

# PARC NATIONAL DE L'UPEMBA. — MISSION G. F. DE WITTE

en collaboration avec

W. ADAM, A. JANSSENS, L. VAN MEEL et R. VERHEYEN (1946-1949)

Fascicule 66

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## TICKS <sup>(1)</sup>

BY

CARLETON M. CLIFFORD (Hamilton) <sup>(2)</sup>  
and GEORGE ANASTOS (College Park) <sup>(3)</sup>

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### INTRODUCTION

The ticks included in this report were sent to the Institute of Acarology, University of Maryland, for study by Dr. V. VAN STRAELEN, President of the Institute of National Parks of the Congo. It is based on extensive collections made in 1946-1949 by the mission of Dr. G. F. DE WITTE to the National Park of Upemba which is located in the southeastern portion of the Congo.

In all, 28 species, comprising 7 genera, are recorded from Upemba Park (Table I). Of these, 7 have not previously been recorded from the Congo and they are marked with an asterisk in Table I. None of the species were new, therefore figures and descriptions were not included.

The major portion of this work gives information by species regarding the distribution, hosts and taxonomic status. Following this section a list of the species by host and more extensive information on the various localities, including altitude, is provided.

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(2) U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Montana.

(3) Department of Zoology, University of Maryland, College Park, Maryland

The authorities for the names of hosts in this report are as follows : Reptiles, G. F. DE WITTE (1953); Birds, R. VERHEYEN (1953); and Mammals, S. FRECHKOP (1954).

For information on the biotic and climatic factors in the Upemba Park the reader is referred to Fasc. 1 : Introduction by G. F. DE WITTE *et al.* (in preparation).

In some instances the identification of *Rhipicephalus* species proved to be extremely difficult, necessitating the study of material in other collections. The following abbreviations are used to designate these collections : BMNH, British Museum (Natural History); HH, Dr. HARRY HOOGSTRAAL (personal collection); FZ, Dr. FRITZ ZUMPT (personal collection); MCZ, Museum of Comparative Zoology, Harvard University; and RML, Rocky Mountain Laboratory.

TABLE I.

## List of ticks of the Upemba Park.

- Boophilus decoloratus* (KOCH, 1844).  
*Amblyomma nuttalli* DÖNITZ, 1909.  
*Amblyomma pomposum* DÖNITZ, 1909.  
*Amblyomma tholloni* NEUMANN, 1899.  
*Aponomma exornatum* (KOCH, 1844).  
 \**Aponomma transversale* (LUCAS, 1845).  
 \**Haemaphysalis hoodi* WARBURTON and NUTTALL, 1909.  
*Haemaphysalis leachii* (AUDOUIN, 1827).  
*Haemaphysalis muhsami* SANTOS DIAS, 1954.  
*Haemaphysalis parmata* NEUMANN, 1905.  
*Ixodes aulacodi* ARTHUR, 1956.  
*Ixodes caviatpus* NUTTALL and WARBURTON, 1908.  
*Ixodes dawesi* ARTHUR, 1956.  
 \**Ixodes nairobiensis* NUTTALL, 1916.  
*Ixodes pseudorasus* ARTHUR and BURROW, 1957.  
 \**Ixodes* sp. nr. *spinae* ARTHUR, 1958  
*Rhipicentor bicornis* NUTTALL and WARBURTON, 1908.  
*Rhipicephalus compositus* NEUMANN, 1897.  
*Rhipicephalus longus* NEUMANN, 1907.  
 \**Rhipicephalus masseyi* NUTTALL and WARBURTON, 1908.  
 \**Rhipicephalus reichenowi* ZUMPT, 1943.  
*Rhipicephalus sanguineus* (LATREILLE, 1806).  
*Rhipicephalus simpsoni* NUTTALL, 1910.  
*Rhipicephalus simus* KOCH, 1844.  
*Rhipicephalus supertritus* NEUMANN, 1907.  
*Rhipicephalus tricuspis* DÖNITZ, 1906.  
*Rhipicephalus ziemanni* NEUMANN, 1904.  
 \**Rhipicephalus* sp. nr. *pravus* DÖNITZ, 1920

The authors are indebted to the following people for examining certain critical specimens for placing collection at our disposal and the ward hospitality accorded during visits to their laboratories : Dr. GERTRUD THEILER, Division of Veterinary Services, Onderstepoort, Republic of South Africa; Miss JANE WALKER, East African Veterinary Research Organization, Kikuyu, Kenya; Dr. HARRY HOOGSTRAAL and Mr. MAKRAM KAISER, Namru No. 3, Cairo, Egypt; Mr. L. PIERQUIN, Institute of Tropical Medicine, Leopoldville, Congo; Dr. FRITZ ZUMPT, South African Institute for Medical Research, Johannesburg; Dr. P. L. G. BENOIT, Royal Museum of Central Africa, Tervuren, Belgium; Dr. G. OWEN EVANS, British Museum (NH), London, England; Dr. DON ARTHUR, Department of Zoology, King's College, London, England; and Dr. H. LEVI, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

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Order **ACARINA**  
Suborder **IXODIDES**  
Family **IXODIDAE.**

Genus **BOOPHILUS** CURTIS, 1891.

**Boophilus decoloratus** (KOCH).

*Rhipicephalus decoloratus* KOCH, 1844, Arch. f. Naturgesch., 10, p. 239.

Host and Distribution :

**HOST UNKNOWN.**

No. 411-B, Lusinga, XII.1948, 2 ♀

This tick is widely distributed throughout most of the African continent. Extensive information on this species is given by HOOGSTRAAL (1956).

Genus **AMBLYOMMA** KOCH, 1844.

**Amblyomma nuttalli** DÖNITZ.

*Amblyomma nuttalli* DÖNITZ, 1909, Sitzungsber. Ges. Naturf. Fr. Berlin, 8, p. 469.

Hosts and Distribution :

**REPTILE.**

No. 432-B, Ganza, 3.VI.1949, 2 ♂, 1 ♀, 1 N, on *Kinixys belliana belliana* GRAY (No. 9476).

**BIRDS.**

Nos. 291-B, Kilwezi, 10.VIII.1948, 1 N, on *Turdus olivaceus stormsi* HARTLAUB (No. 3390); 2185-A, Mabwe, 4.I.1949, 1 N, on *Melocichla mentalis grandis* (BOCAGE) (No. 4276).

*Amblyomma nuttalli* is widely distributed in Africa south of the Sahara. The chief hosts of the adults of this species are land tortoises, with occasional records from other reptiles and mammals. The immature stages

have been reported from tortoises, *Varanus*, lizards, hares and birds. The two nymphs recorded above suggest that birds may serve more frequently as hosts for the immature stages than had been indicated previously.

Extensive information on this species is furnished by HOOGSTRAAL (1956) and THEILER (1959).

### **Amblyomma pomposum** DÖNITZ.

*Amblyomma pomposum* DÖNITZ, 1909, Sitzungsber. Ges. Naturf. Fr. Berlin, 8, p. 466.

Hosts and Distribution :

#### MAMMALS.

Nos. 439-B, Ganza, 17.VI.1949, 1 ♂, on *Hippotragus niger* (HARRIS) (No. 1552); 200-B, Kateke, 2.XII.1947, 1 ♂, on *Hippotragus niger* (HARRIS) (No. 598).

#### HOST UNKNOWN.

Nos. 2506-A, Kabenga, 2-6.IV.1949, 15 ♂, 13 ♀; 30-B, Kamitungulu, 3.IV.1947, 1 ♀; 1246-A, Lufwa, 16.I.1948, 1 ♀; 127-B, Mabwe, 9.IX.1947, 5 ♂.

According to THEILER (1959), « *A. pomposum* is widespread, but confined to the Rhodesian Highland vegetation, extending from Angola through Katanga of the Belgian Congo into Northern Rhodesia, dying out at the southern end of Lake Tanganyika ». This tick has been reported from a variety of wild and domestic animals.

The specimens recorded in this paper agree well with the criteria given by THEILER (1959) and HOOGSTRAAL (1956) for the identification of this species.

### **Amblyomma tholloni** NEUMANN.

*Amblyomma tholloni* NEUMANN, 1899, Mem. Soc. Zool. France, 12, p. 242.

Host and Distribution :

#### MAMMAL.

No. 276-C, Kaswabilenga, 7.X.1947, 6 ♂, on *Mungos mungo* (GMELIN) (No. 470).

The distribution of *A. tholloni* is closely allied to that of its chief host, the African elephant, *Loxodonta africana*. The presence of this tick on *Mungos mungo* is unusual. Some other uncommon hosts are listed by HOOGSTRAAL (1956).

**Amblyomma** ssp.

## Hosts and Distribution :

**BIRDS.**

Nos. 434-B, Ganza, 1.VI.1949, 2 N, on *Turdus olivaceus stormsi* HARTLAUB (No. 5092); 124-A, Lusinga, 29.III.1947, 1 L, on *Sphenorhynchus abdimii* (LICHTENSTEIN) (No. 104).

**MAMMALS.**

Nos. 445-B, Ganza, 23.VI.1949, 1 N, on *Hippotragus niger* (HARRIS) (No. 1562); 440-B, Ganza, 17.VI.1949, 1 N, 50 L, on *Tragelaphus scriptus* (PALLAS) (No. 1554); 448-B, Ganza, 28.VI.1949, 2 N, on *Tragelaphus scriptus* (PALLAS) (No. 1568); 218-B, Kaziba, 13.II.1948, 2 N, *Viverra civetta schwarzi* (CABRERA) (No. 728); 367-B, Mabwe, 15.I.1949, 47 L, on *Mungos mungo* (GMELIN) (No. 1340); 455-B, Mware, 16.VII.1949, 2 N, on *Potamochoerus porcus* (LINNÉ) (No. 1574).

**REPTILE.**

No. 435-B, Ganza, 28.V.1949, 11 N, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 9477).

At the present time the immature stages of several species of *Amblyomma* are unknown; therefore, it is not possible to give more than generic assignment in most cases. Lots 440-B, 435-B, 218-B, 434-B, 445-B, 455-B and 448-B resembled the nymphs of *Amblyomma tholloni* more closely than those of any of the other species whose immature stages are adequately known.

Genus **APONOMMA** NEUMANN, 1899.**Aponomma exornatum** (KOCH).

*Amblyomma exornatum* KOCH, 1844, Arch. f. Naturgesch., 10, p. 231.

## Hosts and Distribution :

**REPTILES.**

Nos. 441-B, Ganza, 12.VI.1949, 11 ♂, 4 N, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 9527); 435-B, Ganza, 28.V.1949, 4 ♂, 2 ♀, 1 N, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 9477); 437-B, Ganza, 6.VI.1949, 6 ♂, 1 ♀, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 9514); 179-B, Kanonga, 13-27.XI.1947, 4 ♂, 4 ♀, 9 N, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 1977); 303-B, Kilwezi, 4.IX.1948, 24 ♂, 37 ♀, 106 N, 5 L, on *Varanus (Empagusia) exanthematicus angolensis* SCHMIDT (Nos. 6343-6344); 327-B, Mabwe, 21.XI.1948, 16 ♂, on *Varanus (Empagusia) exanthematicus angolensis* SCHMIDT (No. 6786); 346-B, Mabwe,

2.XII.1948, 23 ♂, 17 ♀, 4 N, on *Varanus (Empagusia) exanthematicus angolensis* SCHMIDT (No. 7192); 350-B, Mabwe, 15.XII.1948, 10 ♂, 2 ♀, on *Varanus (Empagusia) exanthematicus angolensis* SCHMIDT (No. 7460); 372-B, Mabwe, 23.I.1949, 2 ♂, on *Varanus (Polydaedalus) niloticus niloticus* (LINNÉ) (No. 8064); 121-B, Mabwe, 23.VIII.1947, 57 ♂, 22 ♀, 123 N, 1 L, on reptile? (No. 1162).

*A. exornatum* is distributed throughout most of Africa and feeds primarily on lizards of the genus *Varanus*. However, this species may occasionally parasitize other animals (HOOGSTRAAL, 1956).

#### **Aponomma transversale** (LUCAS).

*Ixodes transversale* LUCAS, 1845, Ann. Soc. Ent. France, 3, p. 64.

This species is represented by a single collection : No. 454-B, Ganza, 6.VII.1949, 6 N, on *Hippotragus niger* (HARRIS) (No. 1572).

To our knowledge this represents the first report of *Ap. transversale* from the Congo. The only host previously reported for this species is the African python. Therefore, the finding of this reptile tick on a mammal can be considered at best accidental and requires confirmation.

#### Genus **HAEMAPHYSALIS** KOCH, 1844.

##### **Haemaphysalis hoodi** WARBURTON and NUTTALL.

*Haemaphysalis hoodi* WARBURTON and NUTTALL, 1909, Parasitology, 2, p. 62.

Hosts and Distribution :

#### **BIRDS.**

Nos. 230-B, Kaziba, 9.II.1948, 1 ♂, on *Monticola gularis angolensis* SOUSA (No. 2452); 221-B, Kaziba, 14.II.1948, 1 L, on *Myrmecocichla arnotti leucolaema* FISHER and REICHENOW (No. 2391); 215-B, Kaziba, 9.II.1948, 1 ♂, on *Turdus olivaceus bocagei* (CABANIS) (No. 2331); 19.II.1948, 1 ♂, on *Turdus olivaceus bocagei* (CABANIS) (No. 2449); 99-B, Kenia, 17.VII.1947, 1 N, on *Coliupasser macrourus macrourus* (GMELIN) (No. 993); 453-A, Mubale, 19.V.1947, 1 N, 1 L, on *Anthus vaalensis marungensis* CHAPIN (No. 526); 91-B, Gorges de la Pelenge, 20.VI.1947, 1 N, on *Coliupasser macrourus macrourus* (GMELIN) (No. 785); 620-A, Gorges de la Pelenge, 17.VI.1947, 1 N, on *Cisticola natalensis katanga* LYNES (No. 791); 73-B, Gorges de la Pelenge, 10.VI.1947, 3 ♂, on *Mirafra rufocinnamomea iwenarum* WHITE (No. 709); 72-B, Gorges de la Pelenge, 10.VI.1947, 1 N, on *Oenanthe pileata livingstonii* (TRISTRAM) (No. 708); 92-B, Gorges de la Pelenge, 17.VI.1947, 1 N, on *Textor xanthops xanthops* (HARTLAUB) (No. 785).

*H. hoodi* is widely distributed throughout tropical Africa and is exclusively a parasite of birds. The above specimens appear to be the first recorded from the Congo, although HOOGSTRAAL (*in litt.*) has also seen specimens from this country.

**Haemaphysalis leachii** (AUDOUIN).

*Ixodes leachii* AUDOUIN, 1827, in Savigny, Description de l'Égypte, 2<sup>e</sup> Ed., 22, Zool., p. 428.

Hosts and Distribution :

**MAMMALS.**

Nos. 255-B, Buye-Bala, 28.III.1948, 43 ♂, 4 ♀, on *Thos adustus* (SUNDEVALL) (No. 755); \*1569-A, Kabwe, 5.V.1948, 54 ♂, 3 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 834); 249-B, Kalungwe, 7.III.1948, 9 ♂, 1 ♀, on *Thos adustus* (SUNDEVALL) (No. 755); \*218-B, Kaziba, 13.II.1948, 9 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 728); 42-B, Lusinga, 9.IV.1947, 35 ♂, 23 ♀, on *Leptailurus serval* (SCHREBER) (No. 85); 36-B, Lusinga, 6.IV.1947, 15 ♂, 3 ♀, on *Thos adustus* (SUNDEVALL) (No. 79); 43-B, Lusinga, 10.IV.1947, 1 ♂, 1 ♀, on *Thos adustus* (SUNDEVALL) (No. 87); 50-B, Lusinga, 13.IV.1947, 36 ♂, 8 ♀, on *Thos adustus* (SUNDEVALL) (No. 89); 8-B, Mukana, 7.III.1947, 20 ♂, 9 ♀, on *Arvicanthis tenebrosus rhodesiae* SAINT-LÉGER (No. 47); 94-B, Mukana, 6.VII.1947, 6 ♂, on *Leptailurus serval* (SCHREBER) (No. 204); 97-B, Mukana, 8.VII.1947, 18 ♂, 2 ♀, on *Leptailurus serval* (SCHREBER) (No. 209); Mukana, 22.I.1948, 12 ♂, on *Leptailurus serval* (SCHREBER) (No. 676); \*355-B, Mabwe, 27.XII.1948, 77 ♂, 3 ♀, on *Steatomys pratensis* PETERS (No. 1285); \*373-B, Mabwe, 25.I.1949, 9 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 1370).

**HOST UNKNOWN.**

Nos. 146-A, Lusinga, 1.IV.1947, 1 ♀; 1141-A, Lusinga, 9-11.XII.1947, 1 ♂.

*H. leachii* occurs throughout most of the Ethiopian faunal region. Adults are often numerous on large carnivores and are less frequently collected on smaller carnivores. HOOGSTRAAL (1956, 1958) summarizes the available data on this species.

The systematic status of ticks in the *Haemaphysalis leachii* group, except for large specimens with well-developed spurs which are easily recognized as *H. leachii* is extremely confused at the present time. SANTOS DIAS (1956a) and HOOGSTRAAL (1956) reviewed the problem and gave their opinion as to the validity of the various species in this group. It is our opinion that until the necessary experimental rearing is completed to determine the extent of variation in the morphological features of each species or subspecies, the more conservative approach of HOOGSTRAAL is preferable. The indiscriminate naming of species in this group can lead only to further confusion.

In this paper we recognize only two species in the *H. leachii* group and separate them according to the criteria given by HOOGSTRAAL (1956). The larger ticks with well developed spurs and narrow scutal outlines are called *H. leachii* and the smaller ticks with less well developed spurs and a

\*See text.



comparatively wider scutal outline are called *H. muhsami*. In several instances both forms occurred on the same host and these lots are marked with an asterisk.

Generally we had little or no trouble placing the specimens in one or the other species, especially the typical large thin *H. leachii*. However, some of the lots we identified as *H. muhsami* contained specimens that approached the lower limit of the size range allowed for *H. leachii*. Usually the scutum of these specimens is thinner and the palpal spurs are more well developed than in typical *H. muhsami*. This apparently is material that SANTOS DIAS (1956) would identify as *H. ethiopica*. One such lot (373-B) was sent to Dr. HARRY HOOGSTRAAL and it was returned with the following information : « 125 ♂, 32 ♀, *H. leachii* subsp. Long, narrow males are *leachii*. Females and a few small males are *muhsami*. Many are intergrades ». This illustrates the difficulty in determining specimens in the *H. leachii* group. HOOGSTRAAL (*in litt.*) also cautions « Any *leachii*-like specimens from non-carnivore hosts are suspect and should be compared with other samples from the same kind of host in an effort to determine whether valid taxonomic criteria can be discerned ».

### **Haemaphysalis muhsami** SANTOS DIAS.

*Haemaphysalis muhsami* SANTOS DIAS, 1954, Mem. Mus. Zool. Univ. Coimbra, 225, p. 1.

Hosts and Distribution :

#### **BIRDS.**

Nos. 2350-A, Kanonga, 17.II.1949, 2 ♂, 2 ♀, on *Bubo lacteus* (TEMMINCK) (No. 4462); 2348-A, Kanonga, 12.II.1949, 2 ♂, on *Erythropygia barbata barbata* (FINSCH and HARTLAUB) (No. 4441).

#### **MAMMALS.**

Nos. 65-B, Gorges de la Pelenge, 26.V.1947, 8 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 143); \*1569-A, Kabwe, 5.V.1948, 1 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 834); 396-B, Kanonga, 22.II.1949, 16 ♂, 10 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1458); 408-B, Kalule-Nord, 3.III.1949, 5 ♂, 5 ♀, on *Herpestes ichneumon* (LINNÉ) (No. 1481); 219-B, Kaziba, 13.II.1948, 3 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 729); 234-B, Kaziba, 26.II.1948, 1 ♂, on *Orycteropus afer* (PALLAS) (No. 753); \*218-B, Kaziba, 13.II.1948, 36 ♂, 9 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 728); 1814-A, Kilwezi, 26.VIII.1948, 3 ♂, on *Mungos mungo* (GMELIN) (No. 1041); 366-B, Mabwe, 14.I.1949, 14 ♂, 9 ♀, on *Atilax paludinosus* (G. CUVIER) (No. 1339); 329-B, Mabwe, 22.XI.1948, 7 ♂, 3 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1187); 330-B, Mabwe, 22.XI.1948, 29 ♂, 4 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1183); 334-B, Mabwe, 28.XI.1948, 23 ♂, 4 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1209); 335-B, Mabwe, 1.XII.1948, 20 ♂, 4 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1212); 336-B, Mabwe, 1.XII.1948, 19 ♂, 5 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1213); 340-B, Mabwe, 6.XII.1948, 6 ♂, 1 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1225); 345-B, Mabwe,

10.XII.1948, 29 ♂, 5 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1230); 351-B, Mabwe, 19.XII.1948, 26 ♂, on *Genetta genetta hintoni* SCHWARZ (No. 1255); 363-B, Mabwe, 10.I.1949, 5 ♂, 2 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1329); 378-B, Mabwe, 31.I.1949, 51 ♂, 4 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1382); 367-B, Mabwe, 15.I.1949, 2 ♂, 1 N, on *Mungos mungo* (GMELIN) (No. 1340); 359-B, Mabwe, 3.I.1949, 15 ♂, 10 ♀, on *Myonax cauxii* (A. SMITH) (No. 1303); \*355-B, Mabwe, 27.XII.1948, 28 ♂, 5 ♀, on *Steatomys pratensis* PETERS (No. 1285); \*373-B, Mabwe, 25.I.1949, 114 ♂, 32 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 1370); 61-B, Mubale, 10.V.1947, 1 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 119).

*H. muhsami* occurs in all areas of the Ethiopian faunal region, including the mountains of Yemen in southwestern Arabia (HOOGSTRAAL, 1956). HOOGSTRAAL (*supra cit.*) says this species is especially common on small carnivores such as mongooses, genets, civets, and wild cats, a fact which is borne out in the above records.

The two records listed above from birds are of additional interest. Dr. HARRY HOOGSTRAAL examined both these lots and determined them as follows : No. 2305A as *H. leachii/muhsami* and No. 2348B as *H. leachii muhsami*. Further remarks on this species are given under *H. leachii*.

#### **Haemaphysalis sp.**

Host and Distribution :

#### **MAMMAL.**

No. 387-B, Masombwe, 6.VII.1948, 1 N, on *Petrodromus robustus* O. THOMAS (No. 976).

This specimen is either *H. leachii* or *H. muhsami*, but at the present time it is not possible to separate the nymphs of these two species.

#### **Haemaphysalis parmata** NEUMANN.

*Haemaphysalis parmata* NEUMANN, 1905, Arch. de Parasitologie, 9, p. 228.

Host and Distribution :

#### **MAMMALS.**

Nos. 61-B, Mubale, 10.V.1947, 1 N, on *Genetta genetta hintoni* SCHWARZ (No. 119); 62-B, Mubale, 11.V.1947, 1 N, on *Genetta genetta hintoni* SCHWARZ (No. 118).

*H. parmata* is a rather common Central and West African tick whose chief hosts are antelopes and domestic animals (HOOGSTRAAL, 1956). HOOGSTRAAL (1954, 1956) also lists *Genetta* sp. as a host for the immature stages.

Genus **IXODES** LATREILLE, 1795.

**Ixodes aulacodi** ARTHUR.

*Ixodes aulacodi* ARTHUR, 1956, Rev. Zool. Bot. Afr., 54, p. 306.

Host and Distribution :

**MAMMAL.**

No. 218-B, Kaziba, 13.II.1948, 2 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 728).

The only previous record of this species is the original holotype female collected from *Aulacodus swinderianus* at Congo da Lemba. The determination of these two females was verified by Dr. DON ARTHUR.

**Ixodes cavipalpus** NUTTALL and WARBURTON.

*Ixodes cavipalpus* NUTTALL and WARBURTON, 1908, Proc. Cambridge Phil. Soc., 14, p. 394.

Host and Distribution :

**MAMMAL.**

No. 213-B, Kaziba, 7.II.1948, 1 ♀, on *Oreotragus oreotragus* (ZIMMERMANN) (No. 703).

HOOGSTRAAL (1956) summarizes the distribution of this species in central, eastern and southern Africa. He indicates that this tick is probably more generally distributed than the meager records indicate.

The hosts reported for this species include a variety of domestic and wild animals.

**Ixodes dawesi** ARTHUR.

*Ixodes dawesi* ARTHUR, 1956, Rev. Zool. Bot. Afr., 54, p. 301.

Host and Distribution :

**MAMMAL.**

No. 315-B, Lusinga, 31.X.1948, 1 ♀, on *Potamogale velox* DU CHAILLU (No. 1162).

This unusual species was previously known only from the type lot collected on the same host at Inkongo, Kasai, Lusambo, Congo.

Identification of this species was verified by Dr. DON ARTHUR.

***Ixodes nairobiensis* NUTTALL.**

*Ixodes nairobiensis* NUTTALL, 1916, Parasitology, 8, p. 299.

Host and Distribution :

**MAMMAL.**

No. 34-B, Lusinga, 2.IV.1947, 1 ♀, on *Arvicanthis tenebrosus rhodesiae* SAINT-LÉGER (No. 59).

The *Ixodes nairobiensis* complex of species was recently reviewed by Arthur (1959). This species has been reported from eastern and southern Africa; however, this appears to be the first record from the Congo. The identification was verified by Dr. DON ARTHUR HOOGSTRAAL (1956) and ARTHUR (*supra cit.*) list a variety of hosts for this species which include several kinds of rodents.

***Ixodes pseudorarasus* ARTHUR and BURROW.**

*Ixodes pseudorarasus* ARTHUR and BURROW, 1957, Bull. Mus. Comp. Zool., 116, p. 502.

Hosts and Distribution :

**MAMMALS.**

Nos. 65-B, Gorges de la Pelenge, 26.V.1947, 5 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 143); 66-B, Gorges de la Pelenge, 30.V.1947, 6 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 146); 67-B, Gorges de la Pelenge, 30.V.1947, 3 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 148); 68-B, Gorges de la Pelenge, 30.V.1947, 1 ♂, 10 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 149); 441-A, Gorges de la Pelenge, 29.V.1947, 1 ♂, 13 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 147); 1569-A, Kabwe, 5.V.1948, 2 ♂, 4 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 834); 607-A, Kenia, 12.VII.1947, 1 ♂, 4 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 225); 608-A, Kenia, 12.VII.1947, 6 ♀, on *Cricetomys gambianus* WATERHOUSE (No. 224); 62-B, Mubale, 11.V.1947, 4 ♂, 23 ♀, 3 N, on *Genetta genetta hintoni* SCHWARZ (No. 118); 61-B, Mubale, 10.V.1947, 1 ♀, 19 N?, 9 L?, on *Genetta genetta hintoni* SCHWARZ (No. 119).

The species of *Ixodes rarus* group, of which *I. pseudorarasus* is a member, have been extensively reviewed by ARTHUR and BURROW (1957). All previous records for this group have to be considered in light of this revision. The material listed above was identified by use of the keys provided by ARTHUR and BURROW and samples have been verified by Dr. ARTHUR. The data presented in this revision indicate that *I. pseudorarasus* is widely distributed in East, West and Central Africa and is found on a variety of wild animals ranging in size from antelopes to small rodents.

**Ixodes** sp. nr. **spinae** ARTHUR.

*Ixodes spinae* ARTHUR, 1958, Parasitology, 48, p. 61.

## Hosts and Distribution :

## BIRD.

No. 176-B, Kankunda, 11.XI.1947, 1 ♀, on *Anthus trivialis trivialis* (LINNÉ) (No. 1865).

## HOST UNKNOWN.

No. 2506-A, Kabenga, 2-6.IV.1949, 1 ♀.

The two specimens listed above, both of which are greatly engorged and in poor condition, were tentatively identified as *I. spinae* since they possess the following characters : a sharp spine on the dorsal surface of palpal article I; strong external spurs on each coxa; and closed anal grooves (difficult to see on one specimen).

The recording of this species from a bird requires confirmation since *I. spinae* was previously known only from 1 male and 3 female specimens collected on *Procapra capensis*, at Pietersburg, South Africa, and thus far ticks off *Procapra* species have proven to be very host specific.

Two other females in excellent condition, tentatively identified as this species from Garamba Park in the northeastern portion of the Congo, have been seen. One female (No. 1061) was collected from the fur of a rodent and the other (E. 3087) was found by digging up the nest of a rodent, « Tula ». Complete data on these specimens will be presented in a separate report on the Garamba Park.

**Ixodes** spp.

## Hosts and Distribution :

## BIRDS.

Nos. 511-A, Gorges de la Pelenge, 5.VI.1947, 1 N, on *Cisticola rufilata ansorgei* NEUMANN (No. 663); 1661-A, Kabwe, 5.V.1948, 2 L, on *Alethe poliocephala ufipae* MOREAU (No. 2943); 227-B, Kaziba, 18.II.1948, 1 L, on *Turdoides jardinei tanzanicae* (REICHENOW) (No. 2439); 240-B, Kenia, 18.III.1948, 1 L, on *Anthus lineiventris* SUNDEVALL (No. 2686); 1406-A, Kenia, 9.III.1948, 1 L, on *Anthus trivialis trivialis* (LINNÉ) (No. 2591); 248-B, Kenia, 11.III.1948, 3 L, on *Cisticola chiniana fortis* LYNES (No. 2616); 243-B, Kenia, 9.III.1948, 2 L, on *Schoenicola brevirostris alexinae* (HEUGLIN) (No. 2592); 380-A, Mubale, 13.V.1947, 1 L, on *Cossypha bocagei* FINSCH and HARTLAUB (No. 465); 393-A, Mubale, 12.V.1947, 1 N, on *Turdus olivaceus stormsi* HARTLAUB (No. 457).

The immature stages of only a few African *Ixodes* species are described; therefore, it is impossible to give more than generic determination at this time.

Genus **RHIPICENTOR** NUTTALL and WARBURTON, 1908.

**Rhipicentor bicornis** NUTTALL and WARBURTON.

*Rhipicentor bicornis* NUTTALL and WARBURTON, 1908, Proc. Cambridge Phil. Soc., 14, p. 399.

Hosts and Distribution :

**MAMMALS.**

Nos. 249-B, Kalungwe, 7.III.1948, 1 ♂, on *Thos adustus* (SUNDEVALL) (No. 755); 218-B, Kaziba, 13.II.1948, 28 ♂, 14 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 728).

These specimens agree completely with the original description and figures given by NUTTALL and WARBURTON. This species is distributed in Central Africa and is found on both wild and domestic animals. THEILER (1954) gives several other locality records for the Congo.

Genus **RHIPICEPHALUS** KOCH, 1844.

**Rhipicephalus compositus** NEUMANN.

(Fig. 11.)

*Rhipicephalus compositus* NEUMANN, 1897, Mem. Soc. Zool. France, 10, p. 393.

Hosts and Distribution :

**MAMMAL.**

No. 218-B, Kaziba, 13.II.1948, 1 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 728).

This single male conforms well to the criteria given for this species by HOOGSTRAAL (1956). However, since only this single specimen was seen, and the host is unusual, the establishment of this species in the Upemba Park requires further confirmation. Further, due to the extreme variation that occurs among *Rhipicephalus* species, any identification based on a single specimen should be considered open to question.

Several single female specimens listed under *Rhipicephalus* spp. also resemble *R. compositus* (Nos. 224-B, 483, 1320-A). However, as noted in the next section, *R. compositus* females resemble those of a species we are tentatively calling *R. pseudolongus*. Therefore, we hesitated to place a specific determination on these specimens.

The distribution of *R. compositus* in the Congo is still not clearly defined. After reviewing this section of the manuscript, Dr. GERTRUD THEILER commented that she has believed for a long time that the *R. capensis* which she recorded in the Congo (THEILER, 1954) needs to be restudied. She says « To me it is neither a true *capensis* nor does it quite tally with *R. compositus*. »

In this same connection we would like to add that we have examined several lots of ticks cited by SCHOENAERS (1951) as *R. capensis* from Ruanda-Urundi and found them to be *R. compositus*. Therefore, the situation in the Congo with regard to these two species is still open to question.

### **Rhipicephalus longus** NEUMANN.

(Figs. 1, 2.)

*Rhipicephalus longus* NEUMANN, 1907, Ann. Trop. Med. Paras., 1, p. 117.

*Rhipicephalus falcatus* NEUMANN, 1908, Notes Leyden Mus., 30, p. 77.

*Rhipicephalus confusus* SANTOS DIAS, 1956, Docum. Mozambique, 87, p. 6.

Hosts and Distribution :

#### **BIRD.**

No. 2004-A, Mabwe, 2.XII.1948, 1 ♂, on *Himantopus himantopus himantopus* (LINNÉ) (No. 3989).

#### **MAMMALS.**

Nos. 157-B, Kaswabilenga, 25.X.1947, 56 ♂, 49 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 175-B, Kaswabilenga, 31.XI.1947, 3 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 527); 199-B, Kateke, 25.XI.1947, 169 ♂, 65 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 562); 258-B, Katongo, 14.IV.1948, 1 ♂, 1 ♀, on *Orycteropus afer* (PALLAS) (No. 811); 234-B, Kaziba, 26.II.1948, 1 ♂, on *Orycteropus afer* (PALLAS) (No. 753); 223-B, Kaziba, 17.II.1948, 2 ♂, 3 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, 17.II.1948, 2 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 742); 201-B, Kubaya, 27.X.1947, 125 ♂, 43 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 620); 50-B, Lusinga, 13.IV.1947, 2 ♂, on *Thos adustus* (SUNDEVALL) (No. 89); 357-B, Mabwe, 29.XII.1948, 65 ♂, 24 ♀, on *Bubalus caffer* (SPARRMANN) (No. 1289); 367-B, Mabwe, 15.I.1949, 1 ♂, on *Mungos mungo* (GMELIN) (No. 1340); 339-B, Mabwe, 3.XII.1948, 81 ♂, 32 ♀, on *Orycteropus afer* (PALLAS) (No. 1223); 344-B, Mabwe, 7.XII.1948, 14 ♂, 3 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1227); 348-B, Mabwe, 7.XII.1948, 12 ♂, 2 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1228); 365-B, Mabwe, 14.I.1949, 152 ♂, 65 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1338).

#### **HOST UNKNOWN.**

Nos. 2506-A, Kabenga, 2-6.IV.1949, 1 ♂, 2 ♀; 1005-A, Kankunda, 16-19.XI.1947, 1 ♂; 1313-A, Kaziba, 19.II.1948, 1 ♀; 1936-A, Mabwe, 30.XI.1948, 1 ♀; 2014-A, Mabwe, 6-8.XII.1948, 2 ♀; 2020-A, Mabwe, 9.XII.1948, 1 ♀; 2115-A, Mabwe, 20.XII.1948, 1 ♂, 2 ♀; 875-A, Piste de Lusinga, 24.X.1947, 3 ♂, 2 ♀.

The specimens identified above as *R. longus* are for the most part very similar to the type of *R. longus* and the cotypes of *R. falcatus*. Since there is a great deal of confusion regarding ticks of the genus *Rhipicephalus* whose males have sickle-shaped adanal shields, some description of the specimens identified under the name *R. longus* is necessary.

**Female :** The scutum has several large and medium-sized punctations on the shoulders and a shiny area but none along the edge of the lateral groove. About 7 or 8 large punctations are located along the lateral groove. These are extremely important in identifying this species. Even if the interstitial punctations are heavy, these larger ones can be recognized. The central area of scutum is covered with medium-sized punctations, the size and depth of which are subject to a great deal of variation in any given series. In some specimens which have punctations in the central area that are rather shallow, larger ones similar to those characteristic of *R. simus* and *R. senegalensis* can be seen.

The unmounted genital aperture is V-shaped (Fig. 1). The width of the V may vary somewhat, depending on the engorgement of the specimen. The area within the V is depressed. This depression becomes greater at the posterior end of the aperture.

The genital aperture of southern Congo specimens (Fig. 2) prepared as outlined by CLIFFORD and LEWERS (1960) is identical to that of the cotype female of *R. falcatus* (Fig. 3) and to that shown by FELDMAN-MUHSAM (1956, fig. 4) for *R. longus* and by TENDEIRO (1959, photos 11 and 12) for *R. confusus*. The opening appears roughly V-shaped and the flaps of the cup are long and quite thin. In examining the mounted genitalia of female ticks, it should be kept in mind that some variation is possible, both due to the method of preparation and to the condition of the specimen being examined. For example, extensive clearing of a specimen obscures the shape of the opening and the internal structure becomes more apparent.

**Male :** The dorsal surface of the scutum has several medium-to large-sized punctations on the shoulders and a few small ones along the margin of the scutum outside the lateral grooves. The lateral groove is deep and marked with several large punctations and a row of 5 or 6 of these structures continue on anterior and medial to the lateral groove. No matter how heavy the interstitial punctations become, they still do not obscure the larger deeper ones. This is extremely important in distinguishing this species from *R. pseudolongus* (discussed below) and from *R. compositus* when the adanal shields of the latter are reduced. The central area of the scutum is covered with medium-sized punctations and these tend to be a little deeper and closer together in the posterior region. In some specimens they are reduced in an area just inside the lateral grooves near the midlength of the scutum. In many of the southern Congo specimens larger *simus*-like punctations are interspersed with the moderate interstitial punctations. In a few



instances the interstitial punctations are so light that they closely resemble the situation noted in *R. senegalensis*. These lightly punctate specimens led us to believe during the early part of this work that *R. longus* and *R. senegalensis* might be the same species <sup>(1)</sup>.

The figures given by SANTOS DIAS (1956*b*) for the type of *R. longus* (p. 3, Fig. 1) and for the cotype male of *R. falcatus* (p. 5, Fig. 2) are good examples of what we consider heavily punctated *R. longus*. Note that the large *simus*-like punctations anterior and slightly medial to the lateral grooves still are apparent. An example of a more lightly punctate specimen is furnished by SANTOS DIAS in the same paper under the name *R. confusus* (see discussion below).

On the ventral surface the adanal shields are sickle-shaped. These shields may be reduced in some of the less robust specimens. Three festoons are protruded in engorged specimens.

A species which has caused considerable confusion in the past few years is *R. confusus* SANTOS DIAS, 1956. This species was described from material collected in Mozambique. After studying paratype specimens in the British Museum, reading the description, and examining his figures, we believe that *R. confusus* falls well within the range of variation we allow for *R. longus*. In any large series of *R. longus*, similar to the southern Congo specimens, there are individuals that will fit the description given by SANTOS DIAS (*supra cit.*) for *R. confusus*. The figure given by SANTOS DIAS (p. 9, Fig. 3) for *R. confusus* represents in our mind a moderately punctate specimen of *R. longus* (*simus*-like punctations show in the central area of scutum). TENDEIRO (1959) gives figures of the genital aperture of *R. confusus* and these apertures are very similar to the one removed from the cotype female of *R. falcatus* syn. = *R. longus* (Fig. 3), the southern Congo specimens listed above (Fig. 2) and *R. longus* as shown in Fig. 4 of Feldman-Muhsam's 1956 paper.

The distribution of *R. longus* includes parts of the Congo, Uganda, southern Tanganyika, Nyasaland, northern Rhodesia, and Mozambique. Further distributional data on this species in the Congo will be given in a future report.

*R. longus* has been reported on a large number of wild and domestic animals. The single male specimen listed above from *Himantopus* h. *himantopus* appears to be the first published record from a bird.

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<sup>(1)</sup> In her review of this manuscript, Dr. GERTRUD THEILER commented that she feels the findings presented here indicate that *R. longus* is a synonym of *R. senegalensis*. She calls attention to the fact that the distribution picture will not be quite as confused as it appears at the moment if we accept her conclusion.

We fully realize that future work may show these two species to be synonymous; until more laboratory rearing can be accomplished and the immature stages studied, we have decided to adopt the more conservative approach and keep them separate.

Since there is so much confusion at the present time regarding the rhipicephalids whose males have sickle-shaped anal shields, we believe that some explanation of our concept of the other species with this feature is necessary. In addition to *R. longus* there are three other species to be considered, *R. simpsoni*, *R. senegalensis* and *R. pseudolongus*.

*R. simpsoni* is the most easily recognized species in this group and can be characterized as follows.

**Females :** The punctations on the scutum are similar to those found on *R. simus* and *R. senegalensis*; however, in most cases the interstitials are very small and the scutum is shiny. The scutum is rather narrow and elongate and the lengthy appearance is accentuated by the sharply marked lateral ridges. These features make the females easy to recognize.

The unmounted genital aperture is roughly trapezoidal (Fig. 4). However, the posterior edge is evenly curved rather than straight. The greatest area of depression is along the posterior and lateral edges of the opening. The area within the trapezoid slopes up gradually toward the anterior edge of the opening.

The very short and thick flaps seen in mounted genitalia will separate this species from others presently under discussion (Fig. 5).

**Males :** The scutum has large punctations similar to those characteristic of *R. simus*. Interstitial punctations are nearly non-existent, and the scutum has a shiny appearance. The body narrows anteriorly and is pear-shaped. THEILER (1947, pp. 284 and 285, Figs. 35 and 36) and HOOGSTRAAL (1956, p. 725, Figs. 297-300) present adequate drawings of both sexes.

The distribution and host range of *R. simpsoni* are given under the section of this paper dealing with this species. The descriptions are based on 6 ♂ and 4 ♀ from the Garamba Park in the northeastern portion of the Congo (E 2649).

*R. senegalensis* bears a close resemblance to *R. simus*.

**Female :** The scutum is smooth and light brown in color. Several (7-10) large punctations are located in the shoulder area and a few are found around the eye; all the others outside the lateral grooves are pinpoint in size. There are 9 or 10 large punctations along the lateral groove and several other large « *simus*-like » punctations in the central region of the scutum. The interstitial punctations are very small and of uniform size throughout the central area.

The unmounted genital aperture is V-shaped; similar to *R. longus* (Fig. 6), but there is a tendency for the aperture to be a little wider and the posterior edge of the opening more broadly rounded in *R. senegalensis*.

The mounted genital aperture is also similar in structure to *R. longus* (Fig. 7) but the flaps are shorter, thicker, and the whole cup has the appearance of being somewhat wider.

Male : The general appearance of the scutum is smooth and shiny with about 10 large punctations located on the shoulders. Several other large punctations are present along the lateral groove and these continue anterior beyond the lateral grooves toward the cervical pits. Large, *simus*-like punctations are present in the central region and they may be slightly more prominent in the posterior half of the scutum. Median and paramedian grooves are present. Three festoons protrude in engorged specimens. ZUMPT (1943, pp. 10 and 11, Figs. 6-7) presents excellent figures of the male of *R. senegalensis* (presented as *R. simus longoides* syn. = *senegalensis*).

Our descriptions are based on two lots from West Africa labeled as *R. falcatus* in the George H. F. Nuttall Collection at the BMNH : Nuttall Coll. No. 2670A, Kamagoto, Sierra Leone, 1.XI.1913, 9♂, 16 ♀, off cattle, coll. Dr. J. J. Wood; and Nuttall Coll. No. 3054A, Kinkintomania, Sierra Leone, 11.VII.1914, 11 ♂, 18 ♀, off sheep, coll. Dr. J. J. Wood. Thirty five other lots in the BMNH as *R. falcatus* from Sierra Leone (32) Gold Coast (1) and Nigeria (2) were also examined and found to be typical *R. senegalensis*. The specimens in the majority of these lots conformed well to the description given above; however, in a few instances the interstitial punctations were a little heavier and could be classified as light to moderate.

We have also examined several vials of ticks that fit the above description of *R. senegalensis* from the Garamba Park in the northeastern Congo and several lots in Dr. Hoogstraal's Collection from the Sudan and Uganda. A tendency toward heavier interstitial punctations was also noted among some of these specimens, especially females from the Garamba Park. These heavier punctate specimens are very close to the lightly punctate specimens of *R. longus*.

In addition, the mounted genitalia of the Garamba Park specimens tend to have flaps that appear a little thinner and longer than the West African specimens; thereby resembling *R. longus* (Fig. 8). However, when only a small series of specimens is available for study, no important taxonomic decisions should be made using the mounted female genital aperture. We have noticed that the amount of clearing and the condition of the specimens can produce some variation in appearance. For this reason we still prefer to consider the material with light interstitial punctations from the Garamba Park and Hoogstraal's Sudan and Uganda specimens as *R. senegalensis*. In the future when the immature stages of both species are studied and large series are available for variation studies the specimens mentioned above which we are now considering as *R. senegalensis* may prove to be nothing more than lightly punctate *R. longus* (includes *R. confusus*).

*R. senegalensis* appears to be widely distributed in West Africa and extends across the northern edge of the Congo into the Sudan and Uganda.

The hosts include a large variety of wild and domestic animals. Further information on hosts and distribution is given by HOOGSTRAAL (1956).

A source of possible future confusion in this group of species is use of the name *senegalensis*. ZUMPT in his 1943 paper on the *simus* group uses the name *R. simus longoides* for material similar to that we are calling *R. senegalensis*, but mentions that KOCH (1844) had described a female from Senegal that might eventually turn out to be a synonym. Then, without explanation, ZUMPT (1950) uses the name *R. simus senegalensis* and considers his *R. s. longoides* to be a synonym. Since, in his 1950 paper, he did not mention having examined Koch's type female of *R. senegalensis*, the use of this name is open to question. However, since the name has been used extensively in the past few years, we believe that a search for Koch's type should be made and if it proves to be lost, as seems to be the case, a neotype should be established. Preferably, this neotype should be selected from a reared series so that specimens could be sent to museums and tick workers throughout the world.

Also it should be noted here that we agree with SANTOS DIAS (1955, 1956b, 1958) and TENDEIRO (1959) in considering *R. senegalensis* as a separate species rather than a subspecies of *R. simus*.

All the species discussed above are considered to be in the *simus* group. Several African tick specialists following Zumpt's 1942 findings considered *R. longus* to be in the *capensis* group. However, we consider it best to place *R. longus* (sensu NEUMANN) in the *simus* group because the scutum of this species has large punctations interspersed with light to medium interstitial punctations. Furthermore, the nymph of *R. longus* lacks dorsal cornua on the capitulum (information furnished by Miss JANE WALKER) and, thereby, is more like the species in the *simus* group than those in the *capensis* group where dorsal cornua are always present on the capitulum.

The heavily and evenly punctate ticks which were confused by ZUMPT with *R. longus* (sensu NEUMANN) we prefer to call *R. pseudolongus*. This species was described as a subspecies of *R. capensis* by SANTOS DIAS in 1953 from material from Cameroon. In 1955 he elevated *R. pseudolongus* to species rank. Then in 1956 he sank it as a synonym of *R. longus*, and in 1958 reiterated this opinion.

We have examined the male holotype of *R. pseudolongus* (kindly furnished by Dr. ERNESTO FERREIRA DE ABREU, Director of Laboratorio Central de Pathologia Veterinaria, Lourenço Marques, Moçambique) and we believe that it is identical to the material we are discussing below under this name and this species is entirely different from *R. longus* (sensu NEUMANN). This species has been the source of confusion for many years, since both sexes resemble the more heavily punctate specimens of *R. longus* and the females and runt males are almost inseparable from *R. compositus*. We consider *R. pseudolongus* to be in the *capensis* group (reasons given below).

The species is characterized as follows :

**Female :** The scutum is heavily and evenly punctate with many moderate sized ones present on the shoulders. A few large punctations are inter-

spersed with the moderate ones in this area. They are scarce along the lateral margin near the eye. In some specimens there is a clear margin along the top of the lateral groove as is characteristic of *R. compositus*. The central area is covered with heavy, deep, evenly spaced punctations and these tend to be somewhat confluent in the cervical areas. The cervical areas are slightly wrinkled in some specimens. Large *simus*-like punctations are lacking entirely along the lateral groove. This is one of the important features in placing *R. pseudolongus* in a group with *R. compositus* and *R. capensis* rather than with species in the *simus* group.

The unmounted genital aperture is roughly V-shaped (Fig 9). However, the V is shorter and wider than in *R. longus* and *R. senegalensis*. Also the pigmented flaps of the cup protrude and can be seen at the lateral edges of the opening. The central area of the opening is depressed. The general appearance of the unmounted aperture is similar to that of *R. compositus*.

The mounted genitalia show a wide cup with highly pigmented lateral flaps (Fig. 10). Comparing this figure with that given by FELDMAN-MUHSAM (1956, Fig. 2) the genital aperture appears to provide a good feature for separating *R. pseudolongus* and *R. compositus*. However, when well cleared genitalia from specimens of laboratory reared *R. compositus* (Fig 11), furnished by Miss JANE WALKER, were compared with the genitalia of our *R. pseudolongus* females, these apparent differences disappeared. This indicates the dangers that can arise when lightly cleared genitalia, such as that shown by FELDMAN-MUHSAM (1956, Fig. 2), are compared with genitalia that have been subjected to more intense clearing.

We are unable as yet to find any features for separating the females of *R. pseudolongus* from *R. compositus*.

**Males :** The scutum is heavily and evenly punctate with several moderate to large-sized ones on the shoulder areas. These punctations are slightly smaller than those in the central region. There are many small to moderate evenly distributed punctations outside the lateral grooves. The central area of the scutum is covered with large evenly spaced punctations; however, a few may run together in the posterior region. No *simus*-like punctations can be seen on these specimens. In some specimens there is a reduction of punctations along the lateral grooves which gives an appearance that is characteristic of *R. compositus*. Three festoons protrude in moderately engorged specimens and in heavily engorged males the festoons lateral and posterior to the spiracular plate are also expressed. As stated above, the adanal shields are typically sickle-shaped, but in several series from the Garamba Park, the shields are reduced. This reduction in the adanal shields would tend to cause difficulty in separating *R. pseudolongus* from *R. compositus*.

**Nymph :** Several fully engorged nymphs were found in Garamba Park material. By breaking open some of them and examining the adults forming

within, it was possible to establish their identity as *R. pseudolongus*. These specimens have pronounced cornua and resemble the nymphs of *R. compositus* as described by THEILER *et al.* (1956). The presence of cornua on the nymphs of *R. pseudolongus* lends further weight to our proposal to consider this species with *R. compositus* and *R. capensis*.

The following authors give figures that represent our conception of this species: ZUMPT (1942) as *R. capensis longus* (pp. 492-493, Figs. 6-8); SANTOS DIAS (1953) as *R. capensis pseudolongus* (p. 6, Figs. 1-3); SANTOS DIAS (1955) as *R. pseudolongus* (p. 110, Fig. 2) and HOOGSTRAAL (1956) as *R. longus* (p. 664, Figs. 277-280).

The specimens described above were from one of several lots (E. 3769) collected in the Garamba Park. Full information on the Garamba Park specimens will be presented in a separate report. In addition to the Garamba Park material, the following lots have been examined: BMNH, Nuttall Coll. No. 2338, Kinkintomania, Sierra Leone, 27.VI.1913, 2♂, off. bush cow, J. J. Wood, coll.; FZ, Cameroon, several ♂'s and ♀'s (ZUMPT, 1942, as *R. capensis longus*); HH, Laboni, Sudan, 27.II.1950, 1♂, on *Syncerus caffer aequinoctialis* (HOOGSTRAAL, 1956, as *R. longus*), H. HOOGSTRAAL, coll. (A. single female of *R. senegalensis* is present in the tube with this male); HH, Kheirallah, Equatoria Prov., Sudan, 25.III.1914, 3♂, 3♀, on buffaló (HOOGSTRAAL, 1956, as *R. longus*) H. H. King, Coll.; HH, Kiqumba, Uganda, 16.VIII.1956, 19♂, 4♀ (det. by HOOGSTRAAL, as *R. longus*, 11♂, 3♀ of *R. longus* in same vial), C. E. Yunker, coll.; and HH, Katulkire, Uganda, 16.VIII.1956, on buffalo, 15♂, 18♀ (det. by HOOGSTRAAL, as *R. longus*, 6♂, 4♀ of *R. longus* in same vial), C. E. Yunker, coll.

Based on the above records and after examining the literature, we believe that *R. pseudolongus* is widely distributed in West Africa and ranges across into the Sudan, northern Congo, and northern Uganda. The hosts of the adults seem to be the larger wild and domestic animals. Several lots of engorged nymphs we examined from the Garamba Park, northern Congo, were collected in the nests of various species of rodents.

### ***Rhipicephalus masseyi* NUTTALL and WARBURTON.**

(Fig. 12.)

*Rhipicephalus masseyi* NUTTALL and WARBURTON, 1908, Proc. Cambridge Phil. Soc., 14, p. 404.

Hosts and Distribution :

#### **MAMMALS.**

Nos. 175-B, Kaswabilenga, 25.X.1947, 10♂, 9♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 175-B, Kaswabilenga, 31.XI.1947, 1♂, on *Potamochoerus porcus* (LINNÉ) (No. 527); 223-B, Kaziba, 17.II.1948, 13♂, 5♀, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 6♂, 6♀, on *Potamochoerus porcus* (LINNÉ) (No. 742);

366-B, Mabwe, 14.I.1949, 1 ♂, on *Atilax paludinosus* (G. CUVIER) (No. 1339); 357-B, Mabwe, 29.XII.1948, 1 ♂, on *Bubalus caffer* (SPARRMAN) (No. 1289); 339-B, Mabwe, 3.XII.1948, 1 ♂, on *Orycteropus afer* (PALLAS) (No. 1223); 344-B, Mabwe, 7.XII.1948, 4 ♂, 1 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1227); 348-B, Mabwe, 1 ♂, 5 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1228); 365-B, Mabwe, 14.I.1949, 32 ♂, 23 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1338).

#### HOST UNKNOWN.

No. 813-A, Lukawe, 6-9.X.1947, 1 ♂.

We have examined the types of *R. masseyi* in the BMNH (20 ♂, 9 ♀) and with the exception of one female specimen they are identical to the material presented here under this name. According to Miss JANE WALKER (*in litt.*) who has examined these specimens, this single aberrant female « looks like *R. hurti* » a species that had not been described when she had previously seen these ticks. Further, the mounted genital apertures of females of *R. masseyi* from the Upemba Park (Fig. 12) are very much like the aperture from a type female shown by FELDMAN-MUHSAM (1956, Fig. 12).

*R. masseyi* has been reported from several localities in Central Africa, but to our knowledge the above records constitute the first report of this species in the Congo.

Larger wild animals such as those listed above seem to be the primary hosts for adults of this species.

#### *Rhipicephalus reichenowi* ZUMPT.

*Rhipicephalus reichenowi* ZUMPT, 1943, Ztschr. Parasitenk., 13, p. 19.

Hosts and Distribution :

#### MAMMALS.

Nos. 517-B, Kaswabilenga, 25.X.1947, 4 ♂, 1 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 175-B, Kaswabilenga, 31.X.1947, 2 ♂, 2 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 527); 223-B, Kaziba, 17.II.1948, 19 ♂, 12 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 30 ♂, 6 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 742); 357-B, Mabwe, 29.XII.1948, 5 ♂, 2 ♀, on *Bubalus caffer* (SPARRMAN) (No. 1289); 201-B, Kubaya, 27.X.1947, 1 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 620); 344-B, Mabwe, 7.XII.1948, 3 ♂, 2 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1227); 348-B, Mabwe, 7.XII.1948, 4 ♂, 3 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1228); 365-B, Mabwe, 14.I.1949, 27 ♂, 11 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1338); 255-B, Buya-Bala, 28.III.1948, 1 ♂, on *Thos adustus* (SUNDEVALL) (No. 785); 339-B, Mabwe, 3.XII.1948, 1 ♂, on *Orycteropus afer* (PALLAS) (No. 1223); 455-B, Mware, 16.VIII.1949, 8 ♂, 4 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1574).

## HOST UNKNOWN.

Nos. 2506-A, Kabenga, 2-6.IV.1949, 1 ♀; 813-A, Lukawe, 6-9.X.1947, 1 ♂.

*R. reichenowi* is a very poorly known species described by ZUMPT in 1943 from 13 males collected at Mikesse, Tanganyika, on a porcupine (*Hystrix africae-australis*). Since this time little mention of this species has been made in the literature. SANTOS DIAS (1950) described *R. zumpti* from Mozambique and after examining material determined by him and checking his figures (p. 157, Fig. 12) and the description, we conclude that his species is a synonym of *reichenowi*.

The following material labeled as *R. zumpti* by SANTOS DIAS was examined: MCZ, Machanga, Mozambique, 24.IV.1952, 2 ♂, on *Potamochoerus porcus*, coll. A. Faira, and RML No. 32587, Gavuro, Mozambique, May 1951; 2 ♂, on *Kobus ellipsiprymnus*.

In addition, we have examined some laboratory reared material of *R. reichenowi*, consisting of males, females, nymphs, and larvae (RML 34803). These specimens were bred from a female collected at the Makumiri River, near Tengeru, Tanganyika, 29.VII.1956, on man, coll. Hoogstraal *et al.*

The above records represent the first report of this species from the Congo.

Various large wild animals seem to be the hosts of predilection for adults of this species.

**Rhipicephalus sanguineus (LATREILLE).**

*Ixodes sanguineus* LATREILLE, 1806, Gen. Crust. et Ins., 1, p. 157.

Hosts and Distribution :

## BIRDS.

Nos. 953-A, Kaswabilenga, 4.XI.1947, 1 ♀, on *Anastomus lamelligerus lamelligerus*, TEMMINCK (No. 1848); 256-B, Katongo, 2.IV.1948, 1 ♂, on *Lissotis melanogaster* (RÜPPELL) (No. 2773).

## MAMMALS.

Nos. 1569-A, Kabwe, 5.V.1948, 2 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 834); 249-B, Kalungwe, 7.III.1948, 1 ♂, on *Thos adustus* (SUNDEVALL) (No. 755); 219-B, Kaziba, 13.II.1948, 2 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 729); 218-B, Kaziba, 13.II.1948, 2 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 218); 43-B, Lusinga, 10.IV.1947, 1 ♂, on *Thos adustus* (SUNDEVALL) (No. 87); 50-B, Lusinga, 13.IV.1947, 2 ♂, 1 ♀, on *Thos adustus* (SUNDEVALL) (No. 89); 42-B, Lusinga, 9.IV.1947, 2 ♂, 4 ♀, on *Leptailurus serval* (SCHREBER) (No. 85); 338-B, Mabwe, 2.XII.1948, 10 ♂, 2 ♀, on *Galago crassicaudatus* E. GEOFFROY SAINT-HILAIRE (No. 1218); 329-B, Mabwe, 22.XI.1948, 1 ♂, on *Genetta genetta hintoni* SCHWARZ (No. 1187); 330-B, Mabwe, 22.XI.1948, 1 ♂, on *Genetta genetta hintoni* SCHWARZ (No. 1183); 334-B, Mabwe, 28.XI.1948, 2 ♂, on *Genetta genetta hintoni* SCHWARZ (No. 1209); 345-B, Mabwe, 10.XII.1948, 4 ♂, on *Genetta genetta hintoni* SCHWARZ



(No. 1230); 363-B, Mabwe, 10.I.1949, 1 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1329); 378-B, Mabwe, 31.I.1949, 1 ♂, 1 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 1382); 355-B, Mabwe, 27.XII.1948, 4 ♂, 1 ♀, on *Steatomys pratensis* PETERS (No. 1285); 255-B, Buye-Bala, 28.III.1948, 2 ♂, 1 ♀, on *Thos adustus* (SUNDEVALL) (No. 785); 373-B, Mabwe, 25.I.1949, 2 ♂, 2 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 1370); Mukana, 22.I.1948, 9 ♂, 3 ♀, on *Leptailurus serval* (SCHREBER) (No. 676); 8-B, Mukana, 7.III.1947, 2 ♂, on *Arvicanthis tenebrosus rhodesiae* SAINT-LÉGER (No. 47).

The specimens listed here agree well with the criteria given by HOOGSTRAAL (1956) for identifying this species. The majority of these specimens were moderately punctate; however, a few had heavier punctations and thus resembled *R. sulcatus*.

HOOGSTRAAL (*supra cit.*) says « this species is present almost everywhere in Africa except possibly in the most extreme situations of the great deserts of northern and southwestern Africa and perhaps in a few of the most isolated oases ». He gives a summary of the host information up to 1956.

### **Rhipicephalus simpsoni** NUTTALL.

(Figs. 4, 5.)

*Rhipicephalus simpsoni* NUTTALL, 1910, Parasitology, 3, p. 413.

Host and Distribution :

#### **BIRD.**

No. 619-A, Gorges de la Pelenge, 18.VI.1947, 1 ♂, on *Chloroptera natalensis major* HARTERT (No. 806).

According to HOOGSTRAAL (1956) « *R. simpsoni* has been reported from widely scattered localities throughout Africa within the Ethiopian Faunal Region and probably occurs wherever its favorite host, the cane rat, does ».

The record listed above from a bird is unusual and requires confirmation.

Information on the differentiation of *R. simpsoni* is included in the discussion following *R. longus*.

### **Rhipicephalus simus** KOCH.

(Figs. 13, 14.)

*Rhipicephalus simus* KOCH, 1844, Arch. f. Naturgesch., 10, p. 238.

Hosts and Distribution :

#### **MAMMALS.**

Nos. 1569-A, Kabwe, 5.V.1948, 5 ♂, 1 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 834); 249-B, Kalungwe, 7.III.1948, 1 ♂, 3 ♀, on *Thos adustus* (SUNDEVALL) (No. 755); 157-B, Kaswabilenga, 25.X.1947, 4 ♂, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 200-B, Kateke, 2.XII.1947, 1 ♂, 1 ♀, on *Hippotragus niger* (HARRIS) (No. 598); 199-B,

Kateke, 25.XI.1947, 19 ♂, 5 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 562); 258-B, Katongo, 14.IV.1948, 2 ♂, 1 ♀, on *Orycteropus afer* (PALLAS) (No. 811); 223-B, Kaziba, 17.II.1948, 7 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 6 ♂, 2 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 742); 218-B, Kaziba, 13.II.1948, 2 ♂, 1 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 728); 34-B, Lusinga, 2.IV.1947, 4 N, 1 L, on *Arvicanthus tenebrosus rhodesiae* SAINT-LÉGER (No. 59); 42-B, Lusinga, 9.IV.1947, 1 ♂, 1 ♀, on *Leptailurus serval* (SCHREBER) (No. 85); 50-B, Lusinga, 13.IV.1947, 3 ♂, 2 ♀, on *Thos adustus* (SUNDEVALL) (No. 89); 357-B, Mabwe, 29.XII.1948, 1 ♂, on *Bubalus caffer* (SPARRMAN) (No. 1289); 62-B, Mubale, 11.V.1947, 2 ♀, on *Genetta genetta hintoni* SCHWARZ (No. 118); 541-C, Senze, 13.III.1948, 2 ♂, 3 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 764).

#### HOST UNKNOWN.

Nos. 1320-A, Kaziba, 21.II.1948, 1 ♂; 1373-A, Kafwe River, 5.III.1948, 1 ♀.

The specimens above agree well with the criteria given by HOOGSTRAAL (1956) for the identification of this species. However, we are now able to separate females of *R. simus* (*R. s. simus* of HOOGSTRAAL) from those of *R. senegalensis* (*R. s. senegalensis* of HOOGSTRAAL) by examining the genitalia.

The unmounted genital opening of *R. simus* is trapezoidal and raised. The area lateral to the opening is depressed, giving the appearance of a border around the actual opening (Fig. 13). In *R. senegalensis* the opening is roughly V-shaped, the area within the V is depressed and there is no indication of a border around the aperture (Fig. 6).

The mounted genitalia appear similar at first glance; however, the distance between the flap is greater in *R. simus* and the over-all shape is quite different from that of *R. senegalensis* (compare Fig. 14 with Figs. 7 and 8).

TENDEIRO (1959) gives figures of the mounted genital aperture of females of *R. simus* from Mozambique and *R. senegalensis* from Portuguese Guinea. Based on the shape of these genitalia and number of festoons encompassed by the lateral grooves he concludes that all of his material from Portuguese Guinea is *R. senegalensis* and not *R. simus*. He further indicates that the West African records of other authors for *R. simus* are open to question and probably refer to *R. senegalensis*. (See Tendeiro's synonymy for *R. senegalensis*).

Since the figures of the mounted genitalia of *R. senegalensis* shown by TENDEIRO (p. 45, Fig. 8 and photos 5 and 6) differ somewhat from our *R. senegalensis* collected in Sierra Leone and the Congo (Garamba Park) (Figs. 7 and 8), we would have to accept these records as *R. senegalensis* with some reservation. Also we have noted considerable variation in the number of festoons enclosed by the lateral grooves in both *R. simus* and *R. senegalensis*; therefore we are hesitant to accept this feature for separating these two species. In addition, we have examined several vials of ticks

labeled as *R. simus* in the RML collection (all verified by Dr. THEILER) and find that they agree perfectly with our criteria for *R. simus*. We, therefore, would have to conclude that *R. simus* is present in West Africa and the records of MOREL (1956, 1958) and MOREL and MOUCHET (1958) and other West African records for this species are in all probability valid.

*R. simus* is widely distributed throughout Africa. A good review of the distribution and host data is presented by HOOGSTRAAL (1956).

### **Rhipicephalus supertritus** NEUMANN.

(Fig. 15.)

*Rhipicephalus supertritus* NEUMANN, 1907, Arch. de Parasitologie, 11, p. 216.

Hosts and Distribution :

#### **MAMMALS.**

Nos. 200-B, Kateke, 2.XII.1947, 14 ♂, on *Hippotragus niger* (HARRIS) (No. 598); 357-B, Mabwe, 29.XII.1948, 1 ♂, on *Bubalus caffer* (SPARRMAN) (No. 1289).

#### **HOST UNKNOWN.**

Nos. 2506-A, Kabenga, 2-6.IV.1949, 23 ♂, 8 ♀; 1032-A, Kankunda, 22-24.XI.1947, 1 ♀; 182-B, Kankunda, 24-28.XI.1947, 1 ♂.

The specimens listed here agree well with the description presented by THEILER (1947) and the characteristics given by HOOGSTRAAL (1956).

An interesting sidelight was noted when the mounted female genitalia of this species (Fig. 15) were compared with the genitalia of the female cotype of *R. coriaceus* syn. = *R. supertritus* as shown by FELDMAN-MUHSAM (1956, Fig. 11). Enough differences were apparent to leave some doubt in our mind as to whether *R. coriaceus*, as represented by this cotype female, is actually a synonym of *R. supertritus*. However, as stated previously we do not believe that important taxonomic decisions should be made without comparing a series of specimens. We do, however, recommend that the cotype specimens be examined again with this thought in mind.

*R. supertritus* is an uncommon tick that has a spotty distribution in east, central and parts of southern Africa. It parasitizes larger wild animals and occasionally domestic animals. HOOGSTRAAL (1956) provides a summary of distribution and host data as well as excellent figures of both sexes.

### **Rhipicephalus tricuspis** DÖNITZ.

(Fig. 16.)

*Rhipicephalus tricuspis* DÖNITZ, 1906, Sitzungsber. Ges. Naturf. Fr. Berlin, 5, p. 146.

## Hosts and Distribution :

## MAMMALS.

Nos. 255-B, Buye-Bala, 28.III.1948, 1 ♂, on *Thos adustus* (SUNDEVALL) (No. 785); 249-B, Kalungwe, 7.III.1948, 3 ♂, 1 ♀, on *Thos adustus* (SUNDEVALL) (No. 755); 157-B, Kaswabilenga, 25.X.1947, 4 ♂, 2 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 200-B, Kateke, 2.XII.1947, 1 ♂, on *Hippotragus niger* (HARRIS) (No. 598); 199-B, Kateke, 25.XI.1947, 15 ♂, 9 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 562); 234-B, Kaziba, 26.II.1948, 1 ♂, 1 ♀, on *Orycteropus afer* (PALLAS) (No. 753); 223-B, Kaziba, 17.II.1948, 27 ♂, 27 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 30 ♂, 13 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 742); 218-B, Kaziba, 13.II.1948, 1 ♂, on *Viverra civetta schwarzi* (CABRERA) (No. 728); 201-B, Kubaya, 27.X.1947, 1 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 620); 42-B, Lusinga, 9.IV.1947, 1 ♂, on *Leptailurus serval* (SCHREBER) (No. 85); 357-B, Mabwe, 29.XII.1948, 14 ♂, 5 ♀, on *Bubalus caffer* (SPARRMAN) (No. 1289); 339-B, Mabwe, 3.XII.1948, 46 ♂, 38 ♀, on *Orycteropus afer* (PALLAS) (No. 1223); 365-B, Mabwe, 14.I.1949, 42 ♂, 36 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1338); 344-B, Mabwe, 7.XII.1948, 3 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 1227); 348-B, Mabwe, 7.XII.1948, 2 ♂, 4 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1228); Mukana, 22.I.1948, 3 ♂, 3 ♀, on *Leptailurus serval* (SCHREBER) (No. 676).

## HOST UNKNOWN.

Nos. 875-A, Piste de Lusinga, 24.X.1947, 4 ♂, 4 ♀; 2212-A, Mabwe, 13.I.1949, 1 ♀.

The material identified here as *R. tricuspis* agrees well with the description presented by THEILER (1947) and the diagnosis presented by HOOGSTRAAL (1956).

*R. tricuspis* is scattered throughout most of Africa and parasitizes a variety of domestic and larger wild animals. Further information on the distribution and host range can be found in HOOGSTRAAL (*supra cit.*)

TENDEIRO (1959) presents evidence to support the separation of *R. tricuspis* and *R. lunulatus* as distinct species. However, after examining his photographs of the female genitalia (photos 7-10) of these two species we do not see enough difference to justify this separation. Further, the other distinguishing features given are, in our experience, variable and would also lead us to question his decision. However, we do agree with TENDEIRO (*supra cit.*) that the female genitalia, mounted or unmounted, will easily separate *R. tricuspis* from *R. simus* (compare Figs. 14 and 16).

**Rhipicephalus ziemanni** NEUMANN.

*Rhipicephalus ziemanni* NEUMANN, 1904, Arch. de Parasitologie, 8, p. 464.

## Hosts and Distribution :

## MAMMALS.

Nos. 157-B, Kaswabilenga, 25.X.1947, 37 ♂, 26 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 510); 223-B, Kaziba, 17.II.1948, 4 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 3 ♂, on *Potamochoerus porcus* (LINNÉ) (No. 742); 218-B, Kaziba, 13.II.1948, 2 ♀, on *Viverra civetta schwarzi* (CABRERA) (No. 728); 201-B, Kubaya, 27.X.1947, 1 ♂, 1 ♀, on *Phacochoerus aethiopicus* (PALLAS) (No. 620); 42-B, Lusinga, 9.IV.1947, 1 ♂, on *Leptailurus serval* (SCHREBER) (No. 85); 357-B, Mabwe, 29.XII.1948, 1 ♂, on *Bubalus caffer* (SPARRMAN) (No. 1289).

The specimens of *R. ziemanni* agree generally with the description presented by THEILER (1947). However, Miss JANE WALKER (*in litt.*) recently examined the cotypes of *R. ziemanni* (BMNH, Nuttall Coll. 2898, Cameroon, 1 ♂, 1 ♀, off cattle) and comments that the apical processes of coxae I are blunt and just show ». Miss WALKER feels that Neumann's (1908) figure of *R. cuneatus* syn. = *R. ziemanni*, which is reproduced by THEILER, is incorrect in that the apical processes of coxae I are drawn as part of the scapular region. Based on our own examination of these type specimens and material we have examined in the Museum of Comparative Zoology and that listed above from the Upemba Park, we agree completely with Miss Walker's observation.

TENDEIRO (1959) summarizes the available information on this species and reproduces Neumann's figure of *R. cuneatus* mentioned above.

*R. ziemanni* is distributed throughout most of West Africa and in parts of the Congo. According to MOREL (1958) it occurs principally on wild herbivores, more rarely on carnivores, and sometimes on domestic animals.

**Rhipicephalus** sp. nr. **pravus** DÖNITZ.

(Figs. 17, 18.)

Distribution and Hosts :

## BIRDS.

No. 256-B, Katongo, 2.IV.1948, 5 ♂, 4 ♀, on *Lissotis melanogaster* (RÜPPELL) (No. 2773).

## MAMMALS.

Nos. 440-B, Ganza, 17.VI.1949, 2 ♂, 5 ♀, on *Tragelaphus scriptus* (PALLAS) (No. 1554); 448-B, Ganza, 28.VI.1949, 3 ♂, 3 ♀, on *Tragelaphus scriptus* (PALLAS) (No. 1568); 445-B, Ganza, 23.VI.1949, 1 ♀, on *Hippotragus niger* (HARRIS) (No. 1562); 433-B, Ganza, 28.V.1949, 4 ♂, 7 ♀, on *Alcelaphus lichtensteini* (PETERS) (No. 1527); 75-B, Gorges de la Pelenge, 10.VI.1947, 10 ♂, on *Oreotragus oreotragus* (ZIMMERMANN) (No. 168); 239-B, Kamitunu, 9.III.1948, 8 ♂, 5 ♀, on *Lepus capensis crawshayi* (DE WINTON) (No. 757); 175-B, Kaswabilenga, 31.XI.1947, 1 ♂, 1 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 527); 223-B, Kaziba, 17.II.1948, 138 ♂, 152 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 743); 224-B, Kaziba, 17.II.1948, 137 ♂, 135 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 742); 213-B, Kaziba, 7.II.1948, 3 ♂, 3 ♀, on *Oreotragus oreotragus* (ZIMMERMANN) (No. 703); 357-B, Mabwe, 29.XII.1948, 58 ♂, 1 ♀, on *Bubalus caffer* (SPARRMAN) (No. 1289); 120-B,

Mabwe, 23.VIII.1947, 5 ♂, 4 ♀, on *Cephalophus sylvicultor* (AFZELIUS) (No. 375); 344-B, Mabwe, 7.XII.1948, 2 ♂, 1 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1227); 348-B, Mabwe, 7.XII.1948, 4 ♂, 5 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1228); 365-B, Mabwe, 14.I.1949, 27 ♂, 24 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1338); 455-B, Mware, 16.VII.1949, 6 ♂, 13 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 1574).

#### HOST UNKNOWN.

Nos. 929-A, Kaswabilenga, 3-4.XI.1947, 1 ♀; 1200-A, Kenia, 19.XII.1947, 1 ♀.

During our early sorting of the Upemba Park material we identified the above specimens as *R. pravus*. Subsequently, upon examination of this material by Miss JANE WALKER, she commented that these specimens were not *R. pravus*, but represented a different species. She indicated that she had seen some lots from Tanganyika that contained similar material. Miss Walker called our attention to the fact that in this species the punctations of the scutum of both the males and females are light and all of a similar size; whereas in typical *R. pravus* the punctations tend to be heavier and are of two different sizes.

In addition we have examined the genitalia of lightly and evenly punctate females from Tanganyika sent by Miss WALKER and find that they are identical to the genitalia removed from females in the Upemba Park material (compare Figs. 17 and 18).

Even before Miss WALKER examined this material, it had been noted that the genital apertures of these Upemba Park specimens were not the same as that shown by FELDMAN-MUHSAM (1956, Fig. 7) for *R. pravus*. At that time we thought that Feldman-Muhsam's identification of this specimen might be incorrect. However, after examining the specimen from which the aperture she figured was removed, we concluded that her identification of *R. pravus* was correct. Later we examined additional material identified as *R. pravus* at the RML and laboratory-reared specimens furnished by Miss WALKER and found that the female genital apertures of these specimens agreed well with the figure shown by FELDMAN-MUHSAM for *R. pravus*.

After it was established that these specimens were different from *R. pravus*, the question arose as to the name to be applied to this species. By chance we noted that the genital aperture of these Upemba Park females was almost identical to that shown by FELDMAN-MUHSAM for the type of *R. kochi* (compare our Fig. 17 with Feldman-Muhsam's, 1956, Fig. 13). Further, we had already concluded that the genitalia shown by FELDMAN-MUHSAM for the type of *R. kochi* were not the same as those of females that most African specialists would determine as *kochi*. (Compare Figs. 19 and 20 with FELDMAN-MUHSAM, 1956, Fig. 13.) (This observation was based on an examination of genitalia from specimens identified as *R. kochi* by Dr. G. THEILER, Miss JANE WALKER, and GLEN M. KOHLS. Some of the specimens sent by Miss WALKER were laboratory reared.) This observation seemed more logical after the literature pertaining to *R. kochi* was examined. ZUMPT (1943b on

p. 104) comments on *R. kochi* as follows (translation) : « A doubtful species is *R. kochi* DÖNITZ. From the Berlin Museum I have one female from Sadani, in German East Africa, which is designated type. The male from Sadani and the remaining 7 females from Sadani and Lindi are apparently lost. At present I am not in a position to give the species identification of the female. The scutum is surprisingly slender. It may be a somewhat aberrant *masseyi* female but may just as well represent another species. Evidently DÖNITZ himself was not sure the females belong to the male. According to the male diagnosis, *kochi* and *jeanneli* are in all probability identical. However, as long as no typical *jeanneli* from Sadani are available, I would place *R. kochi* DÖNITZ provisionally with (?) *R. jeanneli* NEUMANN ».

Should *R. jeanneli* NEUMANN eventually be shown to occur at Sadani then the two species could be taken to be the same. In which case, *R. kochi* DÖNITZ has priority.

Based on these statements by ZUMPT and the figure of the genital aperture of the type of *R. kochi* presented by FELDMAN-MUHSAM we think it is reasonable to assume that the name *R. kochi* DÖNITZ may actually apply to these lightly and evenly punctate ticks from Upemba Park and Tanganyika we have discussed above and not to the specimens identified under this name by the majority of African tick specialists. If upon examining the type specimen which bears the name *kochi* we find that it is identical to these Upemba Park and Tanganyika specimens, then we would recommend that the name *R. jeanneli* NEUMANN be resurrected and applied to the specimens formerly improperly called *R. kochi*. If, on the other hand, we find that the type female in the Berlin Museum is identical to specimens currently identified as *R. kochi* by African tick specialists, then we will have to describe these lightly and evenly punctate specimens as a new species and *R. jeanneli* will remain a synonym of *R. kochi*.

Another interesting fact emerged from the study of female tick genitalia. It was noted that the genital aperture of females of *R. kochi* (specimens currently identified as *R. kochi* by African tick specialists) whether mounted or unmounted was very different from that of the closely related species *R. hurti* (compare Figs. 20 and 21 with 22 and 23). Females of *R. kochi* and *R. hurti* are extremely difficult to separate, especially in mixed lots and this feature provides an apparently valid method for identifying these two species.

### **Rhipicephalus spp.**

Hosts and Distribution :

#### **BIRDS.**

Nos. 2414-A, Kalule-Nord, 3.III.1949, 1 N, on *Poicephalus meyeri neavi* GRANT (No. 4812); 226-B, Kaziba, 18.II.1948, 1 L, on *Melocichla mentalis grandis* (BOCAGE) (No. 2435); 1639-A, Munoi, 1.VI.1948, 1 L, on *Camaroptera simplex katangae* (NEAVE) (No. 3109).

**MAMMALS.**

Nos. 440-B, Ganza, 17.VI.1949, 7 N, 4 L, on *Tragelaphus scriptus* (PALLAS) (No. 1554); 224-B, Kaziba, 17.II.1948, 1 ♀, on *Potamochoerus porcus* (LINNÉ) (No. 742); 120-B, Mabwe, 23.VIII.1947, 1 ♀, on *Cephalophus sylvicultor* (AFZELIUS) (No. 375); 367-B, Mabwe, 15.I.1949, 1 L, on *Mungos mungo* (GMELIN) (No. 1340); 109-B, Mabwe, 12.VIII.1947, 12 N, on *Paraxerus cepapi quotus* WROUGHTON (No. 330); 2342-A, Mabwe, 15.II.1949, 15 L, on *Pelomys fallax* PETERS (No. 1418); 110-B, Mabwe, 14.VIII.1947, 10 N, on *Petrodromus robustus* O. THOMAS (No. 330); 287-B, Masombwe, 6.VII.1948, 19 N, on *Petrodromus robustus* O. THOMAS (No. 976); 321-B, Mabwe, 18.XI.1948, 23 N, 2 L, on *Petrodromus robustus* O. THOMAS (No. 1169); 387-B, Mabwe, 24.II.1949, 7 N, 11 L, on *Petrodromus robustus* O. THOMAS (No. 1451).

**HOST UNKNOWN.**

Nos. 483-A, Gorges de la Pelenge, 10-14.VI.1947, 1 ♀; 2271-A, Kabulumba, 28.I.1949, 1 N; 1320-A, Kaziba, 21.II.1948, 1 ♀; 1384-A, Mukana, 15.III.1948, 1 ♀.

The immature specimens listed above are unidentifiable at the present time, and they may represent a species whose immature stages are as yet unknown. For comments on some of the females listed here see discussion under *R. compositus*.

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## CLASSIFIED HOST LIST

## REPTILES.

## ORDER TESTUDINATA.

## TESTUDINIDAE.

*Kinixys belliana belliana* ... .. *Amblyomma nuttalli*.

## ORDER SQUAMATA.

## VARANIDAE.

*Varanus niloticus niloticus* . ... .. *Amblyomma* spp.  
*Aponomma exornatum*.

*Varanus exanthematicus angolensis* ... .. *Aponomma exornatum*.

Reptile ? . ... .. *Aponomma exornatum*.

## MAMMALS.

## ORDER PRIMATES.

## LARIIDAE.

*Galago crassicaudatus* ... .. *Rhipicephalus sanguineus*.

## ORDER CARNIVORA.

## FELIDAE.

*Leptailurus serval* ... .. *Haemaphysalis leachii*.  
*Rhipicephalus sanguineus*.  
*Rhipicephalus simus*.  
*Rhipicephalus tricuspis*.  
*Rhipicephalus ziemanni*.

## VIVERRIDAE.

*Viverra civetta schwarzi* ... .. *Amblyomma* spp.  
*Haemaphysalis leachii*.  
*Haemaphysalis muhsami*.  
*Ixodes aulacodi*.  
*Ixodes pseudorasus*.

	<i>Rhipicentor bicornis.</i>
	<i>Rhipicephalus compositus.</i>
	<i>Rhipicephalus sanguineus.</i>
	<i>Rhipicephalus simus.</i>
	<i>Rhipicephalus tricuspis.</i>
	<i>Rhipicephalus ziemanni.</i>
<i>Genetta genetta hintoni</i> ... ..	<i>Haemaphysalis muhsami.</i>
	<i>Haemaphysalis parvata.</i>
	<i>Ixodes pseudorasus.</i>
	<i>Rhipicephalus sanguineus.</i>
	<i>Rhipicephalus simus.</i>
<b>HERPESTIDAE.</b>	
<i>Herpestes ichneumon</i> ... ..	<i>Haemaphysalis muhsami.</i>
<i>Mungos mungo</i> ... ..	<i>Amblyomma tholloni.</i>
	<i>Amblyomma</i> spp.
	<i>Haemaphysalis muhsami.</i>
	<i>Rhipicephalus longus.</i>
	<i>Rhipicephalus</i> spp.
<i>Atilax paludinosus</i> ... ..	<i>Haemaphysalis muhsami.</i>
	<i>Rhipicephalus masseyi.</i>
<i>Myonax cauxi</i> ... ..	<i>Haemaphysalis muhsami.</i>
<b>CANIDAE.</b>	
<i>Thos adustus</i> ... ..	<i>Haemaphysalis leachii.</i>
	<i>Rhipicentor bicornis.</i>
	<i>Rhipicephalus longus.</i>
	<i>Rhipicephalus reichenowi.</i>
	<i>Rhipicephalus sanguineus.</i>
	<i>Rhipicephalus simus.</i>
	<i>Rhipicephalus tricuspis.</i>

## ORDER INSECTIVORA.

## TENRECIDAE.

<i>Potamogale velox</i> ... ..	<i>Ixodes dawesi.</i>
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## MACROSCOLIDIDAE.

<i>Petrodromus robustus</i> ... ..	<i>Haemaphysalis</i> sp.
	<i>Rhipicephalus</i> spp.

## ORDER TUBULIDENTATA.

## ORYCTEROPIDAE.

<i>Orycteropus afer</i> ... ..	<i>Haemaphysalis muhsami.</i>
	<i>Rhipicephalus longus.</i>
	<i>Rhipicephalus masseyi.</i>
	<i>Rhipicephalus reichenowi.</i>
	<i>Rhipicephalus simus.</i>
	<i>Rhipicephalus tricuspis.</i>

## ORDER UNGULATA.

## SUIDAE.

<i>Potamochoerus porcus</i> . . . . .	<i>Amblyomma</i> spp. <i>Rhipicephalus longus</i> . <i>Rhipicephalus masseyi</i> . <i>Rhipicephalus reichenowi</i> . <i>Rhipicephalus simus</i> . <i>Rhipicephalus tricuspis</i> . <i>Rhipicephalus ziemanni</i> . <i>Rhipicephalus</i> sp. nr. <i>pravus</i> . <i>Rhipicephalus</i> spp.
<i>Phacochoerus aethiopicus</i> ... ..	<i>Rhipicephalus longus</i> . <i>Rhipicephalus masseyi</i> . <i>Rhipicephalus reichenowi</i> . <i>Rhipicephalus simus</i> . <i>Rhipicephalus tricuspis</i> . <i>Rhipicephalus ziemanni</i> .

## BOVIDAE.

<i>Alcelaphus lichtensteini</i> ... ..	<i>Rhipicephalus</i> sp. nr. <i>pravus</i> .
<i>Hippotragus niger</i> ... ..	<i>Amblyomma pomposum</i> . <i>Amblyomma</i> spp. <i>Aponomma transversale</i> . <i>Rhipicephalus simus</i> . <i>Rhipicephalus supertritus</i> . <i>Rhipicephalus</i> sp. nr. <i>pravus</i> <i>Rhipicephalus tricuspis</i> .
<i>Oreotragus oreotragus</i> ... ..	<i>Ixodes cavipalpus</i> . <i>Rhipicephalus</i> sp. nr. <i>pravus</i> .
<i>Cephalophus sylvicultor</i> ... ..	<i>Rhipicephalus</i> sp. nr. <i>pravus</i> . <i>Rhipicephalus</i> spp.
<i>Tragelaphus scriptus</i> ... ..	<i>Amblyomma</i> spp. <i>Rhipicephalus</i> sp. nr. <i>pravus</i> . <i>Rhipicephalus</i> spp.
<i>Bubalus caffer</i> ... ..	<i>Rhipicephalus longus</i> . <i>Rhipicephalus masseyi</i> . <i>Rhipicephalus reichenowi</i> . <i>Rhipicephalus simus</i> . <i>Rhipicephalus supertritus</i> . <i>Rhipicephalus tricuspis</i> . <i>Rhipicephalus ziemanni</i> . <i>Rhipicephalus</i> sp. nr. <i>pravus</i> .

## ORDER RODENTIA.

## SCIURIDAE.

*Paraxerus cepapi quotus* ... .. *Rhipicephalus* spp.

## MURIDAE.

*Arvicanthus tenebrosus rhodesiae* ... .. *Haemaphysalis leachii*.  
*Ixodes nairobiensis*.  
*Rhipicephalus sanguineus*.  
*Rhipicephalus simus*.

*Pelomys fallax* . ... .. *Rhipicephalus* spp.

*Cricetomys gambianus* . ... .. *Haemaphysalis muhsami*.  
*Ixodes pseudorasus*.

*Steatomys pratensis* ... .. *Haemaphysalis leachii*.  
*Haemaphysalis muhsami*.  
*Rhipicephalus sanguineus*.

## LEPORIDAE.

*Lepus capensis crawshayi* . ... .. *Rhipicephalus* sp. nr. *pravus*.

## BIRDS.

## ORDER GRESSORIFORMES.

## THRESKIORNITHIDAE.

*Anastomus lamelligerus lamelligerus* ... .. *Rhipicephalus sanguineus*.  
*Sphenorhynchus abdimii* ... .. *Amblyomma* spp.

## ORDER GRUIFORMES.

## OTIDIDAE.

*Lissotis melanogaster* ... .. *Rhipicephalus sanguineus*.  
*Rhipicephalus* sp. nr. *pravus*.

## ORDER LARO-LIMICOLIFORMES.

## CHARADRIIDAE.

*Himantopus himantopus himantopus* ... .. *Rhipicephalus longus*.

## ORDER PSITTACIFORMES.

## PSITTACIDAE.

*Poicephalus meyeri neavi* ... .. *Rhipicephalus* spp.

## ORDER STRIGIFORMES.

## STRIGIDAE.

*Bubo lacteus* ... .. *Haemaphysalis muhsami*.

## ORDER PASSERIFORMES.

## ALAUDIDAE.

*Mirafra rufocinnamomea lwenarum* ... *Haemaphysalis hoodi.*

## MOTACILLIDAE.

*Anthus lineiventris* . ... .. *Ixodes* spp.

*Anthus trivialis trivialis* ... .. *Ixodes spinae.*

*Ixodes* spp.

*Anthus vaalensis marugensis* ... .. *Haemaphysalis hoodi.*

## TIMALIIDAE.

*Turdoides jardinei tanganjicae* ... .. *Ixodes* spp.

## SYLVIIDAE.

*Camaroptera simplex katangae* . ... .. *Rhipicephalus* spp.

*Chloroptera natalensis major* .. ... .. *Rhipicephalus simpsoni.*

*Cisticola chiniana fortis* ... .. *Ixodes* spp.

*Cisticola natalensis katanga* ... .. *Haemaphysalis hoodi.*

*Cisticola rufilata ansorgei* ... .. *Ixodes* spp.

*Melocichla mentalis grandis* ... .. *Amblyomma nuttalli.*

*Rhipicephalus* spp.

*Schoenicola brevirostris alexinae* ... .. *Ixodes* spp.

## TURDIDAE.

*Alethe poliocephala ufipae* . ... .. *Ixodes* spp.

*Cossypha bocagei* ... .. *Ixodes* spp.

*Erythropygia barbata barbata* ... .. *Haemaphysalis muhsami.*

*Monticola gularis angolensis* ... .. *Haemaphysalis hoodi.*

*Myrmecocichla arnotti leucolaema* . ... .. *Haemaphysalis hoodi.*

*Oenanthe pileata livingstonii* ... .. *Haemaphysalis hoodi.*

*Turdus olivaceus bocagei* ... .. *Haemaphysalis hoodi.*

*Turdus olivaceus stormsi* ... .. *Amblyomma nuttalli.*

*Amblyomma* spp.

*Ixodes* spp.

## PLOCEIDAE.

*Coliuspasser macrourus macrourus* ... .. *Haemaphysalis hoodi.*

*Textor xanthops xanthops* ... .. *Haemaphysalis hoodi.*

## LIST OF LOCALITIES CITED

- Buye-Bala, left tributary of the Muye and right sub-tributary of the Lufira : 1.750 m.
- Ganza, salt marsh near the river Kamandula, right tributary of the Lukoka and left sub-tributary of the Lufira : 860 m.
- Gorge of the Pelenge : 1.250-1.600 m.
- Kabenga, near the Kaziba (ex P.N.U.) : 1.240-1.300 m.
- Kabulumba, chain of mountains between Mabwe and the Lufira, 22 km to the east of Mabwe : 987 m.
- Kabwe, on the right bank of the Muye, right tributary of the Lufira : 1.320 m.
- Kafwe River, right tributary of the Lufwa : 1.780 m.
- Kalule-Nord, right tributary of the Lualaba (Mt. Kia) near Kiamalwa : 1.050 m.
- Kalungwe, right tributary of the Senze and right sub-tributary of the Lufira : 800-1.700 m.
- Kamitungulu, left tributary of the Lusinga and right sub-tributary of the Lufwa : 1.760 m.
- Kamitunu, left tributary of the Lusinga and right sub-tributary of the Lufwa : 1.760-1.800 m.
- Kankunda, left tributary of the Lupiala and right sub-tributary of the Lufira : 1.300 m.
- Kanonga, right tributary of the Fungwe : 675, 695, 860 m.
- Kaswabilenga, River Lufira : 680 m.
- Kateke, tributary of the Muovwe and right sub-tributary of the Lufira : 960 m.
- Katongo, left tributary of the Mubale and left sub-tributary of the Munte : 1.750 m.
- Kaziba, left tributary of the Senze and right sub-tributary of the Lufira : 1.140 m.
- Kenia, right tributary of the Lusinga and right sub-tributary of the Lufwa (ex P.N.U.) : 1.585 m.
- Kilwezi, right tributary of the Lufira : 700, 1.000, 1.400 m.
- Kubaya, tributary of the Munte and right sub-tributary of the Lufira : 1.600 m.
- Lufwa, right tributary of the Lufira, at the beginning of the source, near Lusinga (ex P.N.U.) : 1.700 m.
- Lukawe, right tributary of the Lufira : 700 m.
- Lusinga : 1.760 m.



Mabwe, east shore of Lake Upemba : 585 m.

Masombwe, on the Grande-Kafwe (ex P.N.U.) : 1.120 m.

Mubale, left tributary of the Munte right sub-tributary of the Lufira : 1.480-1.780 m.

Mukana, marsh near Lusinga : 1.810 m.

Munoi, bifurcation of the river Lupiala, right tributary of the Lufira : 890 m.

Mware, left tributary of the Lufira : 700-950 m.

Road to Lusinga : 1.200 m.

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