THERYA, Abril, 2011
Vol.2(1): 67-76
DOI: 10.12933/therya-11-33

Diet of the endangered Tehuantepec jackrabbit, *Lepus flavigularis*

Consuelo Lorenzo[1], Arturo Carrillo-Reyes[1], Maricela Gómez-Sánchez[2], Azucena Velázquez[1] and Eduardo Espinoza[3]

Abstract

The diet of the endangered Tehuantepec jackrabbit, *Lepus flavigularis*, was studied during the dry and rainy seasons in 2007, in a lowland area in the southeastern Oaxaca, Mexico. Faecal pellets of *L. flavigularis* were collected at regular intervals from four selected sites. Microhistological techniques were employed to analyze the pellets. The epidermal fragments were identified by comparison with a reference collection of plant species. Grass species occurred in high percentage in all samples of faecal pellets (66.7%). The diet of the Tehuantepec jackrabbit is rich in species (18 species in total) and is similar in number and proportion of species consumed during dry and rainy season. This study provides the first results on the Tehuantepec jackrabbit diet. The strategies of conservation of the Tehuantepec jackrabbit and their habitat must consider activities such as the control of fires and a suitable grassland management that does not reduce plant diversity.

Key words: food habits, faecal analysis, microhistological techniques, *Lepus flavigularis*.

Resumen

Se estudio la dieta de la liebre de Tehuantepec, especie en peligro de extinción, durante las temporadas húmeda y seca en 2007 en una planicie costera al sureste de Oaxaca, México. Se colectaron excretas de *L. flavigularis* a intervalos regulares en cuatro sitios de colecta. Para analizar el contenido de las excretas se utilizó la técnica microhistológica. Los fragmentos epidérmicos fueron identificados comparándolos con una colección de referencia de las especies vegetales del área. Los más altos porcentajes de especies vegetales estuvieron representados por pastos (66.7%). La dieta de la liebre de Tehuantepec es rica en especies (18) y es similar entre las dos temporadas monitoreadas. Esta investigación provee los primeros resultados existentes sobre la dieta de la liebre de Tehuantepec. Las estrategias de conservación de la liebre y su hábitat deben incluir actividades como el control de incendios y el manejo sustentable de los pastizales.

Palabras clave: hábitos alimenticios, análisis fecal, técnica microhistológica, *Lepus flavigularis*.

[1]*Departamento de Ecología y Sistemática Terrestres, El Colegio de la Frontera Sur. Carretera Panamericana y Periférico Sur s/n. San Cristóbal de Las Casas, Chiapas. México CP 29290, E-mail: clorenzoecosur.mx (CL), acarrillo@oikos.org.mx, (ACR),azules64@hotmail.com (AV)*
[2]*Facultad de Ciencias Naturales. Universidad Autónoma de Querétaro. Avenida de Las Ciencias s/n, Juriquilla,Quetaro, Querétaro. México CP 76230, E-mail: gomezs@uaq.mx (MGS)*
[3]*Universidad de Ciencias y Artes de Chiapas. Libramiento Norte Poniente s/n, Tuxtla Gutiérrez, Chiapas, México, CP 29039, E-mail: emedinilla@yahoo.com.mx,* Correspondent: Consuelo Lorenzo, clorenzo@ecosur.mx

Introduction

Jackrabbits are an important ecological group whose dietary activity affects plant populations and which are the main prey of many predators in its habitat. Its presence helps maintain the stability of the structure and function of the communities in which it lives (Cervantes 1993).

In spite of the ecological importance of jackrabbits, the dietary requirements of many species in Mexico are unknown, including the Tehuantepec jackrabbit (*Lepus flavigularis*), an endemic species whose distribution is limited to four small populations around of the Laguna Inferior and Laguna Superior in the Isthmus of Tehuantepec, in the southeastern part of Oaxaca (Cervantes and Yépez 1995; Cervantes et al. 1999; Lorenzo et al. 2000, 2001). This species is catalogued as endangered according to Mexican Official Norm "NOM-059-ECOL-2010" (SEMARNAT 2010) and the International Union for Conservation Nature (IUCN 2009). It is considered the species of jackrabbit with the greatest risk of extinction on the American continent (Flux and Angermann 1990), due to the habitat fragmentation and excessive hunting.

Feeding ecology studies are useful to understand topics such as niche dimensions, potential competition, the effects the species exerts on natural and cultivated ecosystems, population dynamics, and how nutritional aspects may affect population size and abundance (Korschgen 1980; De Blase and Martin 1982; Arnaud 1993). We need to understand feeding behavior to understand how species will respond to current habitat changes (Paupério and Alves 2008). However, at present information is lacking about diet variation of the Tehuantepec jackrabbit. Most of the studies on this species have focused mainly on their variability and genetic differentiation, habitat characterization and population density (Vargas 2000; Sántiz 2005; Cruz 2005; Gómez 2005; Farías et al. 2006; Rico et al. 2008).

In this work, we aim to measure the diet composition of one population of the Tehuantepec jackrabbit, and to investigate how its diet changes throughout a year in a lowland area of pasturelands in southeastern Oaxaca by microhistological pellets analysis. The results of this investigation can be useful in the development of future management plans and the conservation of this species.

Methods

Study area

The study area is located in the southeastern section of the state of Oaxaca, in the vicinity of Montecillo Santa Cruz (16º22´2.7´´ N, 94º35´13.0´´ W). It is on the north border of the Laguna Inferior, Oaxaca, and an altitude of 24 m above sea level (Lorenzo et al. 2000). The climate is tropical, with a mean annual temperature of 27.6 ºC, mean annual rainfall of 932.2 mm (García 1988; Millán 1993), and marked seasons. The rainy season extends from May to October with an intra-estival dry period in August, and the dry season extends from November to April, being most severe during late winter and early spring (Zizumbo and Colunga 1982). The study area is characterized by grassland with a forb stratum, and is composed of grasses (*Aristida* sp. and *Trisetum* sp.), forbs, (no grasses), some "morro" trees (*Crescentia alata*) and shrubs (Sántiz 2005).

Recently agriculture has become an important activity for the generation of basic

food products in Montecillo Santa Cruz (Vargas 2001). Extensive cattle grazing is carried out in the whole zone of grasslands, and prescribed burnings are common in order to promote grass regeneration (Lorenzo et al. 2008). The area occupied by the Tehuantepec jackrabbit in Montecillo Santa Cruz is 3,316 ha (33.16 km^2), and jackrabbit densities are low (4.32 ± 1.10 individuals/km^2) in this population, giving an estimated population size of 189 individuals (Lorenzo et al. 2008).

Faecal pellet collections

Collections of fresh jackrabbit faecal pellets were made in four sites where the jackrabbits has been observed in previous studies (Fig. 1). Samples were collected both during the dry (January) and rainy season (August and November) of 2007. All site was separated at least by a distance of 200 m from each other. The faecal pellets of the Tehuantepec jackrabbit are easily distinguishable from faecal pellets of the eastern cottontail rabbit, *Sylvilagus floridanus*, because they are larger and spherical. In each site, a minimum of 20 pellets were collected, placed in paper bags using of gloves, and transported at room temperature for further analysis. A botanical reference collection was created using the floral catalogue of Montecillo Santa Cruz developed by Sántiz (2005).

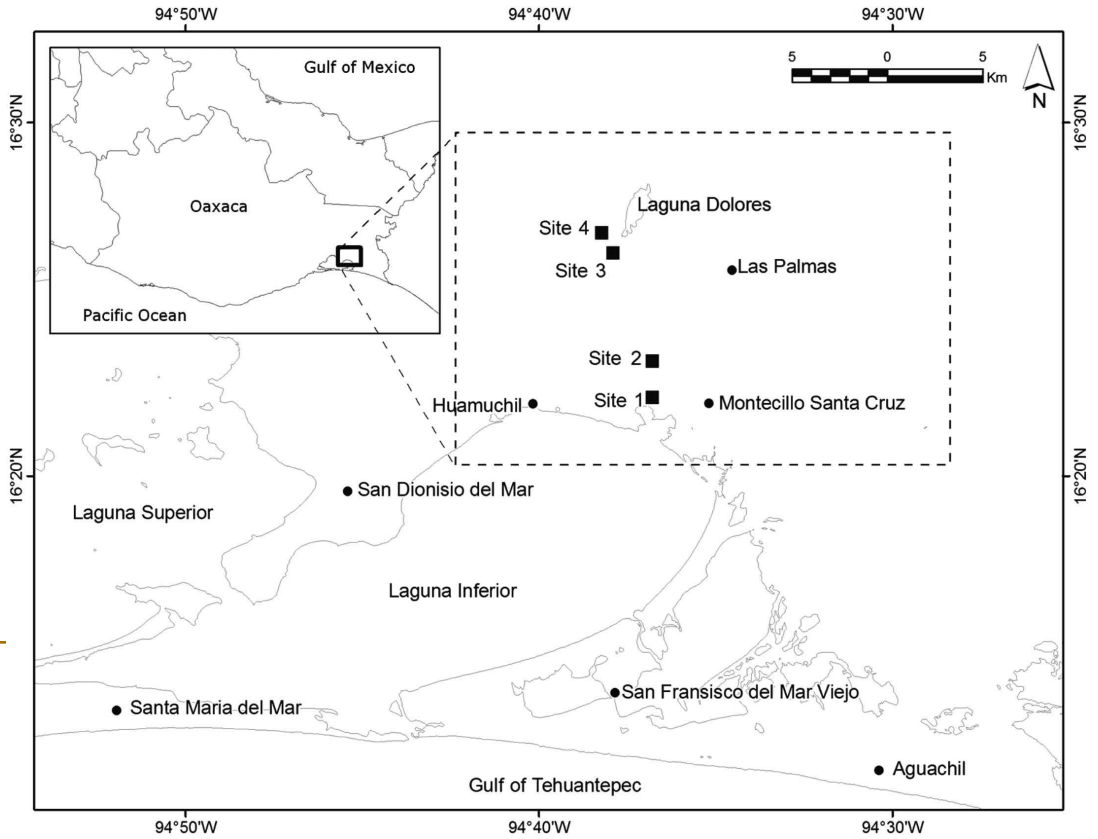

Figure 1. Study area and collected sites in Montecillo Santa Cruz, Oaxaca.

Reference slide collection and faecal pellet analysis

A reference collection of microscope slides of plants was prepared using methods described in Peña and Habib (1980). All the samples of pellets were dried in an oven to 60ºC, and a sub-sample was processed using methods from Peña and Habib (1980). Each slide was prepared with the same amount of plants sample. Micro-photographs

were taken of all slides.

On each slide 20 fields were examined with an optical microscope (objective 10X and 40X); five separate slides were examined for each sample, with a total of 800 fields observed for the entire year of the study. Slides were examined using randomly generated co-ordinates that did not overlap. Where possible, all fragments were identified to species using the reference collection. In most cases it was not possible to identify all species. Unidentified fragments were recorded as unidentified monocotyledon or dicotyledon. We recorded plant species and the accumulated frequency of plant fragments for each species.

The botanical composition (as a percentage) was obtained using the conventional formula of relative abundance (Ramírez 1999), %CB = (density *i* / + density) x 10, where density *i* = density of fragments observed for i species using Fracker and Brischle (1944) table.

Family	Vegetal species	Dry season	Rainy season
Poaceae	*Eragrostis pilosa* (L.) Beauv.	1.67 (0.92)	0.32 (0.18)
	Eragrostis intermedia Hitchc.	0.05 (0.04)	0.05 (0.04)
	Bouteloua dactyloides (Nut.) Columbus *	17.61 (3.06)	16.35 (3.05)
	Bouteloua repens (Kunth) Scribn. & Merr.	6.70 (1.03)	7.12 (1.55)
	Cathestecum brevifolium Swallen *	13.13 (3.26)	9.40 (1.56)
	Muhlenbergia microsperma (DC) Kunth *	12.03 (2.78)	11.97 (3.07)
	Digitaria ciliaris (Retz.) Koeler *	19.06 (2.15)	31.03 (1.43)
	Dactyloctenium aegyptium (L.) Willd.	0.29 (0.25)	0.73 (0.38)
	Urochloa meziana (Hitchc.) Morrone & Zuloaga	2.27 (1.28)	6.07 (0.49)
	Paspalum notatum Flügge	0.27 (0.10)	5.35 (1.60)
	UG 1*	16.51 (3.25)	8.19 (0.20)
	UG 2	2.33 (1.26)	0.28 (0.07)
Cyperaceae	*Cyperus semiochraceus* Boeck.	3.94 (3.41)	2.14 (0.42)
Unidentified	UF 1	2.54 (0.28)	0.73 (0.38)
Malvaceae	*Bastardiastrum gracile* (Hochr.) D. Bates	1.25 (0.52)	0.09 (0.07)
Convulvolaceae	*Ipomea wrightii* A. Gray	0.08 (0.06)	0.00 (0.00)
Fabaceae	*Chamaecrista flexuosa* (L.) Greene	0.20 (0.07)	0.19 (0.09)
	Mimosa tenuiflora (Willd.) Poir.	0.05 (0.04)	0.00 (0.00)

UG = Unidentified grass.
UF = Unidentified forbs.
* Higher consumption values.

Table 1. Botanical composition (%) of the diet of the Tehuantepec jackrabbit by season during 2007, using microhistological techniques to analyze the pellets, and comparing the epidermal fragments with a reference collection of plant species. Standard errors are given in parentheses.

The species richness of each season was measured by the number of species found. The diversity of the diet was calculated using the index of diversity of Simpson (1949), which ranges from 1-D = 0 (no diversity) to 1-D = 1 (high diversity); and the Shannon-Wiener Index (S; Krebs 1989). Both indexes consider in their calculation the number of species found on the slides and their density. The significant differences ($P < 0.05$) in the diet of the jackrabbit between dry and rainy season were determined by qualitative analyses using the Sorensen's coefficient, and a quantitative analyses by the Morisita-Horn coefficient (Márquez *et al.* 2005).

Results

We recorded 52 plant species in the study area, 36 species were dicotyledons (69.2%) and 16 monocotyledons (30.8%). These species were used to create a reference plant collection.

We identified 18 plant species in the faecal pellets of the Tehuantepec jackrabbit in the dry season, and 16 in the rainy season, 12 of which were in the Poaceae family (Table 1). Higher percentages of consumption were found in the grasses: *Cathestecum brevifolium*, an unidentified grass (UG1), *Bouteloua dactyloides, Muhlenbergia microsperma and Digitaria ciliaris* during two seasons of the year.

The Shannon-Wiener index of diet diversity was 2.19 in the dry and 2.07 in the rainy season. Likewise the Simpson Diversity index was 0.86 in the dry and 0.83 in the rainy season. The two seasons were similar (Sorensen's coefficient = 0.94; Morisita Horn index = 0.91, $P < 0.05$).

Discussion

Our results show that the species richness (18) found in the faecal pellets of the Tehuantepec jackrabbit is similar to that of other species of jackrabbits. Tangney et al. (1995) recorded in grasslands of western Ireland an average of 11 species consumed by *L. timidus scoticus*. Dingerkus and Montgomery (2001) reported in grasslands with little agriculture in Northern Ireland that *L. t. hibernicus* consumed 26 species in spring and between 22 and 20 species in summer. However, Paupério and Alves (2008) reported in a mountain ecosystem that *L. granatensis* consumed 32 species. This information suggests that jackrabbits consume a wide variety of species of plants independently of the type of habitat in which they are distributed.

The Tehuantepec jackrabbit consumes mainly grasses, since 66.7% of the plants found in faecal pellets corresponded to plant species in the Poaceae family. This agrees with others studies. Both *L. europaeus* and *L. californicus* include in their diets mainly grass species, principally in the rainy season, when the growth of grasses is fast and competition for this resource by cattle does not exist (Fogden 1979). The diet of the Iberian hare, *L. granatensis* is mainly composed of grasses, varying between a minimum of 49.7% (June) and a maximum of 88.5% (December). The diet of *L. europaeus* indicates as well that grasses are the main component (Wray 1992), with a fluctuation of relative frequencies between 59.3 and 89.0%. In the Irish hare, *L. timidus hibernicus*, grasses are a very important group in the diet, with values generally higher than 50% (Tangney et al. 1995; Dingerkus and Montgomery 2001).

The percentage in the consumption of non-grass plants was low for *L. flavigularis*, representing 33.3% of the total of consumed species. López–Cortés et al. (2007) reported that *L. europaeus* includes in its diet eight exclusively herbaceous species, whereas 75% of their diet is composed of grass species. Rao et al. (2003) report that the diet of the mountain hare (*Lepus timidus*) during summer was dominated by grasses, seeds and in smaller proportion by *Pinus sylvestris* and *Betula pubsescens*. during winter, its diet it was dominated by *Calluna vulgaris*.

The diet of the Tehuantepec jackrabbit is highly diverse, and it does not depend on a single plant species. Nevertheless, it is important to consider that if the jackrabbit

subsists on a diet rich in species (Dingerkus and Montgomery 2001), it can be affected by the predominant practices of cattle ranching in which introduced grasses of a single or a few species are dominant. The transformation of diverse grasslands (with many species of grasses) to monospecific grasslands for cattle ranching (grass of a single species or a few species) could reduce the survival of the Tehuantepec jackrabbit. This is confirmed by results such as those of Tapper and Barnes (1986) and Dingerkus (1997) which report that *L. t. hibernicus* prefers a varied diet, and this is the reason it avoids zones of intensive cattle ranching or industrial agriculture. This permits us to speculate that the ongoing habitat modifications which diminish the plant diversity particularly of potential food plants will negatively affect the jackrabbit.

The diet of the Tehuantepec jackrabbit is highly diverse in both seasons (the diversity is higher when 1-D = 1). This high diversity can be interpreted as a high homogeneity in the relative abundance of the dietary components. The number of species utilized, as well as the uniformity in the proportion of the diet of each one of the species indicates a constant diet in both seasons (Carrillo-Reyes 2001).

The analysis of diversity of both seasons showed that the diet during the dry season was slightly diverse (S = 2.19, 1-D = 0.86) with respect to the rainy season (S = 2.06, 1-D = 0.83). Nevertheless, the analysis of similarity by the indices of Morisita modified by Horn and Sorensen (qualitative and quantitative methods, respectively), showed that the diet of *L. flavigularis* was highly similar between the two seasons of the year (Morisita index 0.91, Sorensen coefficient 0.94). This demonstrates that the diet of the Tehuantepec jackrabbit during both seasons is similar in number of species and proportion consumed of each one of these species. This is also independent of the season of the year or the effect of fires in the habitat (Lorenzo et al. 2008). During the dry season the Tehuantepec jackrabbit uses the same species in spite of the shortage of grasses caused by the grassland fires and the reduced rainfall at that time. In a similar way, Dingerkus and Montgomery (2001) found that *L. t. hibernicus* preferred certain grass species independently of the habitat or the season.

On the other hand, results of previous studies on other *Lepus* species differ from what we found for the Tehuantepec jackrabbit. Wolff (1978) reported for *L. americanus,* indices of similarity and diversity of seasonal diet with significant differences, since the snowshoe hare in Alaska consumed a greater variety of plant species during the spring than in the winter, because during the spring more species were available. Hoogland (1992) reported for *L. californicus* that its diet varies seasonally; during the dry season its feeding was based on forbs whereas during the rainy season its diet consisted of grasses, barks and shrubs. Flux and Angermann (1990) reported for *L. alleni* a consumption of forbs during the rainy season, and mezquite (*Prosopis*) and cactaceous species during the dry season. The diet of the mountain hare (*L. europaeus*) also varies throughout the year. Rao et al. (2003) mention that *L. timidus* was very selective during the winter, when few grasses, rushes, and sedges are available, due to the plant death of winter, and a different food selection when the grasses, sedges, and rushes were widely available in summer. In all these cases, like in the work of Rao et al. (2003), it is probable that food selection varies as a function of the death of vegetation during the winter, while the jackrabbits selected grasses, sedges, and rushes when they were widely available in summer (Flux 1970; Lason and Waterman 1988; Hulbert et al. 2001). Moreover, plant groups that are

more easily digestible and have few secondary compounds are also preferred (Bernays et al. 1989; Lason and Van Wieren 1999).

This it is the first investigation to determine the composition of the diet of the Tehuantepec jackrabbit. The information provided will assist in knowing the plant species that must be protected in the habitat to assure that the Tehuantepec jackrabbit obtains the food that it requires. Although apparently the wet season rains and the dry season fires do not affect the selection of the species that the jackrabbit consumes, it is important to be sure that the grass species that the jackrabbit prefers continue to exist in its small range in spite of those disturbances.

Our results show that Tehuantepec jackrabbit depends on a diversity of food species, and therefore it is necessary to conserve these grassland communities in order to conserve the jackrabbit. Strategies of conservation for the Tehuantepec jackrabbit and their habitat must include the control of dry season fires and sustainable grassland management that does not reduce plant diversity. We also suggest that additional studies are needed to measure the relative availability of plant resources in protected habitats, and to analyze food preferences in more detail.

Acknowledgements

We thank R. Gutiérrez, R. Gutiérrez Jr., J. Antonio, J. Antonio Jr., L. Gutiérrez, J. Bolaños, J. A. López, and the Municipalities of Montecillo Santa Cruz for their invaluable help during the fieldwork. Thanks to Families Gutiérrez-López, Gutiérrez-Vázquez and E. Antonio for housing our crew. C. Krebs, W. Z. Lidicker and an anonymous reviewer provided valuable comments on several drafts of the manuscript. This project was partially funded by Mexico's National Council of Science and Technology (CONACYT) - Chiapas State Government (project CHIS-2005-CO3-001).

References

Arnaud, G. 1993. Alimentación del coyote (*Canis latrans*) en Baja California Sur. Pp 1-464 in Avances en el estudio de los Mamíferos de México (Medellín, R. A., and G. Ceballos, eds.). Asociación Mexicana de Mastozoología, Centro de ecología, UNAM. Publicación Especial 1.

Bernays, E. A., G. C. Driver, and M. Bilgener. 1989. Herbivores and plant tannins. Advances in Ecological Research 19:263–302.

Carrillo-Reyes, A. 2001. Determinación de la dieta estacional de una población reintroducida de guajolote silvestre (*Meleagris gallopavo intermedia*) en Lampazos de Naranjo, Nuevo León. Tesis. Universidad Juárez del estado de Durango. Gómez Palacio, Durango.

Cervantes, F. A. 1993. *Lepus flavigularis*. Mammalian Species 423:1-3.

Cervantes, F. A., and L. Yépez. 1995. Species richness of mammals from the vicinity of Salina Cruz, coastal Oaxaca, Mexico. Anales del Instituto de Biología 1:113-122.

Cervantes, F. A., B. Villa Ramírez, C. Lorenzo, J. Vargas, J. L. Villaseñor, and J. López Blanco. 1999. Búsqueda de poblaciones supervivientes de la liebre endémica *Lepus flavigularis*. Informe final. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Cruz, B. 2005. Variación genética intrapoblacional de *Lepus flavigularis* (Lagomor-

pha: Leporidae) en Montecillo Santa Cruz, Oaxaca, México. Tesis. Universidad de Ciencias y Artes de Chiapas. Tuxtla Gutiérrez, Chiapas, México.

De Blase, A. F., and R. E. Martín. 1982. With keys to families of the world. A manual of Mammalogy 31:294-304.

Dingerkus, S. K. 1997. The distribution and ecology of the Irish hare *Lepus timidus hibernicus* in Northern Ireland. Tesis Queen's University Belfast.

Dingerkus, S. K., and W. I. Montgomery. 2001. The diet and landclass affinities of the Irish Hare *Lepus timidus hibernicus*. Journal of Zoology 253:233-240.

Farías, V., T. K. Fuller, F. A. Cervantes, and C. Lorenzo. 2006. Home range and social behavior of the endangered Tehuantepec jackrabbit (*Lepus flavigularis*) in Oaxaca, Mexico. Journal of Mammalogy 87:748–756.

Flux, J. E. C. 1970. Life history of the Mountain hare in north east Scotland. Journal of Zoology 161:75-123.

Flux, J. E. C. and R. Angermann. 1990. The hares and jackrabbits. Pp. 61-94 in Rabbits, hares and pikas. Status survey and Conservation Action Plan (Chapman J. A., and J. E. C. Flux, eds.). International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.

Fogden, M. P. L. 1979. The Impact of Lagomorphs and Rodents in the cattle rangelands of Northern Mexico. Centre for Overseas Pest Research, London.

Fracker, S. B., and J. A. Brischle. 1944. Measuring the local distribution of Ribes. Ecology 25:283-303.

García, E. 1988. Modificaciones al sistema de clasificación climática de Köpen (para adaptarlo a las condiciones de la República Mexicana). Instituto de Geografía, Universidad Nacional Autónoma de México (UAM). México, D. F.

Gómez, A. 2005. Variación genética intrapoblacional de la liebre del Istmo, *Lepus flavigularis* (Mammalia: Lagomorpha) en San Francisco del Mar Pueblo Viejo, Oaxaca, México. Tesis. Universidad de Ciencias y Artes de Chiapas. Tuxtla Gutiérrez, Chiapas, México.

Hoagland, D. B. 1992. Feeding Ecology of an Insular Population of the Black-tailed Jackrabbit (*Lepus californi*cus) in the Gulf of California. Southwestern Naturalist 37:280-286.

Hulbert, I. A. R., G. R. Iason, and R. W. Mayes. 2001. The flexibility of an intermediate feeder: dietary selection by mountain hares measured using faecal n-alkanes. Oecologia, 129:197-205.

IUCN. 2009. IUCN Red List of Threatened Species. Version 2009.1. (www.iucnredlist.org).Downloaded on 11 July 2010.

Korschgen, L. J. 1980. Procedures for Food- habits Analysis. Pp 113-119 in Wildlife Management Techniques (Giles, R. H., Jr., ed.). The Wildlife Society, Washington.

Krebs, C. J. 1989. Ecological Methodology. Harper and Row Publishers. New York.

Lason, G. R. and P. G. Waterman. 1988. Avoidance of plant phenolics by juvenile and reproducing female mountain hares in summer. Functional Ecology 2:433-440.

Lason, G.R. and S. E. Van Wieren. 1999. Digestive and ingestive adaptations of mammalian herbivores to low-quality forage. Pp 337-369 in Herbivores: between plants and predators (Olff, H., V. K. Brown, and R. H. Drent, eds.). Proceedings of the 38 Symposium of the British Ecological Society. Blackwell Scientific Publications,

Oxford.

López-Cortés, F., A. Cortés, E. Miranda and J. R. Rau. 2007. Dietas de *Abrothrix andinus, Phyllotis xanthopygus* (Rodentia) y *Lepus europaeus* (Lagomorpha) en un ambiente altoandino de Chile. Revista Chilena de Historia Natural 80:3-12.

Lorenzo, C., O. Retana, F. Cervantes, J. Vargas, and G. Portales. 2000. Status survey of the critically endangered *Lepus flavigularis*. Final Report. Chicago Zoological Society.

Lorenzo, C., F. A. Cervantes, J. Vargas and F. X. González. 2001. Conservation of the critically endangered *Lepus flavigularis*. Final Report. Lincoln Park Zoo Neotropic Fund. El Colegio de la Frontera Sur. San Cristóbal de las Casas, Chiapas. México.

Lorenzo, C., T. Rioja, A. Carrillo and F. Cervantes. 2008. Population fluctuations of *Lepus flavigularis* (Lagomorpha: Leporidae) at Tehuantepec Isthmus, Oaxaca, Mexico. Acta Zoológica Mexicana (nueva serie) 24:207-220.

Márquez, O. M., E. García, I. González-Rebeles, and L. A. Tarango. 2005. Composición de la dieta del guajolote silvestre (*Meleagris gallipavo mexicana*, Gould, 1856) reintroducido en tierra fría, Aguascalientes, México. Red de Revistas Científicas de América Latina y el Caribe, España y Portugal. 36: 395- 409.

Millán, S. 1993. Fiestas de los pueblos indígenas, la ceremonia perpetua. Ciclos festivos y organización ceremonial en el sur de Oaxaca. Instituto Nacional Indigenista. Secretaría de Desarrollo Social. México, Distrito Federal.

Paupério, J., and P. C. Alves. 2008. Diet of the Iberian hare (*Lepus granatensis*) in a mountain ecosystem. European Journal of Wildlife Resources 54:571-579.

Ramírez, R. G. 1999. Curso de actualización sobre técnicas de investigación en nutrición de rumiantes en pastoreo. Curso manejo de fauna silvestre en tierras de pastoreo. Instituto de Ecología A. C. SEMARNAP.

Rao, S. J., G. R. Iason, and R. W. Mayes. 2003. Estimating diet composition for mountain hares in newly established native woodland: development and application of plant-wax faecal markers. Canada. Journal of Zoology 81:1047-1056.

Rico, Y., C. Lorenzo, F. X. González- Cózatl, and E. Espinoza. 2008. Phylogeography and population structure of the endangered Tehuantepec jackrabbit *Lepus flavigularis*: implications for conservation. Conservation Genetics 9:1467–1477.

Peña, J. M. and R. Habib. 1980. La Técnica Microhistológica: Un método para determinar la Composición Botánica de la Dieta de Herbívoros. I.N.I.P.- S.A.R.H. Serie Técnico-Científica. 6:1-82.

Sántiz, E. C. 2005. Selección de hábitat y densidad de la liebre del Istmo *Lepus flavigularis* (Wagner 1844) en Oaxaca, México. Tesis. Instituto de Ecología. Xalapa, Veracruz, México.

SEMARNAT. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010. Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario Oficial de la Federación, 30 de diciembre del 2010. 153 p.

Simpson, E. H. 1949. Measurement of diversity. Nature 163:688.

Tangney, D., J. Fairley, and G. O'Donnell. 1995. Food of Irish hares *Lepus timidus* hibernicus in Western Connemara, Ireland. Acta Theriologica 40:403-413.

Tapper, S. C. and R. F. W. Barnes. 1986. Influence of farming practice on the ecology of

the brown hare *Lepus europeaus*. Journal of Applied Ecology 23:39-52.

Vargas, E. Z. F. 2001. Valoración de los vertebrados terrestres por huaves y zapotecas del Istmo de Tehuantepec, Oaxaca, México. Tesis. El Colegio de la Frontera Sur (ECOSUR), San Cristóbal de Las Casas, Chiapas, México.

Vargas, J. 2000. Distribución, abundancia y hábitat de la liebre endémica *Lepus flavigularis* (Mammalia: Lagomorpha). Tesis. Facultad de Ciencias. Universidad Nacional Autónoma de México.

Wolff, J. O. 1978. Food Habits of Snowshoe hares in interior Alaska. Journal of Wildlife Management 42:148-153.

Wray, S. 1992. The ecology and management of European hares (*Lepus europaeus*) in commercial coniferous forestry. Thesis. Department of Zoology. Faculty of Sciences. University of Bristol.

Zizumbo, V. D. and P. Colunga. 1982. Los Huaves. La apropiación de los recursos naturales. Universidad Autónoma de Chapingo, México.

Sometido: 5 febrero 2011
Revisado: 25 marzo 2011
Aceptado: 13 abril 2011
Editor asociado: William Z. Lidicker, Jr.