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ARTHROPOD PARASITES OF HARTMANN'S MOUNTAIN ZEBRA, *EQUUS ZEBRA HARTMANNAE*, IN SOUTH WEST AFRICA/NAMIBIA

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ABSTRACT

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Twelve Hartmann's mountain zebra, *Equus zebra hartmannae*, were shot for arthropod parasite recovery during the period June 1980–June 1981 on a farm in the Khomas Hochland region of South West Africa/Namibia. Four species of *Gasterophilus* larvae, 1 species of *Rhinoestrus* larvae and 3 ixodid tick species were recovered. The seasonal prevalence of the *Gasterophilus* species larvae and of *Rhipicephalus evertsi mimeticus* was determined.

Three horses examined on the same farm were infested with larvae of 2 *Gasterophilus* species and with the same ixodid tick species as the zebras.

INTRODUCTION

Hartmann's mountain zebra, *Equus zebra hartmannae*, is found in mountainous country, mainly in coastal areas, from approximately 160 km north of Mossamedes in Angola to coastal South West Africa/Namibia. It may also at one time have been present south of the Orange River (Ansell, 1971).

In a study on the composition and limiting factors of a population of Hartmann's zebra Joubert (1974) listed the ectoparasites that have been recovered from these animals. With the exception of *Gasterophilus intestinalis*, which is generally regarded as a parasite of horses (Zumpt, 1965) the other *Gasterophilus* species recorded by Joubert (1974), namely, *Gasterophilus haemorrhoidalis* and *Gasterophilus pecorum*, are also found in Burchell's zebra, *Equus burchelli* (Zumpt, 1965; Horak, De Vos & De Klerk, 1984). The 3 tick species listed by Joubert (1974), *Hyalomma marginatum rufipes*, *Rhipicephalus evertsi mimeticus* and *Rhipicephalus oculatus*, have also been recovered from several other hosts (Theiler, 1962).

The present survey was timed to run concurrently with a similar survey in which Burchell's zebra were being shot at monthly intervals in the Kruger National Park (Horak *et al.*, 1984). The arthropod parasite burdens of the zebras in the 2 surveys are compared in this paper.

Several arthropods parasitize both zebras and horses (Theiler, 1962; Zumpt, 1965), and the present paper also compares the arthropod parasite burdens of the Hartmann's zebras with those of 3 horses slaughtered during the survey period on the same farm as the zebras.

MATERIALS AND METHODS

The farm "Kelpie" (22°37′S, 16°50′E) is 4 026 ha in extent and is situated in the Khomas Hochland 40 km to the west of Windhoek. The vegetation comprises open highland savanna (Giess, 1971). In addition to Hartmann's zebra and domestic horses, steenbok, sprinbok, gemsbok, kudu, goats, cattle and donkeys were present on the farm. Daily minimum and maximum atmospheric temperatures were recorded at Windhoek, while rainfall was recorded at Claratal, 10 km to the south-east of the farm. With the exception of January and April 1981, when no zebras could be found, 2 Hartmann's zebra were shot during June 1980 and 1 zebra was subsequently shot on the farm each month until June 1981. Three horses, which had been allowed to roam freely on the farm, were slaughtered during April 1981.

After each zebra had been shot it was exsanguinated, the whole body was searched and all visible ticks were collected. In addition the ear canals were carefully scraped with a small spoon-shaped spatula and the scrapings collected and preserved in 70 % alcohol. The animals were eviscerated and the viscera transported to the laboratory at Windhoek where they were processed for parasite recovery. *Gasterophilus* spp. larvae and *Rhinoestrus* sp. larvae were recovered by the methods described by Malan, Reinecke & Scialdo (1981).

Except for their skins, which were processed for the recovery of ticks as described by Horak, De Vos & Brown (1983), the horses were processed in the same way as the zebras for parasite recovery.

All the *Gasterophilus* larvae, *Rhinoestrus* larvae and ixodid ticks recovered from the zebras were counted and identified with the aid of a stereoscopic microscope. The *Gasterophilus* larvae recovered from the horses were likewise counted and identified. The ticks on the horses were counted as described by Horak, Potgieter, Walker, De Vos & Boomker (1983).

RESULTS

In the graphs (Fig. 1–3) the mean parasite burdens of the 2 zebra shot during June 1980 have been plotted together with the total burdens of the other animals.

Zebras

The numbers of arthropod parasites recovered from the zebras and their prevalence are summarized in Table 1. No attempt was made to identify the 1st stage larvae of *Gasterophilus* or *Rhinoestrus* to species level.

All the zebras were infested with larvae of *Gasterophilus nasalis*, *G. pecorum* and an unidentified *Gasterophilus* sp. and with *R. evertsi mimeticus*.

Gasterophilids

Few 1st stage larvae were recovered and these were found mainly in the tongues and peridontal spaces of the zebras. The greatest numbers of 1st stage larvae were present in June 1980 and May and June 1981.

G. pecorum. The seasonal prevalence of the 2nd and 3rd stage larvae of this fly and the migration of the 3rd stage larvae from the pharynx to the stomach are graphically illustrated in Fig. 1.

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TABLE 1 The arthropod parasites recovered from 12 Hartmann's mountain zebra in the Khomas Hochland region of South West Africa/Namibia

Parasite	Total numbers recovered				Percentage of animals infested
Zebra bot flies	1st stage larvae	2nd stage larvae	3rd stage larvae	Total	
Gasterophilus spp.	80	—	—	80	58,3
Gasterophilus meridionalis	—	44	102	146	83,3
Gasterophilus nasalis	—	420	1 868	2 288	100,0
Gasterophilus pecorum	—	272	1 635	1 907	100,0
Gasterophilus sp.	—	483	1 253	1 736	100,0
Zebra nasal bot fly					
Rhinoestrus sp.	7	—	—	7	33,3
Rhinoestrus usbekistanicus	—	—	3	3	16,7
Ixodid ticks	Larvae	Nymphae	♂♂ ♀♀	Total	
Hyalomma marginatum rufipes	0	0	91 14	105	91,7
Hyalomma truncatum	0	0	5 1	6	33,3
Rhipicephalus evertsi mimeticus	1 894	2 031	348 107	4 380	100,0

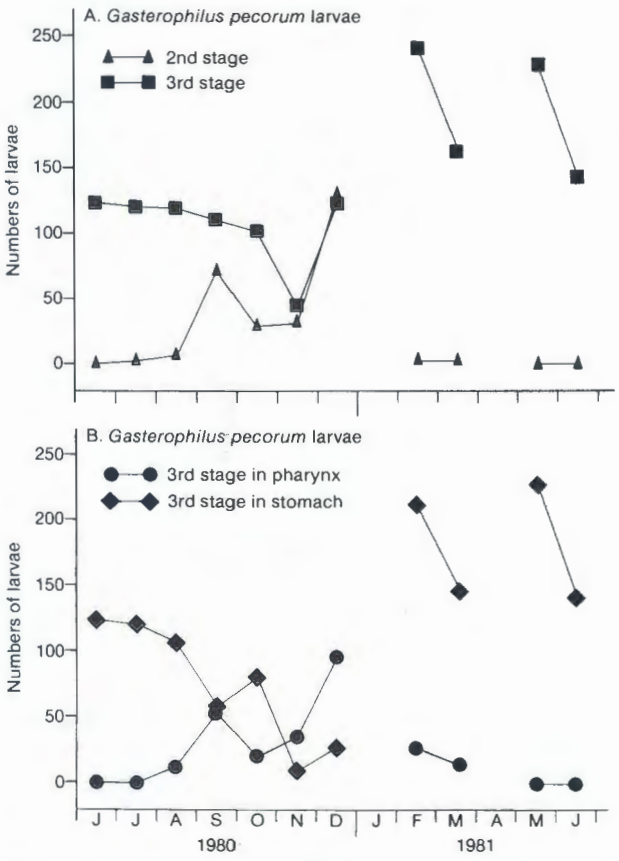

FIG. 1 *Gasterophilus pecorum* larvae in Hartmann's mountain zebra in the Khomas Hochland region of South West Africa/Namibia.

A. Seasonal abundance and
B. Migration of 3rd stage larvae from the pharynx to the stomach

The numbers of 2nd stage larvae increased erratically from August–December and subsequently disappeared. Third stage larvae decreased gradually from June–October, and this was followed by a sharp decline in November and marked rise in December after which they remained at a high level. The 3rd stage larvae migrated from the pharynx to the stomach during the period December–March, and 1 was recovered from the rectum in March and another in August.

G. meridionalis. Few larvae were recovered. The numbers of 2nd stage larvae increased rapidly from October–December (Fig. 2a). Third stage larvae decreased from June–September 1980. Thereafter bur-

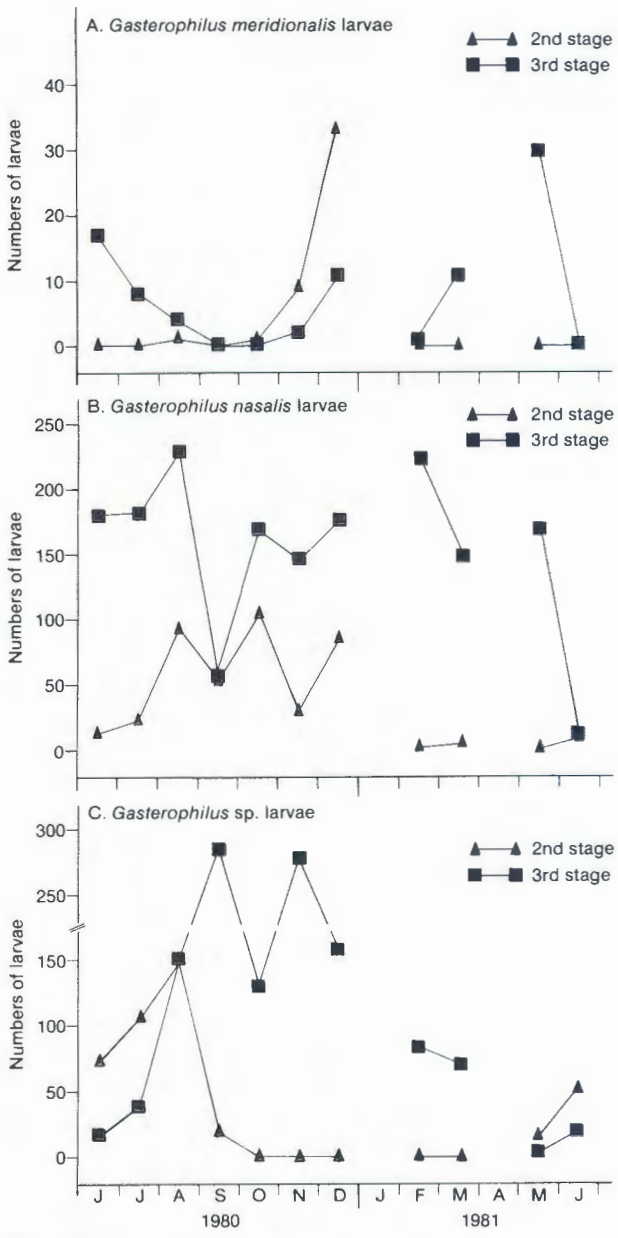

FIG. 2 The seasonal abundance of the larvae of

A. *Gasterophilus meridionalis*
B. *Gasterophilus nasalis*
C. *Gasterophilus* sp.

in Hartmann's mountain zebra in the Khomas Hochland region of South West Africa/Namibia

dens were very erratic, no larvae being recovered during October 1980 and June 1981.

G. nasalis. The highest numbers of 2nd stage larvae were present from August–December (Fig. 2b). Except in September 1980 and June 1981, fairly large numbers of 3rd stage were always present.

Gasterophilus sp. The morphology of the 3rd stage larvae assigned to this species lay somewhere between those of *Gasterophilus ternicinctus* and *G. intestinalis*. *G. ternicinctus* larvae have 3 rows of spines on nearly all the body segments (Zumpt, 1965). Although 3 rows of spines were present on some of the body segments of our *Gasterophilus* sp. larvae, the 3rd row was rarely complete. The armature of 3rd stage *G. intestinalis* larvae consists of double rows of spines which always reach the 11th segment ventrally (Zumpt, 1965), but our *Gasterophilus* sp. larvae had either a few or no spines on the ventral surface of their 11th segment.

Peak numbers of 2nd stage larvae were present during August and 3rd stage larvae from August–December (Fig. 2c). A 3rd stage larva was recovered from the rectum during September.

Oestrids

First stage *Rhinoestrus* sp. larvae were present during December 1980 and February, May and June 1981. No 2nd stage larvae were recovered. Two 3rd stage *Rhinoestrus usbekistanicus* larvae were recovered from 1 of the 2 zebras examined during June 1980 and 1 from the zebra examined during August 1980.

Ixodid ticks

H. marginatum rufipes. Few adult ticks were collected and the largest number of these were present during February, March and June 1981.

H. truncatum. The very small number of ticks recovered precluded the establishment of a pattern of seasonal abundance.

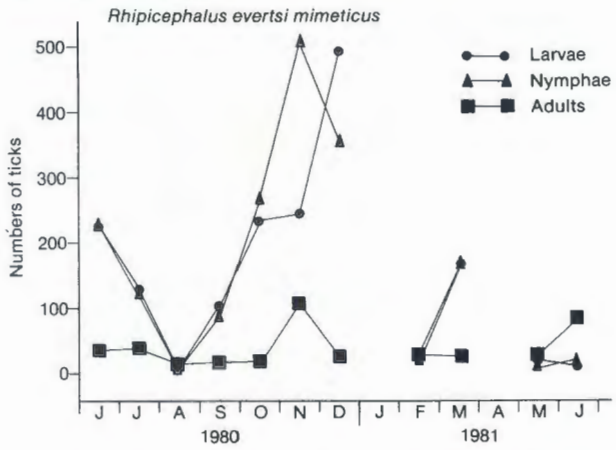

FIG. 3 The seasonal abundance of *Rhipicephalus evertsi mimeticus* on Hartmann's mountain zebra in the Khomas Hochland region of South West Africa/Namibia.

R. evertsi mimeticus. The seasonal prevalence of the immature and adult stages is graphically illustrated in Fig. 3.

Peak numbers of immature ticks were present during June and from October–December 1980. The greatest numbers of adults were recovered during November 1980 and June 1981.

Horses

The arthropod parasite burdens of the 3 horses are summarized in Table 2.

All the horses were infested with *G. intestinalis, G. pecorum, H. marginatum rufipes* and *R. evertsi mimeticus*. Large numbers of larvae, but relatively few nymphae of the latter tick were recovered.

The mean minimum and maximum atmospheric temperatures and total monthly rainfall at Windhoek and Claratal, respectively, are graphically represented in Fig. 4.

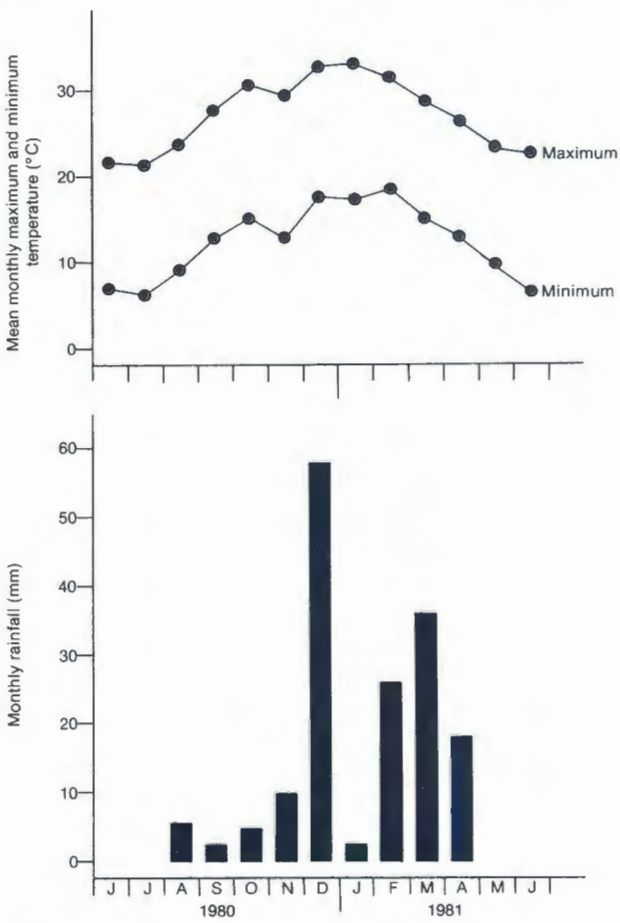

FIG. 4 Monthly mean minimum and maximum atmospheric temperatures at Windhoek and monthly rainfall at Claratal

TABLE 2 The arthropod parasites of 3 horses in the Khomas Hochland region of South West Africa/Namibia

Horse No.	Date slaughtered	Numbers of arthropod parasites recovered												
		Gasterophilus spp. larvae	*Gasterophilus intestinalis* larvae		*Gasterophilus pecorum* larvae		*Hyalomma marginatum rufipes*		*Hyalomma truncatum*		*Rhipicephalus evertsi mimeticus*			
		1st stage	2nd stage	3rd stage	2nd stage	3rd stage	♂♂	♀♀	♂♂	♀♀	Larvae	Nymphae	♂♂	♀♀
1	13 April 1981.....	0	0	19	0	541	44	8	6	2	647	80	115	17
2	14 April 1981.....	3	8	21	0	503	37	8	5	1	429	28	85	10
3	15 April 1981.....	0	4	12	0	112	3	1	0	0	63	3	13	11

The lowest minimum temperatures were recorded during June and July 1980 and in June 1981, and the highest maxima from December 1980–February 1981. Rain fell in each month from August 1980–April 1981, but total rainfall amounted to only 164 mm.

Discussion

Zebras

Gasterophilids

The small number of 1st stage larvae recovered is probably an indication of an inadequate recovery technique. It may also indicate that the larvae spend a relatively short time in this stage of development. It is also probable that the smaller numbers of 2nd stage larvae recovered when compared with the numbers of 3rd stage larvae (Table 1) are a reflection of the comparative lengths of time spent in these stages.

No larvae of those species utilizing the colon and rectum as preferred attachment sites, namely, *G. haemorrhoidalis* and *Gasterophilus inermis,* were found in any of the zebras or horses, although *G. haemorrhoidalis* has been recovered from Hartmann's zebra (Zumpt, 1965). Larvae of both these species were recovered from Burchell's zebra examined in the Kruger National Park, South Africa (Horak *et al.,* 1984) and in Lochinvar National Park, Zambia (Howard, 1981). Very few larvae of the latter species, however, were recovered from the zebras in Zambia. Howard (1981) surmised that, as in the case of *G. pecorum,* which disappeared from the Lochinvar National Park, the low level of *G. inermis* infestation and the decrease in the Lochinvar zebra population indicated that this species was also likely to disappear. Although the zebra population in the Khomas Hochland region is stable, or even increasing slightly, it is possible that *G. meridionalis* may disappear from this region because it is present there in small numbers only.

Third stage larvae of *G. pecorum* and the *Gasterophilus* sp. both inhabit the cardiac region of the stomach. These larvae, however, do not appear to compete for space, as the *Gasterophilus* sp. larvae reach peak numbers in this site from August–December or January and those of *G. pecorum* from January of February-August. In Burchell's zebras in the Kruger National Park competition for space in the cardiac region of the stomach seemed to be avoided in that the 3rd stage larvae of *G. pecorum* reached peak numbers from November–June and those of *G. ternicinctus,* which also inhabit this region, from August–March (Horak *et al.,* 1984).

The seasonal prevalence of the larvae of the various species, as well as the presence of *G. pecorum* larvae in the horses during April 1981, when no zebras were culled, permit the construction of tentative life cycles for the different bot fly species. The life cycles are tentative, as usually only 1 zebra was slaughtered at each occasion, and it would be unwise to rely too heavily on the larval burdens of single animals. In the construction of these life cycles we have assumed that the flies will not be active during late winter from July–August.

G. meridionalis. Although few larvae were recovered and not all the zebras were infested, the following life cycle is suggested. Eggs are laid during September and October, and 1st stage larvae moult to the 2nd stage from October–December. These moult to the 3rd stage from November–December or January. The 3rd stage larvae leave the zebras to pupate from June–August. This life cycle is similar to that proposed for this fly in Burchell's zebra in the Kruger National Park (Horak *et al.,* 1984).

G. nasalis. Eggs are laid from February–May and 1st stage larvae moult to the 2nd stage from June–August. These in turn moult to the 3rd stage from October–December or January, and some of the mature 3rd stage larvae may leave the host and pupate from January–April. The flies hatching from these pupae would then be active during the wet season, as stated by Zumpt (1965). However, judging by the large numbers of 3rd stage larvae present in the zebra slaughtered from June–August 1980 it is possible that some larve may overwinter in the stomach in this stage of development and only leave to pupate during spring. Nevertheless, but for September 1980 and June 1981, when the numbers of 3rd stage larvae decreased, there was no indication that large numbers of larvae were leaving the zebras to pupate at any particular time (Fig. 2b).

Kettle (1974) reported that *G. nasalis* adults were active in New Zealand from December–June while in the Northern Hemisphere Drudge, Lyons, Wyant & Tolliver (1975) suggested that horses in Kentucky, United States of America, became infested between May and November. Hartmann's zebras in the present survey harboured larval burdens similar in magnitude to those of Burchell's zebras in the Kruger National Park, but considerably larger than those of horses in New Zealand (Kettle, 1974) or Kentucky (Drudge *et al.,* 1975).

G. pecorum. Eggs are probably laid from April–June and from September–November, and 1st stage larvae moult to the 2nd stage from September–December. These rapidly moult in the pharyngeal region to the 3rd stage from September–December or January. The 3rd stage larvae migrate from the pharynx to the stomach from December–March and leave the stomach to pass out with the faeces, pupating in the soil from March–October. This supposition is supported by the fact that 3rd stage larvae were recovered from the rectum of zebras examined during March and August. Some of the flies probably hatch before winter while others hatch in the spring. Zumpt (1965) states that in southern Africa adults hatch from February–May and again in August.

This life cycle is similar in some respects to that proposed for this fly in Burchell's zebra in the Kruger National Park (Horak *et al.,* 1984). It differs, however, in that pupation probably occurs from March–October in South West Africa/Namibia and from April–July in the Kruger National Park. At both localities 1 generation only a year seems likely.

Gasterophilus sp. Eggs are probably laid from March–May. First stage larvae moult to the 2nd stage from April–August and these in turn moult to the 3rd stage from June or July–September. The 3rd stage larvae leave the zebras and pupate from January or February–May.

Oestrids

Although very few larvae were present, 3rd stage *R. usbekistanicus* larvae were recovered during June and during August 1980. This corresponds to the months during which the maximum number of 3rd stage *R. usbekistanicus* larvae were recovered from Burchell's zebras in the Kruger National Park (Horak *et al.,* 1984). *R. usbekistanicus* has apparently not previously been recovered from Hartmann's zebra, the larvae found earlier being those of *R. steyni* (Zumpt, 1965).

Ixodid ticks

The hides of Hartmann's zebras are very valuable so these were not processed for tick recovery in the same way as those of the horses because this would have damaged them and decreased their market value. If their

hides had been thoroughly processed we might have recovered more ticks belonging to a wider range of species.

The 3 tick species recovered generally occur in fairly arid regions (Theiler, 1962). Warthogs examined in northern South West Africa/Namibia were also infested with small numbers of these ticks, of which *H. truncatum* was the most numerous (Horak, Biggs, Hanssen & Hanssen, 1983). No clear seasonal pattern of abundance was discernible for either of the *Hyalomma* spp. on the zebras.

R. evertsi mimeticus. Despite the inferior recovery technique large numbers of both immature and adult ticks of this species were recovered from the zebras. This, plus the fact that large numbers of larvae of this two-host tick successfully developed into nymphae (we actually found more nymphae than larvae), suggest that Harmann's zebra is a preferred host. Norval (1981) states that in Zimbabwe the preferred hosts of the closely related *Rhipicephalus evertsi evertsi* are horses, donkeys and zebras, an observation confirmed by the findings of Horak *et al.* (1984) on Burchell's zebras.

The several peaks of immature and adult activity during the year can possibly be attributed to separate generations. A similar phenomenon has been observed with *R. evertsi evertsi* (Matson & Norval, 1977; Horak *et al.*, 1984), a tick which, in the laboratory, has a relatively short life cycle (Rechav, Knight & Norval, 1977).

Horses

Gasterophilids

Few *G. intestinalis* larvae, and none of *G. nasalis*, were recovered from the horses. Larvae of these species have been found world-wide in horses (Zumpt, 1965; Kettle, 1974; Drudge *et al.*, 1975; Hatch, McCuaghey & O'Brien, 1976). All the zebras in the present survey were infested with *G. nasalis*.

The numbers of *G. pecorum* larvae recovered from 2 of the horses were considerably greater than those from any of the zebras. This difference may be an indication of host preference. No 3rd stage *G. pecorum* larvae were recovered from the pharyngeal region of any of the horses, which were all killed in April, a month when no zebras were shot. This supports the postulate made for the life cycle of this fly that in the zebras migration from the pharynx to the stomach was completed during March.

Ixodid ticks

Although the skins of the horses were processed for tick recovery, as described by Horak *et al.* (1983), this more elaborate procedure did not result in the recovery of species additional to those that were present on the zebras. The tick counts of the horses were, however, generally higher than those of the zebras.

The development of the larvae of *R. evertsi mimeticus* to nymphae was not as successful on the horses as it was on the zebras. This may be a fortuitous observation or could indicate that the zebras are more suitable hosts for this tick than are horses.

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REFERENCES

ANSELL, W. F. H., 1971. Order Perissodactyla. 14pp. *In:* MEESTER, J. & SETZER, H. W. (eds). The mammals of Africa: An identification manual. Washington DC: Smithsonian Insitution.

DRUDGE, J. H., LYONS, E. T., WYANT, Z. N. & TOLLIVER, S. C., 1975. Occurrence of second and third instars of *Gasterophilus intestinalis* and *Gasterophilus nasalis* in stomachs of horses in Kentucky. *American Journal of Veterinary Research*, 36, 1585–1588.

GIESS, W., 1971. A preliminary vegetation map of South West Africa. *Dinteria*, 4, 5–114 + map.

HATCH, C., MCCAUGHEY, W. J. & O'BRIEN, J. J., 1976. The prevalence of *Gasterophilus intestinalis* and *G. nasalis* in horses in Ireland. *Veterinary Record*, 98, 274–276.

HORAK, I. G., BIGGS, H. C., HANSSEN, TAMMY S. & HANSSEN, ROSE E., 1983. The prevalence of helminth and arthropod parasites of warthog, *Phacochoerus aethiopicus*, in South West Africa/Namibia. *Onderstepoort Journal of Veterinary Research*, 50, 145–148.

HORAK, I. G., POTGIETER, F. T., WALKER, JANE B., DE VOS, V. & BOOMKER, J., 1983. The ixodid tick burdens of various large ruminant species in South African nature reserves. *Onderstepoort Journal of Veterinary Research*, 50, 221–228.

HORAK, I. G., DE VOS, V. & BROWN, MOIRA R., 1983. Parasites of domestic and wild animals in South Africa. XVI. Helminth and arthropod parasites of blue and black wildebeest (*Connochaetes taurinus* and *Connochaetes gnou*). *Onderstepoort Journal of Veterinary Research*, 50, 243–255.

HORAK, I. G., DE VOS V. & DE KLERK, B. D., 1984. Parasites of domestic and wild animals in South Africa. XVII. Arthropod parasites of Burchell's zebra, *Equus burchelli*, in the eastern Transvaal Lowveld. *Onderstepoort Journal of Veterinary Research*, 51, 145–154.

HOWARD, G. W., 1981. Stomach bots (Diptera: Gasterophilidae) infesting zebra in Zambia. *Proceedings of the 4th International Conference of the Wildlife Disease Association, Sydney, Australia, 25–28 August 1981*, 130–132.

JOUBERT, E., 1974. Composition and limiting factors of a Khomas Hochland population of Hartmann zebra *Equus zebra hartmannae*. *Madoqua*, Ser. 1, No. 8, 49–53.

KETTLE, P. R., 1974. The genus *Gasterophilus* in the horse in New Zealand. *New Zealand Veterinary Journal*, 22, 43–45.

MALAN, F. S., REINECKE, R. K. & SCIALDO, ROSINA C., 1981. The recovery of helminths post-mortem from equines. II. Helminths and larvae of *Gasterophilus* from the gastro-intestinal tract and oestrids from the sinuses. *Onderstepoort Journal of Veterinary Research*, 48, 145–147.

MATSON, B. A. & NORVAL, R. A. I., 1977. The seasonal occurrence of adult ixodid ticks on cattle on a Rhodesian Highveld farm. *Rhodesian Veterinary Journal*, 8, 2–6.

NORVAL, R. A. I., 1981. The ticks of Zimbabwe. III. *Rhipicephalus evertsi evertsi*. *Zimbabwe Veterinary Journal*, 12, 31–35.

RECHAV, Y., KNIGHT, M. M. & NORVAL, R. A. I., 1977. Life cycle of the tick *Rhipicephalus evertsi evertsi* Neumann (Acarina: Ixodidae) under laboratory conditions. *Journal of Parasitology*, 63, 575–579.

THEILER, GERTRUD, 1962. The Ixodoidea parasites of vertebrates in Africa south of the Sahara (Ethiopian Region). Project S.9958. Report to the Director of Veterinary Services, Onderstepoort, Mimeographed.

ZUMPT, F., 1965. Myiasis in man and animals in the Old World. London: Butterworths.