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HABITAT OF A VENEZUELAN LOWLAND RABBIT, *Sylvilagus varynaensis* (LAGOMORPHA: LEPORIDAE)

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ABSTRACT

An ecological study of the Venezuelan rabbit *Sylvilagus varynaensis*, was conducted in two recently disturbed areas known as Millano - Mamonal (08º 46´N and 69º 56'W) and Chorrosco Bajo (08º 05´N and 69º18´W), Barinas state. The following information was recorded from January to December 1989: 1. There was a diverse wildlife associated to the habitat of this rabbit. Birds are abundant and the wild fox (*Cerdocyon thous*) was one of the main rabbit´s predators in the area. *Proechimys* sp. (Rodentia) may be a potential competitor for some food resources. 2. The herbaceous layer was composed mainly of associations between *Malvastrum* and *Sida* spp. (Malvaceae) or "Escobillal"; *Cassia occidentalis-Bauhinia megalandra* (Cesalpiniaceae - Fabaceae) and *Hyptes suaveolens* (Labiatae) - *Sida* spp. or "Mastrantal-Escobillal". 3. Nearly 80 % of the observed and 74 % of the captured rabbits were recorded from the "Escobillal" association. The ecological characteristics of the herbaceous stratum (density, cover, sociability, and height) have a highly significant correlation with the number of rabbits. 4. Eighty-one males and 65 females were captured during 12 collecting periods in 1989. Adult male-female ratio was close to 1:1 and females were larger and heavier than males. August and September had the highest abundance of rabbits (N = 39), while from May to July only seven rabbits per month were recorded. Variations (F) of the body size values were more homogeneous in females (C = 0.002) than in males (C = 1.00). Average of condition index (KI) was relatively high in both sexes (7.62 and 7.68) and the monthly fluctuations were not significant. Helminthiasis (*Taenia* sp. and Nematoda) increased from May to September. These data are discussed as a function of the interactions between the population characteristics of the rabbit and the biological and physical components of its habitat.

Key Words: Lowland Rabbit. Savanna. Habitat. *Sylvilagus varynaensis*. Ecology. Parasites. Floristic Composition. Barinas. Venezuela.

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HÁBITAT DEL CONEJO VENEZOLANO, *Sylvilagus varynaensis* (LAGOMORPHA: LEPORIDAE)

RESUMEN

El presente trabajo se refiere al estudio ecológico de uno de los conejos de Venezuela, *Sylvilagus varynaensis*, realizado en dos áreas recientemente intervenidas identificadas como "Millano-Mamonal" (08º 46' N y 69º 56' O; 146 m) y "Chorrosco Bajo" (08º 05´ N y 69º 18' O; 80 m), Estado Barinas. En 12 períodos de capturas (1989), se obtuvo la información siguiente: 1. Una alta variedad de grupos de vertebrados terrestres resultó asociada al hábitat del conejo estudiado. Las aves constituyeron el taxón dominante y el zorro común (*Cerdocyum thous*) y un félido (*Felis weidii*) se registraron como dos de los principales depredadores en el àrea de estudio. *Proechimys* sp (Rodentia) fue un competidor potencial en algunas fuentes de alimentos. 2. La composición florística del estrato herbáceo estuvo representada por la asociación de especies de *Malvastrum*y *Sida* (Malvaceae) ó "Escobillal"; *Cassia occidentalis-Bauhinia megalandra* (Cesalpiniaceae-Fabaceae) y *Sida* spp-*Hyptis suaveolens* ó "Mastrantal-Escobillal". Cerca del 80% de los conejos observados (N=273) y el 74% de los conejos capturados (N=146) provenían de la asociación "Escobillal". Las características ecológicas del estrato herbáceo (densidad, cobertura, sociabilidad, altura) mostraron una alta y significativa correlación ($P < 0.005$) con el número de conejos observados y/o capturados. 4. Ochenta y un machos y 65 hembras fueron colectados en las áreas de estudio. La relación macho-hembra adultos (TC > 420 mm) fue cercana al 1: 1 esperado. Las hembras presentaron mayor peso y tamaño corporal ($P < 0.005$) que los machos. Agosto y Septiembre fueron los meses de mayor rendimiento (N =39 capturas), mientras que de Mayo a Julio se colectaron sólo siete conejos/mes. Las variaciones (F) de los valores del TC fueron más homogéneas en hembras ($C = 0.002$) que en machos ($C = 1.00$). El índice de condición (IK) promedio fue relativamente alto en los dos sexos (7.62 y 7.68, respectivamente) y sus fluctuaciones mensuales no fueron estadísticamente significativas (6.8 a 8.5). 5. El alto porcentaje de helmintiasis (*Taenia* sp y Nematoda) se registró entre Mayo y Septiembre. Estos datos son discutidos en función de las interacciones entre las características poblacionales estudiadas en *S. varynaensis* y los componentes biológicos (planta-animal) y físicoambientales del hábitat.

Palabras Clave : Conejo. Sabana. Hábitat. *Sylvilagus varynaensis*. Parásitos. Composición Florística. Ecología. Barinas. Venezuela.

INTRODUCTION

The prey-predator relationship has allowed the wild rabbits to be one of the most studied leporids in the temperate zone, from both the ecological and economical point of view. Their role as potential reservoir of some human viral diseases means that they are also a public health concern. Agriculture, intense grazing and the use of concentrated biocides reduce the habitat and population density of rabbit species, especially in the neotropics, where the biology of this animal group is less known.

Three subspecies of forest rabbits (*Sylvilagus brasiliensis* L.), and six subspecies of lowland rabbits (*S. floridanus* Allen) have been recorded in Venezuela (Hershkovitz, 1950; Durant, 1986). The biology of these rabbits remains unknown, with the exception of some studies on *S. f. continentis* (Ojeda and Keith, 1982; Ochoa, 1989; Durant and Pérez, 1989; 1995), and *S. b. meridensis*, the Venezuelan paramo rabbit (Durant, 1981).

This study is part of a project related to the ecology of the Venezuelan rabbits. This part covers the habitat of a recently described species, *Sylvilagus varynaensis* Durant and Guevara, collected in the states of Barinas, Portuguesa and Guárico. The purpose of this work is to complement the current ecological information about wild rabbits, which could be used in an appropriate management strategy for neotropical wildlife populations. Rabbit population densities have been reduced by uncontrolled hunting and deforestation practices, as in the case of the western Venezuelan

cottontail in the states of Zulia, Falcón, and Lara, and of *S. f. valenciae,* the Venezuelan northcentral plain rabbit. The elimination of habitats in the high mountains has reduced the density of *S. b. meridensis* from 4.8 animals/ha to 0.04 animals/ha in the last 15 years (Durant, 1986). Considering these factors, the objectives of this study were: to identify the main habitat characteristics of *S. varynaensis* in several areas of the state of Barinas, to study population patterns, and to establish a relationship between floristic composition and other environmental components of the habitat.

STUDY AREA

Captures of *Sylvilagus varynaensis* were carried out in areas recently disturbed by timber falling and agricultural activities in Obispos and Sosa counties, state of Barinas. These areas are situated between 26 and 29 km N of the Sabaneta - Ciudad de Nutrias road, known as Millano - Mamonal (08° 46´N and 69° 56´ W; 146 m) and Chorrosco Bajo (08° 05´N and 69° 18´W; 80 m), in tropical dry forest (Fig. 1), which is the most extensive (37.6 %) Venezuelan life zone (Ewel et al., 1976).

Climatological data for these areas was as follows during the study period: rainfall was less than 100 mm between November (PP = 94 mm) and March (PP = 38 mm). The first two months of the year had 7.43 mm and 18.3 mm of rain, respectively. May (254.4 mm), June (260.2 mm) and July (205.4 mm) were the rainy months, and the mean annual precipitation was 1624 mm (range: 1000 to 1800 mm). February and March (Fig. 2) were the warmest months (27.6 °C). Temperature dropped about 2 °C in July, August, and September (Fig 2). The mean annual temperature was 26.4 °C (range: 22 to 29°C). The lowest mean relative humidity occurred in March (63.6%) and the highest in June (84.3%). Plant diversity was low and the tree stratum was composed of *Guasuma ulmifolia* (Esterculiaceae), *Spondia lutea* (Anacardiaceae), *Cecropia* sp. (Cecropiaceae) and some scattered specimens of *Phycus glabrata* (Moraceae). The shrubby stratum was more diverse, and the herbaceous layer was dominated by dense formations of several species of *Sida* and *Malvastrum* (Malvaceae), *Mimosa* spp. (Mimosaceae), and native species of Poaceae and Cyperaceae. *Heliconia* spp. (Heliconiaceae) was found in the most humid sites. Physiographically, the study areas are part of an extense plain drained at the western side (Millano - Mamonal), and with flood problems at the eastern side (Chorrosco Bajo).

MATERIALS AND METHODS

Capture of *Sylvilagus varynaensis*. A monthly period of observations with binoculars and capture with shotgun were carried out during three to four consecutive nights from January to December, 1989. Each period started at 1700 - 1800 hrs and ended at 0100 - 0200 hrs. the following day. Between 10 to 15 km^2 of the study area was covered on foot or by vehicle, depending on the topography. The following data were taken for each rabbit captured: Date, locality, size (BS) and body weight (BW), hind foot length (HFL), ear (EL) and tail length (TL), and maximum body length (L), from the tip of the mouth to the median finger tip of the hind foot in a specimen completely extended. These data allow inter and intra-specific comparison in age class estimations (juveniles, < 400 mm; subadults, 401 to 420 mm; adults, > 420 mm as BS). Tey also allowed us to determine sexual dimorphism and to estimate the condition index (KI) from the formula BW/L^3, following Bittner and Chapman (1981). Parasites were recorded during dissection of the rabbits and no attemp was made to identified the worms beyond the Class Nematoda and the genus *Taenia* (Class Cestoda).

Once every three months, terrestrial vertebrates were trapped in the study areas using Sherman and National live traps to obtain information of the accompanying fauna in this habitat. The taxa were compared with those of the Biological Station of “Rancho Grande” (state Aragua, Venezuela) to show the level of vertebrate diversity (%) in the study areas.

Floristic composition was recorded using the Relevé Method (Benninghoff, 1966). Forty plots of 5 x 5 m were set up in each study area during the rainy and dry seasons to record density, plant cover, sociability, and height of each plant species with frequency > 0.2. Additional data on litter thickness (LT), percentage of uncovered soil surface (US), and distance to the nearest body of water (NBW) were also recorded. These data allowed the identification of relationships between the number of rabbits and the biological patterns of its habitat, following August (1983) and Durant and Pérez (1989). Data of precipitation, temperature and relative humidity during the last 10 years (1981 – 1990) were obtained from the regional office of the Ministerio del Ambiente, Barinas, Venezuela. These environmental factors could also have some effects on fluctuations about the numbers of rabbits in the areas.

Variance (F), Student “t” test, correlation analysis and other basic statistics, were used to establish the relationships between the patterns of rabbit populations and their habitat characteristics.

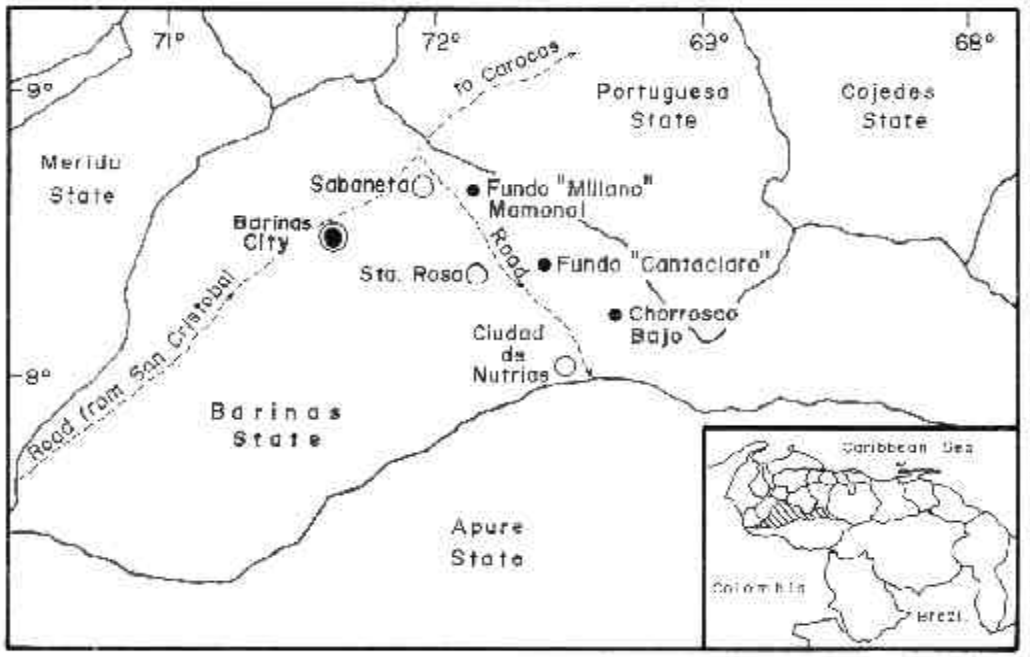

Fig. 1. Location of study areas (Millano-Mamonal, Cantaclaro y Chorrosco Bajo) along the road of Sabaneta and Ciudad de Nutrias towns. Barinas, Venezuela. 1989.

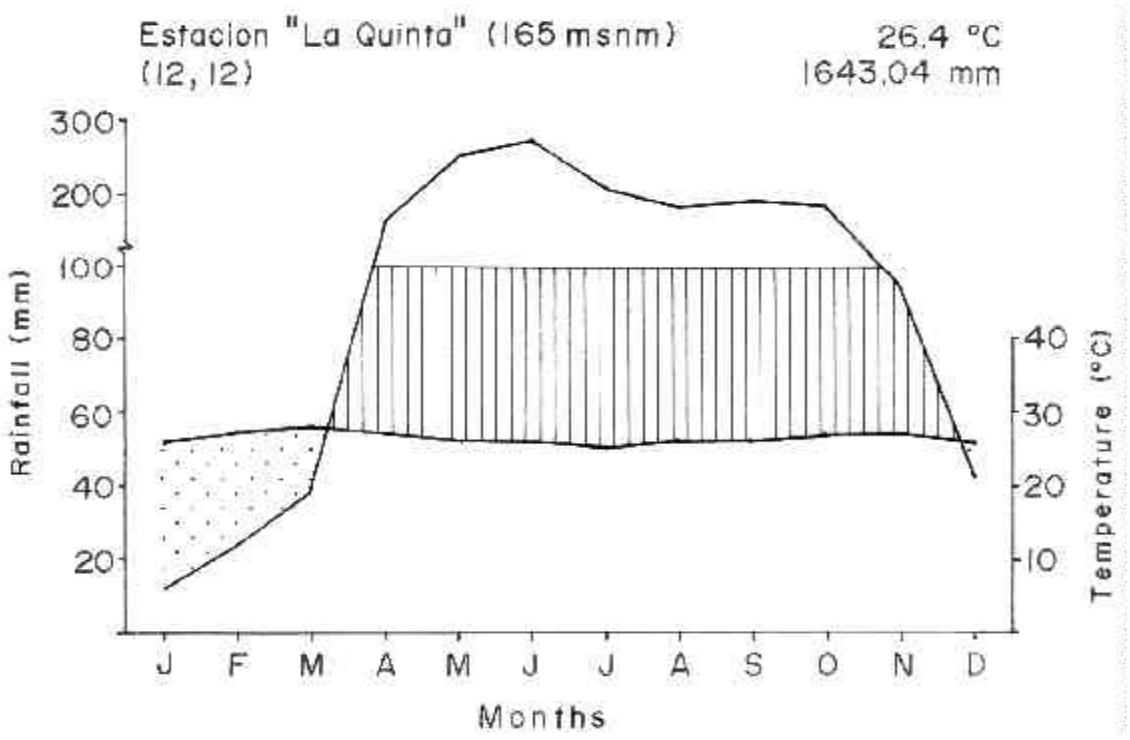

Fig. 2. Climadiagram of "Estación La Quinta", near the study areas. Precipitation and temperature data represent 10 years (1981-1990) average. Data from the regional office of the Ministerio del Ambiente. Barinas, Venezuela.

RESULTS

Population characteristics of *Sylvilagus varynaensis*. A total of 273 rabbits were observed, 53.5% of which were captured between January and December, 1989. Most body measurements recorded in 49 adult males and 50 adult females were significantly different ($P < 0.05$; student "t" test) from the closest rabbit species *S. brasiliensis* (Table 1), collected from similar habitats (Durant, 1986). Females were larger (BS = 436 ± 22.0 mm) and heavier (BW = 1742 ± 38.4 g), than males ($P < 0.01$; "t" test). The Cochran Test gave higher homogeneity for BW variations ($C = 0.02$) for females ($F = 9.33$; $P < 0.05$) than for males ($C = 1.00$), and a minor F value (6.75). Similar results were obtained for BS, L, and HFL (Table 2). The highest number of animals (52.4 %) was observed during the last five months of the year, coinciding with the end of the second rainy peak and the beginning of the dry season (Fig. 3). February, August, and September gave the highest yield (N=73) of animals captured, while from May to July the average was seven specimens/month (Fig. 3). Condition Index (KI) values (Table 3) were highest in April (8.1) and December (8.4) in both sexes, and lowest (6.8) in March for males. Correlation between KI and precipitation patterns was not statistically significant. Some rabbits were infected with larval and adult *Taenia* sp. and Nematoda (Table 3).

Birds (167 species) were the dominant vertebrate group in the habitat of *Sylvilagus varynaensis* with 15 orders and 45 families (Table 4). Ciconiforms (Herons), Anseriforms (Ducks), Falconiforms (Hawks, Eagles), and Strigiforms (Owls) were the most diverse taxa of this class. Some species of the last two orders are predators of wild rabbits. Fourteen species of amphibians and 20 of reptiles, mainly lizards and snakes, were also among the vertebrates recorded in the study areas. The omnivorous spiny rat (*Proechimys* sp) was the most common rodent captured in these areas.

Table 1. Adult body measurements of *S. varynaensis* (1) compared with those of *S. b. brasiliensis* (2). Numbers in parenthesis represent one standard deviation. $P < 0.005$

			Measurements				
Species	**Sex**	**N**	**BW**	**BS**	**HFL**	**EL**	**TL**
1	Males	49	1610 (58.0)	425 (16.0)	86 (3.7)	61 (2.4)	24 (4.0)
	Females	50	1742 (38.4)	436 (22.0)	85 (9.3)	61 (2.8)	24 (4.8)
2	Males	11	1010 (34.0)	378 (3.5)	76 (6.8)	50 (0.5)	26 (1.2)
	Females	10	1180 (31.0)	387 (3.3)	79 (0.8)	54 (1.1)	27 (1.3)

N: sample size. BW: body weight. BS: body size. HFL: hind foot length. EL: ear length. TL: tail length.

Table 2. Variance (F) and Homogeneinity Cochran Test (C) of *S. varynaensis* body measurements (Bm).

	Within Females			Within males			
Bm	**F**	**P**	**C**	**F**	**P**	**C**	**Signif.**
BW	9.33	.003	.02	6.72	.00	1.00	Heterog.
BS	6.72	.010	.00	2.04	.08	.00	Homog.
L	9.66	.002	.04	1.21	.31	.12	Heterog.
HFL	1.86	.180	.00	4.73	.00	.00	Homog.
EL	2.52	.120	.28	.21	.91	.25	Heterog.
TL	0.13	.590	.18	33.3	.00	.13	Heterog.

L: maximum body length. For others symbols, see Table 1.

Table 3. Condition index (KI) and parasitism (*Taenia* sp and Nematoda) recorded in *S. varynaensis* during 1989.

Rabbits/Month		J	F	M	A	M	J	J	A	S	O	N	D
Males	N	4	7	10	6	2	4	4	9	11	6	5	7
	KI	7.8	7.2	6.8	8.1	7.0	7.2	7.6	7.9	7.7	8.4	7.6	8.1
Females	N	6	10	5	4	3	4	4	8	11	5	5	9
	KI	7.7	7.7	7.1	8.4	7.0	7.3	7.6	7.4	8.2	7.8	7.4	8.5
R/*Taenia*		6/46	4/14	0/0	2/19	0/0	1/299	4/123	2/78	2/46	2/30	0/0	3/36
R/Nematoda		5/42	2/7	0/0	0/0	0/0	1/21	2/28	0/0	3/48	2/43	0/0	2/28

R/: number of rabbits with *Taenia* or Nematoda.

Table 4. Vertebrate fauna in the study areas (SA) compared with Venezuelan faunistic groups (VEN)*. Figures in parenthesis: percentage.

	Species		Families		Orders	
Faunistic groups	**SA**	**VEN**	**SA**	**VEN**	**SA**	**VEN**
MAMMALIA	36	304	15	44	8	12
	(11.8)	(100)	(34.1)	(100)	(66.7)	(100)
AVES	167	1312	45	81	16	20
	(12.7)	(100)	(55.6)	(100)	(80.0)	(100)
REPTILIA	20	274	7	13	3	3
	(7.3)	(100)	(53.8)	(100)	(100)	(100)
AMPHIBIA	12	303	4	22	1	3
	(14.0)	(100)	(18.2)	(100)	(33.3)	(100)

* Bisbal, 1991

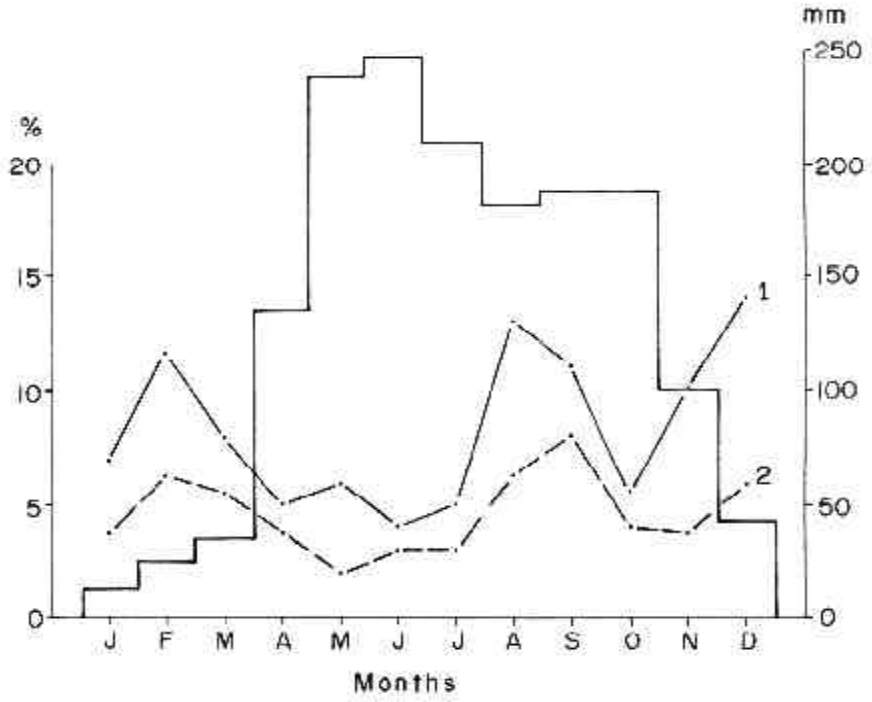

Fig. 3. Rabbits (*Sylvilagus varynaensis*) observed (1) and collected (2) in the study areas and their relationship with rainfall patterns (histograms). Barinas, Venezuela.

Table 5. Ecological characteristics of the vegetation in the study areas. The second figure in each item is the standard deviation.

Plant associations	Spp. Fam.	Dens. Nº/Surf	Cov. %	Soc. (r-5)	Height cm/m	LT (cm)	US %	NBW (m)
Escobillal 1	2.9	16.2	16.5	1.6	22.7	1.3	3.7	57.6
(E1)		14.2	16.6	0.8	10.4	0.9	1.4	6.0
Bruscal-Urapal	2.7	6.7	8.0	1.3	54.3	1.2	1.6	12.0
(BU)		9.1	5.1	0.6	34.6	0.4	2.3	7.1
Mastrantal-Escobillal	1.5	9.4	10.0	1.3	65.6	0.8	24.0	67.0
(ME)		12.0	8.0	0.5	34.7	0.3	0.3	15.0
Escobillal 2 (E2)	1.4	12.7	17.1	1.3	51.8	0.7	12.4	22.0
(E2)		11.0	11.8	0.7	38.0	0.2	8.8	5.0
Forest adjacent to E1								
Arboreal stratum	1.5	1.5	23.6	1.4	11.9	*—	—	—
		2.5	14.2	0.6	0.7			
Shrubby stratum	1.5	0.6	8.7	1.2	3.1	—	—	—
		0.3	7.5	0.1	0.8			
Herbaceous stratum	2.2	10.1	10.3	2.2	85.1	1.0	17.0	15.0
		12.6	6.6	4.1	47.3	0.1	3.1	11.0
Forest adjacent to BU								
Arboreal stratum	1.1	0.9	26.0	1.2	9.6	—	—	—
		0.7	14.2	0.3	1.1			
Shrubby stratum	1.3	1.2	8.6	1.2	4.2	—	—	—
		0.7	5.8	0.3	0.5			
Herbaceous stratum	1.7	9.7	103	1.3	56.1	1.0	17.0	15.0
		9.2	6.5	0.5	29.0	0.0	8.5	8.8
Forest adjacent to ME								
Arboreal stratum	1.0	1.4	28.7	1.0	10.2	—	—	—
		0.8	6.2	0.0	1.4			
Shrubby stratum	1.0	2.8	11.7	1.2	2.4	—	—	—
		2.6	0.3	0.6				
Herbaceous stratum	1.2	19.9	17.6	1.5	62.2	1.7	13.0	13.8
		20.0	17.2	0.5	39.7	0.6	6.0	4.4
Forest adjacent to E2								
Arboreal stratum	1.3	0.5	21.0	1.2	12.7	—	—	—
		0.6	8.4	0.2	3.3			
Shrubby stratum	1.4	1.3	6.6	1.0	4.5	—	—	—
		1.2	1.2	0.1	0.4			
Herbaceous stratum	1.8	5.0	3.6	1.2	68.9	1.4	18.3	76.0
		4.6	2.4	0.3	12.8	0.2	3.5	12.8

Data from floristic composition of the study areas. Spp/Fam.: number of species per Family. Nº/Surf.: nº of plants/ surface unit. Cov.: plant cover. Soc.: plant sociability. LT: litter thickness. US: uncovered soil surface. NBW: nearest body of water. *: not applied for arboreal and shrubby strata.

Table 6. *S. varynaensis* observed and captured in the plant associations of the study areas.

Plant associations (study areas)	Number of *S. varynaensis* Observed	%	Captured	%
Escobillal 1	138	50.5	62	42.5
Bruscal-Urapal	38	14.0	26	17.8
Mastrantal-Escobillal	15	5.5	12	8.2
Escobillal 2	82	30.0	46	31.5
Totals:	273	100.0	146	100.0

Data from Table 5.

Table 7. Relationship between the ecological characteristics of the vegetation recorded at the study areas (Dens., Cobert., Soc. and Height), and the number of rabbits (*S. varynaensis*) observed and captured.

Characteristics of the plant Associations	Rabbits observed r	t	P	Rabbits captured r	t	P
Density (N°/25 m²)	0.9	9.7	+++	0.88	8.7	+++
Plant cover (%)	0.82	6.5	+++	0.88	8.7	+++
Sociability (r to 5)	0.86	7.8	+++	0.83	6.8	+++
Plant height (cm)	-0.63	3.4	++	-0.95	14.6	+++

++: $P < 0.005$. +++: $P < 0.01$.

Floristic composition. Dominant vegetation was a low shrubby-herbaceous savanna composition, identified in this study as: 1. "Escobillal" association (E1, E2), composed by *Sida* spp. and *Malvastrum* spp. (Malvaceae), 22.7 ± 10.4 cm height (Table 5). 2. "Bruscal-Urapal" association (BU), formed by *Cassia occidentalis* (Cesalpiniaceae), and *Bauhinia megalandra* (Fabaceae), 54.3 ± 34.6 cm height. 3. "Mastrantal - Escobillal" association (ME), constituted by *Hyptis suaveolens* (Labiatae) and *Sida* spp., 65.5 ± 34.7 cm height (Table 5). Most rabbits were captured in these types of vegetation. Specimens captured in the adjacent forest were first observed in the nearby herbaceous strata. Eigthy-one percent of the animals observed, and 74 % of the captures were recorded in the "Escobillal" association (E1, E2). Twelve of the 146 rabbits (8 %) were captured in ME, and produced about 18 % of the yield (Table 6). The characteristics of the flora recorded (density, cover, sociability and height), and the number of rabbits observed and/or captured (Table 7) were highly correlated ($P < 0.01$).

DISCUSSION

Rainfall seems to have some effect on rabbit abundance. The lowest captures occurred during periods of most intense rain (May-June), while between August (beginning of the second rainy peak) and March (the end of the dry period), 14 rabbits/month were captured.

Nearly 68 % of the rabbits collected were adults, with a sex ratio of one male/one female. Body measurements, except tail length, were significantly different from *S. brasiliensis*, the rabbit species most closely related taxonomically to *S. varynaensis*, and which inhabits similar areas (Durant, 1986). Differences in weight and body size between males and females, as observed in Table 5, also occurs in other members of the genus *Sylvilagus* (Durant and Pérez, 1995), and in rodents such as *Zygodontomys microtinus* (Durant et al. 1996). These differences are interpreted as a consequence of life habits and behavior, because females are more sedentary and territoriality is more defined in males. In relation to these population aspects, Gibb et al. (1978) recorded that in *Oryctolagus cuniculus*, females use more energy during pregnancy, nest building, nest maintenance, and offspring rearing. The greatest energy drained for males occurs in maintaining territoriality and social hierarchy. Similar findings have been described for *Prochimys* sp. and other small mammals of the Brazilan and Mexican forest (Fonseca, 1989; Medellin and Equihua, 1998).

Like in other studies (Alho et al., 1986; Mason, 1996), mammals and birds were the terrestrial vertebrates with the highest number of species observed in the rabbit habitat, with a representation of 11.8% and 12.7%, respectively. Hawks (*Busarellus nigricollis*, *Heterospizia meridionalis*, *Spizaetus ornatus*), owls (*Otus guatemalae*,

Tyto alba, *Bubo virginianus*), and at least two species of carnivores (*Cerdocyon thous* and *Felis weidii)*, have been recognized as the main predators of rabbits and other small neotropical mammals (Emmons, 1982). *Boa constrictor* and other snakes may also feed on this rabbit species and in some other animal groups too. Twelve species of amphibians were recorded in the study area. Although they are neither predator nor competitors for this rabbit population they should have an important role in the biology of this habitat as one of the most efficient insectivorous, as host or as prey in the trophic relationship of the savanna ecosystem. The rodent *Proechimys* sp. has a general food habits and must be a competitor factor for this rabbit population (Everhard and Tikasingh, 1973). Food quality, predation, and competition are three of the ecological conditions that maintain a certain number of organisms (density) in a given area.

The greatest incidence of *Taenia* sp. was recorded between June and August, while May-July produced the highest number of nematoda. A significant correlation was observed between the number of worms and increasing rainfall ($r = 0.67$, 11df; $P < 0.005$). In spite of these findings, the helminths, as internal parasites, do not seem to greatly influence the number of animals nor their condition index (KI). Host response to helminthiasis should be reflected in the KI fluctuation but at the 5 % level there was no significant variation of KI values. Similar data have been found in *S. f. continentis* and in *S. b. meridensis* (Durant and Pérez, 1989). This implies that either the host is well adapted to the parasites or there were not enough parasites to significant harm the hosts. A more detailed research about the life cycle of these helminths and their rabbit hosts is needed.

In the processed sample, KI remained high, ranging from 6.8 in March to 8.5 in December. Relationship between rain and KI was not statistically significant. For the paramo rabbit this interaction ($r = 0.71$) is significant at the 5 % level (Durant and Pérez, 1989). The KI of males was more closely related to temperature fluctuations than that of female ($r = 0.40$; $P < 0.005$).

The study area contained four plant associations in the shrubby-herbaceous layers and four adjacent forest remains representing the tropical dry forest environment (Ewel et al., 1976). The highest values of the vegetation patterns recorded for the herbaceous strata were "Escobillal" 1 and 2 and "Bruscal – Urapal" association. Residents of the area indicated that these plants constitute the main food of *S. varynaensis*. Observations recorded in semi-natural enclosures, built for reproductive studies, showed that *Sida* spp. was the most readly accepted food. Similar results were also recorded for the western cottontail rabbit (*S. f. continentis*) which incorporates grasses, forbs (*Sida* spp. and *Malvastrum* spp.), and fruits of *Prosopis juliflora* (Mimosaceae) in its diet (Durant and Pérez, 1989). At least five species of grasses and three Cyperaceae are eaten by the paramo rabbit (Durant, 1981). Markham and Webster (1993) found 40 species of plants (23 spp. of grasses and nine spp. of forbs and low shrubs amongst them) in the stomachs of 21 marsh rabbits (*S. palustris*) collected in spring, summer and winter in temperate habitats. Five of these species of plant were consumed all the yearound. Most studies concerning diet and habitat evaluation in terrestrial small mammals, show that number of animals, activity, distribution and trophic relationship were closely associated with diversity, density, plant cover, sociability, and height of the herbaceous layer. Vegetation maintains adequate humidity, offers shelter, food, and protection against predators; decreasing individual and group stress even in marginal or suboptimal habitats (Birney et al., 1976, Litvaitis et al., 1985, Wolf, 1980).

This animal-plant relationship also explains the perturbation effect of the neotropical forest by uncontrolled human activity which changes the natural wildlife habitat. According to Centeno (1990), 58 % of the Venezuelan rain forest, have been destroyed in the last two decades. Some species may remain, as is the case for *Proechimys* sp., but others, like the Venezuelan rabbits, may reduce their densities or even become extinct.

As it was emphasized at the Introduction, the Venezuelan paramo rabbit have become almost extinct in the areas where they were abundant. Density declination recorded until 1984 was attributed to the advance of agriculture, changes of the native plant cover (shrubby stratum by coniferous tree cover in some areas of the Páramo de Mucubají), the action of the feral dogs since 1980, and an increasing invasion of domestic animals and humans since 1976. These activities changed the natural plant-animal relationship. Very few individuals of this species are now seen in the area. The present work is the first investigation about *S. varynaensis* and no population density was projected for it in 1989. Three trips to "Millano-Mamonal" and "Chorrosco Bajo" study areas after that date found a higher number of farms and ranchers in the area. In addition, illegal hunting of rabbits has increased. This means that a significant portion of the rabbit's natural habitat is being transformed. The interconnection between plants and animals is being disrupted and natural habitats may then collapse. However, restoring them will keep going on this and other species with similar ecological requirements. We need to know much more about biology

population of the species, fluctuation of bioclimatic factors, phenology of the most representative plant taxa, together with a better environmental education system to protect its habitat and maintain adequate population levels of this endemic lowland rabbit.

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