# MAMMALIAN WILDLIFE DISEASES AS HAZARDS TO MAN AND LIVESTOCK IN AN AREA OF THE LLANOS ORIENTALES OF COLOMBIA

Authors: WELLS, E.A., D'ALESSANDRO, A., MORALES, G.A., and ANGEL, D.

Source: Journal of Wildlife Diseases, 17(1) : 153-162

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-17.1.153

# MAMMALIAN WILDLIFE DISEASES AS HAZARDS TO MAN AND LIVESTOCK IN AN AREA OF THE LLANOS ORIENTALES OF COLOMBIA

E.A. WELLS,[1] A. D'ALESSANDRO,[2] G.A. MORALES[3] and D. ANGEL[4]

*Abstract:* Development of the Llanos Orientales of Colombia, and access to underdeveloped areas in the Llanos, may create disease hazards to man and domestic animals or introduce exotic pathogens, creating reservoirs of infection for domestic animals and acting as limiting factors on the native wild species. A survey of wild animals common to the Llanos revealed a number of parasites indigenous to the area. A total of 59 mammalian species, representing eight orders were examined. Haematozoa were represented by *Trypanosoma cruzi, T. evansi* and *T. rangeli.* Eight species of ticks were found: *Amblyomma cajennense, A. auricularium, A. rotundatum, A. maculatum, A. longirostre, A. pacae, Ixodes luciae* and *Boophilus microplus.* Four species of fleas were found: *Rhopalopsyllus lugubris lugubris, R. australis tupinus, R. cacicus saevus* and *Polygenis klagesi samuelis.* A species of *Echinococcus* was commonly found in *Cuniculus paca.* Serologic titers and/or isolations of pathogenic viral and bacterial agents generally indicated that the wildlife population had not been exposed to the diseases common to the domestic population. A low prevalence of titers to Venezuelan equine encephalomyelitis was found in *Cebus apella* and *Proechimys* sp. Neutralizing antibodies to Group B viruses were found in *Proechimys* sp., *Coendor* sp. and *Nectomys squamipes.* Antibodies to Group C viruses were found in *Proechimys* sp. Serologic titers to *Leptospira sejroe* and *L. tarassovi* were found in *Proechimys* sp. and *Didelphis marsupialis. L. tarassovi* was isolated from *Proechimys* sp. Titers to *Brucella* were not found in 164 animals. The significance of these findings are discussed.

## INTRODUCTION

The eastern plains (Llanos Orientales) of Colombia form part of the eastern border of the tropical Andes, described as "among the most active pioneer settlement and colonization zones in Latin America".[2] The present study was designed to demonstrate that opening undeveloped or underdeveloped areas in Latin America is accompanied by disease hazards to man, to livestock, and to wildlife.[10,20] Introduced species may contract important clinical infections by intruding into existing sylvatic cycles and, moreover, may introduce pathogens new to the native animal population, creating reservoirs of infection.

In Colombia, previous studies have been made in the Llanos Orientales,[1,16] and also in the adjacent areas of Panama and Colombia where hazards to human health were examined along proposed sea level canal routes.[7,8,17] The present article consolidates and adds to informa-

[1] Centro Internacional de Agricultura Tropical (CIAT) A.A.67-13, Cali, Colombia. Present address: 18, The Croft, Sudbury, Suffolk, United Kingdom CO 10 6HP.

[2] Tulane University International Center for Medical Research (ICRM/CIDEIM), Cali, Colombia.

[3] CIAT. Present address: Servicio Internacional para Desarrollo Agropecuario, SIDA, Casilla 495-A, Quito, Ecuador.

[4] CIAT.

TABLE 1. Check list of mammalian species captured in the wildlife studies at Carimagua, Colombia, October 1972-December 1975. Nomenclature after Morris (1965).

| Mammalian Order | Species | Common name in English | Common name in Spanish used in the Colombian Llanos |
|---|---|---|---|
| Marsupials | *Didelphis marsupialis* | Common opossum | Chucha común |
| | *Caluromys lanatus* | Woolly opossum | " |
| | *Metachirus nudicaudatus* | Rat-tailed opossum | Chucha mantequera |
| | *Marmosa murina* | Murine opossum | Chucha de cola gruesa |
| | *Lutreolina crassicaudata* | Thick-tailed opossum | " |
| | *Caluromys philander* | Philander opossum | Chucha |
| Bats | *Rhynconycteris naso* | Proboscis bat | Murciélago de proboscis |
| | *Saccopterix bilineata* | White lined bat | Murciélago de línea blanca |
| | *Noctilio labialis* | Bull dog bat | Murciélago buldog |
| | *Phyllostomus hastatus* | Spear nosed bat | Murciélago ne nariz de lanza |
| | *Phyllostomus discolor* | " | " |
| | *Phyllostomus elongatus* | " | " |
| | *Mimon crenulatum* | " | " |
| | *Glossophaga soricina* | Long tongued bat | Murciélago de lengua larga |
| | *Sturnira lilium* | Yellow-shouldered bat | Murciélago de espalda amarilla |
| | *Carollia perspicillata* | Short tailed bat | Murciélago de cola corta |
| | *Rhinophylla pumilio* | " | " |
| | *Uroderma bilobatum* | Tent making bat | Murciélago que hace cuevas |
| | *Artibeus lituratus* | American fruit-eating bat | Murciélago fructívero |
| | *Artibeus cinereus* | " | " |
| | *Artibeus jamaicensis* | " | " |
| | *Myotis nigricans* | Common bat | Murciélago común |
| | *Myotis* sp. | " | " |
| | *Eptesicus brasiliensis* | Big brown bat | Murciélago pardo grande |
| | *Lasiurus borealis* | Hairy tailed bat | Murciélago de cola peluda |
| | *Molossus major* | Velvety free-tailed bat | " |
| | *Eumops auripendulus* | Mastiff bat | Murciélago de pelo corto |
| | *Eumops bonariensis* | " | " |
| | *Molossops planirostris* | Dog faced bat | Murciélago cara de perro |

TABLE 1. (continued)

| | | | |
|---|---|---|---|
| Primates | *Cebus apella* | Brown capuchia | Mono maicero |
| | *Aotus trivirgatus* | Douroucouli | Mono de noche |
| Edentates | *Tamandua longicaudata* | Long-tailed tamandua | Oso de cola larga |
| | *Dasypus kappleri* | Kappler's armadillo | Armadillo de Kappler |
| | *Dasypus novemcinctus* | Nine banded armadillo | Armadillo de 9 bandas |
| | *Dasypus sabanicola** | Armadillo | Armadillo |
| | *Priodontes giganteus* | Giant armadillo | Armadillo gigante |
| | *Myrmecophaga trydactila* | Giant ant eater | Oso hormiguero |
| Lagomorphs | *Sylvilagus floridanus* | Eastern cottontail | Conejo sabanero |
| Rodents | *Hydrochoerus hydrochaeris* | Capybara | Chiguiro |
| | *Cuniculus paca* | Paca | Lapa o Guagua |
| | *Dasyprocta fuliginosa* | Agouti | Picure |
| | *Cavia porcellus* | Cavie | Curí |
| | *Coendou* sp. | Tree porcupine | Puercoespín |
| | *Sciurus igniventris* | Tree squirrel | Ardilla |
| | *Proechimys* sp. | Spiny rat | Rata espinosa |
| | *Neotomys squamipes* | Water rat | Rata de agua |
| | *Neacomys spinosus* | Bristly mouse | Ratón espinoso |
| | *Zygodontomys brevicauda* | Cane rat | Ratón gris |
| | *Sigmodon alstoni* | Cotton rat | " |
| | *Oryzomys concolor* | Rice rat | Ratón rojo |
| | *Oryzomys delicatus* | " | " |
| Carnivores | *Cerdocyon thous* | Crab eating fox | Zorro |
| | *Felis pardalis* | Ocelot | Ocelote |
| | *Felis jaguarondi* | Jaguarondi | Jaguar |
| | *Bassaricyon gabbii* | Bushy tailed olingo | Olingo de cola peluda |
| | *Potos flavus* | Kinkajon | Perro de monte |
| Ungulates | *Tayassu albirostris* | White lipped peccary | |
| | *Sus scrofa* | Wild domestic pig | |
| | *Odocoileus virginianus* | White tailed deer | Venado de cola blanca |

*Species not listed by Morri.

tion, some of which was previously available only in annual reports. [3,4,5]

## MATERIALS AND METHODS

The study area included the Carimagua experimental station of the Instituto Colombiano Agropecuario (ICA) and the neighbouring ranches of Caviona, Nueva Colombia, Carraba, Altagracia, La Portuguesa, and La Florida. The total area approximated 500 $km^2$.

Carimagua experimental station is located 350 km east of Villavicencio, the capital of the Department of Meta, at approximately 4-1/2°N 71-1/2°W. Annual rainfall in the region is from 1,800 to 2,000 mm, distributed from April through November. There is a marked dry season from mid-December through late March. The mean annual temperature is 26-27 C with an average minimum of 20 C, an average maximum of 33 C and extremes of 14 C and 35 C. The elevation is 150-157 m. The topography is characterized by very smooth interfluvial savannahs with slopes of less than 0.5%. Side slopes seldom exceed 3% as they drop to well-defined drainages lined with gallery forests of deciduous hardwood and palm.

Trapping or shooting of free-ranging wild animal species was conducted from October, 1972 to December, 1975.

Trapped species were transported to the laboratory and anaesthetized by ether inhalation and bled from the heart. Blood was inoculated into a culture medium suitable for the growth of *Trypanosoma cruzi* and other stercorarian trypanosomes,[18] and into white laboratory rats to detect the salivarian trypanosome, *T. evansi*.[12] Thick and thin blood smears and sera were prepared from the same samples and stained with Giemsa.

Animals were killed by increasing the anaesthetic dose and necropsies were performed. Ectoparasites were collected into glass vials, and intestinal contents stored in sealed containers with formaldehyde solution. Specimens were taken from kidneys for the culture of *Leptospira*.[9] Specimens also were taken of any unusual lesion and fixed in 10% formaldehyde solution.

The same procedure was carried out *in situ* in the field for those animals which were shot. However, blood samples were taken at the time of necropsy, usually from a major vein in the abdominal cavity.

The microscopic slide agglutination test was used for *Leptospira*. All tests were kindly performed in the Panamerican Center of Zoonosis, (CEPANZO) Buenos Aires, Argentina. Search was made for antibodies to *Brucella* using the plate and tube agglutination, and mercaptoethanol tests in sera from 164 animals representing 20 species from seven Orders.

Sera from 175 animals representing 21 species were examined for neutralizing antibody to Venezuelan equine encephalomyelitis (VEE), and 14 animals representing four species were examined for antibody to Eastern equine encephalomyelitis (EEE) and Western equine encephalomyelitis (WEE). All tests were kindly performed in the Microbiology Department, School of Medicine, University of Valle, Colombia.

## RESULTS

Fifty-nine mammalian species, representing eight Orders were captured and identified: marsupials - 6; bats - 23; primates - 2; edentates - 6; lagomorphs - 1; rodents - 13; carnivores - 5; and ungulates - 3 (Table 1). Not all mammalian species known to exist in the Llanos Orientales were represented in the collections, for example *Desmodus rotundus* (vampire bat) and *Mazama* sp. (brocket deer), but the list is the most exhaustive known for a defined area.

**Ectoparasites:** Eight species of hard ticks were collected and identified from 12 wild mammalian hosts representing five Orders (Table 2). Four species of fleas

TABLE 2. Species of hard ticks (Acarina: Ixodidae) found in the Carimagua area infesting wild mammalian hosts from October, 1972 to December, 1975.

| Mammalian host | | |
|---|---|---|
| Order | Species | Tick species |
| Marsupials | *Didelphis marsupialis* | *Amblyomma cajennense* |
| | | *Ixodes luciae* |
| | *Metachirus nudicaudatus* | *A. cajennense* |
| Edentates | *Dasypus kappleri* | *A. auricularium* |
| | | *A. cajennense* |
| | *Dasypus sabanicola* | *A. auricularium* |
| | *Myrmecophaga tridactyla* | *A. cajennense* |
| | *Tamandua longicaudata* | *A. cajennense* |
| Rodents | *Sigmodon alstoni* | *A. auricularium* |
| | *Hydrochoerus hydrochaeris* | *A. cajennense* |
| | | *A. rotundatum* |
| | | *A. maculatum* |
| | | *Boophilus microplus* |
| | *Coendu* sp. | *A. longirostre* |
| | *Cuniculus paca* | *A. pacae* |
| Carnivores | *Cerdocyon thous* | *A. maculatum* |
| Ungulates | *Odocoileus virginianus* | *A. cajennense* |
| | | *B. microplus* |

were detected and identified. *Rhopalopsyllus lugubris lugubris* was collected from *Cuniculus paca*, *Dasypus kapleri* and *Didelphis marsupialis*; *R. australis tupinus* from *C. paca*, and *D. marsupialis*; *R. cacicus saevus* from *C. paca*, and *Polygenis klagesi samuelis* from *Proechimys* sp. and *Nectomys squamipes*. *Cuterebra* sp. larvae occasionally were seen infesting rodents but no quantitative data was collected.

**Hemoparasites:** Hemoparasite infections detected were principally trypanosomes (Table 3). Recovery of *Trypanosoma cruzi* from *Proechimys* sp. and *Potus flavus* represent new records for these genera, and in *Dasyprocta fuliginosa* and *Dasypus kapleri*, new records for these species. *Trypanosoma rangeli* in *Proechimys* was a new Colombian record.[19] *Trypanosoma evansi* was found only in *Hydrochoerus hydrochoeris*, all of which were apparently healthy animals.

**Bacteria:** Low titers were found for *L. sejroe* and *L. tarassovi* in *Proechimys* sp. and *D. marsupialis*. Numerous efforts to culture the organisms finally revealed *L. tarassovi* in *Caluromys philander* and *L. australis* in *Proechimys* sp.

No positive or suspicious results were obtained for antibodies to *Brucella* in all animals tested.

**Virus:** Antibodies to VEE were found in *Cebus apella* (1/2) and *Proechimys* sp. (4/110) (Table 4).

In addition, sera from 163 and 162 animals (both numbers representing 19 species) were examined for Group B and Group C arboviruses, respectively. Neutralizing antibodies to Group B viruses were found in *Proechimys* sp. 4/110), *Coendor* sp. (1/2) and *Nectomys squamipes* (3/4). Antibodies to Group C viruses were found in *Proechimys* sp. (2/110) (Table 4).

**Helminths:** Intestinal contents were stored for future examination and

TABLE 3. Hemoparasite infections of mammalian wildlife identified at Carimagua, Colombia, October 1972-December 1975.

| Mammalian host | | |
|---|---|---|
| Order | Species | Hemoparasite |
| Marsupials | *Didelphis marsupialis* | *Trypanosoma cruzi* |
| | | *Trypanosoma rangeli* |
| | | *Trypanosoma* sp. |
| | | *a piroplasm* |
| Bats | *Phyllostomus hastatus* | *Trypanosoma sp.* |
| | *Glossophaga soricina* | *Trypanosoma* sp. |
| | *Sturnira lilium* | *Trypanosoma* sp. |
| | | *Plasmodium* sp. |
| | *Carollia perspicillata* | *Trypanosoma* sp. |
| | *Myotis nigricans* | *Trypanosoma* sp. |
| | | *Plasmodium* sp. |
| | | a microfilaria |
| | | a piroplasm |
| | *Myotis* sp. | *Trypanosoma* sp. |
| | | *Plasmodium* sp. |
| | | a microfilaria |
| | *Lasiurus borealis* | a piroplasm |
| | *Molossus major* | *Trypanosoma* sp. |
| | | a piroplasm |
| Primates | *Cebus apella* | *Trypanosoma cruzi* |
| | | *Trypanosoma rangeli* |
| | | *Trypanosoma* sp. |
| | *Dasypus kappleri* | *Trypanosoma cruzi* |
| | *Priodontes giganteus* | *Trypanosoma* sp. |
| Rodents | *Hydrochoerus hydrochaeris* | *Trypanosoma evansi* |
| | *Cuniculus paca* | *Trypanosoma cruzi* |
| | *Dasyprocta fuliginosa* | *Trypanosoma cruzi* |
| | *Proechimys* sp. | *Trypanosoma cruzi* |
| | | *Trypanosoma rangeli* |
| | *Zygodontomys brevicauda* | *Bartonella*-like sp. |
| Carnivores | *Felis pardalis* | a piroplasm |
| | *Potos flavus* | *Trypanosoma cruzi* |
| | | *Trypanosoma rangeli* |

visceral lesions caused by helminths were noted. A parasite and associated egg lesions in the liver of three *D. marsupialis* resembled *Capillaria hepatica*. Another helminth commonly was found in the kidneys of *Hydrochoerus hydrochaeris*, but could not be identified. Cysts of *Echinococcus* sp. were found in 38 of 94 *C. paca*, in 2 of 15 *D. fuliginosa* and in 1 of 384 *Proechimys* sp.

## DISCUSSION

Complementary collections of ticks from domestic animals at Carimagua revealed *Amblyomma maculatum*, *Anocentor nitens* and *Boophilus microplus* infesting Zebu and Zebu-criollo cattle, *Anocentor nitens* infesting horses and *Rhipicephalus sanguineus* infesting dogs. *A. maculatum* and *B. microplus* therefore were demonstrated on both wild and domestic animal hosts.

TABLE 4. Mammalian sera tested for virus antibodies using the plate complement fixation test (number positive/number tested), Carimagua, Colombia, October 1972-December 1975.

| Mammalian Order | Species | VEE | EEE | WEE | GpB | GpC |
|---|---|---|---|---|---|---|
| Marsupials | *Didelphis marsupialis* | 0/20 | | | 0/20 | 0/20 |
| | *Metachirus nudicaudatus* | 0/1 | | | 0/1 | 0/1 |
| | *Marmosa murina* | 0/4 | | | 0/4 | 0/4 |
| | *Marmosa* sp. | 0/1 | | | 0/1 | 0/1 |
| Primates | *Cebus apella* | 1/2 | | | 0/2 | 0/2 |
| Edentata | *Dasypus sabanicola* | 0/2 | | | 0/2 | 0/2 |
| | *Priodontes giganteus* | 0/1 | 0/1 | 0/1 | | |
| Lagomorphs | *Sylvilagus floridanus* | 0/1 | | | 0/1 | 0/1 |
| Rodents | *Hydrochoerus hydrochaeris* | 0/4 | 0/3 | 0/3 | 0/1 | 0/1 |
| | *Cuniculus paca* | 0/15 | 0/9 | 0/9 | 0/6 | 0/6 |
| | *Dasyprocta fuliginosa* | 0/1 | 0/1 | 0/1 | | |
| | *Cavia porcellus* | 0/1 | | | 0/1 | 0/1 |
| | *Coendou* sp. | 0/1 | | | 1/2 | 0/2 |
| | *Proechimys* sp. | 4/110 | | | 4/110 | 2/110 |
| | *Nectomys squamipes* | 0/4 | | | 3/4 | 0/4 |
| | *Neacomys spinosus* | 0/1 | | | 0/1 | 0/1 |
| | *Zygodontomys brevicauda* | 0/1 | | | 0/2 | 0/1 |
| | *Oryzomys concolor* | 0/2 | | | 0/2 | 0/2 |
| Carnivora | *Cerdocyon thous* | 0/1 | | | 0/1 | 0/1 |
| | *Felis pardalis* | 0/1 | | | 0/1 | 0/1 |
| | *Felis jaguarondi* | 0/1 | | | 0/1 | 0/1 |
| | Total sera | 5/175 | 0/14 | 0/14 | 8/163 | 2/162 |

Although not detected in this study, *Amblyomma cajennense* also infests cattle. The information is important to any future tick control or eradication program.

The presence of *T. cruzi* emphasized the need both for the type of building construction which discourages the breeding of the reduviid bug vectors and for the routine serological screening of personnel for infection. *T. evansi* in capybara[12] demonstrated the need to examine this species as a possible reservoir host.

Leptospirosis of cattle in the Llanos Orientales is an important disease.[5] Serological evidence indicates that 11 serotypes infect cattle, the most prevalent being *L. hardjo, L. sejroe, L. wolfii, L. hebdomadis* and *L. tarassovi.* A relatively low prevalence was detected in the wild animal population. In addition, no evidence of brucellosis was found; however, the prevalence in Llanos cattle is low.[5] The transmission of these diseases to the Llanos by imported cattle can be assumed; increasing cattle density, and, therefore, cattle-wildlife contact may create important wildlife reservoirs.

The discovery of the *Echinococcus* cysts requires urgent determination of the species. If the species is infective to man or domestic animals, a potential exists for an important health hazard to man or disease of cattle of major economic importance.

The results briefly described stimulated specific investigations. A survey of avian species for ecto- and hemoparasites has been completed (Furness — in preparation). The carrier status of *H. hydrochaeris* for *T. evansi* was established,[12] the probable usefulness of *Proechimys* as a laboratory host defined,[11] and serological evidence collected that isolations of this trypanosome from the horse and the dog as well as the *H. hydrochaeris* shared common agglutinating antigens confirming common species identity.[15] Routine serological screening of the laborers at Carimagua research station for *T. cruzi* was initiated.[5] The helminth infection of the capybara kidneys has been identified as a new species of filaria[6] and intensive work continues on the identity of the *Echinococcus.*[13,19]

## CONCLUSIONS

This research was conducted with minimal human and material resource and was, by the nature of the exercise, incomplete. Nevertheless, potentially important disease situations were revealed.

However, not only do these situations require monitoring, but other specific investigations are needed. A specific example is the relationship of wildlife to bovine anaplasmosis *(Anaplasma marginale),* bovine babesiosis *(Babesia argentina* and *B. bigemina),* and bovine trypanosomiasis *(Trypanosoma vivax),* all of which are endemic in the cattle population.[5,21]

The potential importance of mammalian wildlife diseases in relation to developing cattle areas was demonstated and an input of this nature is an obvious requirement in any human and animal disease surveillance system.

**Acknowledgements**

Thanks are due to several workers and organizations for their assistance in the diagnosis of infections and parasitisms. In particular: Hemoparasites — Dr. Stephen Ayala, Department of Parasitology, Faculty of Medicine, Universidad del Valle, Cali; Bacteriology — Dr. Eduardo Aycardi, Centro Internacional de Agricultura Tropical, Cali and Mr. Myers, Panamerican Center of Zoonosis (CEPANZO); Virology — Dr. Alvaro Dueñas, Department of Microbiology, Faculty of Medicine, Universidad del Valle, Cali; identification of fleas — Dr. Eustorgio Mendez, Gorgas Memorial Laboratory, Panama; identification of bats — Dr. Maurice Thomas, Tulane Universi-

ty International Center for Medical Research, Cali; and identification of ticks — Dr. Ken Thompson, Centro Internacional de Agricultura Tropical, Cali.

## LITERATURE CITED

1. AYALA, S., A. D'ALESSANDRO, R. MACKENZIE and D. ANGEL. 1973. Hemoparasite infections in 830 wild animals from Eastern Colombia. J. Parasit. 59: 52-59.
2. BRUNNSCHWEILER, D. 1972. The llanos frontier of Colombia. Latin American Studies Center. Monograph No. 9. Michigan State Univ.
3. Centro Internacional de Agricultura Tropical. 1974. Ann. rpt. for 1973. CIAT, Cali, Colombia.
4. ———. 1975. Ann. rpt. for 1974. CIAT, Cali, Colombia.
5. ———. 1976. Ann. rpt. for 1975. CIAT, Cali, Colombia.
6. EBERHARD, M.L., G.A. MORALES and T.C. ORIHEL. 1976. *Cruorifilaria tuberocauda* Gen. and Sp. N. (Nematoda: Filarioidea) from the capybara, *Hydrochoerus hydrochaeris* in Colombia. J. Parasit. 62: 604-607.
7. ELDRIDGE, B.F. and G.B. FAIRCHILD. 1973. A survey to assess potential human disease hazards along proposed sea level canal routes in Panama and Colombia. II. Geography of routes. Milit. Med. 138: 269-270.
8. ———, D.G. YOUND and R.R. GERHARDT. 1973. A survey to assess potential human disease hazards along proposed sea level canal routes in Panama and Colombia. III. Survey methods. Milit. Med. 138: 340-344.
9. FLETCHER, W. 1928. Recent work on leptospirosis, Tsutsugamushi disease and tropical typhus in the Federal Malay States. Trans. R. Soc. trop. Med. Hyg. 21: 265-288.
10. LORD, R.D. 1972. The role of wild hosts in the zoonoses. Zoonosis 14: 145-149.
11. MORALES, G.A. and F. CARREÑO. 1976. The *Proechimys* rat: a potential laboratory host and model for the study of *Trypanosoma evansi*. Trop. Anim. Hlth. Prod. 8: 122-124.
12. ———, E.A. WELLS and D. ANGEL. 1976. The capybara *(Hydrochoerus hydrochaeris)* as a reservoir host for *Trypanosoma evansi*. J. Wildl. Dis. 12: 572-574.
13. ———, V.H. GUZMAN, E.A. WELLS and D. ANGEL. 1979. Polycystic *Echinococcus* in Colombia: the larval cestodes in infected rodents. J. Wildl. Dis. 15: 421-428.
14. MORRIS, D. 1965. *The Mammals*. Hodder and Stoughton, London.
15. RAMIREZ, L.E. 1976. Comportamiento antigénico del *Trypanosoma evansi*. Requisito parcial para optar el grado de Magister Scientiae, Facultad de Medicina, Universidad de Antioquia, Medellín, Colombia.
16. RENJIFO, S., C. SANMARTIN and J. de ZULUETA. 1952. A survey of the blood parasites of vertebrates in Eastern Colombia. Acta Trop. 9: 151-169.
17. STACEY, H.G., M.D. YOUNG and G.B. FAIRCHILD. 1973. A survey to assess human disease hazards along proposed sea level canal routes in Panama and Colombia. I. Introduction. Milit. Med. 138: 271-275.
18. TOBIE, E.J., T. von BRAND and B. MEHLMAN. 1950. Cultural and physiological observations on *Trypanosoma rhodesiense* and *Trypanosoma gambiense*. J. Parasit. 36: 48-54.

19. Tulane University International Center for Medical Research. 1976. Annual progress report to March 1976. School of Public Health and Tropical Medicine, New Orleans, Louisiana.

20. WELLS, E.A. 1973. Animal health hazards in developing new beef cattle production areas. In: proceedings "*Tropical America: Potential to Increase Beef Production.*" Centro Internacional de Agricultura Tropical, Cali, Colombia.

21. ——, A. BETANCOURT and L.E. RAMIREZ. 1977. The epidemiology of *Trypanosoma vivax*: some results from the use of an indirect fluorescent antibody test. J. Protozool. 24: 41A-42A (seminar abstract).

*Received for publication 7 June 1977*