

Zoological Survey of the Union of South Africa. Tick Survey—Part VI.

By GERTRUD THEILER, Section Parasitology, Onderstepoort.

DISTRIBUTION OF THE IXODEDS: IXODES PILOSUS AND IXODES RUBICUNDUS.

The DISTRIBUTION I. PILOSUS. The Russet tick, the Bush tick.

General Distribution.

I. pilosus is present in the Northern Transvaal in parts of the Waterberg, in parts of the Limpopo Highlands of Pietersburg and of the Zoutpansberg: in the Eastern Transvaal in the Ermelo, Barberton, and Lydenburg districts extending from the *Highveld* into the *Middleveld*. In Natal and Swaziland it is not very common either and its distribution is somewhat scattered, and apparently equally haphazard. This haphazard distribution follows along the coast east of the Escarpment into the Eastern Province right down to the Somerset East—Port Elizabeth level. In the Cape it follows the coast line south of the mountain ranges, dying out at the level Cape Town—Paarl.

Distribution in the Vegetational Types.

The vegetation map shows *I. pilosus* to be PRESENT:

1. In regional patches of all three types of *forest*.
2. In regional patches of all three types of *parklands*.
 - (a) *Evergreen and deciduous tree and bush*.
 - (b) *Sub tropical evergreen and deciduous tree and thorn forest*.
 - (c) *Evergreen Sclerophyllous bush or Western Province flora*.
3. In regional patches in two out of the three *grass lands*.
 - (a) *Tall grass lands*.
 - (b) *Short grass* of the *Highveld* of the Eastern Transvaal.

The Vegetation Map shows *I. pilosus* to be solidly ABSENT:

1. From the *thorn country* or *Bushveld type of Parkland*.
2. From the *mixed grass lands* of the *Middleveld* and from the major portion of the *Highveld*.
3. From all three types of *desert shrub*.
 - (a) *Thorn country and desert shrub*.
 - (b) *Desert succulents and desert grass*.

I. pilosus is thus seen to occur in *grass veld* and not in *scrub* or *Karoo veld*. Its distribution in *grass veld* is, however, very regional and patchy and is mainly confined to the coastal areas and to parts of the Northern Transvaal. A careful study of the data available shews it to be present only in areas having what is known locally, in each instance, as "*sour veld*". *Sour veld* is a general term covering long rank grass, growing in more or less larger tufts in areas of a relatively high rain fall; it is usually perennial, and unpalatable to stock when mature or dry; the soil is usually poor. In different parts of South Africa the *sour veld* is made up of different species of grass, so that the composition of the *sour veld* of the Western Province is different from that of the Eastern Province, which in turn differs from that of Natal or from that of the Zoutpansberg.

In many areas the veld is made up of both sweet and sour grasses. With judicious veld management the sweet grasses can be maintained; with over-grazing, however, the sweet grasses gradually become eliminated giving the veld a sour character. In these mixed sweet and sour grass lands *I. pilosus* has but an insecure footing. As the veld definitely swings towards the sour the tick becomes more firmly established—one is almost tempted to leave it to *I. pilosus* to decide whether the veld is sour or not—for what to one man is already sour, in another's opinion is only partly sour veld etc.

In area 40, Government Veterinary Officer Grahamstown, the farmers associate the tick, not so much with the sour veld as with the bush, its common name throughout being the *bush tick* or the *bushbuck tick*. Some of the farmers even go so far as to blame the Kudu, or the still fairly abundant Bushbuck, for maintaining the tick in the veld.

It is interesting to note that though *I. pilosus* occurs in the *Western Province flora* of the Klein and the Groot Zwartberg and in the Outeniqua Mountains and of the Kamanassieberg running parallel with the South coast, it is absent from the *Western Province flora* of the Cedarbergen and of the Olifantsberg running parallel with the West Coast. The explanation may lie in the different facies of the flora present in these North Western areas. The Restionaceae etc. so prevalent in the South and South West Cape and giving the veld its sour character, being absent in the north west, their place being taken by annual flowering plants, locally referred to as "opslag". This change in facies might also account for the presence of *I. rubicundus* in the Cedarbergen—*I. rubicundus* being otherwise essentially a *Karoo* or *scrub tick*.

The Influence of Dipping.

From the data available in these records it is difficult to decide what role dipping plays in the control of the tick. Some of the Natal and Southern Zululand returns, where the tick is frequently absent on sour veld and where dipping on the whole is conscientiously carried out, taken in conjunction with those from the Eastern Province, where *I. pilosus* is abundant on all sour veld and where dipping is carried out in a perfunctory manner, suggest that *I. pilosus* can be controlled with the usual arsenical dips.

The influence of temperature and of altitude.

In the Northern Transvaal and in the Eastern Transvaal where there are never any severe frosts *I. pilosus* flourishes up to 5,000 feet in tall grass *sour veld*. In the Eastern Transvaal in the Pilgrims Rest and in the Mauchberg areas it is present up to 5,500 feet in the *short grass* of the *Highveld* having 30 days of frost per annum. It is also present in *sour veld* of the Standerton *Highveld* at 5,000 feet, having over 90 days of severe frost per annum, the actual record here is a winter one.

In the *tall grassveld* of Natal, in the Underberg area, it is securely established at 5,300—6,000 feet and is liable to be active during all seasons of the year.

Thus it would seem to be the nature of the vegetation, rather than the actual altitude or cold, that prevents *I. pilosus* from becoming established in the higher lying parts of South Africa.

The influence of rainfall. The influence of seasonal variations in the relative humidity and/or aridity.

According to the literature *I. pilosus* is said to be predominantly a winter tick and is said to be most active from about April to September. The present findings in no way support this general belief, on the contrary the tick is found to be very variable in its behaviour.

In the *winter rainfall areas* of the Cape i. e. from Cape Town to Swellendam, its behaviour is anything but consistent. At the Cape, area 45, it appears to be relatively inactive during the April-June period, becoming more active during July-September and being most abundant during early Summer, October-December, with a falling off in activity in the late Summer Jan.-March, i. e. here it is essentially an early summer rather than a late winter tick. In the Swellendam-Heidelberg area, Area 36, it appears to be liable to be active at all seasons, being however most frequently absent from the July-September collections.

In the areas with *no definite rainy season*, from Mossel Bay to Grahamstown, areas 39, 40 and part of 37, *I. pilosus* appears to be equally active at all times of the year, this does not necessarily mean that it was sent in from each individual farm at each collection, but that in the area as a whole it is consistently present throughout the year.

In the *coastal summer rainfall areas*, from the Transkei to Zululand, its behaviour also shews considerable variation. In area 20, with a heavy annual rainfall 30—45" and where the winters are never really very dry, the tick is apparently quiescent during the winter months, with its period of greatest activity during the late summer months. This winter quiescence is, however, not so well marked in other collecting areas of Natal, thus in area 18 it was sent in in some early winter collections, it was present in most late winter collections i. e. July-September and was absent from a few summer collections. In these areas dipping, which is carried out concientiously, may disturb the activity—as well as the distribution—picture.

For the Transvaal, with a *pronounced summer rainfall*, most regrettably not one collection is good enough to allow any conclusions being drawn. Unfortunately in the Piet Potgietersrust area, where excellent monthly collections were made, the tick seems to be but very precariously established, being recorded but once from 4A 2 in July and once from 4A 4 in December. In the other areas it appears to be liable to be present in any month and the records from area 7, where one incomplete early summer and two winter collections were made, are of interest in that only once was the tick collected from any one farm during both winters, nor does it appear to have been more prevalent during the one winter than during the other.

In the Eastern Province, in area 47, with a rainfall 10—15" which is very low compared with other areas in which *I. pilosus* is present, it appears to have a rather insecure footing. When it does appear it is at odd intervals mainly during the summer months, although there are one or two winter records as well. On the

Somerset East commonage conditions seem to be exceptionally favourable for the tick, it was present in each of the eight collections sent in. However, on the whole there were an insufficient number of winter collections to warrant any conclusions being drawn about its activities at this season of the year in these areas.

In how far increasing aridity affects either the distribution or the activities of *I. pilosus* is difficult to assess. The influence of precipitation appears to be indirect rather than direct, in that the vegetational coverage, i. e. the *sour veld*, suitable for the tick varies with the rainfall; tall rank *sour veld* being associated with heavy rainfall whereas *sour veld* in the lesser rainfall areas of the highveld is made up mainly of short grasses, the length of the grasses is apparently more important than the precipitation; one is tempted to assume that the rougher and tougher the *sourveld* the greater the chances of survival of the tick.

General discussion.

Unlike the other genera, the hyalommas, the amblyommas and the rhipicephalids, the ixodids never occur in great numbers on domestic stock, nor do they seem to have predilection sites. Only adults are found on domestic stock. Three to four ticks to an animal is a heavy infection on cattle. Usually *I. pilosus* occurs singly, and is liable to occur anywhere on the body in cattle, most usually on the hairy parts. This means that it is difficult to see, unless the female is engorged, when it is located by the disturbance of the smooth surface of the coat of the host. In sheep it is more usually attached to those parts of the body not covered by wool, including the head, ears and eyes.

The smallness of the numbers present, and the difficulty of locating any but the engorged females, may help to explain the irregularity of the records and the apparent contradiction in collections from similar areas. The results, once again, but too frequently reflect the quality of the collector.

This unevenness of the collections, whilst allowing the general conclusion to be drawn that *I. pilosus* is associated with *sour veld*, however, does not permit any statements to be made in regard to the factors limiting distribution of the tick or the factors influencing its activities; further and more detailed collections need to be made before these factors can be established.

Notes on the distribution of I. pilosus in other parts of Africa.

According to Aneurin Lewis 1939 (*The Empire Jnl. of Exp. Agric.* VII) *I. pilosus* in East Africa is a species of the hills and mountains or forest areas, rather than of the lowlands. It infests cattle, sheep and goats on the slopes of the escarpments of the Great Rift Valley, in the forested areas of the Aberdares, on the Mau Hills, in the Thompson Falls and Limuru districts (i. e. all high rainfall areas). Wild animals are often infested with this tick.

According to Jack (*Rhodesian Jnl.* XXXIX, 1942) it is an uncommon species in Southern Rhodesia, all the specimens in the collection were taken on the domestic dog.

In Nyasaland S. G. Wilson 1944, (private correspondence) states that *I. pilosus* is found on cattle in small numbers only during the rains i. e. December-March. It disappears from all collections during the dry season. "I can say for certain that it does not occur as adults during any other season on cattle". Wilson gives as his host list:—Cattle, dog, sheep, lion, oribi, steenbok and reedbok.

Comments on the ecology of ixodids in other countries.

The distribution of *Ixodes holocyclus* (the Australian scrub tick) according to Roberts (*Queensland Agric.*; Jnl. March '41) is throughout the entire length of the coastal areas of Queensland. . . . It does not appear to be able to exist except under humid conditions, and for this reason is practically confined to scrub country. . . . Cases of tick paralysis occur chiefly in spring and summer, particularly during wet humid weather. They can, however, occur at any time of the year for warm periods during the winter may be followed by cases of paralysis. If the weather is dry, on the other hand, the ticks usually remain inactive.

Working in Great Britain with *Ixodes ricinus* Milne and Macleod come to the conclusions:—

- (a) That, provided vegetation conditions are suitable, altitude has no limiting effect on density distribution, enough work has been done to shew that distribution according to altitude is, as expected, a function of vegetation conditions.
- (b) That in Britain the limiting factor to distribution is moisture: the factor influencing activity is temperature (In North Africa *I. ricinus* is active only in winter, whereas in N. Russia it is active only in summer). All stages of the tick may be found on sheep.
- (c) That *I. ricinus* is present in rough grazing, with poor natural drainage and poor soil, irrespective of whether the dominant plant is one of the rough grasses—bracken or heather. *I. ricinus* is absent where the natural drainage and soil are both relatively good.
- (d) That the vegetation type influences the distribution of *I. ricinus* through its effect on the microclimatic humidity, in that the thicker and rougher the vegetation the thicker the basal mat formed by the decaying matter; there is a consistent positive correlation between this mat-thickness and the population density.
- (e) Humidity in itself is not directly correlated with the rhythm of activity in the areas studied. The tentative conclusion is that the duration of the humidity level during daylight, in conjunction with temperature, may partly decide the amount and the extent of the activity during summer. The limits of active temperature are given as between 45°—60° C.
- (f) That the chief controlling factor in the distribution of *I. ricinus* is the physical character of the vegetation layer (This is virtually the same as the tentative conclusion drawn for *I. pilosus* in South Africa).

Disease.

I. pilosus in the past has been accused of causing paralysis in sheep. This statement is based partly on incorrect identifications and partly on hasty assumptions. Recent findings go to shew that *I. pilosus* does not cause paralysis.

*Remarks on the separate Government Veterinary Officers' control areas.**Area 4, G.V.O., Potgietersrust.*

Ticks in this area were collected monthly; only two records were obtained, one from A2 near Alma in July and the other from A4 near Rankins Pass in December; both *sour veld* farms in the Limpopo highlands. No *I. pilosus* were found on the other two Waterberg farms A1 and A3 although both are also on *sour veld*. In A3 it is possible that the tick has been dipped out—this being the farm from which

both *B. decoloratus* and *R. appendiculatus* have been eradicated, but dipping cannot be given as a possible explanation for its absence from 4 A.1. or for the four Block B farms also in the neighbourhood of Nylstroom and which are also given as being mainly sour veld; the other farms on which no *I. pilosus* were collected are all situated in the sweet veld of the Bushveld.

Area 5, G.V.O., Pietersburg.

As in area 4, the grassveld in the Limpopo highlands of this collecting area varies from *sour* to *sweet veld*. *I. pilosus* however has only been sent in from three of these *sour veld* farms; D2 in the *lowveld*, given as a *sourveld* farm showed *I. pilosus* in both collections sent in. The haphazard distribution in the *sourveld* may be ascribed to the poor collections sent in; usually only one, at most two, collections from each farm. No ticks are recorded from the *sweetveld* farms of the *Bushveld* and of the *Lowveld*. Where present, it is present in each of the collections sent in; no collections taken during the winter months.

Area 6, G.V.O., Zoutpansberg.

I. pilosus is recorded from 3 out of the 7 farms labelled as *sourveld* lying in the *Limpopo highlands*. A. 7 is plotted as lying in the *Bushveld* and is given as being *sweetveld*; D.2 lies in the *lowveld*, immediately at the base of the Louis Trichardt mountains. No *I. pilosus* are recorded from the *Parklands* of the *Lowveld* (except D.2) with *sweetveld*. *I. pilosus* has been taken separately on different farms during different months of the year; absent from the two July-September collections.

Area 7, G.V.O., Barberton.

Collections irregular, mainly only early summer i. e. October-December or early winter, April-June, batches being sent in. The distribution picture is most confused. *I. pilosus* is absent from the *sweetveld* of Nelspruit, Kaapsche Hoop and of De Kaap. It is recorded most unexpectedly from three *lowveld* farms; these records may be due to the local habit of trekking from the *sour highveld* to the *sweet lowveld* for winter grazing. Its absence from some of the *sourveld* farms may be due to inadequate collecting. Except for the above three instances it is not recorded from "middel" or *lowveld* farms which are given as *sweetveld*. This is the only area in South Africa in which *I. pilosus* is recorded from the *Highveld*. The confusion of the distribution picture is undoubtedly also to be ascribed to the enormous amount of trekking that goes on every year. Two winter collections were made throughout the area, but in only one instance was *I. pilosus* present during both winters, in every other instance it was absent for one or other winter—the chances of its occurrence on any given farm were equal for either winter. It was present in all but two summer collections sent in.

Area 9, G.V.O., Lydenburg.

In this area four types of vegetation are represented:—the *short grasslands* of the *Highveld* tending to be sour, the *mixed grasslands* of the *Middleveld*, the *sweetveld* of the dry *Bushveld* and the *Parklands* of the *Evergreen and deciduous tree and bush* of the *Bankenveld*. These latter *parklands*, which may carry *sourveld* in the wetter areas of the Waterberg and the Limpopo highlands, consist mainly of *sweetveld* in the drier areas in these northern regions and in the Southern *Bankenveld*.

I. pilosus is recorded twice from 9A. 7. an April-June and a September-December record, lying in the *middleveld*. This is the only *middleveld* record in the whole of the Union and may represent a recent introduction. *I. pilosus* is recorded once from C. 7 in the *tall grasslands* of the Pilgrims Rest area; this record agrees with the records from the adjoining areas in the Barberton district.

Portuguese East Africa.

I. pilosus has thus far not been recorded in any collections made in Portuguese East Africa.

Swaziland.

I. pilosus was sent in from the two dipping tank areas A. 107 and B. 157 both in *sourveld*. These two tanks, however, are not the only tanks situated in *sourveld*; why the ticks should occur in these two areas and not in the others is difficult to explain, possibly it is a question of less conscientious dipping—or of inadequate collections—or of some other factor?

Area 10, G.V.O., Ermelo.

I. pilosus was sent in once, a winter collection, from 10. D. 2. on the Swaziland border; the farm being described as "poor soil and bad grazing" which may be interpreted to mean *sourveld*?

Area 16, G.V.O., Ladysmith.

The collections from this area are extremely poor. *I. pilosus* is recorded but once from D. 2, a late summer collection. Most of the farms in this area are described as *sour* or *sweet and sour veld* mixed, thus larger and more consistent collections can be expected to shew the tick to be more generally prevalent than the present records indicate. Conscientious 7—14 dipping may play a rôle.

Area 17, G.V.O., Estcourt.

Much of the Estcourt area is *sourveld* yet *I. pilosus* is recorded but once from A3 in winter, and yet three to four collections were made from each area. Conscientious 7—14 dipping may play a rôle in controlling the tick.

Area 18, G.V.O., Pietermaritzburg.

I. pilosus is recorded from most of the *sourveld* farms in this area, where it is liable to be present at all times of the year. Its absence from B. 1 might be ascribed to very conscientious dipping, it is absent from the 6 batches sent in. *I. pilosus* does not occur on any of the *sweetveld* farms.

Area 19, G.V.O., Greytown.

A great part of Umvoti and part of New Hanover is *sourveld*, the rest of New Hanover is *sweetveld*. The collections sent in were very poor indeed; only one record, an April-June one was obtained for the whole area. With more conscientious collecting the tick will doubtlessly be found to be more prevalent than the present records indicate; unless it is that the 7—7 or the 7—14 dipping is sufficiently conscientiously carried out to control the tick? The tick is liable to be present at all seasons of the year—but never continuously on any one farm.

Area 20, G.V.O., Ixopo.

I. pilosus is present only on those farms in Ixopo which are definitely labelled as *sour* farms otherwise it is absent from Ixopo. In Polela D.1 is *sourveld* with *I. pilosus* present; O. 2, 4,500', is given as mixed *sour* and *sweet*, dipping 7—7, *I. pilosus* is present in the late summer collection; D. 3, 4,500', is also given as mixed *sour* and *sweet* with dipping however as only 14—28, but *I. pilosus* appears to be absent. *I. pilosus* is also absent from Underberg E. 3 and E. 4 lying above 5,000', dipping 7—14, or 14—0 given as *sour* and as *sour* and *sweet* veld respectively. It would seem that either *I. pilosus* is but insecurely established in the district, or that 1938 was a "bad year", for *I. pilosus*, or that *sweet veld* dominates the *sour* in those farms labelled as *mixed grass veld* and that conditions are not really favourable for the maintenance of the tick.

Area 21, G.V.O., Port Shepstone.

I. pilosus is absent from the belt of Wattle plantations in the Harding collecting block where the natural vegetation is given as *mixed sweet* and *sour*; it was sent in but once—a September collection from B. 1 from the Port Shepstone sugar belt where the natural vegetation is given as *sour veld*. It is absent from the grassland and shrub areas of Umzinto.

Area 22, G.V.O., Eshowe.

The veld in Southern Zululand appears to be mainly *sweetveld* going over into *Bushveld*; the Wattle plantations in the Melmoth district being on *sourveld*; dipping 7—14. *I. pilosus* is recorded from but three areas C. 2 in Nkandhla in an early and a late summer collection; D. 2 near Ntambanana an early summer collection; In E. 1. Eshowe-*sourveld*, it occurs in the only collection sent in, an early summer one.

Area 26, G.V.O., Umtata.

The whole of this area is described as *sourveld*, dipping in most instances is 7—7 with an occasional 5—5 or 14—14. *I. pilosus* seems to be securely established in the *coastal subtropical* belt, where it is liable to occur at any season of the year or is even present throughout the year, rainfall 45". It is also present at any time of the year in the belt adjoining shewing the first appreciable rise from the coastal strip but still within 20 miles of coast, rainfall 35"; further inland it is consistently absent except at G. 3, Engcobo village, where it occurs in an early summer collection. The veld conditions, grass on the hills and scrub thickets along the river banks, are almost identical throughout. Large tracts lie in the mist belt, but detailed information as to the mist belt is wanting. It may be that the very regular dipping enforced in these native areas is playing a rôle in controlling *I. pilosus*?

Area 28, G.V.O., Butterworth.

Dipping mostly 7—14, in Kentani 14—28, rainfall 25"—42"; vegetation mostly *grassveld* with scrub or bush in the valleys; in the districts of Kentani and of Komgha the veld tends to become *sour*, *I. pilosus* only occurs in these two areas and may be present either in summer or in winter.

Area 29, G.V.O., Flagstaff.

Collections poor. The only record, a winter one, is from Port St. Johns in the *sub tropical* belt, which tends towards *sourveld*. For the rest, the tick appears to be absent from the undulating grasslands and from the Thornbush Savannah areas. Dipping regular 7—14.

Area 30, G.V.O., Kokstad.

I. pilosus is present in late summer and winter in the *sourveld*-wattle plantations of Unzinkulu, dipping 7—14, having but medium frosts in winter. It is absent from the *mixed grass veld* of Mt. Currie, Mt. Fletcher and Matatiele, having severe frosts in winter.

Area 35, G.V.O., Worcester.

Due to the Great Robertson Fault there is a large incursion of *Karoo veld* into *sourveld* of the *Western Province flora* of this area; the vegetation is further mixed by the presence of large irrigation schemes. Generally speaking *I. pilosus* does not occur on pure *Karoo veld*, or on clean *sweet veld*, it is present on *sourveld* or on mixed *sour* and *Karoo* or even on *Karoo veld* under irrigation. Apparently it does not occur during the April-June period, but this apparent early winter inactivity may be ascribed to inadequate collections; too frequently no collections were made at this time of the year.

Area 36, G.V.O., Swellendam.

I. pilosus is present throughout at practically all times of the year. It is absent from a few farms which are given as *sweetveld*—in contradistinction to the prevalent *sourveld* obtaining throughout the area.

Area 37, G.V.O., Oudtshoorn.

I. pilosus is present along the mountain ranges lying in the Belts of the *sourveld* of the *Western Province flora*, in the broken grass-heather veld of Mossel Bay and of the Long Kloof and also in the *temperate evergreen forest* belt of George and Knysna. It is absent from the *Karoo veld* of the Little Karoo—except on some farms on the Kamanassie irrigation scheme. It is liable to be present at all times of the year and is often present without a break throughout the year.

Area 39, G.V.O., Port Elizabeth.

I. pilosus is absent from the *Karoo veld* of Jansenville and of Steytlerville as also from the so-called *middlebush Karoo* of Uitenhage and of Port Elizabeth. It is present in those areas of Port Elizabeth which show the coastal *sourveld* of the *Western Province flora*; in these areas it may be active at all or at any season of the year.

Area 40, G.V.O., Grahamstown.

I. pilosus is absent from the *Tall grasslands* of Peddie and from all *Karoo and Karroid* farms in the area. It is present and active at almost all seasons on the *tall grass veld* mixed with small bush or scrub. Throughout this area the farmers associate the tick not so much with the *sourveld* as with the bush, its common name throughout being the bush-tick or the bushbuck tick. Bushbuck and Kudu are both still to be found throughout the district. On the farm 40. F. 3 the farmer makes the definite statement that his stock only pick up *I. pilosus* on top of the hills on his farm—with *sourveld*, but not in the valley which is *sweetgrass*.

Area 45, G.V.O., Cape Town.

I. pilosus is present at odd times during the year on most of the farms. It was however not sent in from the three farms situated in the wheat fields of Belville.

Area 47, G.V.O., Bedford.

The collections from these areas are most unequal. *I. pilosus* seems to have but an insecure footing in the *mixed grassveld* but is well established on the *sourveld*, and is entirely absent from the *Karoo veld* of Somerset East. The Pearston collections, which were also good, shew it to be but insecure in the *mixed grass and bush veld* and quite absent from the *Karoo veld*. The records from Fort Beaufort, Cradock and Adelaide are poor, but indicate that the distribution would tally with that established for Pearston and Somerset East. In these regions it appears to be more prevalent during the summer months, but is also occasionally collected during the winter.

Summary.

1. The distribution of *I. pilosus* has been given in terms of political divisions, as well as in terms of vegetational coverage.
2. It appears to be associated with *sour-veld*; sour veld which, in its turn, is mainly associated with high rainfall in most instances.
3. From the data available it is difficult to establish which factors influence its activities or which factors exercise a limiting rôle to its distribution. It is liable to be present during most seasons in most areas.
4. The data available suggest that it can be controlled with the usual arsenical dips.

DISTRIBUTION OF *IXODES RUBICUNDUS*—(the Karroo Paralysis Tick).

General Distribution.

Ixodes rubicundus is confined to the Cape Province, with but one odd record from the Standerton district in the Highveld of the Transvaal and one from the *Brokenveld* of Fauresmith in the Orange Free State.(*)

The distribution, according to the data collected up to the present, is very uneven and discontinuous and at first glance seems to be very haphazard. Further collections if consistently carried out, however, will undoubtedly bring out more clearly the factors influencing its distribution.

Distribution in the vegetational types.

The distribution may show *I. rubicundus* to be PRESENT:

1. In but one type of forest.
 - (a) *Evergreen sclerophyllous bush* or *Western province flora*, only in certain localities however.
2. In but one type of *Desert shrub*.
 - (a) *Desert shrub* or *Karoo bush*. This is its preferred vegetation, but even here it is not solidly present throughout.

The distribution Map shows *I. rubicundus* to be ABSENT:

1. From two types of forest.
 - (a) *Evergreen and deciduous bush and tropical forest*.
 - (b) *Temperate evergreen forest*; with one odd record from Knysna and one from George.

* Since going to press it has been found that *I. rubicundus*, and with it sheep paralysis, is much more prevalent in the *mixed veld* of Edenburg, Bethulie, Trompsburg, Smithfield, Fauresmith and Ladybrand of the Southern Orange Free State than the Tick Survey indicated.

2. From all three types of *Grasslands*.
 - (a) *Tall grass*; with one odd record from Alexandria on a farm which, however, is mainly karroid Fish River-Bush.
 - (b) *Short grass* of the *Highveld*, with one odd record from the Standerton area.
 - (c) *Mixed grass of the Middleveld*.
3. From all three types of *Parklands*.
4. From two types of *Desert Shrub*.
 - (a) *Thorn country and desert shrub*.
 - (b) *Desert succulents and desert grass* of Bushmanland and Namaqualand.

The influence of dipping.

I. rubicundus occurs mainly in areas where there is no dipping, so that from the data available in this survey it is impossible to say whether dipping has any effect on the tick or not.

The influence of temperature and of altitude.

Altitude and low temperature in themselves are not a limiting factor to the distribution of *I. rubicundus*. The tick is found in the very cold regions of the Roggeveld and Nieuwveld mountains of the Sutherland district, having up to 120 days of heavy frost.

It is of interest to note that in the farmer's mind *I. rubicundus* is associated with hills and with mountain slopes; with localities having a "definite type of Karroo vegetation". The data accumulated thus far, at first glance, seems to support this belief—thus the main collections come (a) from the Olifants-Cedar and Bokkeveld-Kamiesberg ranges in the Western and North Western regions; (b) in the Roggeveld and Nieuwveld Ranges in the cold Sutherland regions; (c) in the Koudeveld, Sneeuwberg, Rhenosterberg, Kikoorschberg of the Graaff Reinet-Middelburg area with Koppie-outliers stretching to Colesberg and Norvalspont, whereas it is generally absent from the intervening flats.

It is however not associated with all the major Karroo mountain ranges: thus it is noticeably absent, according to present day records, from the Tandjesberg-Grootbruintjes-hoogte group of the Graaff Reinet-Cradock-Somerset East regions; the Karroo vegetation of these Eastern Province areas shewing a somewhat different facies from the central and from the Western Karroo.

Our information however is too incomplete to allow any definite pronouncements being made.

The greatest bulk of the distribution lies within the zone having more than 90 days of severe frost with light frosts from end of April till October; the records from the Zwartberg are from a zone having over 60 days of severe frost with light frosts from Mid May to mid September. The Cedarberg-Bokkeveld records are from regions having less than 30 days of heavy frost per annum, with light frosts from mid June to mid September approximately.

The influence of rainfall.

Independently of vegetation and of temperature preferences, humidity seems to play a limiting role in the distribution of *I. rubicundus*. Thus the tick is solidly absent from areas with a rainfall below ten inches. Other factors being

favourable, it can maintain itself in areas with more than 10 inches per annum. It is, however, not present in all Karroo areas with over 10 inches per annum, thus it is notably absent from the De Aar, Philipstown, Petrusville, Hopetown regions, areas of typical flat open Karroo.

Seasonal variations in the activity of I. rubicundus.

I. rubicundus is active during the early winter months, in most instances during April and May, both in the Summer and in the Winter-rainfall area, at a time before the heavy frosts have set in. In the Western winter rainfall areas its activities may extend into July, i.e. in areas where heavy frosts are not very common; very seldom is it collected later in the year. In one or two instances only, was it sent in before April.

The value of some collections, and hence of the conclusions drawn therefrom, is doubtful—since too often no winter collections were sent in. Further and more consistent collections are needed to give a more accurate picture of the factors influencing the activities and limiting the distribution of *I. rubicundus*.

Disease.

I. rubicundus may cause paralysis in sheep; the removal of the tick, provided paralysis has not gone too far, leads to immediate recovery. Not all ticks cause paralysis. Further field observation and laboratory experiments need to be made to elucidate the conditions leading to paralysis.

Remarks on the separate Government Veterinary Officer control areas.

These remarks must be read in conjunction with maps 1 and 2 of Part 1, and map 1 of this article.

Area 10, G.V.O., Standerton.

Present at 10. A. 4 in a July-Sept. collection, a typical *Highveld* farm at about 5,000 feet; summer rainfall 25 inches per annum, and no dipping. In all probability this represents a recent introduction which will not be able to maintain itself.

Area 31, G.V.O., Aliwal North.

Absent from the *grasslands* of the *Highveld* of Herschel, Lady Grey, Barkly East, Wodehouse, Albert and Aliwal North. Only recorded thus far from the mixed veld of Molteno from D2 at 5,000 ft; 20 inches per annum, no dipping. It apparently is absent from the *Karoo veld, mixed grass and bush*, of Venterstad: 4,500—5,000 feet; summer rainfall 12 inches per annum; no dipping; drought conditions during the previous year. Had July-September collections been made the tick may have been found to be more prevalent in the *Karoo veld* of this area than the records shew.

Area 35, G.V.O., Worcester.

Together with *I. pilosus* present in the incursion of *Karoo veld* into the *Western Province flora* in the Worcester-Robertson area; 8 inches per annum, but farms under irrigation; found only in the July-September collections, absent at other times of the year. No dipping. Its apparent absence from the *Karoo areas* of Ceres may be due to the fact that only summer collections were sent in from the warm *Bokkeveld*.

Area 39, G.V.O., Port Elizabeth.

The collections from this area are very patchy and irregular. *I. rubicundus* is present at 39. A. 2 in the so-called *middelbush Karroo* of Uitenhage in a July-September collection (no April-June collection) but it is absent from 39. A. 1. a *middelbush Karroo* farm in the Humansdorp district, also no April-June collection. It is present at 39.B.2. in an April-June collection near Assegaaibosch in Humansdorp district but absent in the other coastal areas; at B₁ and B₄ the April-June collection was skipped. Its absence from the flat Karroo veld of Jansenville and Steytlerville fits in with its absence from the equally flat areas of the adjoining district, of Aberdeen. It is difficult to say whether this absence is more apparent than real for in each instance no winter collections were made.

Area 40, G.V.O., Grahamstown.

This area lies in the *Tall grass lands* of the *Eastern grass lands*; it is however intersected by xerophytic Karrooid scrub along its main river valleys. *I. rubicundus* is recorded once, an October-December collection from 40. B₃ in the Bushman's River valley, having typical *Fish River Bush* covering. Otherwise *I. pilosus* is the ixodid prevalent in the Alexandria district.

Area 41, G.V.O., Middelburg.

Present in the *Karroo and grassveld* of Richmond, Hanover, Colesberg, Middelburg, Steynsberg in April-July collections, absent from all other collections. Its absence from many of the farms may be ascribed to the fact that only summer collections were made. It is quite safe to assume that *I. rubicundus* is solidly present throughout the area. No dipping; summer rainfall 12 inches per annum; 3,500—5,500 feet.

Area 42, G.V.O., Calvinia.

The vegetation in this area varies considerably, stretching from the *Western Province flora* of the Swarttruggens, Cedarbergen and Olifants bergen and outliers in the South East, through the dry arid Knersvlakte to the *desert succulents and desert grass* of Bushmanland in the North and into the *Karrooveld* of Sutherland and of Williston.

The distribution picture is not very clear. *I. rubicundus* appears to be absent or insecurely established in the lower lying *Warm Bokkeveld* of Ceres though present in the more mountainous *Cold Bokkeveld*. It is absent in the dry and arid Ceres and Calvinia-Karroo lying between the Cedarbergen and the Roggeveld escarpment, though present in both these mountain ranges. It is also absent from the arid flat regions of Williston and Calvinia. When present it occurs in most of the April-June collections. Dropping down from the Bokkeveld at Nieuwoudtville *I. rubicundus* is still found on the Onderbokkeveld hills on farms lying on the edge of the winter rainfall area.

In several *Karroo areas* in South Africa the farmers maintain that *I. rubicundus* is found only on a "certain type of veld", that it is usually to be found on the eastern slopes of hills "facing the rising sun". Conditions in area 42 might be taken to give support to this belief, for here the tick is mainly found on the hills and not in the lower lying intervening valleys. "e. g. . . . it is essential to bear in mind that the ticks were found on top of the range of hills that are on the farm . . . the sheep grazing to the flats". The most probable explanation here, however, is the marked difference in humidity, with its attendant changes in vegetation etc. rather than the eastern aspect of the hillside, the mountains having a decidedly heavier rainfall than the valleys.

The records shew the tick to be present during the April-June period—and in the Knersvlakte area during July. According to the Government Veterinary Officer the farmers of the Roggeveld area of Calvinia lying on the edge of the winter rainfall area state in the years of normal rain the paralysis season is end of March, April and May; they are emphatic in stating that when the rains are delayed it is usual to find the season extending into June. They also state that when the season of winter rains is poor it is not unusual to experience isolated or sporadic outbreaks, usually confined to single cases occurring throughout July and August. It is interesting to note that some of these areas lie within the coldest regions of the Union, the coldness being accentuated by the winter rainfall—and that the farmers associate the presence of the ticks with the rainfall.

Area 43, G.V.O., Beaufort West.

The collections made may not give a true reflection of the distribution of *I. rubicundus* in that no July-September collections were sent in. The few records are all April-June.

The vegetation throughout is *Karoo* and the rainfall is below 10 inches per annum, except on the mountain ranges. *I. rubicundus* is present at A. 1 in the Prince Albert region of the Zwartberg at 9" per annum; it is present at E. 1 in the Nieuweveld range of Beaufort West: 6,000 feet; rainfall 10—15"; and in the Koudeveld Bergen of Murraysburg; 4,000—5,000 feet, rainfall 15". Its absence from the more arid regions fits in with absence from similar dry areas in the adjoining *Karoo* districts. Here, once again, its association with the hill slopes may be due to the increase in precipitation with its attendant changes in vegetal covering, rather than to any other factors.

Area 45, G.V.O., Cape Town.

The one odd winter record from a Dairy at Lakeside in all probability represents an accidental introduction.

Area 51, G.V.O., Kimberley.

The tick survey shews this area to be clear of *I. rubicundus*, the collections sent in, however, were not consistently carried out and may not give a true picture. According to a stud farmer in the Fauresmith district "the paralysis tick worries the sheep during the period between April and August; after this only lambs are paralysed but shew only the *Karoo* brown tick and not an *Ixodes*." *R. capensis* is also accused of causing paralysis in one or two other *Karoo* areas. The position in regard to paralysis in this area needs further investigation before any pronouncement can be made.

Area 55, G.V.O., Namaqualand.

The vegetation of the major part of this district is the *desert succulents and desert grass*; with *desert shrub* or *Karoo veld* along the Langeberg and the Kamiesberg reaching up to Steinkopf. The rainfall on the coastal belt and in little Bushmanland is below 5 inches rising to 15" on the hills. The only two place records for *I. rubicundus* are from the *scrub and mesembrianthemum veld* in the Kamieskroon area—reputedly the wettest region of Namaqualand. The tick was sent in in April-June, July-Sept. and in Oct.-Dec. collections.

Area 58, G.V.O., van Rhynsdorp.

The part of the area along the coast is mainly very arid with a vegetation of *desert succulents* and *desert grass*; in the hills the vegetation is mainly of the *Western Province* type, with incursions of *karroo mesembrianthemums*; and to the north of van Rhynsdorp-Klaver lies the notorious Knersvlakte with its characteristic desert succulents.

I. rubicundus is recorded from the hilly regions; at A. 1. on the Giftbergen, having mainly *mesembrianthemum veld*, rainfall 5" per annum, winter rainfall, collected in the July-September period and again in October-December.

The December record from D, just to the north of Klaver, on the edge of the dry arid Knersvlakte, is unexpected. Trekking, which is a fairly common practice in Namaqualand apparently does not take place on the farm.

Area 59, G.V.O., Clanwilliam.

Winter rainfall area, most of the district is covered with *Western Province* flora, this is most pronounced on the top of the hills, but gives way to *mesembrianthemum Karrooveld* at the foot of the hills sloping towards the arid Calvinia Karroo on the East; and on the west the hills slope down to the dry coastal strip. *I. rubicundus* is mainly present in the moister regions having a *Western Province* flora or a mixture of *Western Province* and *Karroo veld*; it is absent from the *coastal sandveld* and from the Calvinia Karroo, absent in four collections. At A.1 it was collected in July-September, at A. 4 and A. 5 in April-June, and at B. 1 in October-December.

Area 57, G.V.O., Graaff Reinet.

I. rubicundus is recorded from the Koudeveld and Sneeuwbergen on the Murraysburg and Graaff Reinet district and from the foothills of the Swartbergen in Willowmore. It is absent from the Aberdeen flats; nor has it been recorded from the Tandjiesbergen and the Grootbruintjieshoogte ranges. It appears to be present in the April-June and July-Sept. periods and was once sent in in a Jan.-March collection. Summer rainfall area; averaging 10" to 20" per year. Veld mainly *Karroo scrub and some grass*.

Summary.

1. The distribution of *Ixodes rubicundus* has been given in terms of political divisions, as well as in terms of vegetational coverage.
2. *I. rubicundus* is shewn to be confined to the moister regions of the *Karrooveld*; regions which are more generally hilly or mountainous rather than flat and open.
3. *I. rubicundus* is shewn to be active in the early winter months of April and May; occasionally it is active until July. Its occurrence during summer months is very exceptional.
4. As it occurs in areas where dipping is not practised, it is impossible to conclude from the data presented in the survey, what effect dipping has on it.
5. *I. rubicundus* is the only tick incriminated thus far with tick paralysis in South Africa.

UNION OF SOUTH AFRICA

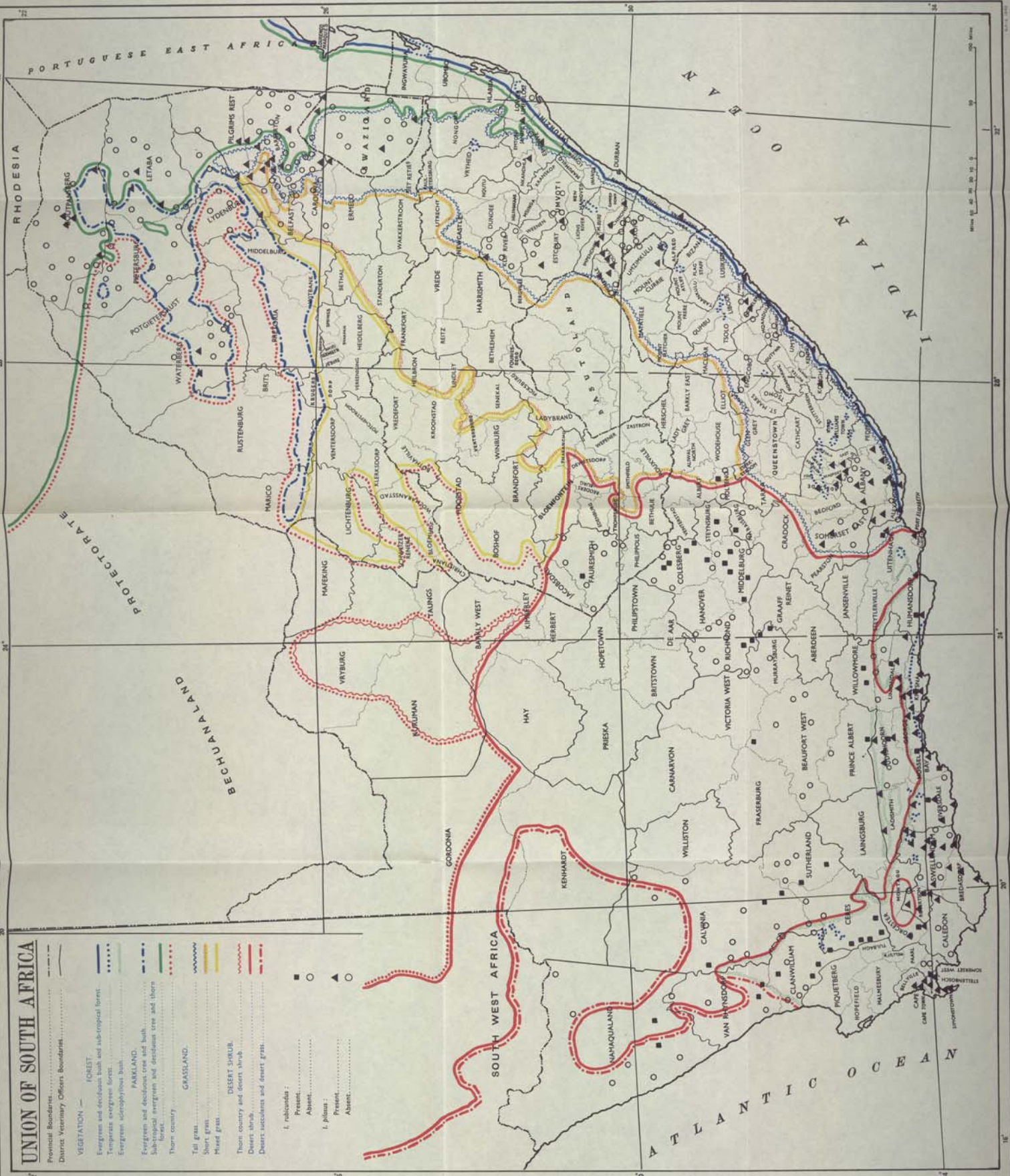
Provincial Boundaries: —
 District: Veterinary Officers Boundaries: - - - - -

VEGETATION

- FOREST**
 Evergreen and deciduous bush and sub-tropical forest: ————
 Temperate evergreen forest: ————
 Evergreen sclerophyllous bush: ————
PARKLAND
 Evergreen and deciduous bush: ————
 Sub-tropical evergreen and deciduous tree and thorn forest: ————
THORN COUNTRY
GRASSLAND
 Tall grass: ————
 Short grass: ————
 Mixed grass: ————
DESERT-SHRUB
 Thorn country and forest: ————
 Desert shrub: ————
 Desert succulent and forest grass: ————

I. reduplicata :
 Present: ●
 Absent: ○

I. johnii :
 Present: ▲
 Absent: ○



Scale: 0 10 20 30 40 50 Miles

22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100