wheatgrass (*Agropyron cristatum*). These are grazed seasonally by livestock.

All areas accessible by road were searched at least once for nesting pairs. Since this species nests in burrows, attempts to count completed clutches would result in nest failure. Although one could estimate clutch size based on data from egg collections, annual fluctuations in food supply may influence the number of eggs laid by this species (Murray 1976). Henny and Blus (1981) have cautioned against the use of casual counts of broods in calculating productivity because some young have been observed to move to adjacent burrows as early as 10 days following emergence. Our estimates of brood size were not affected by such movements since each was based on at least seven counts during a period of two weeks after the young first emerged.

Castings were recovered from the vicinity of burrow entrances and dissected in the laboratory. Mammalian prey were identified by dental characteristics and the minimum number of individuals estimated from the number of paired mandibles. Invertebrate prey were identified and the minimum number of individuals estimated from counts of heads, mandibles, and elytra.

Results

Only 6 nesting pairs were found on the site annually, a density of 1 pair per 58 km^2. In

[1]Department of Biological Sciences, University of Idaho, Moscow, Idaho 83843.
[2]Present address: 2217 NE 12th Avenue, Portland, Oregon 97225.

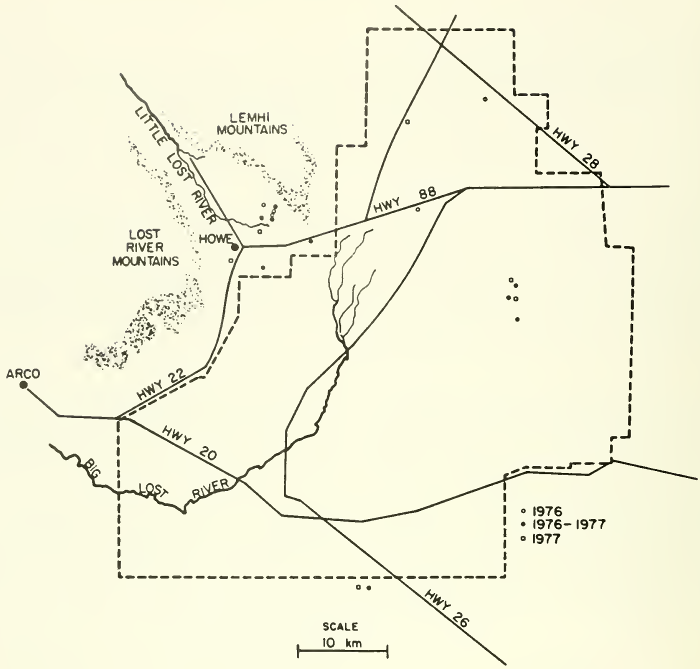

Fig. 1. Distribution of burrowing owl nesting pairs within and adjacent to the INEL, 1976 and 1977.

addition, 7–8 pairs nested adjacent to cultivated land near Howe and 1–2 pairs near Atomic City south of the INEL (Fig. 1). Approximately 75% of the nesting pairs utilized burrows excavated by badgers, and the remainder occupied natural cavities in lava flows.

Productivity was determined for 14 breeding pairs in 1976 and 13 pairs in 1977. The mean brood size of 3.6 per nesting pair (range 1–7) was smaller than that reported for other North American populations (Thomsen 1971, Butts 1971, Martin 1973, Wedgwood 1976). There was no significant difference in brood size between that of 14 pairs nesting near irrigated alfalfa crops at Howe and that of 13 pairs nesting in rangeland elsewhere on the study area ($F = 1.52$, $P > 0.05$). However, there was a significant difference in brood size between 1976, a year with normal precipitation, and 1977, when a drought occurred ($F = 3.77$, $P < 0.05$).

Of the 22 mortalities confirmed (2 nestlings, 15 juveniles, and 5 adults), 6 resulted from collisions with motor vehicles. Most of the others were recovered from the vicinity of nest sites, and the cause of death was not identified. Two nestlings were found dead within a burrow, which was excavated after the nesting pair disappeared. We assume that badgers were the major predator on nestlings prior to emergence. A badger was observed entering one of the nest burrows containing an unknown number of young, only one of which later fledged.

Food availability affected the productivity of the study population. Ord kangaroo rats (*Dipodomys ordii*), deer mice (*Peromyscus maniculatus*), and Great Basin pocket mice (*Perognathus parvus*) composed 40% of the biomass taken by burrowing owls in 1976 and 32% of that taken the following year (Table 1), a reduction in proportion that is highly significant ($Z = 13.3$, $P < 0.001$). This dietary change probably represents a functional response to the decrease in density of these species on the INEL in 1977 (Table 2). Based on analysis of castings recovered from nesting sites, there was a significant positive relationship between the biomass of rodents in the diet of individual nesting pairs and the size of their respective broods in 1976 ($r = 0.56$, $N = 10$, $P < 0.05$) but not in 1977.

Discussion

Most of the burrows on the INEL probably resulted from attempts by badgers to capture Townsend ground squirrels (*Spermophilus townsendii*). However, nesting pairs also utilized badger-excavated burrows of Ord kangaroo rats near Howe, a location where no ground squirrels occurred. Given the wide distribution of prey suitable for badgers, we assume that large portions of the study area lacked burrowing owls because of factors other than the availability of suitable nesting sites.

Although fratricide may have caused some mortality before fledging, we observed no agonistic encounters between siblings. Most mortality occurred after fledging, when the young may be particularly vulnerable to starvation because of their inexperience in capturing prey.

Rodents rather than invertebrates represent a more reliable energy source during periods of food-stress because individual captures provide greater biomass. However, the use of Jerusalem crickets is energetically favorable because of their large size and ease of capture. This insect, which is common throughout the arid portions of the western United States (Essig 1936), is usually active above ground only at night, although some are found at the surface on cool, cloudy days (La Rivers 1948). We have no information on annual changes in the density of Jerusalem

Table 1. Diet of burrowing owls on the INEL site based on casting analysis, 1976 and 1977.

	1976			1977		
	N	% N	Percent biomass	N	% N	Percent biomass
Mammals	340	12.6	85.6	160	4.9	61.5
Dipodomys ordii	59	2.2	21.7	44	1.4	23.7
Microtus montanus	89	3.3	22.6	56	1.7	20.8
Perognathus parvus	84	3.1	8.4	39	1.2	5.7
Peromyscus maniculatus	84	3.1	9.6	14	0.4	2.3
Thomomys talpoides	23	0.9	23.1	6	0.2	8.8
Mus musculus	1	<0.1	<0.1	1	<0.1	<0.1
Birds						
Unidentified passerine	1	<0.1	<0.1	1	<0.1	<0.1
Amphibians						
Scaphiopus intermontanus	6	<0.1	0.1	2	<0.1	0.1
Arachnids	520	19.4	4.2	480	14.8	5.8
Scorpionidae	244	9.1	2.4	251	7.8	3.6
Solpugidae	276	10.3	1.8	229	7.1	2.2
Insects	1824	67.8	9.6	2595	80.1	32.3
Gryacrididae	491	18.2	6.6	1451	44.8	28.4
Acrididae	78	2.9	0.3	209	6.5	1.3
Cicadidae	10	0.4	<0.1	—	—	—
Carabidae	69	2.6	<0.1	22	0.7	<0.1
Silphidae	156	5.8	0.3	84	2.6	0.2
Scarabaeidae	267	9.9	0.5	222	6.9	0.6
Tenebrionidae	125	4.6	0.5	15	0.5	0.1
Formicidae	21	0.8	<0.1	33	1.0	<0.1
Unid. Hymenoptera	48	1.8	<0.1	7	0.2	<0.1
Unid. Coleoptera	559	20.8	1.1	552	17.0	1.6
Total	2691			3238		

Table 2. Availability (N/100 trap days) and utilization of major prey species on the INEL, 1976 and 1977.

Species	1976		1977		% Biomass in diet	
	Spring	Fall	Spring	Fall	1976	1977
Peromyscus maniculatus	64	87	56	26	3.0	0.3
Perognathus parvus	4	9	6	1	3.7	1.4
Dipodomys ordi	17	33	25	16	1.9	1.6
				Total	8.6	3.3

crickets on the INEL during this period, but their biomass in the diet increased from 6.6% in 1976 to 28.4% in 1977. This food source served to buffer the effects of a reduction in rodent density in 1977. Jerusalem crickets were an important dietary component of this nesting population in an earlier study (Gleason and Craig 1977), as well as that of other nesting populations (Thomsen 1971, Green 1983). We suggest that the density of Jerusalem crickets as well as that of rodents should be monitored in future investigations of numerical and functional responses of burrowing owl populations in the western United States.

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