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 (Monococcestus macrobursatum, M. hagmanni), 2 nematodes (Vianellia hydrochoerii, 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. hydrochoerii* 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; 7°25’N, 69°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): \[ \text{body condition index} = \frac{\text{eviscerated body mass (kg)}}{\text{estimated body mass (kg)}} \]

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...
intestine contents, we estimated helminth intensity at these sections by taking aliquots. We brought each caecal content up to 201 by adding water, stirred it to homogenize the material, and a 20% aliquot was collected. Similarly, we brought each large intestine content up to 101 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, and trematodes and nematodes were identified with descriptions of Mones and Martinez (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).

RESULTS

Six helminth species were found: 2 cestodes (Monoecestus macrobursatum Rego 1961 and Monoecestus hagmanni Diesing 1856), 2 nematodes (Viannella hydrochoeri Travassos 1914 and Protozoophaga obesa Diesing 1851) and 2 trematodes (Hippocrepis hippocrepis Diesing 1850 and Taxorchis schistocotyle Fischchoeder 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>
<thead>
<tr>
<th>Helminth species</th>
<th>Site</th>
<th>Prevalence (%)</th>
<th>Mean (± SE) abundance</th>
<th>Morisita index (Ip)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monoecestus macrobursatum</td>
<td>Small Intestine</td>
<td>98</td>
<td>112 ± 96</td>
<td>0.509</td>
<td>40</td>
</tr>
<tr>
<td>Monoecestus hagmanni</td>
<td>Small Intestine</td>
<td>73</td>
<td>7 ± 15</td>
<td>0.555</td>
<td>40</td>
</tr>
<tr>
<td>Viannella hydrochoeri</td>
<td>Small Intestine</td>
<td>100</td>
<td>6275 ± 6076</td>
<td>0.523</td>
<td>40</td>
</tr>
<tr>
<td>Protozoophaga obesa</td>
<td>Caecum</td>
<td>100</td>
<td>2663 ± 2003</td>
<td>0.514</td>
<td>20</td>
</tr>
<tr>
<td>Taxorchis schistocotyle</td>
<td>Caecum</td>
<td>83</td>
<td>18 ± 26</td>
<td>0.533</td>
<td>30</td>
</tr>
<tr>
<td>Hippocrepis hippocrepis</td>
<td>Large Intestine</td>
<td>80</td>
<td>41 ± 88</td>
<td>0.558</td>
<td>40</td>
</tr>
</tbody>
</table>

n: number of capybaras sampled for each helminth species.
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 helmint 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 helmint species could be specific to a region and geographical barriers or the reproductive cycles of helmints 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 helmint 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 helmint 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 helmints. 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 helmint 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 helmint 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 helmint 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: Ojastí 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

### TABLE II

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

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

DISCUSSION

The 6 helmint 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).

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of capybaras and helminth intensity for *M. macro-
bursatum* and *V. hydrochoeri*, and possibly also of *H. hippo-
crepis* might be pointing to a potential host-popu-
lation 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 evalu-
ated separately. It has been found that there is a consid-
erable degree of variation in helminth abundances between
social groups (Holt 1993, Balbuena & Raga 1994).

ACKNOWLEDGEMENTS

To the owners of Hato El Cedral for permission to work in
their ranch and S Gutierrez for logistic support. To P Alvizu, P
Borges, J Fuenmayor, A Gols, R Guerrero, A Kelly, D Manzano,
J Mavarez, F Michelangeli, M Oliveira, J Ortiz for assistance.
To R Guerrero, P Borges, G Barreto, G Morales for their sug-
gestions.

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