TICKS OF THE GENUS *AMBLYOMMA* (ACARI: IXODIDA: IXODIDAE) FROM WHITE-LIPPED PECCARIES, *TAYASSU PECARI*, IN NORTHEASTERN BOLIVIA, WITH COMMENTS ON HOST SPECIFICITY[1]

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ABSTRACT: Adults of the ixodid ticks *Amblyomma cajennense, A. naponense, A. oblongoguttatum,* and *A. pecarium* are reported from Bolivian populations of the white-lipped peccary, *Tayassu pecari*. These are the first published records of *A. naponense* and *A. pecarium* from Bolivia. Infestations of the three most numerous tick species on *T. pecari* are shown to be statistically independent of host age and sex. It is suggested that in some species of *Amblyomma,* host specificity may manifest itself chiefly at the preimaginal level, diminishing or disappearing in adults.

It has often been noted that ticks of the genus *Amblyomma* parasitize all classes of terrestrial vertebrates, but that among those specific to mammals, adults are generally more common on large herbivores, while immatures infest much smaller mammals (e.g., rodents) or even birds (Hoogstraal 1973, Hoogstraal and Aeschlimann 1982, Hoogstraal 1985). Less often reported are data on the frequency or extent of multi-species assemblages of adult *Amblyomma* on large mammal hosts (Fairchild et al. 1966, Matthysse and Colbo 1987, Walker and Olwage 1987). In February of 1996, and again in February of 1997, one of us (WBK) traveled to the Lago Caiman research camp (13.35S, 60.54W), Noel Kempff Mercado National Park, in the northeastern corner of the Department of Santa Cruz, Bolivia, to assess the health of three herds of 15-40 white-lipped peccaries, *Tayassu pecari* (Link, 1795), that had been caught as groups in a 0.405 ha capture corral. *Tayassu pecari* occurs from southern Mexico to northeastern Argentina, but because the large tracts of wilderness on which it depends are rapidly being fragmented, this species has disappeared or become rare in the northern and southern portions of its range and is now listed in appendix 2 (species not necessarily threatened with extinction but that may become so unless trade is subjected to strict regulation) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora

[1] Received August 7, 1997. Accepted August 30, 1997.

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(Mayer and Wetzel 1987, Nowak 1991, Wilson and Reeder 1993). Accordingly, we decided to collect all tick specimens found on our Bolivian peccaries in order both to document the diversity of species parasitizing *T. pecari* at this locale and to determine whether particular host attributes have a bearing on parasitization. Continuing habitat loss will render such analyses impossible within the working lifetime of contemporary investigators.

METHODS

Over a period of years, one of us (RLEP) developed the Lago Caiman research camp and constructed the peccary capture areas. The lowland forest of Noel Kempff Mercado National Park is broadly classified as subhumid but comprises several forest types; one of these, which includes Lago Caiman, is tall forest with canopy heights of 30-35 m. This part of Bolivia is characterized by a marked dry season in the austral winter, a mean daily temperature of 25°C, and annual precipitation greater than 1500 mm (Killeen 1996).

On 26 February 1996, 13 captured peccaries were randomly targeted for immobilization and tick collection at Lago Caiman. On 17 and 18 February of the following year, an additional 27 peccaries were similarly selected. All peccaries were sedated using a combination of tiletamine hydrochloride and zolazepam administered by projectile syringe dart. Their pelage was then carefully searched for ticks, and virtually complete collections were secured from 35 of the 40 animals. Following recovery from anesthesia, all peccaries were released. Ticks were preserved in 70% ethanol and shipped to RGR for identification.

By means of contingency tests, it was possible to examine whether tick infestations were dependent on particular attributes of individual peccaries, such as age (adults vs. immatures) and sex. Weight was discounted as a testable attribute because of its dependence on numerous variables, including sex, health and season. In all cases, the variety of contingency test used was the log likelihood ratio or G-test, with Yates' correction for small sample sizes (Sokal and Rohlf 1973). Peccaries harboring only preimaginal ticks (larvae, nymphs), which could not be identified to species, were excluded from this analysis. Because all tests were 2 x 2, computed values of G were compared with a critical value of the chi-square distribution of 3.841 (one degree of freedom) at $P = 0.05$.

RESULTS AND DISCUSSION

Adults of four species of *Amblyomma* – *A. cajennense* (Fabricius, 1787) (9♂), *A. naponense* (Packard, 1869) (35♂, 27♀), *A. oblongoguttatum* Koch, 1844 (36♂, 40♀), and *A. pecarium* Dunn, 1933 (35♀) – were found on 31 of 35 parasitized *T. pecari* at Lago Caiman (four peccaries harbored only *Amblyomma* nymphs or larvae). All are relatively common ticks that have previ-

ously been reported from this host (Aragão and Fonseca 1961, Hoffmann 1962, Fairchild et al. 1966, Jones et al. 1972). Yet, to the best of our knowledge, these are the first published records of *A. naponense* and *A. pecarium* from Bolivia.

The Field Veterinary Program, Wildlife Conservation Society (formerly New York Zoological Society), has assigned accession numbers WLP 2 through WLP 14 and MEDARKS (Medical Archives) numbers 96-0422 through 96-0435 to the tick collections made at Lago Caiman in 1996; those made in 1997 have received accession numbers WLP 15 through WLP 40 and MEDARKS numbers 97-0546 through 97-0567. All collections are on long-term loan to RGR.

Descriptive statistics for the prevalence and intensity of parasitization by adults of each tick species appear in Table 1. Typically, ectoparasites are contagiously dispersed (overdispersed, clumped) on host populations, a condition in which the zero class is often large (Robbins and Faulkenberry 1982). In the case at hand, of 31 sampled peccaries, only 6 were infested by *A. cajennense*, 15 by *A. naponense*, 23 by *A. oblongoguttatum*, and 19 by *A. pecarium*. However, the range of parasitization was broad, as reflected in the disproportionately large standard deviations and coefficients of variation of each tick species. Also, sex ratios (males/females) differed dramatically among the four species of *Amblyomma*: all male for *A. cajennense*, 1.29 for *A. naponense*, 0.90 for *A. oblongoguttatum*, and all female for *A. pecarium*, perhaps an indication that these species were sampled at different stages of their life cycles on *T. pecari*, or that *T. pecari* is an incidental host for one or more of them. In this regard, it should be noted that while males of *A. cajennense* and *A. pecarium* differ markedly in facies, females of the two species are easily confused. Therefore, throughout this study, no female specimen was accepted as *A. pecarium* unless it met all the differential criteria of Jones et al. (1972): palpal segment II about $2^1/_2$ times as long as segment III; festoons ventrally rugose and relatively poorly defined, first 4 on either side of the median festoon each with a well-

Table 1. Descriptive statistics for adults of four species of *Amblyomma* parasitizing 31 individuals of *T. pecari* from Lago Caiman, Bolivia, 26 February 1996 and 17-18 February 1997, collector W. B. Karesh.

Tick Species	Range (Ticks/Peccary)	Mean with Standard Error	Standard Deviation	Coefficient of Variation
A. cajennense	0-2	0.3 ± 0.1	0.6	200.0
A. naponense	0-34	2.0 ± 1.1	6.1	305.0
A. oblongoguttatum	0-13	2.5 ± 0.6	3.1	124.0
A. pecarium	0-5	1.1 ± 0.3	1.4	127.3

developed tubercle at the posterointernal angle; and internal spur of coxa I broad and blunt.

G-test results for the three most numerous tick species on *T. pecari* appear in Table 2, where the observed statistical independence between tick infestation and host age or sex indicates that factors other than host attributes are responsible for the spectrum of parasitization summarized in Table 1. Because 53 of the world's approximately 104 *Amblyomma* species occur in the Neotropics, host specificity is almost certainly one such factor. But while adults of *A. pecarium* seem to be strict parasites of peccaries (Fairchild et al. 1966), adults of *A. cajennense, A. naponense* and *A. oblongoguttatum* are known from a variety of large- and medium-sized mammals (Jones et al. 1972). Clearly, our results lend themselves to any number of explanations, yet we suggest that the presence of four species of *Amblyomma* on but a single species of host may be a sign that host specificity either diminishes or disappears in adults of some amblyommines, manifesting itself instead chiefly at the preimaginal level. However, as has often been stated (Fairchild et al. 1966, Jones et al. 1972, Keirans 1992, Robbins et al. 1997), immature *Amblyomma*, especially in the Neotropics, remain mostly unidentifiable. Until rearing or molecular genetic studies enable us to associate the immatures found on one set of hosts with the adults found on another, definitive explanations for ostensible instances of host specificity will remain beyond our grasp.

Table 2. Tests of association between tick infestation and attributes of *Tayassu pecari*.

Attribute	Tick Species	Results
Age	*A. naponense*	Independent; G = 0.370; P >> 0.05
	A. oblongoguttatum	Independent; G = 0.308; P >> 0.05
	A. pecarium	Independent; G = 1.066; P > 0.05
Sex	*A. naponense*	Independent; G = 0.016; P >> 0.05
	A. oblongoguttatum	Independent; G = 0.086; P >> 0.05
	A. pecarium	Independent; G = 0.348; P >> 0.05

ACKNOWLEDGMENTS

We thank the Bolivian National Secretariat for Protected Areas for permission to work in Noel Kempff Mercado National Park, and the National Directorate for the Protection of Biodiversity for help in acquiring the necessary permits. We are extremely grateful to Robert Wallace, Marcela M. Uhart, Nicolas Tagua, Jose Chuviña and Walter "Piraña" Perez, whose dedication and initiative were exemplary throughout this study. Thanks also to Damian Rumiz and the staff of the Bolivian Sustainable Forestry Project (BOLFOR) and to F.A.N. (Fundación Amigos de la Naturaleza, Santa Cruz, Bolivia) for the logistical support they provided. For their insightful comments on an earlier version of this work, we thank Thomas J. Daniels and Richard

C. Falco of Fordham University's Louis Calder Center in Armonk, New York. And thanks to Lance A. Durden and James E. Keirans, Institute of Arthropodology and Parasitology, Georgia Southern University, Statesboro, for generously providing several important taxonomic references and for critical assistance in distinguishing *A. cajennense* from *A. pecarium*. This study was funded primarily through a grant from the Environmental Program of the Dutch Embassy in Bolivia, by BOLFOR (which is financed by the U.S. Agency for International Development and the Bolivian government), and by the Wildlife Conservation Society. The opinions and assertions advanced herein are those of the authors and are not to be construed as official or reflecting the views of the U.S. Departments of the Army or Defense.

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