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THE SEASONAL INCIDENCE OF HELMINTH PARASITES AND OF *OESTRUS OVIS* IN KARAKUL SHEEP IN THE KALAHARI REGION OF SOUTH WEST AFRICA/ NAMIBIA

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ABSTRACT

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The seasonal incidence of gastro-intestinal helminths and of *Oestrus ovis* was determined by slaughter of successive groups of 4 tracer lambs, each exposed on pasture for 33 days.

Haemonchus contortus was present from March 1979 to early July 1979, with a generally increasing percentage of 4th stage larvae in each successive month. A "spring rise" in the egg count was seen in flock sheep in October 1978. *Oesophagostomum columbianum* was recovered from tracers slaughtered in March 1979. Apart from December and March, *Moniezia* spp. were present from November 1978 to early July 1979.

Oestrus ovis was active from September 1978 to early June 1979, with peak larval burdens recorded from October to December and from April to early June.

INTRODUCTION

The southern farming areas of SWA/Namibia are used chiefly for Karakul pelt production. In spite of low rainfall figures and the fact that isohyets tend to run from west to east in this area, sheep in the red sandveld ("dune Kalahari") region, which lies in the eastern part of this Karakul farming area, are reported to be plagued by endoparasitism on a scale far larger than in the western ("hardveld") regions (Anon., 1956, 1960). The red sandveld area, the worst plagued of all, is the so-called "Soutblok" described below (A. J. J. Meyer, personal communication, 1978). A seasonal incidence study of gastro-intestinal parasites and of the sheep nasal bot, *Oestrus ovis*, in Karakul sheep on the edge of the "Soutblok" area was therefore undertaken to enable sound recommendations to be made on parasite control, recommendations that will hopefully be applicable to the whole southern Kalahari region of SWA/Namibia.

MATERIALS AND METHODS

Survey locality

The farm "Sophie's Pan" No. 500 (25° 00′S 19° 50′E; Alt. 1 050 m) in the Aranos District was chosen as representative of a large Karakul sheep farming unit with jackalproof fencing, where kraaling or penning is not practised. The farm lies on the northern edge of the area referred to as the "Soutblok" by Gerber (1967). This is an area where the underground waters have a very high total salt content and where the levels of sulphate and/or nitrate and/or fluoride and/or total dissolved solids are often such that the water is rated as unsuitable for human or animal consumption by the Department of Water Affairs. Despite this, most farms are occupied and used for Karakul farming. "Sophie's Pan" is in a zone with water of a more acceptable standard (Tredoux, 1971).

Physiographically, the farm lies in the "dune Kalahari", described by Leser (1976) as a zone in which the soils are "bodenfeuchtegünstig" (literally "ground-moisture-favourable"). Louw (1964), working in the nearby Kalahari Gemsbok Park, showed that the dunes themselves have more favourable superficial moisture conditions than the intervening valleys or "streets". The study farm itself, and parts of the "Soutblok", have a reticulate dune formation (Goudie, 1970), referred to locally as "broken duneveld without streets".

According to available figures till 1970, the mean annual rainfall for the study area is approximately 240 mm, most of which falls from January to April. In the summer of 1977/78, that is, before the study started, only 35 mm fell on "Sophie's Pan", but during the survey period itself the rainfall (197 mm) was nearer to the mean. Monthly rainfall figures on the farm and mean monthly maximum and minimum temperatures taken at Mariental weather station are shown in Fig. 1. Although

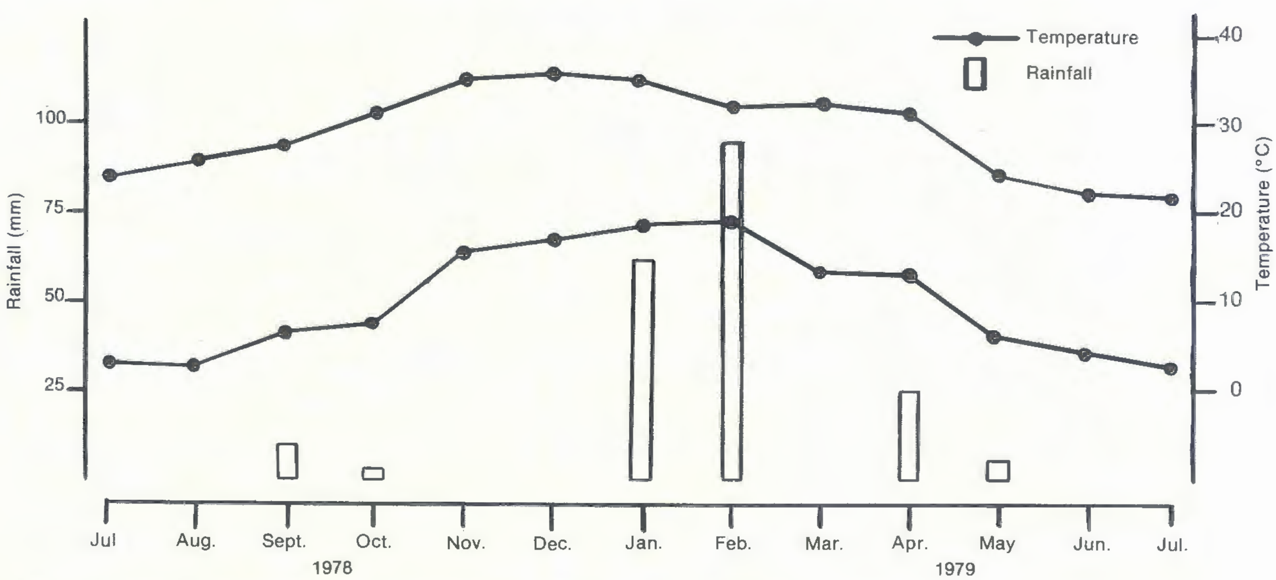

FIG. 1 Mean monthly maximum and minimum temperatures and monthly rainfall during the study period.

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Mariental and "Sophie's Pan" are 200 km apart, they lie between the same isotherms (1 °C interval) for both the mean daily maximum temperatures for the warmest month and the mean daily minimum temperatures for the coldest month of the year. They are therefore considered comparable as far as temperature records are concerned.

The vegetation in the whole dune Kalahari consists of mixed tree and shrub savanna (Leistner, 1967; Giess, 1971).

Infestation and management

The survey was carried out from August 1978 to the end of July 1979. The chief source of contamination in the survey area was a flock of between 300 and 450 Karakul sheep. The flock composition, which varied slightly from month to month, was approximately as follows: 65% wethers, 12–24 months old; 15% wethers, less than 12 months old; 15% ewes of all ages, and 5% lambs. Lambs were born during August 1978 and March 1979.

Four camps, each of about 300 ha, were used in rotation by the flock. The sheep were moved to a fresh camp at the end of May 1978 and then moved again at 2-month intervals thereafter, each time to a pasture which had been rested for 6 months. Individual faecal worm egg counts and group differential larval cultures were done at monthly intervals on 25 marked sheep, representative of different classes, to obtain an indication of pasture contamination. Except where indicated below, the marked sheep were subject to the same dewormings as the main flock.

For several years before the survey commenced, dewormings on the farm had followed a particular regimen. A combination product containing rafoxanide and thiabendazole was administered at the beginning of the rainy season in January or February, then rafoxanide alone was administered when tactically necessary (usually once or twice) during the remainder of the rainy season (usually until April). A combination product containing rafoxanide and thiabendazole was again administered after the first severe frost (usually in April or at the beginning of May), and also in September. Cambendazole was used for lambs in November 1977 only. However, the above programme was abandoned during the survey period because of the severe nodular worm problem reported by the farmer. During this period the sheep were dosed according to the schedule given in Table 1.

Tracer lambs

Each month, 4 Karakul wethers, aged between 12 and 18 months, were removed from the flock and treated orally with rafoxanide, levamisole and a 4 × therapeutic dose of febantel. They were then housed in a shed, which was closed in on 3 sides and had a concrete floor, under worm-free and, as far as could be determined, oestrid-free conditions. The shed was thoroughly cleaned twice weekly. After 4 deaths due to coccidiosis (in the groups slaughtered in April and May), tracer groups were also given 2 courses of sulphonamides during this preparation period in the shed.

When the lambs had spent 4 weeks in the shed, rectal faecal samples were taken and, apart from the first group, which was not treated for cestodes, they were treated orally with niclosamide, trichlorfon, levamisole and a 2 × therapeutic dose of febantel. They were then put out onto pasture with the flock, but were not subject to the general flock dewormings. After 33 days they were removed from the flock again, housed on concrete, starved for 48 hours and given no water for 24 hours prior to slaughter. There was an overlap of 5 days between tracer groups on pasture.

Parasite recovery

The ingesta from the abomasum and the small intestine were washed through a sieve with apertures of 38 μm to recover the helminths. Ingesta from the large intestine were washed through a sieve with apertures of 150 μm to remove the coarser ingesta and recover the larger helminths, then the filtrate was washed through a sieve of 38 μm to recover any smaller forms. The specimens were preserved in formalin. The mucosa and muscularis layers of these organs were scraped and the scrapings subjected to pepsin-HC1 digestion, as described by Reinecke (1973). In most instances 5 × $^1/_{50}$ aliquots (a total of $^1/_{10}$ aliquot) of each sample were examined under a stereoscopic microscope. The residual $^9/_{10}$ was examined macroscopically, but it was found that only *Oesophagostomum columbianum* and cestodes could be accurately counted. Higher counts of *Haemonchus contortus* were obtained from the $^1/_{10}$ aliquot rather than the macroscopic counts. The latter were subsequently abandoned in favour of the higher counts of this worm obtained from the microscopic examinations. *O. ovis* larvae were recovered and counted using the technique described by Horak (1977 a).

RESULTS

Rectal faecal samples, taken on the day on which the tracers were introduced into the flock, were in all cases negative for roundworm eggs but were often positive for coccidial oocysts.

Monthly faecal worm egg counts performed on the 25 marked sheep and the resultant differential larval culture results, together with details of the treatment of the flock and the marked sheep, are given in Table 1.

The mean burdens of intestinal helminths and oestrid larvae for each set of tracer lambs are summarized in Table 2. In the case of the higher burdens of *H. contortus*, the percentages of 4th stage larvae (expressed as a percentage of the total *H. contortus* burden) are also given.

H. contortus was present in fair numbers in those tracers slaughtered from March to early July only. Peak burdens of adults and immature stages, which were present in almost equal numbers, were recovered in March. Thereafter, the percentage of 4th stage larvae showed a general tendency to increase, reaching a maximum of 96,3% in July. The tracers slaughtered in early April showed a sudden decrease in total *H. contortus* burdens, when compared to burdens in March. This was followed by an increase in burdens in the 2 subsequent groups and then a decline in the group slaughtered in early July. During the period July to early February, virtually no infestation occurred in tracers, apart from the sheathed 3rd stage larvae found in November. The egg counts of the marked sheep showed a notable "spring rise" (see Discussion) in October. Egg counts began rising sharply again in March, and peak egg counts were seen in April and May.

O. columbianum was encountered in fair numbers in tracers slaughtered during March only. The percentage 4th stage larvae (expressed as a percentage of the total *O. columbianum* burden) in this group was 91,7%. *O. columbianum* larvae were obtained from a culture from the marked sheep in May 1977 only.

Other nematode genera: Very small numbers of *Trichostrongylus falculatus*, *Strongyloides papillosus* and a *Cooperia* sp. were collected from tracers slaughtered in May and/or June 1979.

TABLE 1 Monthly differential egg counts of faeces from 25 sheep

Date	Treatment	Mean EPG	Larvae from pooled culture
24/7/78	Whole flock: febantel "Rintal" (Bayer) 5 mg/kg (before study began)	—	—
1/8/78		30	Negative
29/8/78		0	Negative
26/9/78		25	*H. contortus*
24/10/78		730	*H. contortus*
8/11/78	Whole flock: rafoxanide "Ranide" (MSD) 7,5 mg/kg	—	—
20/11/78		16	*H. contortus*
18/12/78		12	*H. contortus*
17/1/79		26	*H. contortus*
12/2/79		52	*H. contortus*
12/3/79	Whole flock: febantel "Rintal" (Bayer) 5 mg/kg (after samples collected)	452	Sample accidentally discarded
9/4/79		909	*H. contortus*
23/4/79	Egg count sheep: albendazole "Valbazen" (Smith Kline) 3,8 mg/kg Remainder of flock: closantel "Flukiver" (Ethnor) 10 mg/kg	—	—
7/5/79		900	93% *H. contortus* 7% *O. columbianum*
13/5/79	Egg count sheep: rafoxanide "Ranide" (MSD) 7,5 mg/kg		
4/6/79		14	Negative
2/7/79		74	Negative
30/7/79		24	Negative

TABLE 2 The mean parasite burdens of tracer lambs

Date slaughtered*	Mean numbers of parasites recovered										
	H. contortus			*O. columbianum*		*Moniezia* spp.	*Avittelina* sp.	Other helminths	*Oestrus ovis larvae*		
	4th	Ad	% 4th stage	4th	Ad				1st	2nd	3rd
1/8/78	0	0,75	—	0	0	0,25	0	—	0	0	0
29/8/78	0	0	—	0	0	0	0	—	0	0	0
26/9/78	0	0	—	0	0	0	0	—	0,75	0	0,75
24/10/78	5	0	—	0	0	0	0	—	31,0	0,75	1,5
20/11/78	(217)†	0	—	0	0	0,25	0,25	—	7,25	1,0	2,5
18/12/78	0	0	—	0	0	0	0	—	7,25	1,0	1,0
17/1/79	2,5	0	—	0	0	0,5	0	—	0	0	0
12/2/79	10	0,25	—	2,5	0	0,75	0	—	1,5	1,0	0
12/3/79	970	980	49,7	33	3	0	0	—	0,5	0	0,5
‡9/4/79	35	6	85,4	0	0	1,0	0	—	3,0	2,5	2,5
‡7/5/79	425	135	75,9	0	0	1,5	0	*Trichostrongylus falculatus* 14	2,5	1,0	0
4/6/79	705	85	89,2	0	0	0,25	0	*Strongyloides papillosus* 55 *Trichostrongylus falculatus* 5 *Cooperia* sp.5	5,75	1,25	0
2/7/79	130	5	96,3	0	0	0,5	0	—	0	0	0
30/7/79	0	0	—	0	0	0	0	—	0	0	0

Notes: * after 33-day tracer period
Ad = adult
4th = 4th stage larvae
† 3rd stage larvae with sheaths
‡ on these occasions 2 tracers only were slaughtered

Cestodes: Except in December and March, *Moniezia* spp. were present in tracers slaughtered from November to July. One *Avitellina* sp. was recovered in November. *Stilesia hepatica,* although present in most tracers, was not monitored.

O. ovis was not recovered in July and August, but had reached peak burdens in the tracers slaughtered in October. Thereafter, the burdens remained fairly high for 2 months, dropped to zero in the group slaughtered in January, and then rose again for the period April to early June. The highest proportions of 1st stage larvae (expressed as a percentage of the total *O. ovis* burden) were seen in October, June and December respectively, though the highest actual burdens of 1st stage larvae were found from October to December, and in June. Two mature larvae which were placed in vermiculite at room temperature on the farm after collection on 20 November 1978 hatched on 17 and 18 December (27 and 28 days later) respectively. Another 2 mature larvae, 1 collected on 24 October 1978 and the other on 20 November 1978, failed to hatch. No other mature larvae were found during the study period.

Discussion

The use of tracer lambs on natural pasture and with normal management procedures taking place, was similar to that described by Horak (1978).

The coccidial oocysts found in rectal faecal samples taken on the day on which tracers were introduced into the flock, were found to be particularly numerous in younger tracers (12 months old) during the late summer. Four tracer lambs died on the veld from coccidiosis. This infestation was acquired during their preparation period in the shed despite the precautions taken with sanitation.

The seasonal occurrence of *H. contortus* in sheep in southern Africa has been described in several localities by various authors (Barrow, 1964; Rossiter, 1964; Viljoen, 1964; Muller, 1968; Viljoen, 1969; Horak, 1977 b; 1978) and inhibition in the 4th larval stage by Blitz & Gibbs (1972 a). The findings in the seasonal incidence surveys generally show a similar pattern of peak adult burdens during and/or after midsummer, while most surveys also show increasing 4th stage larval burdens in autumn and winter. Both patterns hold true for the present survey. The 3rd stage larvae recovered from tracers in the present survey in November, being sheathed, are thus believed to have infested these sheep after their removal from the flock in the waiting pens prior to slaughter. The sudden decrease in burdens of *H. contortus* in April in this survey appears to be related to the absence of rainfall in March.

Several of the authors cited above report a "spring rise" in *H. contortus* egg counts, and a clear "spring rise" was also seen in this survey, with no evidence that it originated from freshly acquired infestation. The "spring rise" would appear to be generally due to maturation of 4th stage overwintering larvae (Blitz & Gibbs, 1972 b). The "spring rise" in this case occurred in spite of a midwinter deworming with febantel (24 July 1978) and without any evidence that infestation could have been acquired between the time of deworming and the "spring rise". The fact that high egg counts were recorded 14 days after marked sheep had been dewormed with albendazole on 23 April 1979 suggests that *H. contortus* is possibly showing resistance, although no confirmatory slaughter trials were performed.

Work published on the seasonal incidence of *O. columbianum* in southern Africa shows less defined patterns. Adults were recovered regularly by Viljoen (1964, 1969) at Grootfontein in the Karoo; by Rossiter (1964) in the Eastern Cape, and by Barrow (1964) in the Border area, with predominantly 4th stage larvae being recovered from autumn to spring at Grootfontein, and between January and June in the Eastern Cape. Horak (1977 b) recorded peak larval and adult burdens in tracers on irrigated pastures in the Transvaal in April and May. Although the *O. columbianum* burdens recorded in this survey were low, a definite peak of infestation occurred in tracers slaughtered in March. The fact that no rain fell during the period when the next group of tracers were at pasture and that febantel was administered to the flock sheep on 12 March 1979, probably explains the short seasonal incidence of this parasite. The survey farm has a long history of severe *O. columbianum* lesions in sheep at slaughter. This was attributed by the authors to the long use of anthelmintics with little or no effect against the immature stages of *O. columbianum*. One deworming with febantel in July 1978 appeared to have reduced the problem greatly. The recovery from a faecal culture made in May, of *O. columbianum* larvae (presumably from eggs laid by worms which were present in the sheep in February/March and survived the deworming of 12 March 1979) gives a possible indication of the prepatent period of the worm in this survey.

The seasonal incidence of *Moniezia* spp. agrees in general with that determined by Horak (1977 b, 1978), except that infestation in this study continued for an additional month, June. The 1st group of tracers was not treated against cestodes, and this may explain the presence of a *Moniezia* sp. in 1 tracer slaughtered on 1 August 1978.

The absence or near absence of species such as *Trichostrongylus* spp. and *Nematodirus* spp., which were present in other surveys in arid country (Viljoen, 1964, 1969), cannot be explained, but it is noteworthy that *Nematodirus* spp. were not recorded in adjacent Botswana by Carmichael (1972). The parasites *Strongyloides papillosus* and *Gaigeria pachyscelis* are reported in old records to have caused considerable problems in the Kalahari (Anon., 1955, 1963). In recent years most farms in the southern SWA/Namibian Kalahari have been enclosed with jackalproof fences, thus eliminating the practice of kraaling (penning). This probably accounts for the absence or near absence of these 2 parasites in this survey and in the present-day Kalahari.

The seasonal incidence of *O. ovis* has been studied by Horak (1977 a), who found that flies were active from October to June, with the peaks in 1 locality (Hennops River) in November to December and in May to June, and in another (Tonteldoos) in November to December and again in February. In the current survey the total period of fly activity corresponds with that found by Horak (1977 a), but the peaks in this case were from October to December and from April to early June. The November administration of rafoxanide, which would have killed the larvae, may partially account for their absence in the group slaughtered in January. These larvae would presumably have matured and pupated during the rest of November and in early December, and then hatched later in December (judging by the pupal periods for mature larvae that we found in November). The counts of larvae in December remained high, presumably because the pupae (which give rise to the adult flies which in turn gave rise to these larvae) were developing on the pasture at the time of deworming in November. Similarly, the closantel treatment given to all the flock except the 25 marked sheep in April, and the rafoxanide treatment given to 25 marked sheep in May, may have partly influenced the winter occurrence. Although gedoelstiasis was recorded in sheep in eastern Mariental (eastern Gibeon) in the 1940's and 1950's (Basson, 1962) and specifically on "Sophie's Pan" in the 1950's (Basson, personal communication, 1980), no evidence of *Gedoelstia* spp. was found in this study.

In general, the seasonal incidence findings in this survey are similar to those found elsewhere in southern Africa, although this is less true in the case of *O. columbianum*. Burdens of helminths in this survey are considerably lower than the burdens found in most other surveys cited above. The severe roundworm problems described in the introduction are thought to result mainly from incorrect deworming and pasture rotation practices, although the possibility that lower burdens of these parasites are pathogenic in Karakul sheep under arid grazing conditions cannot be discounted. The authors postulate that the higher roundworm burdens reported from the eastern sandveld areas (see Introduction) develop because the free-living stages of these worms are favoured by the more suitable moisture conditions in these areas.

The burdens of *O. ovis* are comparable with those found by Horak (1977 a) at Hennops River. The importance of this parasite in the Kalahari should be stressed to local farmers, particularly in view of the known production losses due to such burdens in Merino sheep (Horak & Snijders, 1974).

Recommended time of deworming

Most farms in the Kalahari still suffer economic losses from parasites. One possible practical deworming programme (based on the above findings) is:

October: treat with a drug effective against *H. contortus* and *O. ovis*.

When the main rains start (usually January or February): administer a long-acting haemonchicide

After the first severe frost (usually April/May): treat with a drug which is effective against all parasitic stages of both *H. contortus* and *O. columbianum*. On farms where tapeworms are considered to cause economically important problems, a drug can be chosen which is also effective against *Moniezia* spp.

The importance of moving sheep to new pastures immediately after deworming should be stressed. Additional treatments can be given if specific parasites are not adequately controlled by the above programme, e.g. additional treatments against *O. ovis* in December and June.

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