Intestinal Helminths of Capybaras, *Hydrochoerus hydrochaeris*, from Venezuela

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Quantitative parameters of intestinal helminth species and their potential relations to host characteristics in a population of capybaras (Hydrochoerus hydrochaeris) *from Venezuela are reported for the first time. The intestines of 40 capybaras were collected during the 1992-annual harvest at Hato El Cedral. Six helminth species were found: 2 cestodes* (Monoecocestus macrobursatum, M. hagmanni), *2 nematodes* (Viannella hydrochoeri, Protozoophaga obesa), *and 2 trematodes* (Hippocrepis hippocrepis, Taxorchis schistocotyle). *This is the first report for* M. macrobursatum *in Venezuela. Helminth abundance did not differ between sexes or age classes. Although patterns of distribution for all helminth species were overdispersed, the high prevalence found for all species (over 70%) and the high abundance observed for nematodes made it difficult to assess the effect that these helminths may produce on capybaras. Nevertheless, the negative associations found between the body condition of capybaras and helminth intensity for* M. macrobursatum *and* V. hydrochoeri, *might be pointing out potential host population regulatory role for these parasites which require further research.*

Key words: helminths - intestinal - capybara - *Hydrochoerus hydrochaeris* - overdispersion - Venezuela

Capybaras, *Hydrochoerus hydrochaeris*, are 50 kg caviomorph rodents that are widely distributed in South America (Mones & Ojasti 1986). These rodents are abundant on cattle ranches in the Venezuelan seasonally flooded savannas or Llanos, where they are commercially exploited under a program regulated by the Ministry of the Environment (Ojasti 1991).

Although more than 80 parasite species have been reported for capybaras (Mones & Martínez 1982), data on parasite abundance is scarce because the majority of studies have concentrated on parasite taxonomy. Since parasite abundance can affect survival and reproductive performance of infected animals (Caughley & Sinclair 1994), the relationship between this variable and host characteristics such as body weight and condition is clearly an important aspect to be studied.

In South America, two studies have quantified the abundance of intestinal helminth species of capybaras: one in Brazil (Fagonde & Batista 1994) and the other in Bolivia (Casas et al. 1995). In Venezuela, some authors have reported prevalence for intestinal helminth species (Ojasti 1973, Mayaudon 1980) but their abundance has never been quantified. In this paper we report quantitative parameters (prevalence, intensity, abundance) of intestinal helminth species and the relationship between

helminth intensity and host characteristics such as age, sex, and body condition in a population of capybaras from Venezuela.

MATERIALS AND METHODS

This study was based on a sample of 40 capybaras (8 females and 32 males) collected in March 1992 (dry season), during the annual harvest carried out in Hato El Cedral (Apure State, Venezuela; 7º 25' N, 69º 20' W) under authorization of the Wildlife Service of the Venezuelan Ministry of Environment. Our sample is biased towards males because slaughtermen at El Cedral harvest preferably capybaras of this sex.

All sampled capybaras were aged using the age classes described by Ojasti (1973) and based on the degree of humeri ossification (Ojasti 1973). Two age classes were distinguished: adults (classes IV or more) and subadults (class III) based on the descriptions in Ojasti (1973). Capybaras classified at class III are between 1 and 2 years of age, when they reach sexual maturity (Ojasti 1973).

Females were checked for pregnancy. Body condition was estimated using a simple regression analysis with eviscerated body mass (nearest kg) and total length (nearest cm) (measured as in Ojasti 1973) as dependent and independent variables respectively. Body condition index was calculated with the following formula, assuming that for a given size, a heavier individual has a better body condition (Berger & Peacock 1988): [eviscerated body mass (kg) – estimated body mass (kg)]/estimated body mass (kg).

Capybaras were eviscerated 1 to 3 h post-mortem. The entire gastrointestinal tract was removed and the small and large intestine and caecum were isolated by ligature. Stomach contents were not analyzed because of logistic limitations with time and materials available. Each section was then opened and the contents washed into separate containers. The entire content of the small intestine was collected. Due to the large volume of caecal and large

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intestine contents, we estimated helminth intensity at these sections by taking aliquots. We brought each caecal content up to 20 l by adding water, stirred it to homogenize the material, and a 20% aliquot was collected. Similarly, we brought each large intestine content up to 10 l and a 50% aliquot was collected. These aliquots have shown to be good estimators of the entire gut section in other large animals (Morales et al. 1991). Parasites were recovered after washing the contents from each intestinal region through a series of sieves (2000, 1000 and 200 µm mesh). Cestodes and trematodes were fixed in AFA solution while nematodes were fixed in a mixture of ethyl alcohol and glycerin (Pritchard & Kruse 1982).

Because of the large numbers and small size of individuals (under 1 mm long) of the species *Viannella hydrochoeri,* 25% aliquots of the total small intestine content were removed for examination. For the same reason, estimates of intensity of this species were calculated for a sample of only 20 capybaras (8 females and 12 males). Similarly, because males of the species *Protozoophaga obesa* were also abundant and small, estimates of intensity for this species were calculated for 20 capybaras only.

Intensity for each helminth species was estimated according to the examined aliquot. However, intensity values for *Taxorchis schistocotyle* and *Hippocrepis hippocrepis* should be taken with caution. Both the stirring procedure to homogenize the material and aliquots might have affected the number of helminths collected due to the large size and low abundance of these species (compared to *V. hydrochoeri* and *P. obesa*). Prevalence values were calculated for 40 individuals in all helminth species, with the exception of *T. schistocotyle* (n = 30), because we did not note that these trematodes may remain adhered to the caecum walls in the first 10 capybaras examined.

Helminths were counted under a stereomicroscope and species identification was done under the guidance of R Guerrero, a parasitologist at Universidad Central de Venezuela. Cestodes were stained with Mayer's Haemalum, mounted on Canada balsam (Díaz-Ungría 1955) and identified following the descriptions of Rego (1961). Nematodes and trematodes were identified with descriptions from Mayaudon (1980). Scientific names for all species follow Mones and Martínez (1982).

The ecological terms follow Bush et al. (1997). Due to large differences between intensity values of helminth species, we used the standardized Morisita index *(Ip)* to measure the degree of overdispersion because it is independent of sample size. This index varies between –1 and –0.5 for uniform, between –0.5 and +0.5 for random, and between +0.5 and +1 for aggregated patterns (Krebs 1999). Comparisons for age and sex were tested using the Mann-Whitney test (*U*). Associations between helminth intensity and body condition index were tested using Spearman rank correlation coefficients (r_s). Significance level for all tests was 0.05.

RESULTS

Six helminth species were found: 2 cestodes (*Monoecocestus macrobursatum* Rego 1961 and *Monoecocestus hagmanni* Diesing 1856), 2 nematodes (*Viannella hydrochoeri* Travassos 1914 and *Protozoophaga obesa* Diesing 1851) and 2 trematodes (*Hippocrepis hippocrepis* Diesing 1850 and *Taxorchis schistocotyle* Fischoeder 1901). Site of these species in the capybara intestinal tract are listed on Table I.

Both nematodes were present in all examined capybaras, the cestode *M. macrobursatum* was found on 39 out of 40 capybaras while prevalences were over 70% for the other 3 helminth species (Table I). As a consequence of high prevalence values, 14 out of 30 capybaras (47%) were infected with all helminth species and there were 13 (43%) and 3 (10%) hosts with 5 and 4 helminth species respectively.

Nematodes were the most abundant helminths in capybara intestinal tract (Table I). The pattern of distribution of helminth intensity in the host population was overdispersed for all species (Table I).

Helminth intensity was independent of the age of capybaras, since we found no significant differences between adults and subadults for all helminth species (Table II). There were no significant differences in helminth abundances between female and male capybaras for all species (Table II). A significant negative association was found between the capybara's body condition and helminth intensity of the species *M. macrobursatum* and *V. hydrochoeri*, while the association between the intensity of *H. hippocrepis* and the host's condition was also negative and close to significance (p = 0.07) and no association was evident between these variables for the rest of helminth species (Table II).

TABLE I

Site on intestinal tract, prevalence, mean (± SE) abundance and Morisita overdispersion index *(Ip)* for six helminth species of capybaras from Venezuela

Helminth species	Site	Prevalence (%)	Mean (± SE) abundance	Morisita index *(Ip)*	n
Monoecocestus macrobursatum	Small Intestine	98	112 ± 96	0.509	40
Monoecocestus hagmanni	Small Intestine	73	7 ± 15	0.555	40
Viannella hydrochoeri	Small Intestine	100	6275 ± 6076	0.523	20
Protozoophaga obesa	Caecum	100	2663 ± 2003	0.514	20
Taxorchis schistocotyle	Caecum	83	18 ± 26	0.533	30
Hippocrepis hippocrepis	Large Intestine	80	41 ± 88	0.558	40

n: number of capybaras sampled for each helminth species.

TABLE II

Relationship between helminth intensity and host age class, sex and body condition index of capybaras from Venezuela

Helminth species	Age class		Sex		Body condition index	
	U	p	U	p	r_s	p
Monoecocestus macrobursatum	176.0	0.67	145.0	0.57	-0.34	0.03
Monoecocestus hagmanni	159.0	0.93	93.0	0.23	0.17	0.28
Viannella hydrochoeri	40.0	0.87	63.0	0.25	-0.50	0.03
Protozoophaga obesa	49.0	0.55	33.0	0.25	-0.04	0.86
Taxorchis schistocotyle	66.5	0.13	61.0	0.56	-0.04	0.83
Hippocrepis hippocrepis	210.0	0.14	134.5	0.83	-0.29	0.07

U: Mann-Whitney statistic; r_s: Spearman rank correlation coefficient

DISCUSSION

The 6 helminth species found in this study were reported in a similar study in Bolivia (Casas et al. 1995) and 5 of them were also found in another study in Venezuela (Mayaudon 1980) and in Brazil (Fagonde & Batista 1994). The exception was *M. macrobursatum*, although Rego (1961) did find this species for capybaras in Brazil. This is the first report for *M. macrobursatum* in Venezuela. Although Mayaudon (1980) reports *M. decrescens* in his study, the description on this species coincides with the one of *M. hagmanni* (Fagonde & Batista 1994 and personal observation).

Fagonde and Batista (1994) reported the species *Capillaria hydrochoeri* and *Strongyloides chapini* living in the small intestine of juvenile capybaras. It is possible that we did not find these species because our sample is composed of adults and subadults only. Mayaudon (1980) reported *C. hydrochoeri* in Venezuela which suggests that his sample included juvenile capybaras (the age of individuals was not reported).

Other species that were not found in our study include: *Trichostrongylus axei* and *Nudacotyle tertius* found in Brazil (Fagonde & Batista 1994), *Habronema clarki* reported in Bolivia (Casas et al. 1995), and *M. hydrochoeri* collected both in Brazil and Bolivia (Fagonde & Batista 1994, Casas et al. 1995). We could have not found *T. axei* because this helminth lives in the stomach and we did not sample this section. *T. axei* is also a parasite of bovines (Fagonde & Batista 1994), so it is important to investigate whether they are present in the flooded savannas of Venezuela where cattle ranching is the main economic activity as in the Pantanal region. The rest of the helminth species could be specific to a region and geographical barriers or the reproductive cycles of helminths may have prevented the dispersion of these species to Venezuela. However, it would be interesting to collect samples from other regions of the country such as the forests in the South of Venezuela, where capybaras are also found.

The site of most helminth species in the intestinal tract coincides with previous studies (Mayaudon 1980, Fagonde & Batista 1994, Casas et al. 1995). The exception was *H. hippocrepis* which was found in the caecum by Mayaudon (1980), in the large intestine in our study and in both sections by Fagonde and Batista (1994). This variation could be related to differences in the ages of the capybaras sampled in each study (see above). It could be that *H. hippocrepis* lives at the caecum in juvenile capybaras and in the large intestine in adults.

Prevalence and abundance of the six helminth species in the present study were higher than those reported for capybaras from Bolivia by Casas et al. (1995). The discrepancy might be attributed to differences in the methodology used by each study. Casas et al. (1995) collected only visible worms, while we used a series of sieves to collect helminths. Furthermore, there are some differences between the prevalence found in the present study and those of Mayaudon (1980) that could be attributed to differences in sample size and living condition of individuals. Mayaudon (1980) only checked 7 capybaras (3 males, 4 females) that were kept in captivity.

Similar prevalence and abundance of 4 helminth species (*M. hagmanni*, *V. hydrochoeri*, *P. obesa*, *T. schistocotyle*) were found both in Brazil by Fagonde and Batista (1994) and in Venezuela (this study). In the case of *H. hippocrepis* we found higher prevalence and lower abundance than Fagonde and Batista (1994), probably because our sample did not include juvenile capybaras. Fagonde and Batista (1994) found that juveniles had lower prevalence and higher abundance than adults within their sample.

As the pattern of distribution found for all helminth species was overdispersed we could consider all species found as actual parasites of capybaras (Crofton 1971, Anderson 1978). However, the particular case of *P. obesa* suggests that this helminth could be a symbiont rather than a parasite because it is present in high numbers in all capybaras sampled in different countries (Brazil: Fagonde & Batista 1994; Bolivia: Casas et al. 1995; Venezuela: Ojasti 1973, Mayaudon 1980, and this study). It is difficult to trace the thresholds between benefit and damage because the parasite-host-environment system is dynamic. We would therefore agree with Araújo et al. (2003) that the concept of parasitism may encompass commensalism, mutualism, and symbiosis.

The effect that a parasite produces on its host is difficult to assess, because by examination of hosts carcasses we may be underestimating mortality and missing sublethal effects on host reproduction (Holt 1993). Still, the negative associations found between the body condition

of capybaras and helminth intensity for *M. macro-bursatum* and *V. hydrochoeri*, and possibly also of *H. hippocrepis* might be pointing to a potential host-population regulatory role for these parasites (Caughley & Sinclair 1994), which would require further research.

Although we did not observe differences in helminth intensity between males and females or adults and sub-adults, we cannot conclude that this is a general trend for capybaras. The majority of capybaras sampled in this study were males and they had a narrow range of ages. Future studies on the intestinal helminths of capybaras should include a larger number of females and juveniles. Because capybaras live in social groups (Herrera & Macdonald 1987, Salas 1999) each group should be evaluated separately. It has been found that there is a considerable degree of variation in helminth abundances between social groups (Holt 1993, Balbuena & Raga 1994).

REFERENCES

Anderson RM 1978. The regulation of host population growth by parasitic species. *Parasitology 76*: 119-157.

Araújo A, Jansen AM, Bouchet F, Reinhard K, Ferreira LF 2003. Parasitism, the diversity of life, and Paleoparasitology. *Mem Inst Oswaldo Cruz 98* (Suppl. I): 5-11.

Balbuena JA, Raga JA 1994. Intestinal helminths as indicators of segregation and social structure of pods of long-finned pilot whales *(Globicephala melas)* off the Faroe Islands. *Can J Zool 72*: 443-448.

Berger J, Peacock M 1988. Variability in size-weight relationships of *Bison bison*. *J Mammal 69*: 618-624.

Bush AO, Lafferty KD, Lotz JM, Shostak AW 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. *J Parasitol 83*: 575-583.

Casas MC, Zalles LM, Patrick MJ, Dailey M 1995. Intestinal helminths of capybara *(Hydrochaeris hydrochaeris)* from Bolivia. *J Helminthol Soc Wash 62*: 87-88.

Caughley G, Sinclair ARE 1994. *Wildlife Ecology and Management*, Blackwell Science, Oxford, 334 pp.

Crofton HD 1971. A model of host-parasite relationships. *Parasitology 63*: 343-364.

Díaz-Ungría C 1955. Cestodes de Venezuela. Especies señaladas hasta la fecha. *Mem Soc Cienc Nat La Salle 25*: 189-244.

Fagonde CA, Batista J 1994. Helmintos parasitos de capivaras *(Hydrochaeris hydrochaeris)* na sub-região da Nhecolândia, Pantanal Sul-Mato-Grossense. *Rev Brasil Biol 54*: 39-48.

Herrera EA, Macdonald DW 1987. Group stability and the structure of a capybara population. *Symp Zool Soc Lond 5*: 115-130.

Holt RD 1993. Infectious disease of wildlife, in theory and in practice. *TREE 8*: 423-425.

Krebs CJ 1999. *Ecological Methodology*, 2nd ed., Addison Wesley Longman, Menlo Park, 620 pp.

Mayaudon H 1980. Sobre una colección de helmintos del chigüire *(Hydrochoerus hydrochaeris)* de Venezuela. *Rev Fac Cienc Vet UCV 28*: 19-47.

Mones A, Martínez S 1982. Estudios sobre la familia Hydrochoeridae (Rodentia), XIII, parasitosis y patologías de *Hydrochoerus*, Brisson, 1762. *Rev Fac Hum y Cienc 1*: 297-329.

Mones A, Ojasti J 1986. *Hydrochoerus hydrochaeris. Mamm Species 264*: 1-7.

Morales G, Pino LA, Graterol D, Perdomo L 1991. Técnica de muestreo para la estimación de la abundancia y la prevalencia de nemátodos parásitos de bovinos. *Rev Cient Fac Cien Vet LUZ 1*: 46-50.

Ojasti J 1973. *Estudio Biológico del Chigüire o Capibara*, Fonaiap, Caracas, 275 pp.

Ojasti J 1991. Human exploitation of capybara. In JG Robinson, KH Redford (eds), *Neotropical Wildlife Use and Conservation*, University of Chicago Press, Chicago, p. 236-252.

Pritchard MH, Kruse GOW 1982. *The Collection and Preservation of Animal Parasites*, University of Nebraska Press, Lincoln, 141 pp.

Rego AA 1961. Revisão do gênero *Monoecocestus* Beddard, 1914 (Cestoda, Anoplocephalidae). *Mem Inst Oswaldo Cruz 59*: 325-354.

Salas V 1999. *Social Organization of Capybaras in the Venezuelan Llanos*, PhD Thesis, University of Cambridge, Cambridge, 110 pp.