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THE ECOLOGY OF *RHIPICEPHALUS ZAMBEZIENSIS* AND *RHIPICEPHALUS APPENDICULATUS* (ACARINA, IXODIDAE) WITH PARTICULAR REFERENCE TO ZIMBABWE

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ABSTRACT

NORVAL, R. A. I., WALKER, JANE B. & COLBORNE, J., 1982. The ecology of *Rhipicephalus zambeziensis* and *Rhipicephalus appendiculatus* (Acarina, Ixodidae) with particular reference to Zimbabwe. *Onderstepoort Journal of Veterinary Research*, 49, 181–190 (1982)

R. zambeziensis, like *R. appendiculatus*, is primarily a parasite of domestic and wild herbivores, and sometimes carnivores. Both species occur in parts of east, central and southern Africa, but they are not as a rule sympatric. In general, *R. zambeziensis* occurs in hotter, drier areas than does *R. appendiculatus*, especially along some of the great river valleys. In Zimbabwe, *R. zambeziensis* is largely restricted to the northern, north-western and southern parts of the country, whereas *R. appendiculatus* is widely distributed in the eastern and southern areas.

INTRODUCTION

The ixodid ticks *Rhipicephalus zambeziensis* and *Rhipicephalus appendiculatus* are morphologically very similar and have often been confused in the past. Laboratory experiments have shown, though, that they do not interbreed (Walker, Norval & Corwin, 1981). Both species occur in parts of eastern and southern Africa, and are sympatric in some places, but in general *R. zambeziensis* is found in hotter, drier areas than *R. appendiculatus*.

In this paper all available information, published and otherwise, on the host relationships and distribution of *R. zambeziensis* throughout its range in Africa is reviewed. In Zimbabwe, the ecology of this species is compared with that of *R. appendiculatus*.

SOURCES OF MATERIAL

R. zambeziensis has been listed as *Rhipicephalus* species II in Tanzania (Yeoman & Walker, 1967) and Botswana (Walker, Mehlitz & Jones, 1978). Ticks from Zambia that are now accepted as *R. zambeziensis* include heavily punctate "specimens near *R. appendiculatus*" (MacLeod, 1970, p. 257); the atypical, heavily punctate "*R. appendiculatus* infesting wild ruminants along the escarpment slopes of the Zambezi" (MacLeod, Colbo, Madbouly & Mwanaumo, 1977, p. 172), and "the *R. appendiculatus*-like tick found in parts of the Luangwa and lower Zambezi valleys" (MacLeod & Mwanaumo, 1978, p. 426). Many of these Zambian collections have subsequently been seen, and the identity of the ticks confirmed, by one of the authors (J.B.W.).

The majority of our collections were obtained during a recent national tick survey in Zimbabwe. The aim of this survey was to cover as wide an area as possible, and the methods used are described briefly by Mason & Norval (1980). Most of the collecting was done by Animal Health Inspectors and by staff of the Department of National Parks and Wildlife Management, the National Museums and the Department of Agricultural Development, and some by other interested persons. Collectors were simply asked to take a representative sample of ticks from each part of the host's body and, on an accompanying form, to comment on the degree of infestation. It would have been unreasonable to expect more than this, especially as most of the collecting was done under wartime conditions, when the time that could be spent at any one place was generally very short. Sampling was, therefore, seldom quantitative, but enough information was obtained in most areas to give a good idea of the abundance and distribution of the tick species present, especially those commonly parasitic on domestic stock. In the laboratory special care was taken to distinguish between *R. zambeziensis* and *R. appendiculatus*. In Zimbabwe, therefore, it has been possible to describe the ecology of *R. zambeziensis* in greater detail than elsewhere and to compare it with that of *R. appendiculatus*.

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HOST RELATIONSHIPS

Host records of *R. zambeziensis* from all parts of its range, and of *R. appendiculatus* from Zimbabwe, are listed in Tables 1 and 2 respectively.

In Zimbabwe, over 10 times more specimens of all stages of *R. appendiculatus* (11 465) than of *R. zambeziensis* (1 088) were collected during the survey, and the infestations of *R. appendiculatus* on individual animals were usually greater.

On domestic animals proportionally more samples of both species were collected from horses (*R. zambeziensis* 15,4%, *R. appendiculatus* 68,4%) than from cattle (*R. zambeziensis* 10,4%, *R. appendiculatus* 32,2%).

This is possibly because cattle are dipped regularly, but horses are not. Immature specimens of *R. zambeziensis* (nymphae) were found on cattle only, whereas larvae and nymphae of *R. appendiculatus* were taken from cattle, sheep, goats and horses. Elsewhere in Africa cattle are the only domestic animals on which *R. zambeziensis* has as yet been found.

Regarding wild animals in Zimbabwe, although relatively few eland, sable antelope and reedbuck were examined, it is noteworthy that their percentage infestation with 1 or both of these species was fairly high. The figures for 14 eland were *R. zambeziensis* 21,4%, *R. appendiculatus* 50%; for 24 sable antelope *R. zambeziensis* 25%, *R. appendiculatus* 62,5%, and for 3 reedbuck *R. appendiculatus* 66,7%. All 6 of the waterbuck examined carried *R. appendiculatus*, and they can apparently become heavily infested with this tick. The percentage infestation rates of the 30 or more individuals of each of the following species that were examined are also interesting: greater kudu *R. zambeziensis* 15,6%, *R. appendiculatus* 40,6%; impala *R. zambeziensis* 22,1%, *R. appendiculatus* 43%; African buffalo *R. zambeziensis* 11,3%, *R. appendiculatus* 11,3%, and Burchell's zebra *R. zambeziensis* 5,9%, *R. appendiculatus*, 20,6%.

Very few larvae and nymphae of *R. zambeziensis* were collected from wild animals in Zimbabwe. Most were taken from impala, which also appear to be the favourite hosts of the immature stages of *R. appendiculatus*. In total tick collections made in South Africa from 8 greater kudu in the Kruger National Park, in August and September, I. G. Horak (personal communication, 1981) found 1113 nymphae of *R. zambeziensis*. Of these, 784 nymphae (70,4%) were attached on the lower legs and feet; 234 (21%) on the neck, body and upper part of the legs; 84 (7,5%) on the head, and the remaining 11 (1%) on the tail.

TABLE 1 Host records of *Rhipicephalus zambeziensis*

	Zimbabwe						Elsewhere in Africa: No. of collections	Total collections
	No. of collections made	No. containing *R. zambeziensis*	Total ♂♂	♀♀	NN	LL		
DOMESTIC ANIMALS								
Cattle	722	**75**	144	299	23	—	**10**	**85**
Horses	39	**6**	31	51	—	—	—	**6**
Dogs	282	**12**	3	16	—	—	—	**12**
WILD ANIMALS								
Greater kudu (*Tragelaphus strepsiceros*)	32	**5**	36	19	—	—	**40**	**45**
Nyala (*Tragelaphus angasi*)	—	—	—	—	—	—	**2**	**2**
Bushbuck (*Tragelaphus scriptus*)	—	—	—	—	—	—	**10**	**10**
Eland (*Taurotragus oryx*)	14	**3**	52	29	—	—	**2**	**5**
Roan antelope (*Hippotragus equinus*)	—	—	—	—	—	—	**1***	**1**
Sable antelope (*Hippotragus niger*)	24	**6**	7	7	—	—	**1**	7
Blue wildebeest (*Connochaetes taurinus*)	—	—	—	—	—	—	**13**	**13**
Impala (*Aepyceros melampus*)	104	**23**	102	51	24	21	**10**	**33**
Common duiker (*Sylvicapra grimmia*)	7	**2**	—	—	10	—	—	**2**
Klipspringer (*Oreotragus oreotragus*)	2	**1**	—	—	2	—	—	**1**
African buffalo (*Syncerus caffer*)	133	**15**	66	27	—	1	**4**	**19**
Giraffe (*Giraffa camelopardalis*)	8	**2**	9	8	—	—	—	**2**
Bush pig (*Potamochoerus porcus*)	15	**2**	1	3	—	—	—	**2**
Wart hog (*Phacochoerus aethiopicus*)	18	**1**	2	2	—	—	**28**	**29**
Burchell's zebra (*Equus burchelli*)	34	**2**	4	1	—	—	—	**2**
Spring hare (*Pedetes capensis*)	4	**1**	—	—	2	—	—	**1**
Cape hare (*Lepus capensis*)	9	**1**	—	—	1	—	—	**1**
Slender mongoose (*Herpestes sanguineus*)	11	**1**	—	—	7	—	—	**1**
Black-backed jackal (*Canis mesomelas*)	—	—	—	—	—	—	**2**	**2**
Brown hyaena (*Hyaena brunnea*)	—	—	—	—	—	—	**1**	**1**
Leopard (*Panthera pardus*)	9	**3**	3	5	—	—	**1**	**4**
Lion (*Panthera leo*)	7	**4**	10	6	—	—	**10**	**14**
Cheetah (*Acinonyx jubatus*)	—	—	—	—	—	—	**1**	**1**
Antbear (*Orycteropus afer*)	2	**1**	—	3	—	—	—	**1**

* Nuttall collection No. 1314, 3 ♂♂, 3 ♀♀ from roan antelope, upper Luangwa River, N.E. Rhodesia, collected on 7. viii. 1910 by S.A. Neave; originally identified as *Rhipicephalus appendiculatus*

TABLE 2 Host records of *Rhipicephalus appendiculatus* from Zimbabwe

Host	No. of collections made	No. containing *R. appendiculatus*	Total ♂♂	♀♀	NN	LL
DOMESTIC ANIMALS						
Cattle	722	**240**	1 532	1 530	937	23
Sheep	35	**10**	12	16	112	11
Goats	28	**4**	15	5	9	—
Horses	39	**13**	234	168	6	—
Donkeys	11	**1**	1	—	—	—
Dogs	282	**3**	2	1	—	—
WILD ANIMALS						
Greater kudu (*Tragelaphus strepsiceros*)	32	**13**	149	80	173	9
Eland (*Taurotragus oryx*)	14	**7**	119	108	39	14
Blue wildebeest (*Connochaetes taurinus*)	14	**5**	1	1	33	4
Tsessebe (*Damaliscus lunatus*)	2	**1**	—	1	—	—
Sable antelope (*Hippotragus niger*)	24	**15**	286	209	18	—
Impala (*Aepyceros melampus*)	104	**45**	91	108	3 385	859
Waterbuck (*Kobus ellipsiprymnus*)	6	**6**	28	42	113	2
Reedbuck (*Redunca arundinum*)	3	**2**	17	14	—	—
Common duiker (*Sylvicapra grimmia*)	7	**2**	2	4	3	—
Klipspringer (*Oreotragus oreotragus*)	2	**1**	—	—	4	—
African buffalo (*Syncerus caffer*)	133	**15**	219	116	34	—
Bush pig (*Potamochoerus porcus*)	15	**4**	1	2	3	—
Wart hog (*Phacochoerus aethiopicus*)	18	**2**	1	1	8	—
White rhinoceros (*Ceratotherium simum*)	19	**4**	1	1	6	—
Burchell's zebra (*Equus burchelli*)	34	**7**	44	20	78	2
Spring hare (*Pedetes capensis*)	4	**1**	—	—	142	24
Cape hare (*Lepus capensis*)	9	**1**	—	—	93	14
Cape dassie (*Procavia capensis*)	20	**3**	—	—	42	1
Bruce's dassie (*Heterohyrax brucei*)	7	**1**	—	—	4	1
Wild cat (*Felis libyca*)	4	**1**	—	—	4	—
Serval (*Felis serval*)	6	**1**	—	—	1	—
Civet (*Viverra civetta*)	15	**3**	5	4	3	—
Genet (*Genetta* spp.)	38	**3**	1	1	1	—
White-tailed mongoose (*Ichneumia albicauda*)	2	**1**	—	—	1	—
Egyptian mongoose (*Herpestes ichneumon*)	3	**2**	—	—	4	5
Jackal (*Canis* spp.)	24	**7**	—	2	11	—
Brown hyaena (*Hyaena brunnea*)	1	**1**	—	1	—	—
Chacma baboon (*Papio ursinus*)	1	**1**	—	—	13	—
Vervet monkey (*Cercopithecus aethiops*)	3	**2**	—	—	16	4

In wildlife reserves in the higher rainfall areas of Zimbabwe *R. appendiculatus* has frequently reached problem levels, and in several instances heavy parasitism by this tick has caused mortalities in wild ungulate populations (Lightfoot & Norval, 1981). *R. appendiculatus* has also been found in large numbers on many cattle ranches on which sizeable populations of wild ungulates exist. Similar high levels of abundance of *R. zambeziensis* have not been recorded, either in wildlife reserves or on cattle ranches.

Outside Zimbabwe *R. zambeziensis* has been collected most frequently from cattle, wart hog, blue wildebeest, greater kudu, bushbuck, impala and lion. All but 1 of the collections from impala were made in the northern sector of the Kafue National Park, north of the main E.–W. highway in Zambia. Six of the collections from lion, plus 1 from a leopard, were taken from animals shot by R. H. Ivy in the Shingwidzi block, Sibasa, N.E. Transvaal, during the period 1952–1954.

Zoogeography

Distribution (Fig. 1–3)

In Zimbabwe, *R. zambeziensis* is largely restricted to the northern, north-western and southern areas, while *R. appendiculatus* is widely distributed throughout the central and eastern parts of the country.

The distributions of the 2 species overlap in the Chiredzi, Filabusi, Bulawayo and Plumtree Districts, and at the Victoria Falls. There are also parts of the country, such as the Mudzi District in the north-east, the Nkai and Lupane Districts in the north-west, and the Kezi District in the south-west, from which both appear to be absent.

(a) *R. zambeziensis* (Fig. 1 & 2)

This species occurs in northern Zimbabwe in the Zambezi Valley and Gokwe District; in the north-west in the Kamativi, Victoria Falls, Wankie, Tjolotjo, Plumtree and Bulawayo Districts, and in the south in the Gwanda, West Nicholson, Beitbridge, Nuanetsi, Vila Salazar and Chiredzi Districts and the Sabi Valley.

FIG. 1 Distribution of *Rhipicephalus zambeziensis*

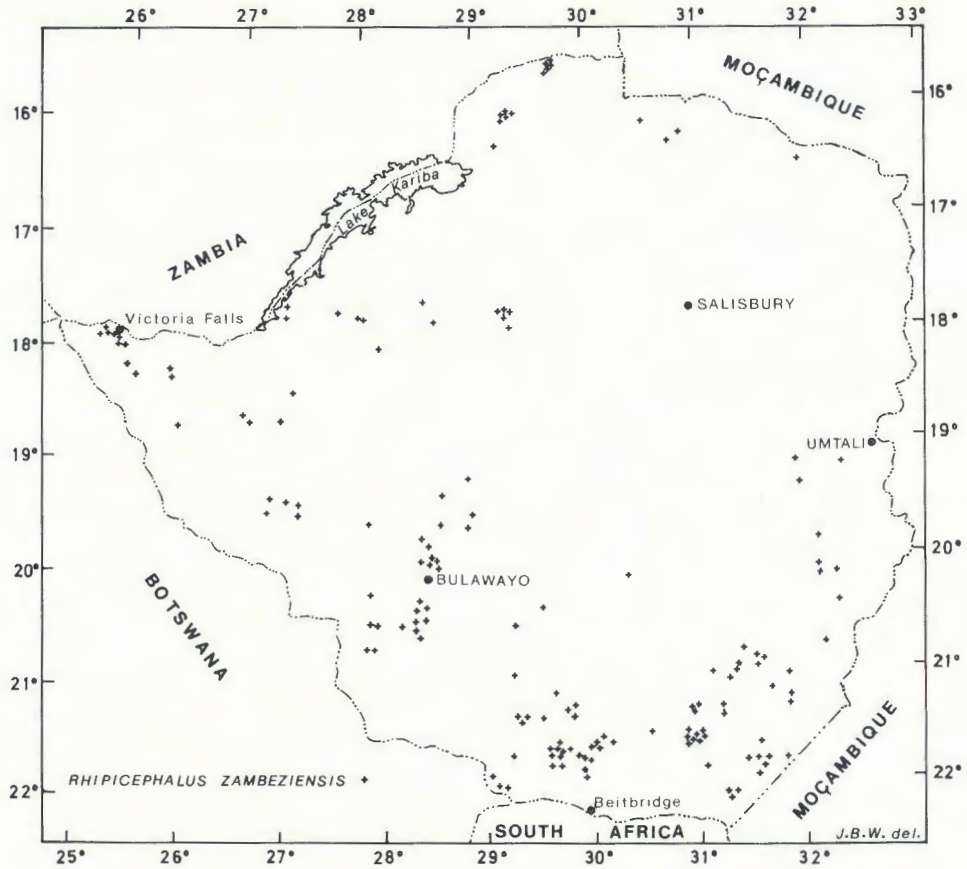

FIG. 2 Distribution of *Rhipicephalus zambeziensis* in Zimbabwe

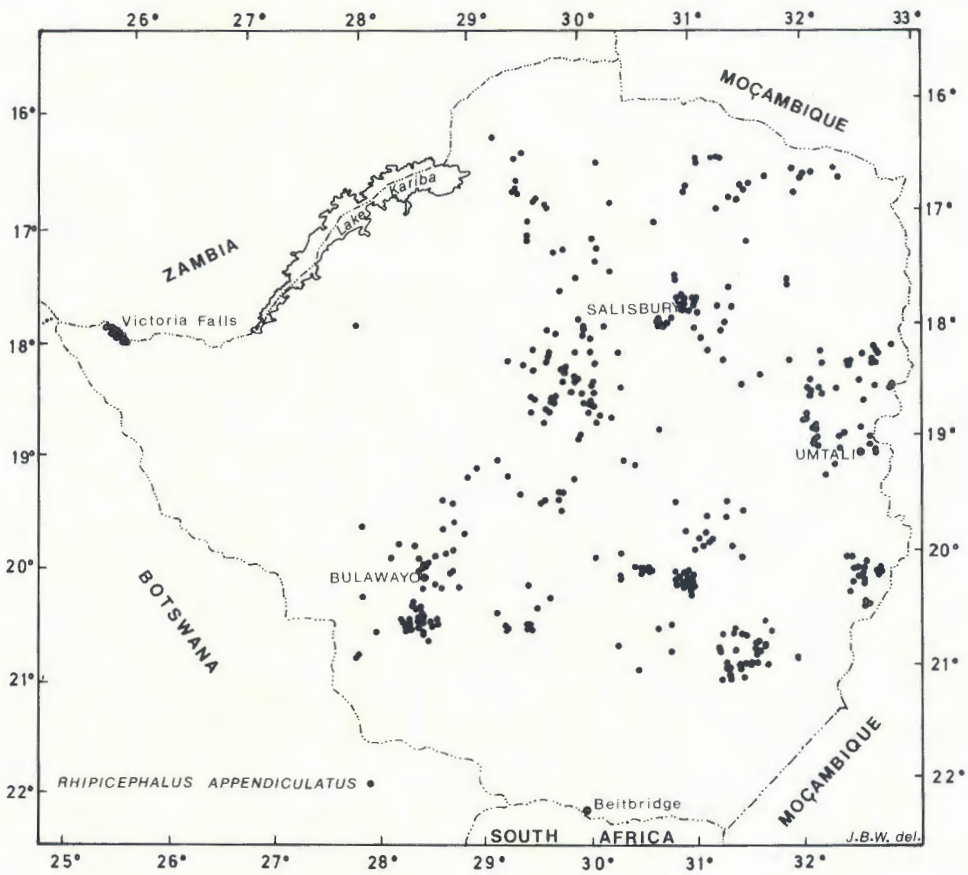

FIG. 3 Distribution of *Rhipicephalus appendiculatus* in Zimbabwe

Outside Zimbabwe there are scattered records of *R. zambeziensis* from many widely separated areas. Our northernmost records of this tick are from Tanzania, in the Ruaha Valley and also on its southern slopes, at Kilolo (8°07′S., 34°25′E.); Bekker's Camp, Usangu (8°14′S., 34°32′E.); Igawa (*c.* 8°50′S., 34°23′E.); Migoli (7°07′S., 35°50′E.), and Kiwere (7°33′S., 35°37′E.).

In Zambia *R. zambeziensis* has been recorded in the south-east at Chipangali (13°10′S., 32°46′E.). It also occurs in the Luangwa Valley, which runs in a south-westerly direction through the eastern part of the country, but at present we do not know its exact whereabouts in this valley. One collection, made by S. A. Neave from roan antelope in the upper Luangwa Valley on 7 August 1910 (Nuttall Collection No. 1314), was doubtless obtained during his journey through the valley from July to September 1910 (Neave, 1911). Its presence in "parts of the Luangwa Valley" is also noted by MacLeod & Mwanaumo (1978). It is recorded from the escarpment slopes of the Zambezi Valley by MacLeod *et al.* (1977) and in the lower Gwembe Valley by MacLeod (1970). Subsequent to the publication of these papers the presence of this tick was confirmed at Feira (15°40′S., 30°25′E.); Shanduka (16°05′S., 28°28′E.); Lusita (16°15′S., 28°35′E.); Cha'anga (16°20′S., 28°25′E.), and Chibelele (16°25′S., 28°48′E.) in the Gwembe Valley; further west at Ngoma (15°55′S., 25°55′E.), and in the northern sector of the Kafue National Park (precise localities unknown) (J. B. Walker, unpublished data, 1980; R. G. Pegram and B. Mwanaumo, personal communication, 1980).

Records of *R. zambeziensis* in other parts of southern Africa are sporadic. In South West Africa/Namibia it is recorded in Kaokoland at Otjipemba (*c.* 17°10′S., 12°53′E.); Ekoto (*c.* 17°59′S., 13°08′E.), and Ondjarakagha (*c.* 17°47′S., 13°34′E.), and in Grootfontein District at Grootfontein itself (19°34′S., 18°07′E.). In Botswana it has been collected in the west in the Marope Swamps, Ngamiland (not located); in the Okavango area (precise locality not known) and just south-west of Sehitwa (20°29′S., 22°42′E.). In the east it occurs at Tshesebe (20°43′S., 27°35′E.), Kgomodiatshaba (23°38′S., 26°06′E.); Mfaladi (23°47′S., 26°10′E.); Dibete (23°45′S., 26°28′E.) and, near Gabarone, at Bokaa (24°25′S., 26°01′E.); Oodi (24°33′S., 26°02′E.); Glent Farm (24°38′S., 26°07′E.), and Egepetwa (24°39′S., 25°59′E.) (Walker *et al.*, 1978).

In South Africa all the records of *R. zambeziensis* to date come from the Transvaal. It has been recorded in the west of the province on the farms "Papendorp" (22°51′S., 28°10′E.) and "Koornhuis" (22°50′S., 28°16′E.) near Swartwater; at Rooiberg (24°46′S., 27°44′E.), near Warmbaths, and on the farm "Karoobult" (25°03′S., 27°34′E.), near Thabazimbi. In the east it has been collected in the Phadzima area (22°57′S., 30°10′E.), Dzanani District; in the Shingwidzi block (*c.* 22°52′S., 30°48′E.), Sibasa; and in the Kruger National Park at Pafuri (22°23′S., 31°12′E.); Skukuza (24°59′S., 31°36′E.); Lower Sabie (25°08′S., 31°55′E.); in the Makhuthwanini area (25°15′S., 31°32′E.), and at Crocodile Bridge (25°22′S., 31°54′E.) (I. G. Horak, personal communication, 1982).

(b) *R. appendiculatus* (Fig. 3)

In central and eastern Zimbabwe *R. appendiculatus* has been recorded from most areas which lie outside the Zambezi and Sabi/Limpopo River valley systems. In the western half of the country, however, this species is restricted to the Gwelo, Bulawayo, Filabusi, Matopos and Plumtree Districts and to a small area around the Victoria Falls (the Victoria Falls rain forest and along the Zambezi River, upstream from the Falls).

There is some evidence that in recent years *R. appendiculatus* has spread in the Chiredzi District to several ranches from which it was previously absent. Local ranchers attribute this spread of the tick to the increasing abundance of wild ungulates in the area and their movements between ranches.

A discussion of the distribution of *R. appendiculatus* in other parts of its range lies outside the scope of this paper.

Physiography (Fig. 4)

In Zimbabwe, the distribution of both *R. zambeziensis* and *R. appendiculatus* is clearly related to physiography. *R. zambeziensis* is mainly confined to the Zambezi and Sabi/Limpopo River valley systems and adjacent low-lying areas. Most parts of its distributional range, therefore, lie at altitudes below 900 m; only in the extreme west is it found at altitudes exceeding 1 200 m. *R. appendiculatus*, on the other hand, is largely restricted to the high-lying central plateau which forms a watershed between the Zambezi and Sabi/Limpopo systems, so this species is generally found at altitudes of 1 200–1 800 m.

The distribution of *R. zambeziensis* only really overlaps that of *R. appendiculatus* in areas where increases in altitude from the river valley systems to the plateau are gradual. In the eastern Zambezi and Sabi Valleys, where steep escarpments exist, their distributions hardly overlap at all.

The vast majority of records of *R. zambeziensis* from outside Zimbabwe also come from areas below 1 200 m in altitude. Some are from other great river valleys in eastern, central and Southern Africa, including the Ruaha, Luangwa, Kafue and Cunene (Fig. 1).

Climate

(a) *Rainfall* (Fig. 5)

In Zimbabwe, there is a clear relationship between the distribution of *R. zambeziensis* and *R. appendiculatus* and rainfall. *R. zambeziensis* occurs in the drier parts of the country where the mean annual rainfall ranges from 400–700 mm. *R. appendiculatus* is absent from areas receiving a mean annual rainfall of less than 500 mm and occurs most commonly in areas receiving 700–2 000 mm. The transition from *R. zambeziensis* to *R. appendiculatus* occurs in the 500–700 mm zone.

In general, the relationship between the occurrence of these 2 species and rainfall is better defined in the eastern half of Zimbabwe than it is in the west. It is also evident that in eastern Zimbabwe *R. appendiculatus* occurs in areas receiving lower rainfall than areas in which it occurs in the west. For example, the species is established in the Chiredzi District in the south-west, where the rainfall is 500–600 mm per annum, but is absent from the Gokwe District in the north-west, where the rainfall is 600–800 mm per annum.

So far as can be determined, the mean annual rainfall in areas outside Zimbabwe where *R. zambeziensis* occurs also ranges from about 400–700 mm, and sometimes even less.

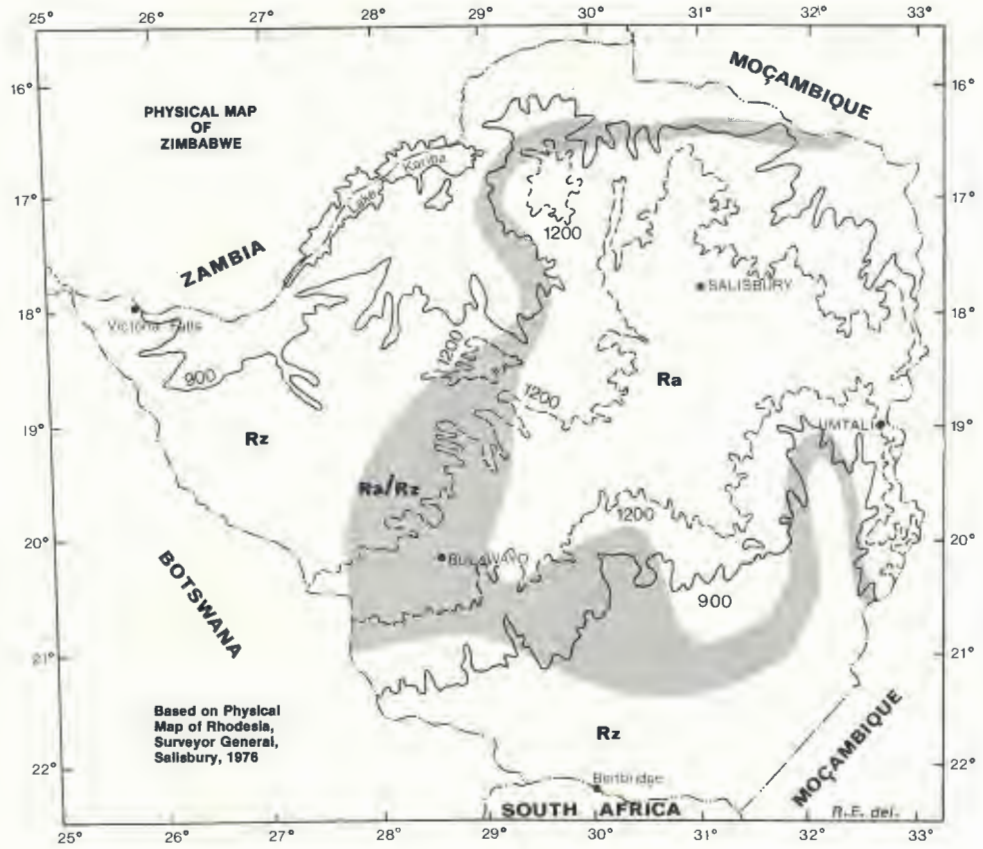

FIG. 4 Physical map of Zimbabwe

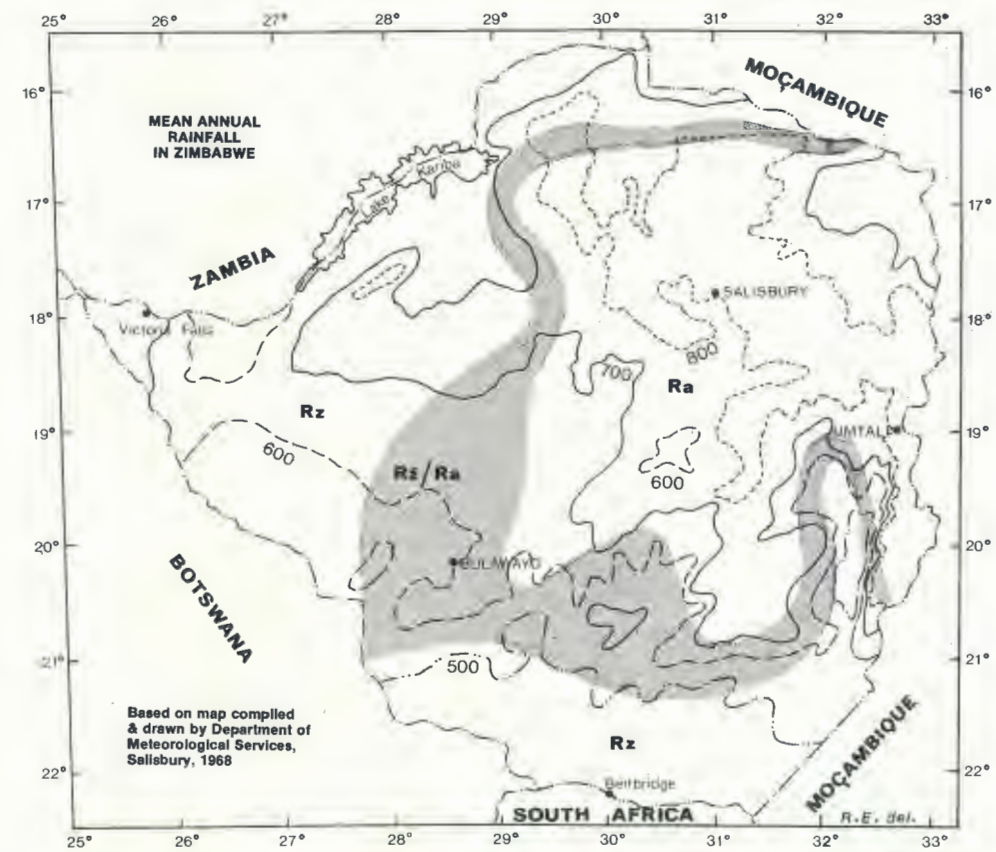

FIG. 5 Mean annual rainfall in Zimbabwe

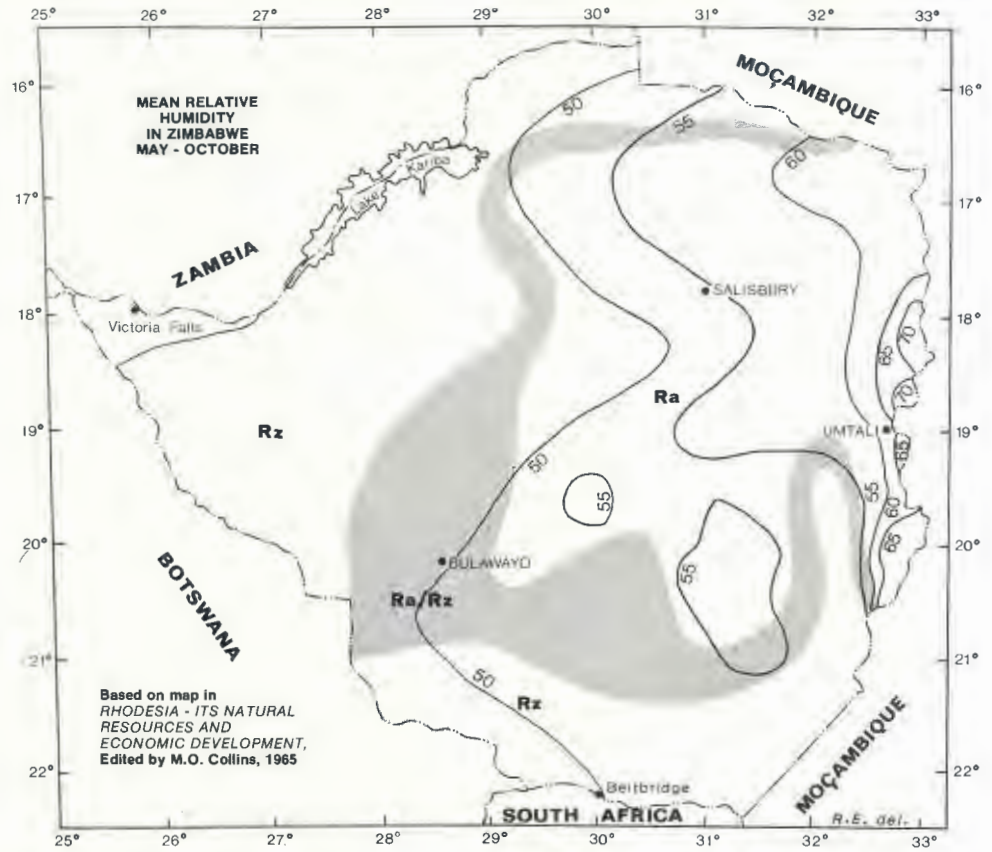

FIG. 6 Mean relative humidity in Zimbabwe (May–October)

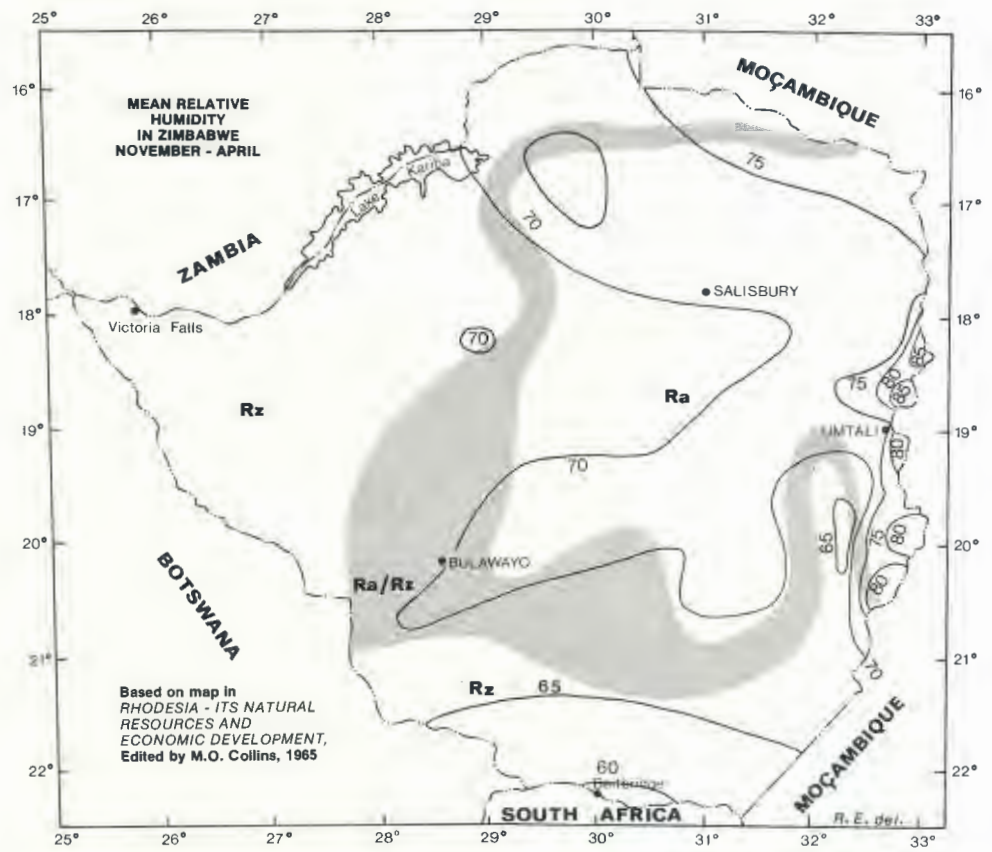

FIG. 7 Mean relative humidity in Zimbabwe (November–April)

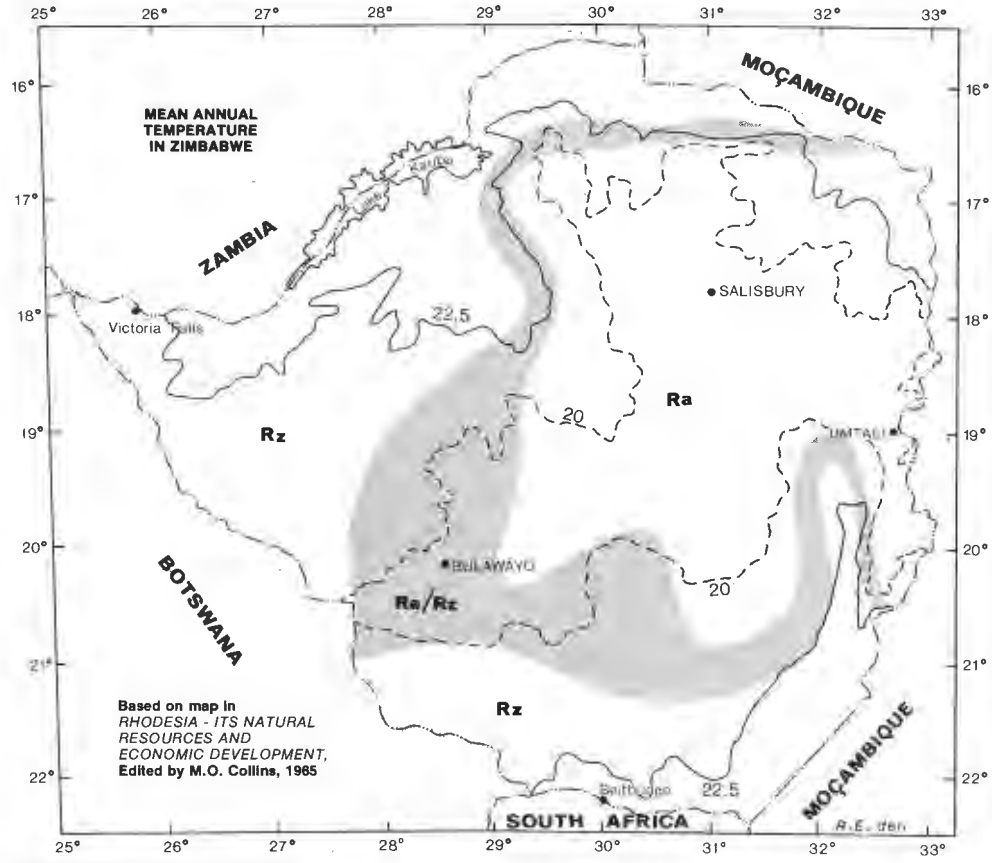

FIG. 8 Mean annual temperature in Zimbabwe

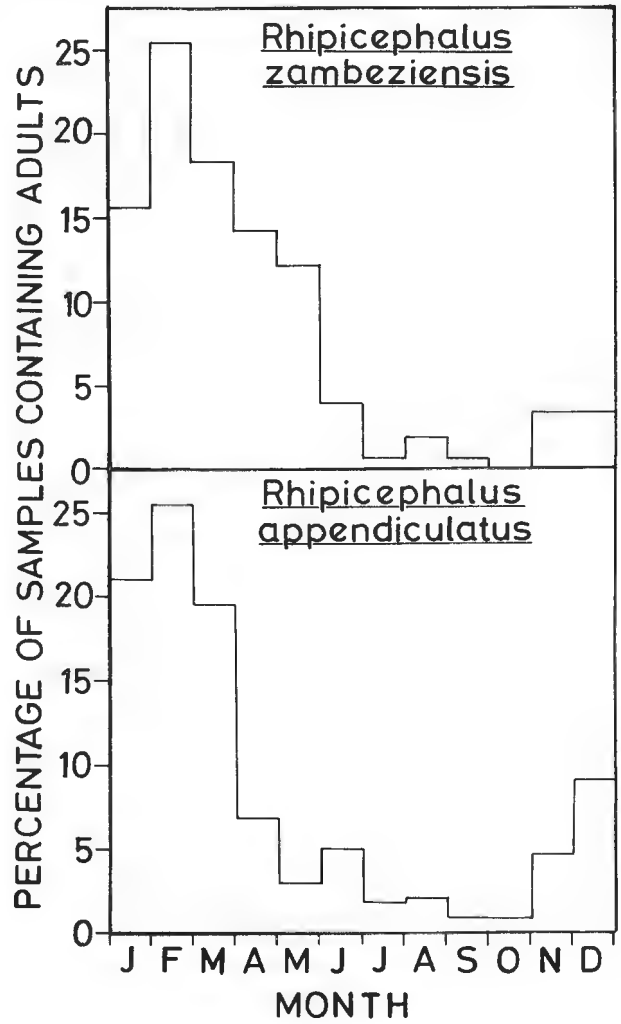

FIG. 9 The seasonal occurrence of *Rhipicephalus appendiculatus* and *Rhipicephalus zambeziensis* in Zimbabwe

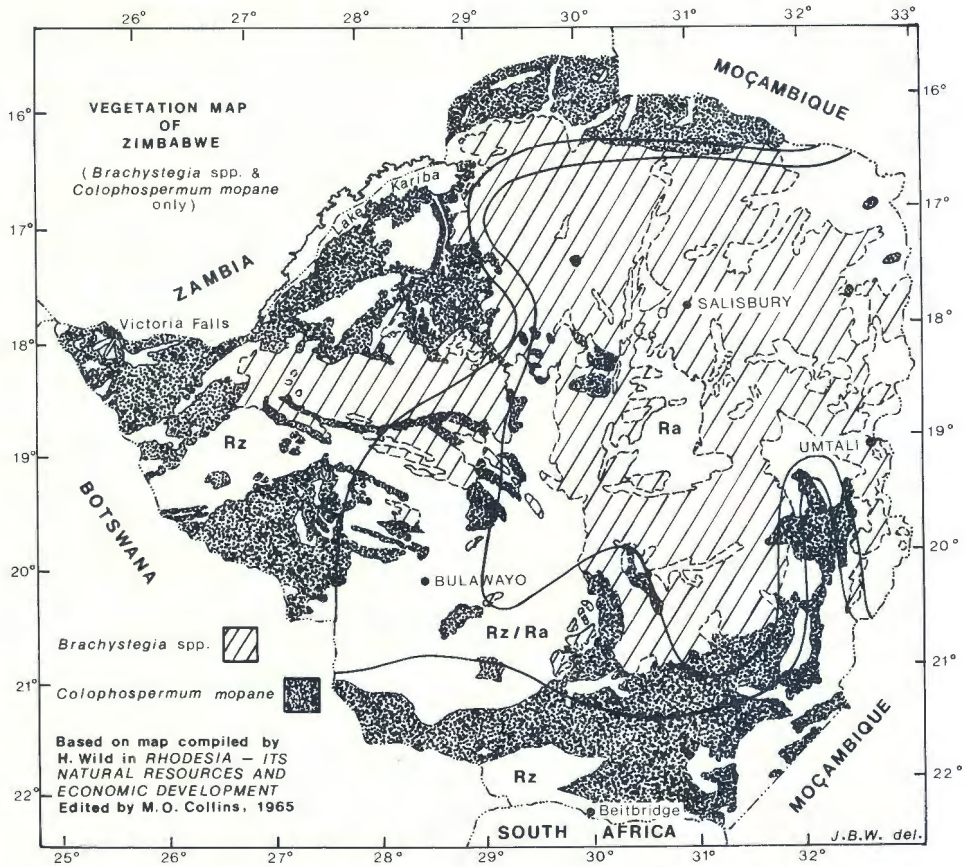

FIG. 10 Vegetation map of Zimbabwe, showing the distribution of *Brachystegia* spp. and *Colophospermum mopane* only

(b) *Relative humidity* (Fig. 6 & 7)

In relation to rainfall (Fig. 5), relative humidity (RH) is higher in the eastern half of Zimbabwe than it is in the west. Consequently, the distributions of *R. zambeziensis* and *R. appendiculatus* conform even more closely with RH zones than with rainfall zones. In the dry months (May–October) the mean RH for most of the *R. appendiculatus* area is 50–70%, as opposed to less than 55% for most of the *R. zambeziensis* area. In the wet months (November–April) the mean RH for a large portion of the *R. appendiculatus* area is 70–85% and the species is absent from places where the mean RH is less than 65%. In the same months the mean RH for most of the *R. zambeziensis* area is less than 70% and along the Limpopo River, in the Beitbridge District, it is less than 60%.

The survival of an isolated population of *R. appendiculatus* in the fairly dry Victoria Falls area is possibly due to the localized effects of the Falls, which generate considerable spray and mist and must therefore increase the RH in the immediate surroundings.

In other parts of Africa *R. zambeziensis* is also found in areas where the atmospheric relative humidity remains fairly low for most of the year.

(c) *Temperature* (Fig. 8)

In general, *R. zambeziensis* occurs in the hotter parts of Zimbabwe and *R. appendiculatus* in the cooler parts. With the exception of the higher-lying parts of the Plumtree, Bulawayo and Filabusi Districts, *R. zambeziensis* is restricted to areas where the mean annual temperature is higher than 20°C. *R. appendiculatus* is absent from all areas where the mean annual temperature exceeds 22,5°C and is present in only a few districts (Chiredzi, Bulawayo, and Victoria Falls) where the mean annual temperature exceeds 20°C.

(d) *Seasonal occurrence*

The percentages of tick samples containing adults of *R. zambeziensis* and *R. appendiculatus* which were collected from cattle in each month of the year are shown in Fig. 9.

The seasonal occurrence of *R. appendiculatus* in Zimbabwe is well documented (Jooste, 1966a, b; Matson & Norval, 1977; Short & Norval, 1981). Adults are most abundant in the latter half of the rainy season (January–April), larvae in the cool dry season (May–August) and nymphae in the hot dry season (August–October). The incidence of the 3 instars in survey collections made in different months of the year confirms this pattern.

The seasonal activity of *R. zambeziensis* follows a similar pattern. In both species the frequency of collection of adults was highest in February and declined to low levels between July and October.

(e) *Vegetation and land utilization*

In Zimbabwe, *R. zambeziensis* is frequently associated with *Colophospermum mopane* woodland and *R. appendiculatus* with *Brachystegia* woodland (Fig. 10). Both species do occur, however, in other vegetation types and there is not a strict association between either species and vegetation type.

Over much of the country and, in particular, the communal tribal areas, the vegetation has been considerably altered by land utilization practices. Trees have been removed for fuel, house-building and to clear the land for agriculture, while high densities of cattle, sheep, goats and donkeys have caused severe over-grazing. Norval (1977) observed that *R. appendiculatus* was largely absent from the tribal lands and suggested that this was because of over-grazing. The present survey findings support this observation. In tick samples collected from cattle, only 8,3% of those from tribal lands contained *R.*

appendiculatus, as opposed to 40,2% of those from commercial farms and ranches (which are generally not overgrazed). The data for *R. zambeziensis* are similar: this species was present in only 3,9% of cattle samples from tribal lands, as opposed to 13,3% of cattle samples from commercial farms and ranches. The areas in Zimbabwe from which both species are absent (Fig. 2 & 3) are almost all tribal lands. There is evidence, however, that in recent years *R. appendiculatus* has become re-established in some tribal lands. This development has followed reductions in grazing pressure brought about by disease outbreaks during the Zimbabwean war (Norval, 1979).

Many, but not all, of the areas outside Zimbabwe in which *R. zambeziensis* has been collected have a Woodland or Savanna type of vegetation containing abundant *C. mopane*, e.g. in Zambia (Wild & Grandvaux Barbosa, 1968) and in the north-west corner of South West Africa/Namibia (Giess & Tinley, 1968). In Tanzania, in parts of South West Africa/Namibia and in Botswana this tick occurs in Wooded Steppe with abundant *Acacia* and *Commiphora* (AETFAT/UNESCO[1], 1958).

In South Africa it has been recorded in several different types of relatively dry Bushveld (Acocks, 1975).

DISCUSSION

There is little doubt that further collecting will show that *R. zambeziensis* is far more widely distributed than our present records indicate.

The survey findings from Zimbabwe show that RH is probably the most important single factor influencing the distributions of *R. zambeziensis* and *R. appendiculatus*. Rainfall and temperature are undoubtedly also important, but in the absence of experimental data it is impossible to separate the effects of these interrelated climatic factors. Physiography obviously also has a marked influence on the climate, and at a local level, vegetation and land utilization have a strong modifying effect on the microclimate.

As no reports on disease transmission by *R. zambeziensis* have yet been published, it is impossible to assess the economic importance of the tick. It is noteworthy, however, that in the absence of tick control *R. zambeziensis* does not appear to achieve the same high levels of abundance that are characteristic of *R. appendiculatus*.

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[1] Association pour l'Étude Taxonomique de la Flore d'Afrique Tropicale/United Nations Educational, Scientific and Cultural Organization

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