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The Effect of Two Years of Livestock Grazing Exclosure upon Abundance in a Lizard Community in Baja California Sur, Mexico

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Abstract

Using a 2400 m^2 two-year exclosure, lizard abundance was compared between grazed and ungrazed tropical deciduous forest sites in the Sierra de La Laguna, Baja California Sur, Mexico. For a full week in September 1991 we censused two transect systems, one inside and one outside the exclosure, in search of active lizards. Also, the substrate availability and vegetation cover were estimated for both transects. All five lizard taxa for which data were recorded are endemic to the Cape Region of Baja California Sur at the species or subspecies level. On average, lizards were four times more abundant inside the exclosure. *Urosaurus nigricaudus* was particularly abundant inside the exclosure. We discuss the differences that we found with regard to the impact of livestock upon populations of these five endemic taxa.

Introduction

It has been established previously that livestock grazing has a direct effect on vegetation diversity and structure (Milchunas et al., 1988). Also, livestock grazing has been associated with alterations in faunal abundance, including invertebrates (Heske and Campbell, 1991), reptiles (Bock et al., 1990; Janzen, 1976), birds (Bock et al., 1984), and rodents and lagomorphs (Linsdale, 1946; Reynolds, 1950; Heske and Campbell, 1991).

However, most earlier studies on the response of vegetation and fauna to grazing have involved desert or semidesert grassland habitats (e.g., Anderson and Holte, 1981; Brown and Heske, 1990; Chew, 1982; West et al., 1984); there exist few works concerning the effects in tropical deciduous forests. The present study involves a tropical deciduous forest in Mexico that has been overgrazed for at least 200 years (Arriaga, 1990; Arriaga and Léon de la Luz, 1989), during which time the impact of the livestock grazing has been so important that it has profoundly changed the vegetation structure and composition of a biogeographic unity — the Cape Region (Arriaga and Cancino, in press). Also, this study is limited to a very few species and subspecies, all of which are known to be endemic to this region.

Materials and Methods

The study was performed during September 1991 at "Casas Viejas," a ranch situated in the tropical deciduous forest of the Sierra de La Laguna, Baja California Sur. The Sierra de La Laguna is located at the southern tip of the Baja California peninsula, in what is called the Cape Region. It is a mountainous complex that runs north–south, reaching altitudes of up to 2100 m, and comprises four main physiographic–floristic associations (León de la Luz et al., 1988): desert scrub, tropical deciduous forest, oak–pine forest and pine forest. The tropical deciduous forest is the vegetation unit most widely distributed in the Sierra and includes the greatest species diversity in Baja California Sur (Morelos, 1988).

The herpetofauna of the Cape Region is unique because of the high incidence of endemic species and subspecies (Stebbins, 1985). Most of these endemics are distributed within the tropical deciduous forest (Alvarez et al., 1988).

Beginning in 1989, Laura Arriaga and her colleagues have established an exclosure system consisting of four areas of 2400 m^2 each (Arriaga and Cancino, in press). For the present study we established inside one exclosure five transects, 10 m apart and marked by flagged wire stakes at 5-meter intervals. Each transect was 25 m long by 5 m wide, a total area of 625 m^2. Outside of the exclosures, we established an equivalent system of transects of the same total area. Transects outside the exclosure were placed 35 m from the fence to match as closely as possible the perennial vegetation and substrate conditions of the transects within the exclosure.

Lizard abundance was measured by counting the number of lizards observed per given length of time spent steadily looking for them. Lizards were detected by their movements. Censuses were performed at varying times and following different routes.

Around each flagged wire stake the following characteristics were visually estimated for an area of 1 m^2: bare soil cover percent; annual plants and grasses, height and cover percent; number and cover percent of rocks in each of three diameter categories (less than 20 cm, 20–50 cm, and greater than 50 cm); fallen trunks cover percent; tree density and species richness; and finally, average tree height and cover percent.

Results

During the field work we observed a total of 32 lizards inside the exclosure system, whereas outside we saw only seven (Table 1). All of the lizards belonged to the following five endemic species (*) or subspecies (**): *Urosaurus nigricaudus* (*), which occurred mainly on trees and small to medium rocks; *Sceloporus hunsakeri* (*), common on medium and big rocks; *Sceloporus licki* (*), seen on trees and in rocky terrain; *Petrosaurus thalassinus thalassinus* (**), which made specific use of big rocks and wall rocks; and *Cnemidophorus hyperythrus hyperythrus*, seen mainly on the ground.

Table 1 shows differences in the abundance of lizards inside and outside the exclosure. The most abundant species within the exclosure are *U. nigricaudus*, *C. hyperythrus* and *S. hunsakeri*.

Table 2 displays microhabitat characteristics on both sides of the fence. There are notable differences in vegetation structure and substrate availability, especially with regard to grass and herb cover and average height, which are higher inside the exclosure, and proportion of bare soil cover, which is higher outside the exclosure.

Discussion

Herpetofaunal response to livestock grazing has been relatively poorly studied, although it has been found that grazing can reduce lizard abundance (Jones, 1981) and that certain lizards can be quite sensitive to the changes provoked by livestock (Bock et al., 1990). Moreover, there exist very few ecological studies at all on the five endemic lizards listed above (Alvarez et al., 1988; Galina-Tessaro et al., 1991), and nothing has been published previously regarding their population responses to the effects of livestock grazing.

Most lizard species are highly dependent on microhabitat features such as availability and structure of the optimal substrate (Ortega et al., 1982, 1989). But livestock grazing could strongly affect lizards in other ways, both indirectly and directly. Indirectly, livestock might impact lizard density by altering the species composition of the vegetation, thus reducing protective cover and food available for insects, affecting in this way insectivorous lizard species like those studied in this work. Also, cattle might affect lizard populations directly by disturbing individuals and even crushing them, especially in situations where the cattle create trails that they use repeatedly.

As Table 2 shows, grasses as well as annual herbs are higher and more abundant inside the exclosure. This could help to explain the higher density of *C. hyperythrus* inside the exclosure: the lizards are more protected and prey availability could be higher in the ungrazed zone. However, if *U. nigricaudus* live mainly on trees and there are no differences between tree density, diversity, height and cover inside and outside the exclosure, why are there more individuals inside the exclosure?

We do not know exactly why, but this could be because *U. nigricaudus* individuals need to descend from the trees frequently in order to change perches, to hunt some forms of prey, and even to sleep (Grenot et al., in press). Certainly, the risk probabilities are higher when such individuals must traverse the open zones outside the exclosure. However, to answer the question properly it seems necessary to study specifically the behavioral responses of *U. nigricaudus* to the absence of livestock grazing and to experimentally offer distinct levels of additional cover and food in order to quantify the responses.

Table 1. Number of lizards observed inside and outside the exclosure. N represents the total number observed. $\bar{X}$ represents the average number observed per day in which transects were traversed. The number in parentheses is the standard deviation.

	Outside		Inside	
Species	N	$\bar{X}$	N	$\bar{X}$
Sceloporus hunsakeri	2	0.500 (0.577)	6	1.500 (1.732)
Urosaurus nigricaudus	2	0.500 (0.577)	16	4.000 (2.160)
Cnemidophorus hyperythrus hyperythrus	1	0.250 (0.500)	7	1.750 (0.956)
Sceloporus licki	1	0.250 (0.500)	2	0.500 (0.577)
Petrosaurus thalassinus thalissinus	1	0.250 (0.500)	1	0.250 (0.500

Table 2. Microhabitat characteristics inside and outside the exclosure. Cover in % represents the proportion of the ground covered by the specific substrate—thus the first four lines add to 100%. The number in parentheses represents the standard deviation.

	Outside	Inside
Bare soil cover %	59.182 (24.408)	21.827 (18.777)
Grass and herbs cover %	10.364 (8.535)	53.077 (23.588)
Stones cover %	24.091 (21.543)	21.250 (20.424)
Fallen trunk cover %	6.363 (14.334)	3.846 (11.209)
Number of stones diameter < 20 cm	5.750 (14.930)	4.846 (3.614)
Number of stones diameter 20–50 cm	2.250 (0.957)	2.692 (3.700)
Number of stones diameter > 50 cm	1.167 (3.601)	1.231 (1.922)
Grass and herbs height (cm)	6.450 (2.773)	36.154 (21.031)
Tree density	1.846 (0.801)	2.091 (1.424)
Number of tree species	7	8
Tree height (m)	2.919 (2.20)	3.025 (1.840)
Tree cover %	57.5 (33.961)	69 (38.715)

Conclusion

It seems evident that it is necessary to study specifically the behavioral responses of the individual lizard species inside and outside the studied transects. However, this paper documents an interesting difference in abundance between two study groups of endemic lizards in a poorly studied and fragile ecosystem: the tropical deciduous forest of Baja California Sur, Mexico.

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A Further Analysis of the Cedros Island Boa, *Lichanura trivirgata bostici*

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Lichanura trivirgata bostici was described from four specimens (Ottley, 1978) from Isla Cedros, Mexico. This island is in the Pacific Ocean, about 12 miles off Punta Eugenia, the nearest point on the peninsula of Baja California, Mexico. Between Isla Cedros and Punta Eugenia lies Isla Natividad from which island one specimen, presumably *L. t. trivirgata*, has also been recorded. The only documentation of this specimen (Bostic, 1973) is a mere mention in a checklist and includes no reference to a specimen number. This specimen is missing. The holotype of *L. t. bostici* (BYU 41385) is also missing. Of the original four, only two paratypes are available for study (BYU 42355 and 42356).

Typically, the *Lichanura* have three longitudinal stripes, which vary greatly in color and evenness. The exception is the northwestern Baja California, Mexico, population, which has very indistinct stripes. The colors of the stripes of the nominate subspecies, *L. t. trivirgata*, have been described by various authors as dark brown, chocolate brown, deep liver brown and black.

Superficially, the Isla Cedros population resembles *L. t. trivirgata*. The three main characteristics that were used to describe *L. t. bostici* included narrow black stripes, yellow color on the venter, and ten or more scale rows from the ventrals to the dorsolateral stripe. I have previously documented the comparison of wild-caught male and female *Lichanura* from Isla Cedros, with the mainland form, *L. t. trivirgata* (Spiteri, 1992). That article also documented the first wild-caught female for this subspecies.

This article is to inform the reader of the first captive breeding and birth for the Cedros Island population and to document the data from two male specimens, wild-caught in 1993. I will also compare data from the Isla Cedros population to the *L. t. trivirgata* of the mainland.

The female was captured on 26 October 1991, from the southern end of Isla Cedros. Since we did not anticipate the capture of a male from this rarely seen population, she was not well fed for brumation nor readied for captive breeding. The capture of a male in April 1992 was unexpected and captive mating with the female was considered unlikely. However, since the male had naturally brumated the winter, we planned to put the pair together in hopes of a mating.

We hastily prepared the female by increasing her feed and introduced the male to her in late May.

The mating proved to be successful and produced four healthy offspring. Two males and two females were born 18 September 1992. The coloring of the young included a considerable amount of yellow in the interspaces (between the dark stripes) and on the venter. This is consistent with the original description of the subspecies. However, the young are now approaching their second year in age and have already lost the yellow coloration. Many newborn *L. t. trivirgata* from the mainland also have yellow on them, which is quickly lost with age. These include snakes from Organ Pipe Cactus National Monument, Arizona, and Loreto and San Ignacio, Baja California Sur, Mexico. Scale counts and pattern of the