Winter diet of burrowing owls in the Llano La Soledad, Galeana, Nuevo Leon, Mexico

Jose I Gonzalez Rojas Corresp., Equal first author, [1], **Miguel Angel Cruz Nieto** [2], **Antonio Guzmán Velasco** [1], **Irene Ruvalcaba-Ortega** [1], **Alina Olalla-Kerstupp** [1], **Gabriel Ruiz Ayma** Equal first author, [1]

[1] Universidad Autónoma de Nuevo León, Facultad de Ciencias Biologicas, San Nicolas de los Garza, Nuevo Leon, México

[2] Organización Vida Silvestre A.C., San Pedro Garza García, Nuevo León, México.

Corresponding Author: Jose I Gonzalez Rojas
Email address: jose.gonzalezr@uanl.mx

We determined dietary niche breadth of Burrowing Owl (*Athene cunicularia* Molina, 1782) in Llano La Soledad, Galeana, Nuevo Leon in northern Mexico, considering prey type, frequency of occurrence, and biomass. We compared data from three winters (2002-2003, 2003-2004, 2004-2005) by analyzing 358 pellets and identifying 821 prey items. Vertebrates accounted for 87% of consumed biomass of which 74% represented mammals. Most of the mammal biomass consumed was comprised of Cricetid rodents (58%). Ninety percent of prey items were invertebrates, most of which were insects (84%); beetles were the most common insects found in pellets (55%). Niche breadth based on frequency of occurrence and biomass confirmed the burrowing owl as a generalist species with mean values per year ranging between 0.68 and 0.82. There was a significant association between both relative biomass of rodent species and invertebrate families in the winters. This association was driven mainly by changes in composition and frequency of these types of prey during the second winter, which was likely caused by high annual rainfall. The second season also showed a significantly narrower niche (0.68 vs. 0.82) and the smallest overlap (<47% *vs.* 88%) among the three winters.

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José I. González Rojas[1]*, Miguel A. Cruz Nieto[2], Antonio Guzmán Velasco[1], Irene Ruvalcaba-Ortega[1], Alina Olalla Kerstupp[1], Gabriel Ruiz-Ayma[1].

[1] Universidad Autónoma de Nuevo León (UANL), Facultad de Ciencias Biológicas, Laboratorio de Biología de la Conservación y Desarrollo Sustentable. Nuevo León, México.

[2] Organización Vida Silvestre A.C. San Pedro Garza García, Nuevo León, México.

*Corresponding Author:

José I. González Rojas

Ave. Universidad s/n. Cd. Universitaria, 66455, San Nicolas de los Garza, Nuevo Leon, Mexico

Email address: jose.gonzalezr@uanl.mx

Abstract

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caused by high annual rainfall. The second season also showed a significantly narrower niche (0.68 vs. 0.82) and the smallest overlap (<47% *vs.* 88%) among the three winters.

Key words: biomass, burrowing owl, grassland, niche breadth, winter diet.

INTRODUCTION

The Burrowing Owl (*Athene cunicularia* Molina 1782) is distributed in North America; it is migratory, and a great number of individuals spend part of their yearly life cycle in the three countries some portion of the year (*Howell & Webb 1995*). This bird is a predator of great importance because it can maintain the populations of its pray in stable numbers (*Coulombe 1971*). It is considered an opportunistic feeder regarding its feeding habits (*Rodriguez-Estrella 1997*). The Burrowing Owl has diurnal activity and fossorial habits (*Coulombe 1971*). It lives in open areas like grasslands, deserts, and disturbed areas (*Coulombe 1971; Butts, 1976; Ruiz-Ayma 2019*). Its habitat with discontinuous vegetation and low bushes allows the Burrowing Owl to increase its visibility to hunt, watch against predators, and to keep watch over its burrow (*Coulombe 1971; Howell & Webb 1995*). It is strictly related to Black-tailed prairie dog (*Cynomys ludovicianus*) and Mexican prairie dog (*C. mexicanus*) colonies in Mexico, using their burrows for protection against predators and to from nests (*Coulombe 1971*; *Butts 1976*; *Coulombe 1971*; *Butts, 1976*; *Ruiz-Ayma 2019*).

The Burrowing Owl has shown a significant negative population trend in the United States for almost 50 years (-0.91%/yr.; 1966-2015; *Sauer et al*., 2017). In Canada, this decline is especially steep (-6.42%/yr.; 1966-2015; *Sauer et al*., 2017), where it is listed as an endangered species (Committee on the Status of Endangered Wildlife in Canada [*COSEWIC*] 2006). The Burrowing Owl is considered a National Bird of Conservation Concern (U.S. Fish and Wildlife Service [*USFWS]* 2008), whereas in Mexico it is protected under the “Special Protection” category

(Secretaria de Medio Ambiente y Recursos Naturales [*SEMARNAT*] 2010). The current population status of the Burrowing Owl is a result of multiple threats such as habitat fragmentation, decreased prey availability, increased predation, inclement weather, vehicle strikes, environmental contaminants, and the loss of burrows (*Rodriguez-Estrella 2006*, *Enríquez and Vázquez-Pérez 2017*). Prey availability, in particular, is one of the most important natural limiting factors in populations during the winter (*Newton 1998; McDonald et al., 2004*).

Most winter diet studies of the Burrowing Owl have been conducted in Texas, Nevada, and California, in the United States as well as in other countries in both North and South America (*Littles et al., 2007; Nabte et al., 2008*; *De Tommaso et al., 2009*; *Andrade et al., 2010)*. In most studies, Burrowing Owl diet consists mainly of invertebrates, small mammals, and reptiles *(Plumpton & Lutz 1993; De Tommaso et al., 2009*; *Andre 2009*; *Williford et al., 2009*). Invertebrates are consumed most frequently (*Poulin 2003*) but mammals account for most of the percent biomass (*Andrade et al., 2004*; *Littles et al., 2007*; *Nabte et al., 2008*; *De Tomasso et al., 2009*; *Andrade et al., 2010*; *Carevic et al., 2013*).

However, the frequency of occurrence of insect orders is highly variable, both temporally and spatially. Consumption of Beetles (Coleoptera) and crickets (Gryllidae) ranged from 20% to 80% percent occurrence in pellets. On the other hand, mammal species, which include North American Deer-Mice (*Peromyscus maniculatus*), Silky Pocket Mice (*Perognathus flavus*) and Merriam's Kangaroo Rats (*Dipodomys merriami*), are reported to be as high as 98% percent occurrence in pellets (*Ross & Smith 1970; Coulombe 1971; Butts 1976; Tyler 1983; Barrows 1989; Mills 2016*). Data from British Columbia, Canada, indicated that 56% of their diet is insects, such as earwigs and beetles (*Morgan et al., 1993*). The only study of winter diet from Mexico comes from central Mexico in the state of Guanajuato, where 78% of prey items were invertebrates (*Valdez-Gómez 2003*). Biomass data was more evenly distributed among Orthoptera (26.8%), Lepidoptera (20.6%) and rodents (20.9%; *Valdez-Gómez et al., 2009*). Diet in the breeding has also been analyzed in the states of Durango and Nuevo León, where insects were the most abundant prey items (67-84%); mammals represented 50% of the biomass (*Rodríguez-Estrella 1997; Ruiz-Aymá 2019*).

Variation in diet has been associated with prey availability, suggesting that small mammals are selected over invertebrates when their densities are sufficiently high (*Silva et al., 1995*). A change in prey composition has also been associated with rainfall, with more grasshoppers and some rodents (e.g., *Perognathus sp.*, *Onychomys leucogaster)* consumed during dry years and birds during wet years (*Conrey 2010*). The quantity and pattern of precipitation in arid and semi-arid environments can also influence the quality of the habitat and the abundance of prey (*Ernest et al., 2000*; *Reed et al., 2007*; *Thibaultet al., 2010*). It is well established that, in general, an increase in precipitation leads to an increase in coverage and diversity of small mammals (*Ernest et al. 2000*; *Thibault et al., 2010*).

Information on the winter diet of Burrowing Owls in Mexico is limited, and temporal variation has not been examined. Thus, our objective was to determine the diet composition and dietary niche breadth of Burrowing Owls during three winters (2002-2003, 2003-2004, 2004-2005) in northern Mexico (Llano La Soledad, in the southern Chihuahuan Desert). Our hypotheses are (1) that in years with high rainfall, diet composition will be different than in drier years, and (2) that differences in rainfall will also affect dietary niche breadth.

STUDY AREA AND METHODS

Site Description

Llano la Soledad is a plain habitat located in the northeastern Mexican state of Nuevo Leon, municipality of Galeana, within the Grassland Priority Conservation Area “El Tokio” (*CEC & TNC 2005, Pool & Panjabi 2011*). This area is a part of the Chihuahuan Desert ecoregion (25° 9’ 8.87” N, 101° 6’ 8.00” W and 24° 18’ 54.12”N, 100° 23’ 41.48” W; Fig. 1). It is a State Natural Protected Area (*Diario Oficial de la Federación 2002*) internationally known for its importance for shorebird conservation (*WHSRN, 2004*). It is also part of an important bird area "Pradera de Tokio" (AICA-NE-36; *Del Coro & Márquez 2000*) that harbors vulnerable bird species both endemic and migratory. The Llano La Soledad also contains the largest colony of the Mexican Prairie Dog (*Cynomys mexicanus)* (*Treviño & Grant 1998*), and therefore represents the most extensive and continuous habitat in terms of burrow and food availability for Burrowing Owls in northeastern Mexico (*Ruiz-Ayma et al., 2016*). The area is dominated by open grasslands with 80% bare ground and 20% plant cover (3% of grass and 17% forbs and shrubs) (*Cruz-Nieto 2006*). The semi-arid climate features temperatures ranging from 6 to 25 °C with an annual average of 16 °C (*CONAGUA, 2019*).

Pellet Collection and Analyses

We collected pellets at active burrows located along 20 random transects of 1 Km x 20 meters were selected at random and each one measured 1 km long by 200 meters wide, representing an area of 400 Ha sampled coverage (5% of the Natural Protected Area). We traveled the transects daily from the first week of October through the first week of March over three wintering seasons (2002-2003, 2003-2004 and 2004-2005) in order to collect population density data, however we collected the pellets every other day.

We analyzed and quantified the remains of each pellet according to the methods of *Ruiz-Ayma* (2019). The remains were separated in items; the most represented structures used to identify each group were: elytron, heads, tarsi, mouth parts, quelas, stingers (invertebrate arthropods); bones, teeth, scales, and feathers (birds, reptiles and mammals). We calculated the frequency of occurrence (FRO) of the sampled prey items and Index of relative importance (IRI) (*Pinkas et al., 1971*).

We identified mammals according to *Anderson* (*1972*) and *Roest* (*1991*), herpetofauna following *Smith & Taylor* (*1950)* and *Smith & Smith* (*1993*), birds following *Howell & Webb* (*2004*) and *Dunn* (*2006*), and invertebrates according to *Borror et al.*, (*1989*). All vertebrate prey items that could not be identified to the species level were included in the unidentified category.

We estimated biomass (Bs) multiplying weight for the frequency of occurrence (FRO) of each type of prey. For mammals we used the median of the weight for each species to avoid overestimation (*Holt & Childs* 1991). Medians were obtained from data given for Mexico by *Ceballos & Oliva* (*2005*). For reptiles, birds and mammals, we used specimens from the Herpetology, Ornithology and Mastozoology collections at the Universidad Autonoma de Nuevo Leon/Facultad de Ciencias Biologicas; for insects, data reported by *Olalla* (*2014*); and for spider, median weights were obtained from live specimens of the Arachnology collection at the Facultad de Ciencias Biologicas/Universidad Autonoma de Nuevo Leon. All protocols were performed according to the ethical guidelines adopted by the ethic committee of the Facultad de Ciencias Biologicas of the Universidad Autonoma de Nuevo Leon. However in order to comply with the Mexican regulations we have a permit (SGPA/DGVS/01588/10), granted by the Secretaria del Medio Ambiente y Recursos Naturales/Subsecretaria de Gestion para la Proteccion Ambiental/Direccion General de Vida Silvestre. (SGPA/DGVS/01588/10), granted by the Secretaria del Medio Ambiente y Recursos Naturales/Subsecretaria de Gestion para la Proteccion Ambiental/Direccion General de Vida Silvestre.

Statistical Analyses

We estimated niche breadth and their 95% confidence intervals (CI) for each winter using Smith's (FT) measure (*Smith 1982*), and their overlap using Horn's index (1966) with Ecological Methodology 7.2 (*Krebs 2011*) software. We considered niche breadth estimates with non-overlapping 95% confidence intervals as statistically different.

To test for an association ($\alpha = 0.05$) of prey frequency and biomass among taxonomic levels and years we used χ^2 contingency tests (*Zar 1998*). We also calculated and interpreted Cramér's phi coefficient (ϕc) as a measure of the effect size of the association (*Cohen 1988*) in annual rainfall for the years 2002-2004 (Meteorological station in La Carbonera; 19032; *CONAGUA 2019*). Average annual precipitation is 427mm (*INEGI 2005*). These analyses were conducted using PAST 3.14 (*Hammer et al.,* 2001).

RESULTS

We counted a total of 34 Burrowing Owls during the three winters with an average of 11 per winter and we collected and analyzed 358 pellets. We were able to identify 821 prey items from 26 taxa. The prey ítems belonged to 7 Orders and 17 Families of invertebrates, 6 Genera of small mammals, 2 Genera of reptiles, and 1 avian Genus. Vertebrates represented 10% and invertebrates 90% of total prey items consumed during the three winters, whereas these proportions were the opposite for biomass, with vertebrates comprising 84% and invertebrates 16% of biomass consumed. Rodents, cricetid in particular comprised 7% of all prey items eaten, but 82% of the biomass. Insects, primarily from the Orders Coleoptera (IRI=41%; 54%) and Orthoptera (IRI=10%; 26%), represented 84% of consumed items but contributed only to 12% of the biomass (Table 1).

Niche breadth measures were wide, indicating a generalist species, with consistent overall estimates for both frequency (FT= 0.77; 95%CI=0.74-0.80) and biomass (FT=0.74; 95%CI=0.70-0.77). However, the niche breadth based on biomass was significantly minor for the winter of 2003-04 (Fig. 2). This also coincided with above average (395 mm; 1956-2014) annual precipitation of 505 mm during 2003, compared with drier years: 288 mm (2002) and 304 mm (2004).

There was a highly significant and small correlation between winters and prey items for invertebrate Classes (χ^2=23.13, *df*=2, *p*<0.0001, ϕ_c =0.18) and Orders (χ^2=47.14, *df*=8, *p*<0.0001, ϕ_c =0.18), and a moderate correlation for Families (χ^2=215.2, *df*=32, p<0.0001, ϕ_c =0.38). There were weak to strong associations between biomass and year at every taxonomic level. Year associations with vertebrate taxonomic levels were primarily caused by a greater consumption of mammal (rodents) biomass, particularly, Spotted Ground Squirrel (*Xerospermophilus spilosoma*) and Mexican Woodrats (*Neotoma mexicana*). During the second (wet) year, Merriam´s Kangaroo Rat (*Dipodomys merriami*) consumption decreased during the same period (Table 1). Changes in prey composition and relative biomass during the second winter were also evident from niche overlap indices, which show the smallest values when compared to the first and third winter (0.45 and 0.47), and greater frequency of occurrence, ranging from 0.78 to 0.87. Birds on the contrary, were very stable among years with a relative biomass between 11 and 13% (Table 1).

DISCUSSION

The Burrowig Owl is characterized by its twilight habits and the method for capturing them varied according to prey and time of capture. Our findings provide additional evidence that the burrowing owl is a generalist and opportunistic predator. Invertebrates (mainly arthropods) were the most common and abundant food items, corroborating previous studies that have shown that overwintering Burrowing Owls feed mainly on arthropods and small mammals (*Ross & Smith 1970; Coulombe 1971; Butts 1976; Tyler 1983; York et al., 200; Valdez- Gómez 2003; Littles et al., 2007; Hall et al., 2009*). Invertebrates represented 90% of prey items consumed, which is similar to results from other studies (*Littles et al., 2007; Caveric et al., 2013; Cavalli et al., 2014*) as they report values ranging from 93% to 98%, but higher than the 78% reported by *Valdez- Gómez* for Mexico (*2003*).Insects represented 84% FRO of in the diet, which was very similar among the winters, varying between 83 and 87%, which is greater than the 63% reported in México (*Valdez- Gómez 2003*) and less than the 91% reported in southern Texas (*Littles et al., 2007*).

Beetles were the most-frequently consumed insects overall with 55%, and a maximum variation of 10% between years. Beetles have not been commonly observed as prey in North America, having only been observed during the breeding (39%-54%; e.g. *Haug 1985; Green et al., 1993; Floate et al., 2008*). They appear to be more prevalent and more prevailing in South America (e.g. *Andrade et al., 2010; Cavalli et al., 2013*). In most North American studies, crickets (Gryllidae) were the most frequently ingested insects (*York et al., 2002; Valdez- Gómez 2003; Littles et al., 2007; Hall et al., 2009*). Carabid beetles were the most frequently consumed (25%) in our study, while other authors report Gryllidae (crickets; *Valdez- Gómez 2003*; *Littles et al., 2007*). *Jonas et al.*, (*2002*) observed a positive correlation between native vegetation and beetles, whose consumption by Burrowing Owls in our study was likely related to the high proportion of native vegetation in Llano La Soledad. Beetles have an affinity for native vegetation (*Crisp et al., 1998; Jonas et al., 2002; Littles et al., 2007*), whereas crickets are common in disturbed areas (*Jonas et al., 2002*) in North America, especially in grazed and overgrazed pastures, abandoned pastures (*Jonas et al., 2002*), abandoned crop fields, lawns, old fields, and other grassy areas (*Cade & Otte 2000; Moulton et al., 2005*), as well as in tilled and plowed fields (*Carmona 1998*); however, these types of fields were not common in our study area, the closest being about located approximately 10 km away. Conversely, in South America, although beetles have been found to be highly consumed and preferred by the Burrowing Owl, their relative abundance was higher in agricultural areas than in vegetated sand-dunes (*Andrade et al., 2010*; *Cavalli et al., 2013*; *Cadena-Ortiz et al., 2016*). These authors suggested that beetles may also have been common in the owls' diet because they require little effort to capture, particularly when they are abundant near burrows. *Littles et al.,* (*2007*) reported that beetles were the second most consumed item (32%) of all prey items on a barrier island, where vast expanses of the native vegetation occur in comparison to agricultural and grassland. The second-most frequently consumed prey items in our study were grasshoppers (22%), while *Valdez- Gómez* (2003) reported this same group (15%) and *Littles et al., 2007*, mentioned Lepidoptera (13%). Our data showed variation in relative frequency of consumption among arthropod groups, with the greatest frequency of occurrence of spiders during the first season (<10%); and a decrease in the presence insects (Scarabeidae, Tenebrionidae and Gryllidae) between winters (Table 1). The wide variety of insect prey consumed in the diet of Llano de la Soledad, N.L., reaffirms the behavior of opportunistic hunters, in other words, it feeds on what is available in a natural habitat. (*Jaksic & Marti 1981*; *Jaksic 1988*; *Green et al., 1993*; *Haug et al., 1993*; *Littles 2007*). Vertebrates represented 10% FRO of the Burrowing Owls, which was less than the 21% recorded in Guanajuato, Mexico (*Valdez- Gómez 2003*), and greater than the 2% recorded in southern Texas (*Littles et al., 2007*). However, rodents were consistent as the most frequent vertebrate with 74%, in comparison with 70% reported by *Littles et al.*, (*2007*) and 86% by

Valdez- Gómez (*2003*). We found that the Silky Pocket mice was the most common rodent prey (19%), followed by the Western Harvest Mouse (15%), the Deer Mice and Merriam's Kangaroo Rats (14% each). In contrast, the most commonly found rodents in Guanajuato were (39%) and Silky Pocket Mice (35%; *Valdez- Gómez 2003*); while in Texas the most common were Northern Pigmy (23%) and Fulvous Harvest Mice (19%; *Littles et al., 2007*). All of these rodent species are distributed in U. S. and Mexico, mostly within arid areas of both countries, and their variation as the most consumed prey per region is consistent with the capacity of the Burrowing Owl to use what is likely most available in each region. According to IRI (Pinkas et al. 1971), the main food component was invertebrates (IRI = 98%; 90%) Insects (IRI = 97%: 96%) with the highest Coleoptera consumption (IRI = 41%; 54%) and Orthoptera (IRI = 10%; 26%). Now, there are either large prey that are eaten infrequently or predominate in the samples because they are slowly digested such as vertebrates (IRI = 1.7%; 10%) and Arachnida (IRI = 0.44%; 2%), as mentioned by *Hart. et al.* (2002) (Table 1).

Even though vertebrates only represent 10% of total prey items, they accounted for 87% of the total biomass consumed, which is similar to other authors' findings (*Littles et al., 2007; Nabte et al., 2008*; *Carevic et al., 2013*). Mammal biomass of 74% and varying between 62 and 82% among years, which is higher than what has been reported for Texas (52%) (*Littles et al., 2007*) and Mexico (25%; *Valdéz-Gómez et al., 2009*), but within the 25 to 95% reported in Argentina and Chile (*Andrade et al., 2004; Nabte et al., 2008; De Tomasso et al., 2009; Andrade et al., 2010; Carevic et al., 2013*). Cricetid rodents comprised 58% of the biomass, which falls within the range of 37 to 95% found in other studies (*Littles et al., 2007; Nabte et al., 2008; Andrade et al., 2010*).

As previously stated, within vertebrates, changes in rodent species biomass during the second winter drove the main differences in niche breadth and prey composition among years. These differences coincide with a high annual rainfall that may have resulted in irruptive population events (*Greenville et al., 2012*), or caused changes in rodent species' population densities, which would affect their availability and their selection as prey by the Burrowing Owl (*Silva et al., 1995*; *Thibault et al., 2010*; *Ernest et al. 2000*). Although this was not measured, temporal variation in populations of all prey taxa in our study have been associated with rainfall, more strongly for the species we found changed the most, such as Merriam's Kangaroo Rat, Silky Pocket Mice, Spotted Ground Squirrel and Western Harvest Mouse (*Whitford 1976; Brown & Zeng 1989; Brown & Ernest 2002*).

Temporal studies that include prey availability in disturbed and undisturbed areas of the southern Chihuahuan Desert would clarify the dynamics of prey use and preference for this vulnerable owl species. Examining the effects of the variation in vertebrate biomass consumption on survival of Burrowing Owls during wet and dry years would also be informative, especially considering climate change scenarios. Another relevant aspect of the temporal framework for diet studies is their relationship with pesticides and indirect exposure to contaminated prey, which is likely, although with limited evidence at the moment (*Haug & Oliphant 1987; James et al., 1990*).

Finally, it is also important to highlight that Llano La Soledad grasslands are key to maintaining healthy populations of the Burrowing Owl and other species (*Aquila chrysaetos, Numenius americanus, Charadrius montanus and Spizella wortheni*). The conservation and management of this population depends on the depth of our knowledge of the Natural History of this species, including the key components is its foraging ecology.

Conclusions

These results represent the first systematic effort for the winter diet of Burrowing owl in prairie dog colonies in northeastern Mexico. Furthermore, these results provide new information on the Burrowing Owl's winter prey consumption. The southern Chihuahuan Desert where the study was conducted is considered to contain the largest expanse of Mexican prairie dog colonies harboring winter populations of Burrowing Owl, as well as other birds with conservation status in North America.

Acknowledgements

We are grateful to the Universidad Autonoma de Nuevo Leon through the support program for Scientific and Technological Research (PAICyT).

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Figure 1

Location of State Natural Protected Area Llano La Soledad, Galeana, N.L., Mexico. .

Location of State Natural Protected Area Llano La Soledad, Galeana, N.L., Mexico.

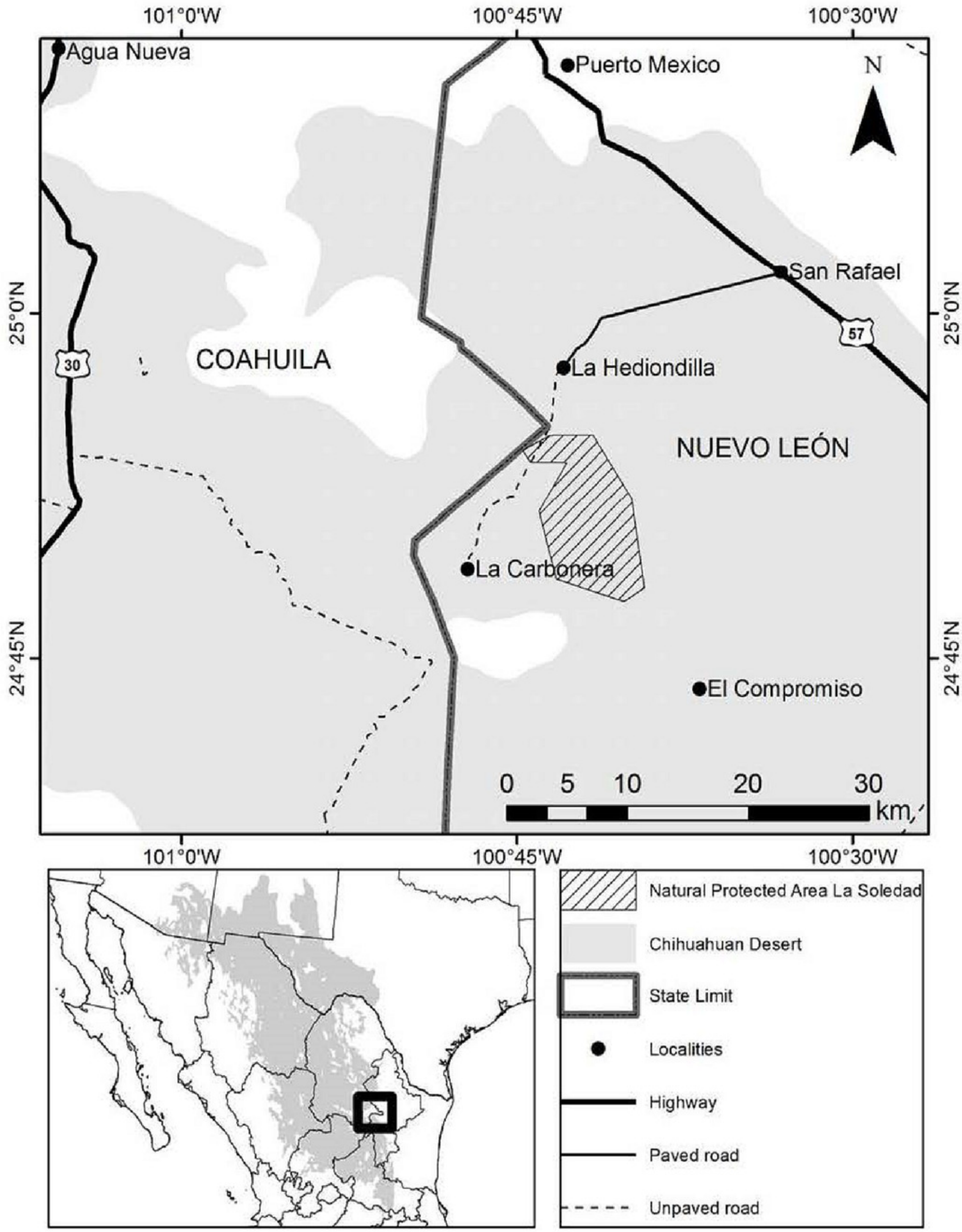
101°0'W
100°45'W
100°30'W
Agua Nueva
Puerto Mexico
N
San Rafael
25°0'N
25°0'N
57
30
COAHUILA
La Hediondilla
NUEVO LEÓN
La Carbonera
24°45'N
24°45'N
El Compromiso
0 5 10 20 30
km
101°0'W
100°45'W
100°30'W
Natural Protected Area La Soledad
Chihuahuan Desert
State Limit
Localities
Highway
Paved road
Unpaved road

Figure 2

Dietary niche breadth estimate (*Smith 1982*) and 95%CI of Burrowing owl (*Athene cunicularia*) during three winter seasons (2002-2005) based on biomass.

Dietary niche breadth estimate (*Smith 1982*) and 95%CI of Burrowing owl (*Athene cunicularia*) during three winter seasons (2002-2005) based on biomass.

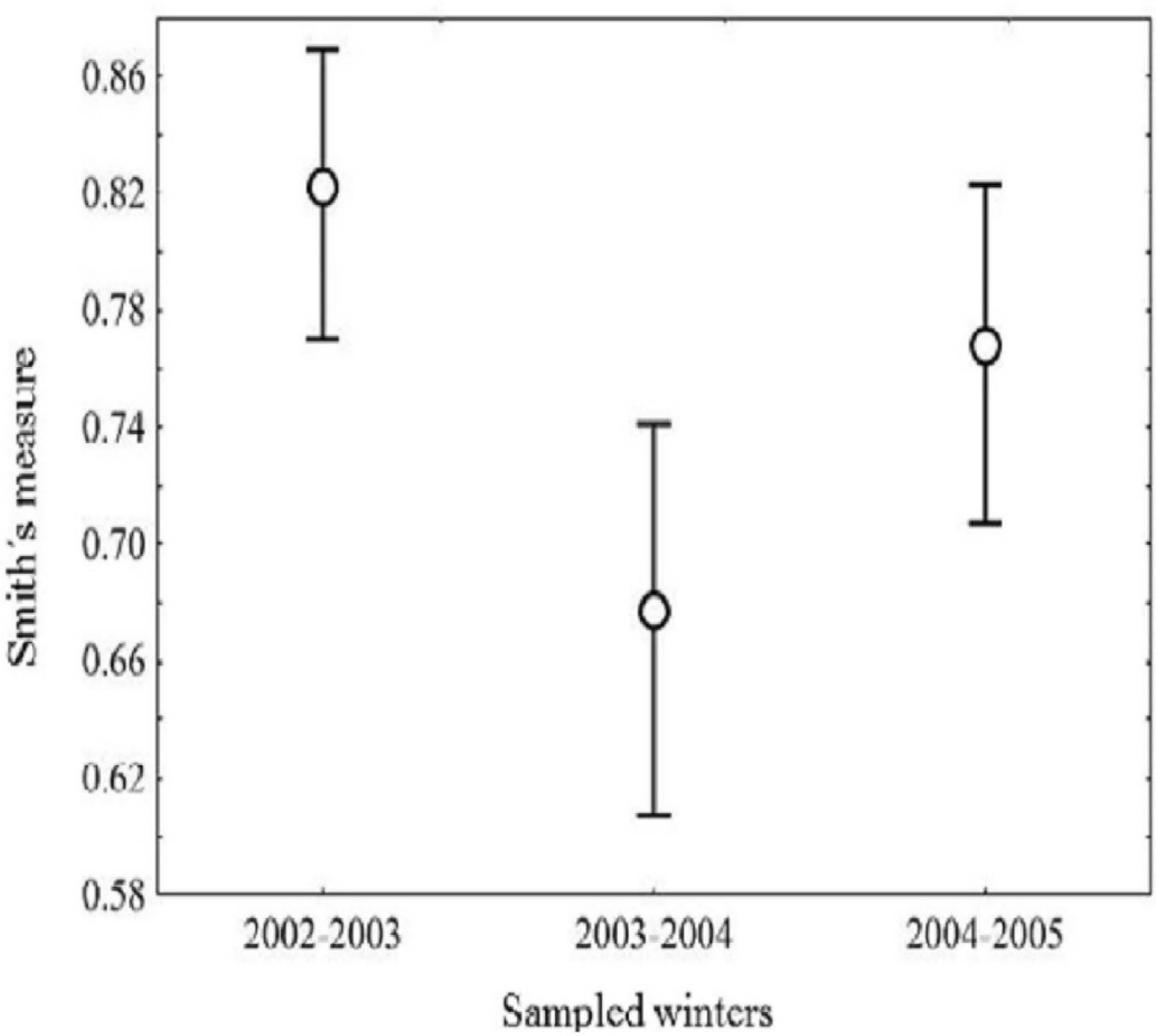

Table 1(on next page)

Analysis of the winter diet of the Burrowing owl in Llano La Soledad, Galeana, N.L., Mexico.

Analysis of the winter diet of the Burrowing owl in Llano La Soledad, Galeana, N.L., Mexico.

Prey Items	2002-2003 (N=125)				2003-2004 (N=116)				2004-2005 (N=117)				Total (N=358)			
	P	RFO	V	IRI	P	RFO	V	IRI	P	FRO	V	IRI	P	FRO	V	IRI
Vertebrates																
Mammalia	16	5.63	62.97	2.02	17	6.83	93.64	4.12	26	9	77	3.82	59	7.17	82.8	1.67
Rodentia																
Cricetidae																
Deer Mouse (*Peromyscus maniculatus*)	2	0.70	14.10	0.05	3	1.20	7.64	0.07	3	1.04	14	0.07	8	0.97	10.7	0.03
Western Harvest Mouse (*Reithrodontomys megalotis*)	2	0.70	2.35	0.01	1	0.40	1.19	0.005	8	2.77	18	0.30	11	1.34	6.9	0.04
Mexican Woodrat (*Neotoma mexicana*)	-	-	-	-	2	0.80	45.74	0.21	-	-	-	-	2	0.24	24.1	0.01
Heteromyidae																
Merriam's Kangaroo Rat (*Dipodomys merriami*)	3	1.06	39.94	0.21	1	0.40	4.81	0.01	4	1.38	37	0.23	8	0.97	20.3	0.05
Sliky Pocket Mouse (*Perognathus flavus*)	1	0.35	2.35	0.01	3	1.20	2.55	0.04	5	1.73	8	0.09	9	1.09	4.0	0.02
Scuridae																
Spotted Ground Squirrel (*Spermophilus spilosoma*)	-	-	-	-	2	0.80	31.70	0.15	-	-	-	-	2	0.24	16.7	0.01
Rodent unidentified	8	2.82	-	-	5	2.01	-	-	6	2.08	-	-	19	2.31	-	-
Aves	4	1.41	3.76	0.05	11	4.42	-	-	6		-	-	21	2.55	0.7	0.09
Passeriformes																
Emberizidae																
Black-throated Sparrow (*Amphispiza bilineata*)	1	0.35	3.76	0.01	-	-	-	-	-		-	-	1	0.12	0.07	0.09
Birs unidentified	3	1.06	-	-	11	4.42	-	-	6	2.08	-	-	20	2.43	-	-
Reptilia	1	0.35	2.38	0.01	2	0.80	4	0.003	-	-	-	-	3	0.36	0.07	0.002
Squamata																
Phrynosomatidae																

Lesser Earless Lizard (*Holbrookia maculata*)	1	0.35	2.38	0.01					-	-	-	-	1	0.12	0.05	0.0003
Teiidae																
Little Striped Whiptails (*Aspidoscelis inornata*)	-	-	-		1	0.40	0.42	0.003	-	-	-	-	1	0.12	0.02	0.0002
Reptiles unidentified	-	-	-		1	0.40	-	-	-	-	-	-	1	0.12	-	-
Invertebrates																
Arthropoda																
Insecta	236	83.10	19.39	96.26	206	82.73	5.39	95.29	251	86.86	17.10	96.02	693	84.20	11.7	97.79
Coleoptera (Beetles)	152	53.52	6.23	38.42	152	61.04	2.38	51.35	147	50.57	6.23	32.14	451	54.80	4.2	41.10
Elateridae	-	-	-	-	2	0.80	0.02	0.01	6	2.08	0.12	0.05	8	0.97	0.04	0.01
Carabidea	71	25	2.22	8.30	65	26.10	0.74	9.35	71	24.57	1.52	7.35	207	25.15	1.2	8.63
Scarabaeidae	48	16.90	1.50	3.80	45	18.07	0.51	4.45	4	1.38	0.09	0.02	97	11.79	0.6	1.90
Curculionidae	19	6.69	1.19	0.61	17	6.83	0.38	0.65	17	5.88	0.73	0.43	53	6.44	0.6	0.57
Cerambycidae	14	4.43	1.32	0.34	7	2.81	0.24	0.11	21	7.27	1.35	0.67	42	5.10	0.8	0.36
Passalidae	-	-	-	-	16	6.43	0.49	0.58	6	2.08	0.35	0.05	22	2.87	0.4	0.10
Buprestidae	-	-	-	-	-	-	-	-	2	0.69	0.22	0.01	2	0.24	0.1	0.001
Tenebrionidae	-	-	-	-	-	-	-	-	20	6.92	1.85	0.62	20	2.43	0.5	0.08
Orthoptera (Grasshoppers, crickets and bush-crickets)	72	25.35	12.65	9.73	49	19.68	3.01	5.58	101	34.95	10.85	16.12	222	26.97	7	10.18
Acrididae	69	24.30	12.32	8.96	43	17.27	2.78	4.31	69	23.88	8.44	7.62	181	21.99	6.2	6.78
Gryllidae	3	1.06	0.33	0.02	6	2.41	0.24	0.08	32	11.07	2.40	1.57	41	4.98	0.9	0.34
Hymenoptera (Ants, bees and wasps)	2	0.7	0.11	0.01	5	2.01	0.005	0.05	2	0.69	0.001	0.01	9	1.09	0.02	0.02
Vespidae	2	0.7	0.11	0.01	-	-			-	-	-	-	2	0.24	0.02	0.001
Formicidae	-	-	-	-	5	2.01	0.05		2	0.69	0.001	0.01	7	0.55	0.001	0.1
Dermaptera (Earwigs)	10	3.52	0.39	0.17	-	-	-	-	1	0.35	0.03	0.001	11	1.34	0.5	0.03
Forficulidae	10	3.52	2.51	0.20	-	-	-	-	1	0.35	0.17	0.002	11	1.34	0.5	0.03
Arachnida	27	9.51	11.54	1.66	12	4.82	0.55	0.33	6	2.08	5.81	0.10	45	5.47	4.1	0.44
Araneae (Spiders)	23	8.10	10.89	1.24	4	1.61	0.08	0.04	3	1.04	3.42	0.03	30	3.65	3.1	0.20
Theraphosidae	6	2.11	9.98	0.15	-	-	-	-	3	1.04	3.42	0.03	9	1.09	2.9	0.02

Araneidae	17	5.99	0.91	0.49	4	1.61	1	0.03	-	-	-	-	21	2.55	0.2	0.09
Solfugae	4	1.41	0.65	0.03	8	3.21	0.47	0.15	1	0.35	0.11	0.002	13	1.58	0.4	0.03
Eremobatidae	4	1.41	0.65	0.03	8	3.21	0.47	0.15	1	0.35	0.11	0.002	13	1.58	0.4	0.03
Uropygi (Whipscorpions or vinegaroons)	-	-	-	-	-	-	-	-	2	0.69	2.28	0.01	2	0.24	0.6	0.001
Thelyphonidae	-	-	-	-	-	-	-	-	2	0.69	1.23	0.01	2	0.24	0.3	0.001

P=Presence

RFO= Relative frequency of Occurrence of the item in relation to the total of items found.

V= Volume consumed by the Burrowing owl

IRI= Index of relative importance