

Chapter 4

Incidence of *Haemonchus* spp. and effect on haematocrit and eye colour in goats farmed under resource-poor conditions in South Africa*

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Abstract

The diversity and predominance of nematode genera in goats of resource-poor farmers at Rust de Winter, Gauteng Province, Impendle, KwaZulu-Natal Province, and Kraaipan, North-West Province, South Africa, was determined by means of a longitudinal study of the nematode faecal

* Submitted to *Vet. Parasitol.* on 3 October 2001; major revision and reduction in length advised in March 2001; original paper split into Chapters 4 to 7; Chapter 4 resubmitted on 24 July 2001.

egg counts and differential third-stage nematode larvae. The animals were bled for haematocrit determination and scored for palor of ocular mucous membranes using the FAMACHA[®] method, an assay for clinical evaluation of anaemia caused by *Haemonchus* spp. Animals considered to be in danger of dying from anaemia caused by haemonchosis were selectively treated with an anthelmintic.

Lower haematocrit values were registered during periods of heavier *Haemonchus* infection, which periods occurred from December/January to March for Rust de Winter; from December to March/April for Impendle; and from November/December to February or April for Kraaipan. There was agreement too between the lower haematocrits and paler mucous membranes scored according to the FAMACHA[®] method. The use of this system may be recommended as part of an integrated approach to worm control in goats kept in the resource-poor areas studied.

Keywords: Eye colour chart; FAMACHA[®]; Goats; Haematocrit; *Haemonchus* spp.

4.1. Introduction

Small ruminants play an important socio-economic role within traditional farming systems in many developing countries, including South Africa. However, in this country, little is known about the role of diseases within these animals, including helminthosis. Boomker and Horak have studied worms in goats raised under commercial farming conditions (Boomker et al., 1989; Horak et al., 1991) and Boomker in indigenous goats (Boomker et al., 1994). The epidemiology of helminths in sheep raised within the summer-rainfall area of South Africa, where the present study was conducted, has also been well-described (Horak, 1978; Horak and Louw, 1977). Nevertheless, little is known about the epidemiology of internal parasites and their effects on the production of small ruminants raised under resource-poor conditions.

Indiscriminate and overuse of anthelmintics has led to the development of severe anthelmintic resistance on commercial sheep farms and resistance has been reported from sheep raised under resource-poor conditions in South Africa (Van Wyk et al., 1999), but had not been reported from goats in South Africa until now (Chapter 3). An emphasis is currently being placed on assisting resource-poor farmers to improve the production of their livestock and in this respect the management of worms is seen to be a researchable constraint. The testing of worm control strategies in small ruminants, appropriate to the resource-poor farmer and sustainable in terms of maintaining anthelmintic efficacy, is needed.

The aim of this study was to determine the diversity and predominance of nematode genera in small ruminants in three resource-poor farming study areas. Emphasis was placed on determining the incidence of *Haemonchus* spp., in relation to evaluating the effect of the level of worm infection on the haematocrit and to determine the suitability of the production system and management for the introduction of the FAMACHA[®] system. This assay uses the comparison of the colour of the ocular mucous membranes (eye colour) of a sheep to a colour chart for the classification of the animal into one of five colour categories reflecting the range of anaemia from “A” (healthy) to “E” (severely anaemic) (Van Wyk et al., 1997b). Only those animals that are considered to be in danger of dying from *Haemonchus* infection (categories “D” and “E”) are selectively treated. In the latest version of the chart (Bath, 2000), the letters, “A” to “E”, have been substituted by the numbers, one to five, and hence this latter convention has been used in this paper.

4.2. Materials and methods

4.2.1. Study sites, animals and sampling

Three study sites were selected within the summer-rainfall area of South Africa: one near Rust de Winter, Gauteng Province, one in Impendle, KwaZulu-Natal Province, and one in Kraaipan, North-West Province (Fig. 1.2). A summary of the trial periods and frequencies of visits, breeds of

animals, sample sizes, and anthelmintics used is given in Table 2.1.1 The grazing practices, vegetation types, winter supplements and rainfall for each study site are given in Table 2.1.2. During the day, the goats at Rust de Winter browsed on the natural vegetation while the farmer at Site 2, Impendle, allowed his animals to graze communal pasture surrounding his homestead. At Site 1, Impendle, and at Kraaipan, the animals were grazed on communal pasture tended by a shepherd. The animals at all sites were penned in kraals at night.

At Rust de Winter, all the weaner and adult goats present at each visit were sampled/scored. For the two farmers at Impendle, a representative sample of the weaner and adult goats was selected based on the first animals brought into the crush at the first visit, and when available the same goats were sampled/scored throughout the trial period. Unfortunately, the initial sample sets for each of the two sites at Impendle had diminished in number by the end of the trial, owing to sales or slaughtering of animals and at least one death. At Kraaipan, a representative sample of the goat flock was chosen in a similar manner as for Impendle, but the animal numbers also started to dwindle and for this reason every 10th animal brought into the crush in May 1999 was added to the sample group. This resulted in four goats being added to the representative sample group.

4.2.2. *Diagnostic techniques*

Faecal samples were collected at each visit from the animals at Rust de Winter and the representative sample sets at Impendle and Kraaipan (the “trial” animals). Additional samples were collected from April 1999 at Kraaipan and from May 1999 at Impendle to ensure that there would be sufficient faeces for a good yield of third-stage nematode larvae (L₃) when cultures were made (see below). The faecal samples were processed for nematode faecal egg count (FEC), following the method of Van Schalkwyk et al. (1995) and at a sensitivity of 100 eggs per gram of faeces (epg). *Strongyloides*, *Nematodirus* and *Trichuris* eggs were counted separately from the other nematode eggs, which are herein referred to as “strongyle” eggs.

Samples were screened for *Fasciola* eggs by means of the sedimentation method (Van Wyk et al., 1987) performed on samples pooled from ten goats selected at random from each site at each visit.

Faeces remaining after the FECs had been processed were cultured for third-stage nematode larvae (L₃) at a temperature of approximately 25°C until November 1999 when a new room was used and the temperature then adopted was approximately 26°C. The L₃ were identified using the keys of Van Wyk et al. (1997a) and Dunn (1978). Where possible, at least 50 L₃ were identified per culture. No attempt was made to differentiate *Teladorsagia* spp. from *Trichostrongylus* spp. The proportions of the strongyle L₃ were used to estimate the proportional FECs of the various strongyle worm genera. (The L₃ results are recorded in Appendix 3.)

The animals were bled and their haematocrits were determined using the microhaematocrit method, they were scored for body condition (Vatta et al., 2000), and they were inspected for ticks.

4.2.3. Scoring for level of anaemia

This has been described in detail in Chapter 3. In brief, at the scheduled visits, the first author or one of the assistants on the project scored each animal for level of anaemia using the FAMACHA[®] card. Occasionally, monitoring was done in-between scheduled visits by the farmer at Site 1, Impendle, and by the animal health technicians (AHTs) assisting with the project at Kraaipan. Only the animals that were considered to be pale, i.e. categories four and five, were treated with an anthelmintic. At times, animals scored as category three were erroneously treated by the AHTs at Kraaipan and the farmer at Site 2, Impendle, initially misunderstood the aim of the trial and treated all his goats sometime between 24 November and 22 December 1998. Between 23 November and 21 December 1999, ten goats were apparently treated by the shepherd of the farmer at Site 1, Impendle, but the animal identifications were not recorded.

4.3. Results

4.3.1. General

Figs. 4.1-4.4 illustrate the FECs and mean haematocrits for the study sites. Complete results for the L₃ cultures were not obtained during October 1998, the beginning of November 1998 and late July 1999 owing to problems in the laboratory. In these cases, the averages of the proportions for *Haemonchus* spp. and for the other nematode genera for the visit dates immediately prior to and following the dates of missing data were applied to the FECs. These results are indicated by dotted lines in the figures. Since *Haemonchus* predominated in many of the cultures, the graphs were drawn to reflect the mean *Haemonchus* FECs and the mean total FECs for the other genera. Mean *Strongyloides* FECs were less than 200 epg for all sites and all visits, while *Trichuris* and *Nematodirus* FECs were negligible, maximum individual counts never exceeding 200 epg.

In summary, L₃ of *Haemonchus* spp., *Teladorsagia/Trichostrongylus* spp., *Oesophagostomum* spp. and *Strongyloides* spp. were identified in the faecal cultures from each of the trial sites. Periods of heavier worm infection during which *Haemonchus* was the predominant species occurred from December/January to March at Rust de Winter; from December to March/April at Impendle; and from November/December to February or April at Kraaipan. During these periods, the mean haematocrits dropped.

Treatment of goats from November to April (period of heavier *Haemonchus* infection) is summarised in Table 4.1. Both the percentage of animals treated (FAMACHA[®] values four and five) and the percentage of animals scored within the lower FAMACHA[®] categories (three, four and five) are given in Table 4.1. (Full details of the numbers of animals scored in each FAMACHA[®] category over time are recorded in Appendix 4.) Except for Site 1, Impendle, relatively more goats were treated during the *Haemonchus* seasons (November to April) than in-between (May to October).

Fig. 4.1 : Strongyle faecal egg counts and haematocrits from goats at Rust de Winter

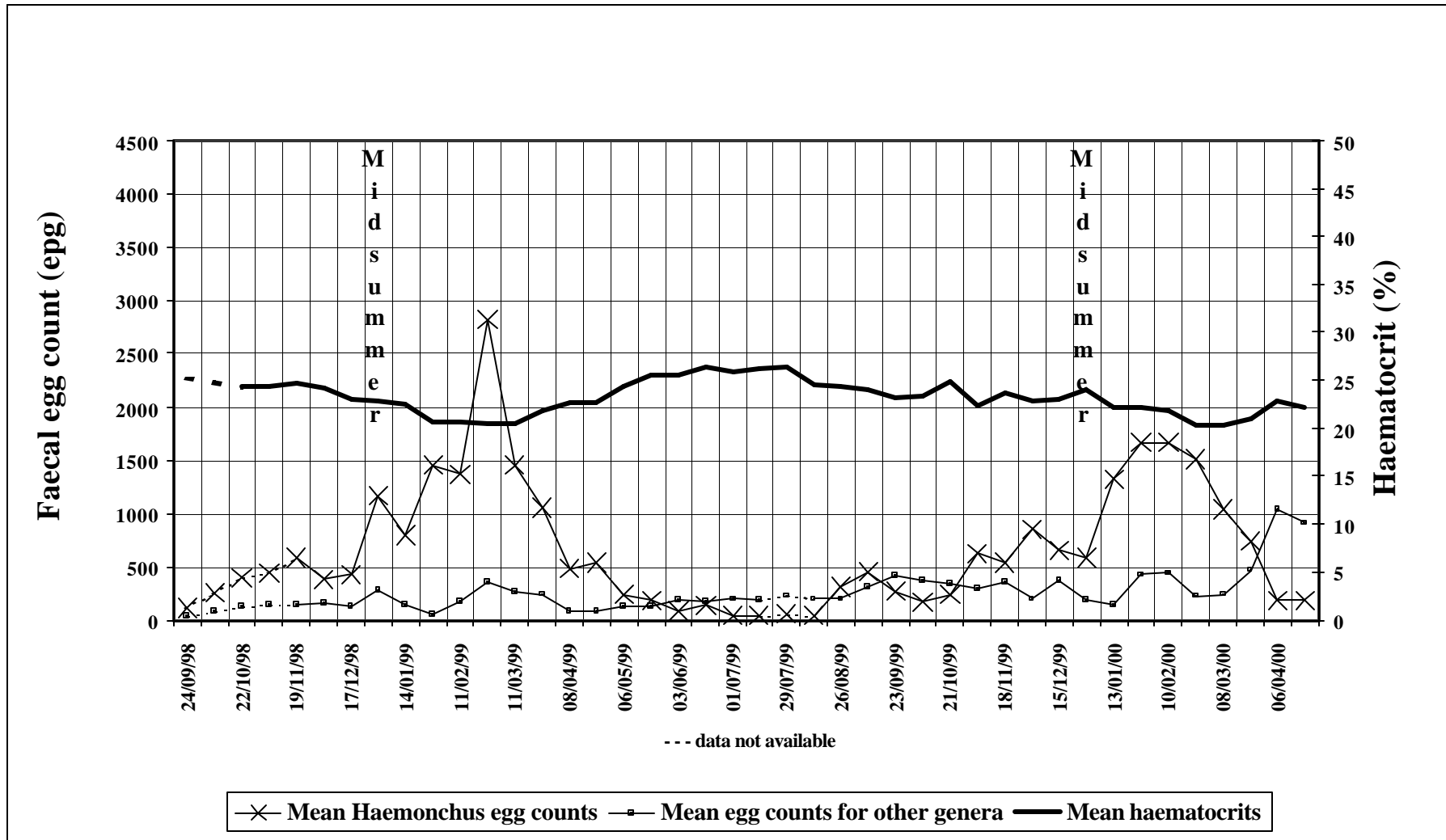


Fig. 4.2 : Strongyle faecal egg counts and haematocrits from goats at Site 1, Impendlle

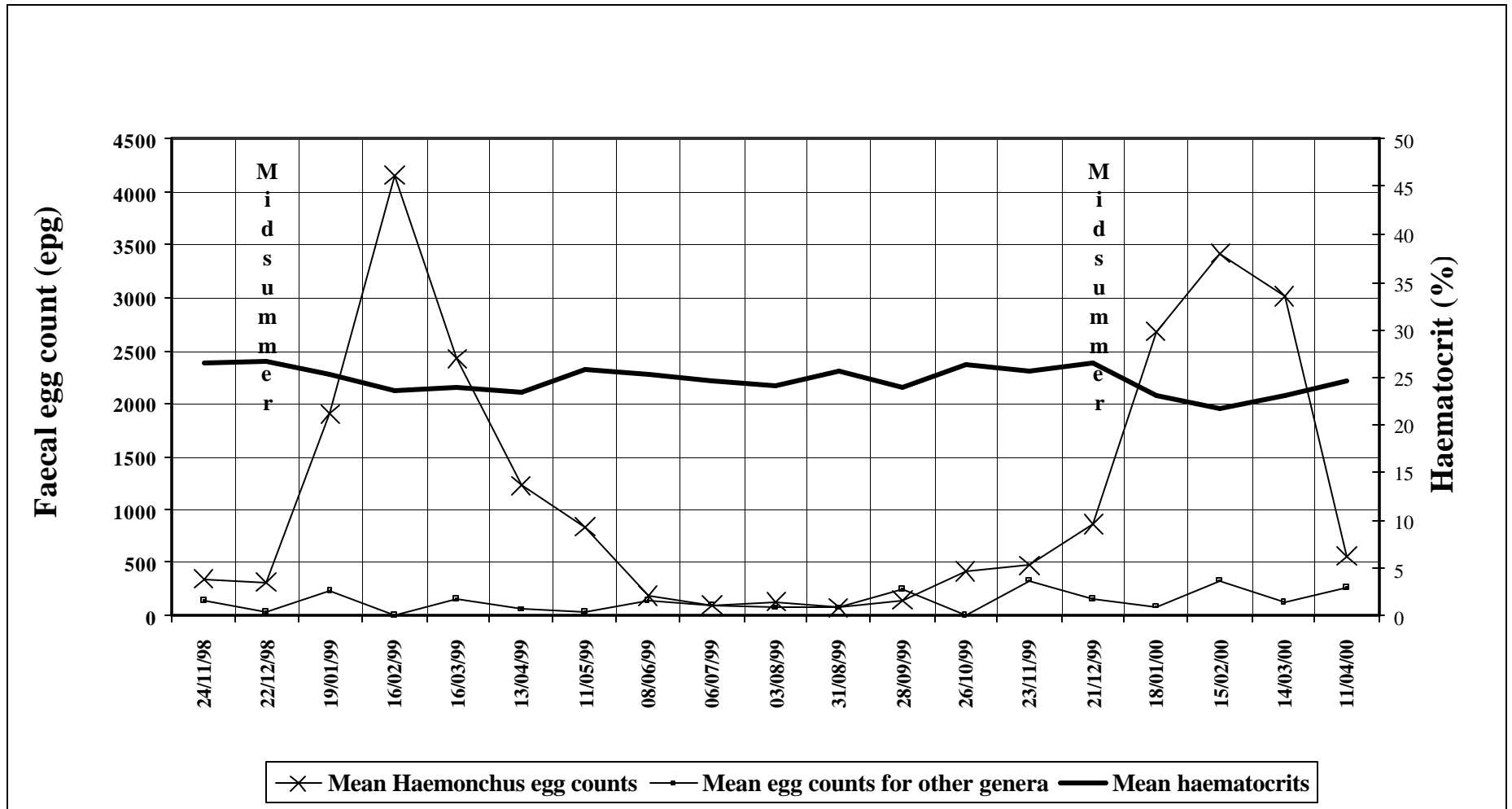


Fig. 4.3 : Strongyle faecal egg counts and haematocrits from goats at Site 2, Impendle

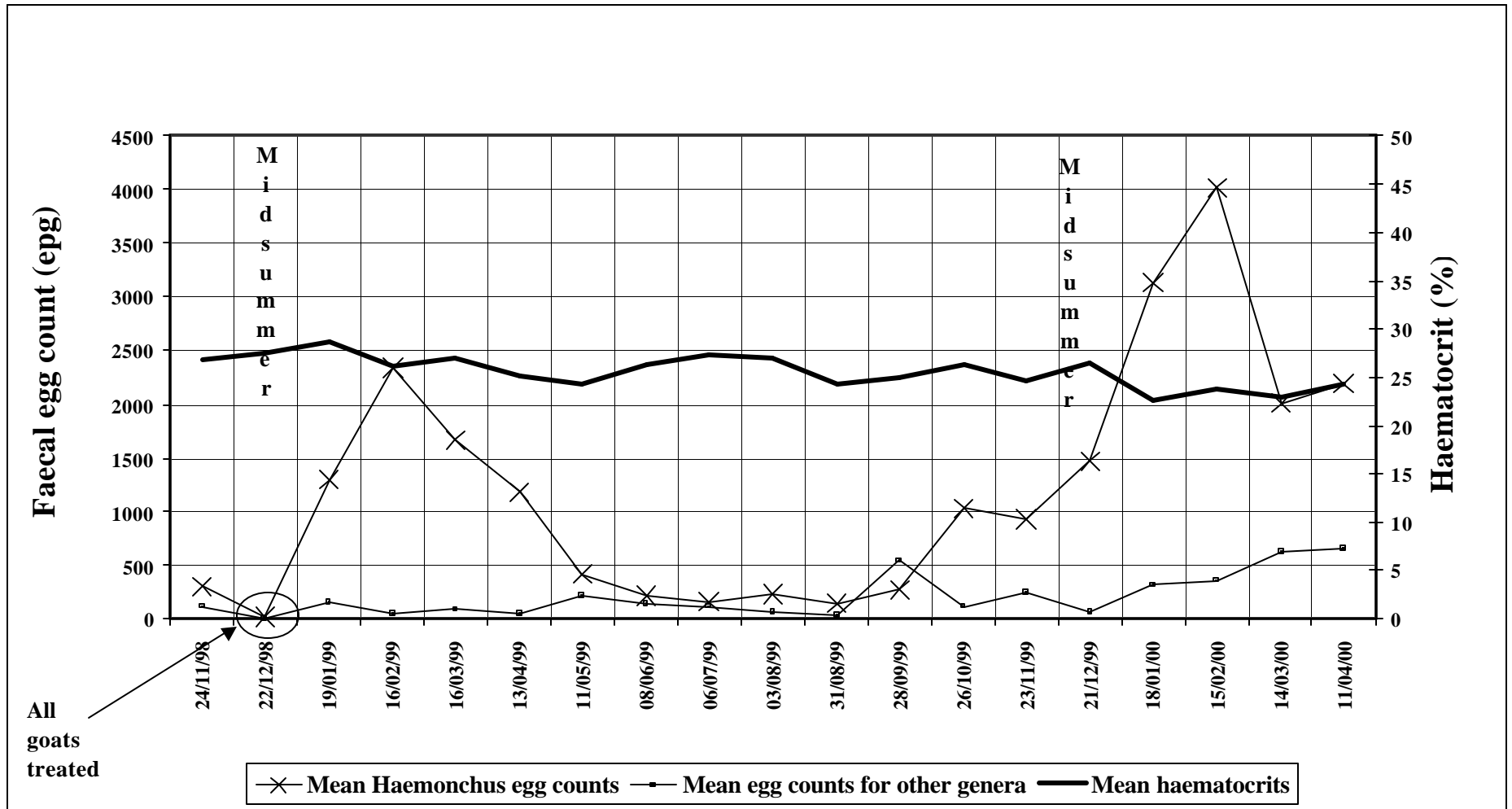


Fig. 4.4 : Strongyle faecal egg counts and haematocrits from goats at Kraaipan

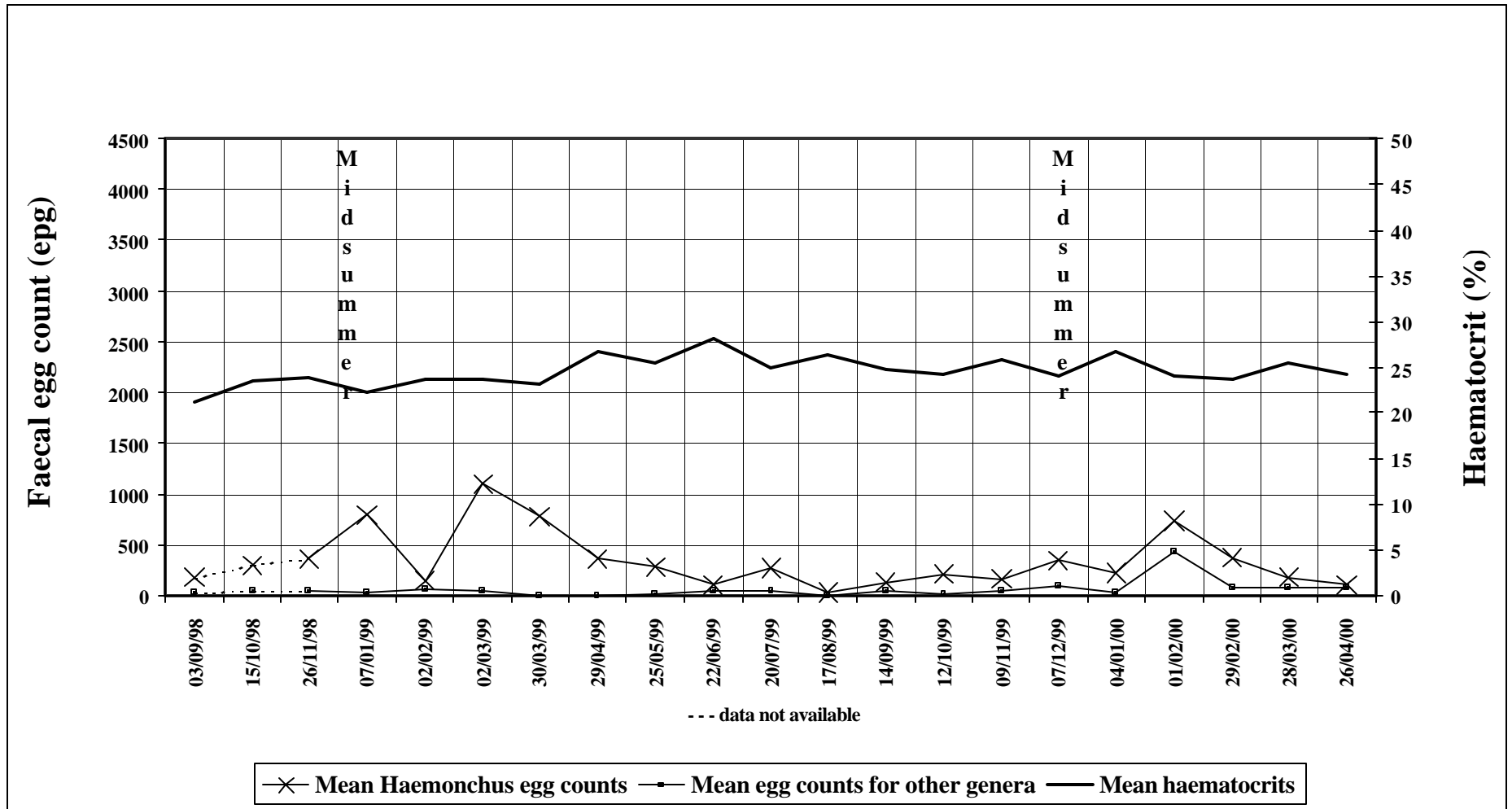


Table 4.1

Percentage of goats treated from November to April (*Haemonchus* season) and May to October

Location	Total examined	F [©] 4 and 5 treated (percentage) ^a	F [©] 3, 4 and 5 (percentage) ^b
Rust de Winter			
Nov 98 — Apr 99	434	9,4 %	47,2 %
Nov 99 — Apr 00	372	8,1 %	46,8 %
May — Oct 99	398	6,3 %	34,4 %
Site 1, Impendle			
Nov 98 — Apr 99	129	12,4 %	52,7 %
Nov 99 — Apr 00	83	19,3 %	55,4 %
May — Oct 99	141	14,9 %	58,2 %
Site 2, Impendle			
Nov 98 — Apr 99	134	8,2 %	48,5 %
Nov 99 — Apr 00	104	16,3 %	62,5 %
May — Oct 99	134	2,2 %	35,1 %
Kraaipan			
Nov 98 — Apr 99	121	11,6 %	43,0 %
Nov 99 — Apr 00	91	12,1 %	57,1 %
May — Oct 99	105	2,9 %	35,2 %

^aFAMACHA[©] values 4 and 5 treated.^bFAMACHA[©] values 3, 4 and 5 treated (theoretical).

Tick burdens were not deemed heavy enough to be important contributors to anaemia in any of the study areas. *Fasciola* eggs were found in faecal samples of goats at Rust de Winter and Site 2, Impendle, in low numbers (range: 2-4 epg, when positive) and incidence (Chapter 6). Periods of poorer body condition, as an indication of nutritional status, occurred from August to early December 1999 at Rust de Winter and from June to September 1999 at Impendle (Chapter 5). These periods did not clearly correspond to any periods of lower haematocrit. The goats at Kraaipan did not show any clear seasonal trend in body condition.

4.3.2. Specifics of study sites

At Rust de Winter, FECs started to rise during late August 1999 (Fig. 4.1). Mean FECs for the other worm genera reached a level of over 1000 epg in early April 2000.

At both sites at Impendle, the animals showed a distinct peak in *Haemonchus* FECs during February (Figs. 4.2 and 4.3). In addition to the above genera, L₃ resembling those of *Gaigeria* or *Bunostomum* spp. were also found in the faecal cultures from Site 2, Impendle. These L₃ occurred with a low frequency in November and December 1998 and in January, May, August and September 1999.

The mean FECs at Kraaipan remained below 1200 epg (Fig. 4.4) throughout the period of the investigation. The drops in haematocrit during the periods of heavier worm infection were less noticeable than those recorded for the sites discussed above.

4.4. Discussion

4.4.1. General

In common with the results of Boomker et al. (1994) in goats at Roedtan (in the Northern Province, approximately 80 km in a direct line from Rust de Winter), this study has demonstrated a seasonal distribution of *Haemonchus* spp. in the summer months. Similarly, Horak (1978) and Horak and Louw (1977) reported greatest numbers of *Haemonchus contortus* in sheep from January to May or June on dryland and irrigated pastures, respectively. Tick burdens, worm infections and inadequate nutrition were considered as differential diagnoses of anaemia. Of these, the most important of the possible causes of anaemia in the animals studied was *Haemonchus* spp. The high *Haemonchus* FECs during the summers account for the drops in haematocrit seen during these periods. These periods of lower haematocrit were reflected clinically by the fact that more animals were scored as having paler mucous membranes during the periods of heavier worm infection (November to April) than during the winter period (May to October). As discussed in Chapter 3, a sensitivity of 76% to 85% was established for the FAMACHA[®] method in goats provided categories three, four and five are treated. This means

that the system may be used to identify correctly 76% to 85% of those animals in need of treatment with an anthelmintic. Since this implies that some animals in need of treatment would be missed, the use of the FAMACHA[®] system in isolation to other worm management strategies cannot be recommended.

4.4.2. *Specifics of study sites*

An increase in worm infection in spring is known as a “spring rise” (Gordon, 1973) and is thought to arise from the resumption of development of larvae retarded in the fourth-stage during the cooler months of the year (Michel, 1974). Hence, the rise in FECs during late August 1999 at Rust de Winter may be attributed to this phenomenon, since no rain fell during June to August 1999 (South African Weather Bureau). While Horak and Louw (1977) and Horak (1978) showed retarded larval development in sheep in their studies, Boomker et al. (1994) suggest that arrested development is not significant in indigenous goats at Roedtan. On the other hand, lactating animals show a periparturient relaxation of resistance (PPRR) which also manifests as a rise in worm infection (Gordon, 1973). Since many of the female goats kidded in August and September 1999, the rise in FECs is perhaps also partially attributable to this phenomenon in the female animals. The mean haematocrits are seen to decrease concurrently with the increase in FECs, which would seem to agree with the findings by Dorny et al. (1995). These workers reported a significant drop in haematocrit and a significant rise in FECs (predominantly *Haemonchus contortus* infection) during the periparturient period in two sheep flocks and one of two goat herds kept under the traditional husbandry systems of peninsular Malaysia. In the second goat herd, the changes were similar, though not significant.

Fewer of the goats at Site 1, Impendle, were treated during the periods of heavier *Haemonchus* infection than during the other months. It is possible that the number of treatments given at scheduled visits was reduced because of treatment by the farmer or his shepherd in-between the scheduled visits. In order to confirm the identity of the L₃ resembling those of *Gaigeria* or *Bunostomum*, animals from

Site 2, Impendle, or an animal experimentally infected with L₃ recovered from faeces collected at the site would need to be necropsied for worm recovery.

At Kraaipan, nematodes assume greater importance only during the periods of higher FECs from November/December to February or April, when *Haemonchus* predominated. Treatment by AHTs of animals in-between scheduled visits may have reduced the number of treatments given at these visits.

4.5. Conclusion

There is agreement between the periods of heavier *Haemonchus* infection, lower haematocrits and paler mucous membranes scored according to the FAMACHA[®] method. As such the latter may be recommended as an appropriate intervention within the context of an integrated worm control programme for the areas studied.