NEMATODE AND OTHER HELMINTH PARASITES OF THE KANGAROO ISLAND WALLABY, *MACROPUS EUGENII* (DESMAREST). 2. SITE SELECTION WITHIN THE STOMACH

by LESLEY R. SMALES* and PATRICIA M. MAWSON*

Summary

SMALES, L. R. & MAWSON, P. M. (1977) Nematode and other helminth parasites of the Kangaroo Island Wallaby, *Macropus eugenii* (Desmarest). 2. Site selection within the stomach. *Trans. R. Soc. S. Aust.* **102**(3), 79-83, 31 May, 1978.

Stomachs of 99 Kangaroo Island Wallabies were divided into regions. The anterior 4/5 of the stomach appears to be analagous to the rumen while the posterior 1/5 corresponds to the abomasum of the sheep. Nematodes present were identified and site preferences determined.

Introduction

The stomach, caecum, and colon of many herbivorous hosts offer an environment capable of supporting a number of closely related nematode species. Such species flocks have been described for the rhinoceros and elephant (Chabaud 1956), tortoise (Schad 1963; Petter 1963) and kangaroo (Mycylowycz 1964). Holmes (1973) has shown that nematodes actively chose preferred sites within the host. Species flocks are able to exist in a host because each member species occupies a different ecological niche. These niches can be separated by spatial, behavioural or temporal characters.

The nematode *Labiostrongylus eugenii* occurs in the Kangaroo Island Wallaby (*Macropus eugenii*). A survey undertaken preliminary to a study of the life history of this nematode (Smales[1]) revealed the presence of such a species flock in the stomach. During a subsequent epidemiological survey of the nematodes (Smales & Mawson 1978), an opportunity was provided to study the ecology of the species comprising this flock. Spatial distribution in the stomach lumen was investigated, and some observations made on the feeding behaviour and seasonal occurrence of each species.

In addition the site preferences of the developmental stages of *L. eugenii* were defined.

Methods

The general gross and microscopical appearance of the wallaby stomach was examined and found to resemble that of the Red Kangaroo (*Megaleia rufa*) as described by Griffiths & Barton (1966) (Fig. 1).

Ninety-nine male wallabies were taken at two monthly intervals, between April 1973 and March 1975 from Kangaroo Island, South Australia. The collecting areas and methods of capture used have been described (Smales & Mawson 1978).

At post mortem the stomach of each wallaby was carefully removed and ligatured so that it was divided into the following four regions:

1. The cardiac end of the saccular stomach including the oesophageal opening.
2. The central section of the saccular stomach.
3. The pyloric end of the saccular stomach including the non-saccular region.
4. The gastric pouch and pylorus.

The contents of each section so formed were treated separately, by sieving through bolting

* Department of Zoology, University of Adelaide, North Terrace, Adelaide, S. Aust. 5000.

[1] Smales, L. R. (1976) A study of the biology of a nematode *Labiostrongylus eugenii* (Johnson & Mawson) parasitic in the stomach of the tammar wallaby (*Macropus eugenii* Desmarest). Ph.D. Thesis, University of Adelaide (unpublished).

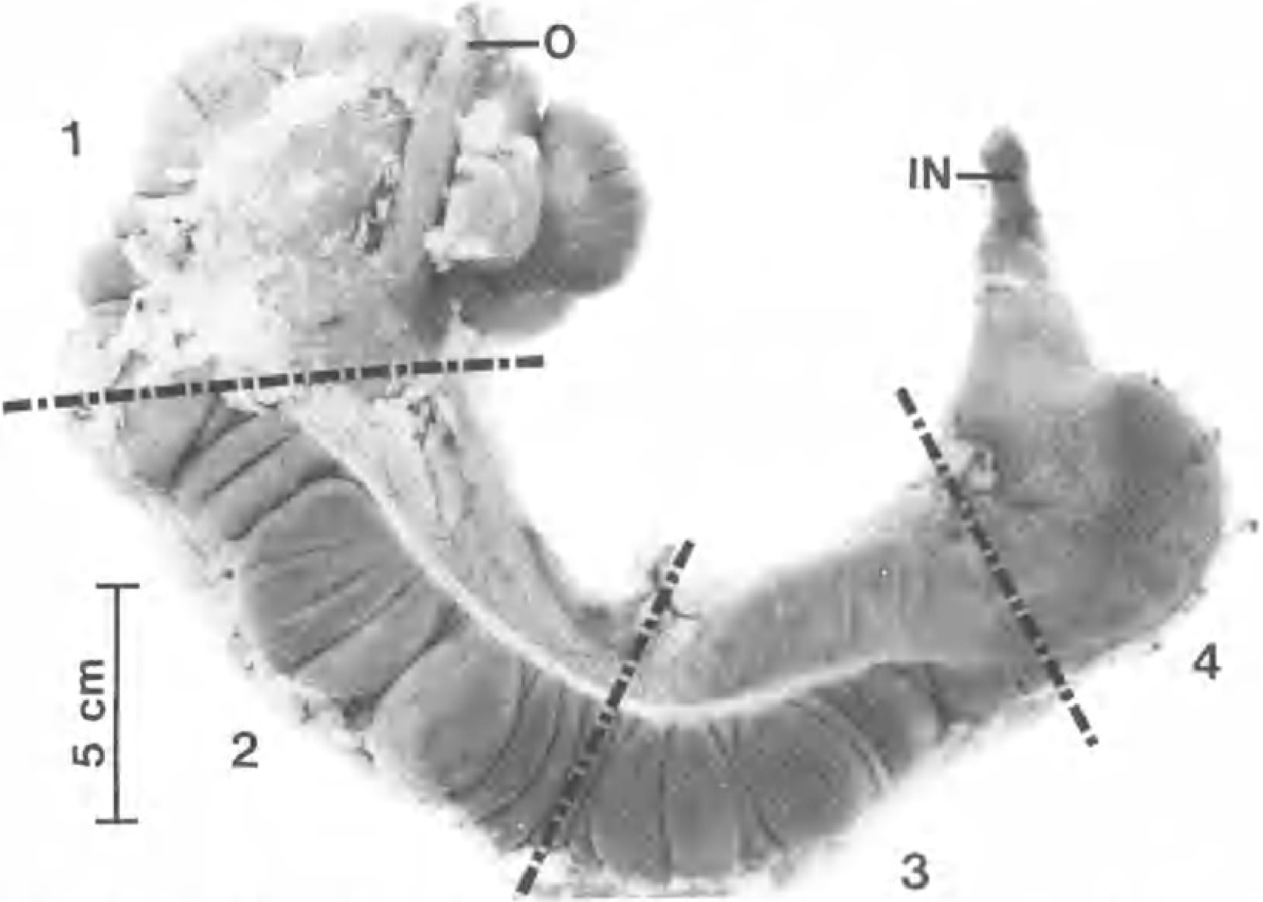

Fig. 1. Stomach of wallaby, showing positions (dotted lines) where ligatures were placed. Numbers indicate sections referred to in text. O, oesophagus; IN, anterior end of intestine.

TABLE I

Mean measurements from 20 wallabies of the pH values in three parts of the stomach

	pH ± S.D.	Range
saccular stomach	6.99 ± 0.5	6.3 - 7.8
non-saccular stomach	6.7 ± 0.7	5.5 - 7.8
gastric pouch	3.27 ± 0.87	2.6 - 5.1

silk (64 mesh/inch), diluting the retained solid material to an appropriate volume (200 or 400 ml), and sampling using the method of Clark et al. (1971) enabling calculation of worm totals to a S.D. of ± 5 worms. All nematodes in each sample were fixed in hot alcohol, cleared in lactophenol, indentified and counted.

An indication of the environment in each region was obtained by measuring the pH of the stomach contents of the first 20 wallabies autopsied, using a glass electrode. The pH of the stomach contents ranged from 7.8 in the saccular region to 2.6 in the gastric pouch (Table I). This agrees with the findings of Moir et al. (1956) in some other macropods, that the anterior 4/5 of the stomach appears to be analogous to the rumen of the sheep while the posterior 1/5 corresponds to the abomasum.

Results

The nematode species studied were *Cloacina* spp. (the genus considered as a whole because some of the species present have not been described), *Macropostrongylus pearsoni*, *Oesophagonastes kartana*, *Rugopharynx australis* and *Labiostrongylus eugenii*. *L. longispicularis* Wood, whose distribution in the stomach of the Red Kangaroo has been described by Dudzinski & Mykytowycz (1965), is present only in small numbers in the wallaby, so was not considered in this study. *Filarinema* sp., occasionally found in small numbers, was restricted to the fourth region of the stomach, and was the only species congregating in that region.

Of the other species found each showed a definite site preference along the length of the stomach (Fig. 2). *Cloacina* spp. and *M. pearsoni* were most common in the first section.

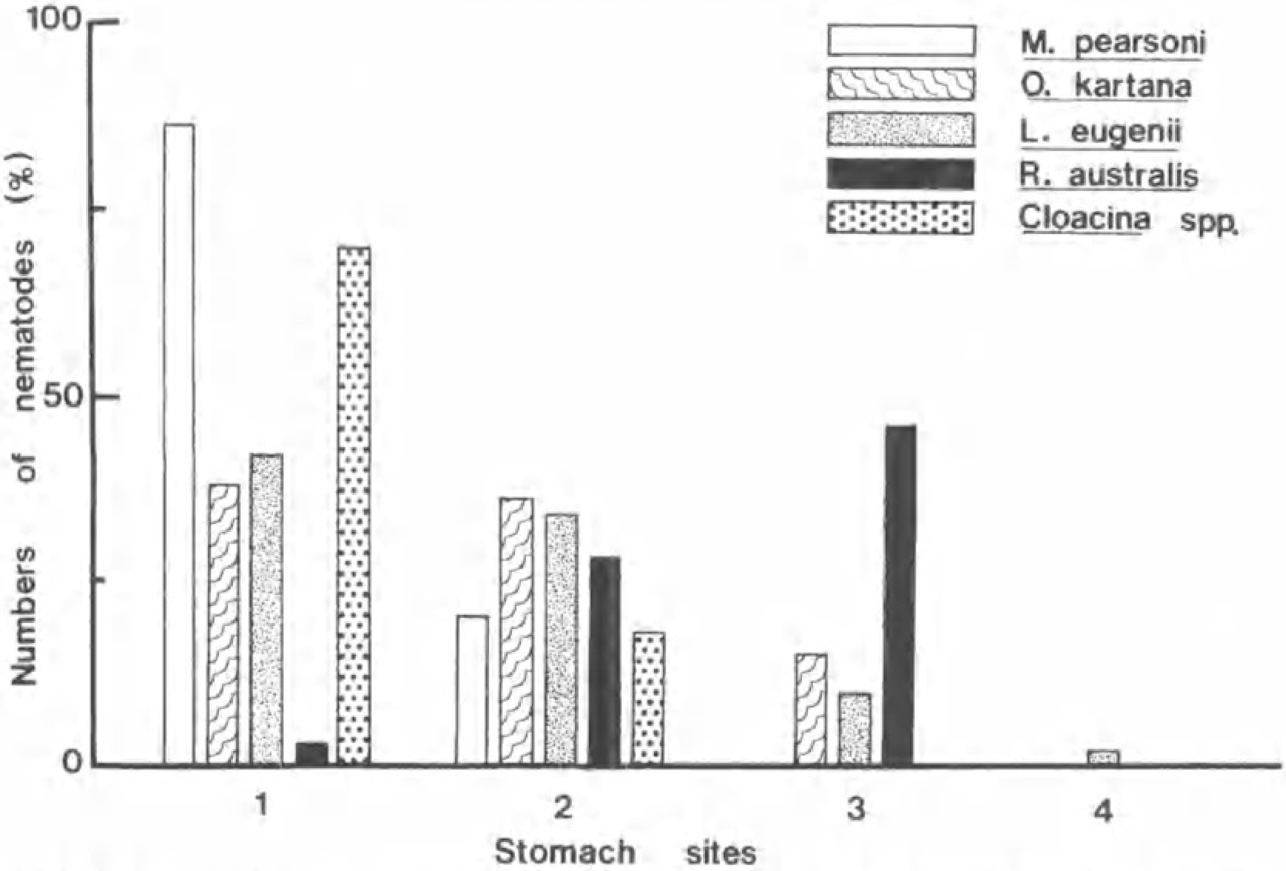

Fig. 2. Histogram showing occurrence of different nematode species in the four stomach sections referred to in text.

TABLE 2

Population structure of *L. eugenii* in four parts of the wallaby stomach. Results expressed as % of total number collected in each site. L = larva

	% *L. eugenii* *site 1*	*site 2*	*site 3*	*site 4*
♂	20.15	19.43	39.48	0
♀	22.13	21.49	43.68	0
L_4	53.51	45.82	16.50	0
L_3	4.21	13.26	0.35	0

O. kartana is normally found in the oesophagus and is present in the stomach only when there is a heavy infestation.. *R. australis* was most common in the third section of the stomach.

L. eugenii congregated in both first and second sections of the stomach but most were in the first. As with *L. longispicularis* (Dudzinski & Mykytowycz 1965) this may be related to the position of the oesophageal opening, worms being attracted to recently ingested food. In wallabies with heavy infestations, *L. eugenii* were seen protruding through the sphincter into the oesophagus.

In newly opened stomachs *L. eugenii* was found congregated in the paramucosal region of the stomach lumen. The *Cloacina* spp. were more often found in the central core whereas *O. kartana* was frequently associated with the crypts of the mucosal glands on the saccular stomach wall. This suggests that a radial distribution, across the 1st and 2nd sections separates these 3 species.

Seasonal observations on the occurrence of *M. pearsoni* (Smales & Mawson 1978) suggest that overlap with *Cloacina* spp. is minimal as the former seems to be present in large numbers at times when those of the latter are low.

Nearly all the third and some of the fourth stage larvae of *L. eugenii* were found in nodules on the stomach wall in the second section of the stomach. It was not practicable to assess the number of worms in these lesions. The site preference of *L. eugenii* was further analysed in terms of population structure (Table 2). No statistical difference was found in the numbers of adults and larvae free in sections 1 and 2. However, significantly more adults than larvae were found in section 3.

Discussion

The environment along the digestive tract is not stable, nor do changes occur abruptly, rather one region gradually merges with the next. Consequently nematodes are not restricted to a single anatomical region but move within limits to remain in the most favourable site (Crompton 1973). When sections of the wallaby stomach were ligatured no allowance could be made for any environmental changes in the stomach lumen which may have occurred in an individual wallaby. Some of the observed overlap between preferred sites may have been due to the necessarily arbitrary placing of the ligatures. Also when a large number of the same species infest a host the increased population density may cause some of the worms to move to less favourable sites (Crompton 1973). Examples of this appeared to be the presence of *O. kartana* in the stomach as well as the oesophagus and *M. pearsoni* and *Cloacina* spp. in the second sections of the stomach as well as the first.

Avoidance of the fourth section by those species congregating in any of the three sections comprising the saccular stomach was very marked. No doubt the differences in digestive function of the fourth section resulted in an unsuitable environment. Similarly the rumen-like conditions of the saccular stomach appeared to be unsuitable for *Filarinema* sp.

The nematode distribution described above, showing considerable spatial separation of niches both longitudinally and radially is similar to that found by Schad (1963) in analyses of *Tachygonetria* spp. in the colon of the tortoise *Testudo graeca*.

Where the site preferences of species overlap spatially there are usually differences in food habits, that is, behavioural separation of niches. Schad (1963) showed that while *T. robusta* (Drasche) and *T. stylosa* Thapar are found in the same site one species is an indiscriminate feeder while the other selects fine particulate matter, mainly bacteria. Observations of *L. eugenii* suggest that it is an indiscriminate feeder. Dudzinski & Mykytowycz (1965) suggest that *L. longispicularis* also feeds indiscriminately. The differences in oral morphology found amongst the *Cloacina* spp. and *M. pearsoni* may be associated with selection of different sized food particles. Some species may feed on material ingested by the host and others feed on the bacterial or ciliate populations present.

Petter (1966) suggested that the species flock may vary with age and sex of host as well as season. As only male wallabies were studied the question of sex was not considered. It was noted that *Cloacina* spp. were the earliest to infest joeys but this was not investigated further because of insufficient host numbers for each range. Seasonal differences appeared to provide niche diversification between *M. pearsoni* and *Cloacina* spp.

The species present in the *Cloacina* spp. flock have not been studied individually, but general observations suggest that the species composition of the flock does change with the season.

Acknowledgements

Our thanks are due to Mr P. Davis who collected the wallabies used in this study. The work was supported by a Grant from the Rural Credits Development Fund and a Commonwealth Postgraduate Research Award.

References

CHABAUD, A. G. (1956) Remarques sur les nématodes parasites du caecum des éléphants, milieu tres préserve des phenomènes de selection. *C.r. hebd. Seanc. Acad. Sci.*, Paris **243**, 436-439.

CLARK, C. J., TUCKER, A. M. & TURTON, J. A. (1971) Sampling technique for estimating round worm burdens of sheep and cattle. *Expl Parasit.* **30**, 181-186.

CROMPTON, D. W. T. (1973) The sites occupied by some parasitic helminths in the alimentary tract of vertebrates. *Biol. Rev.* **48**, 27-83.

DUDZINSKI, M. L. & MYKYTOWYCZ, R. (1965) Distribution of the nematode *Labiostrongylus longispicularis* (Wood) within the stomach of the red kangaroo *Megaleia rufa* (Desmarest). *Parasitology* **55**, 543-550.

GRIFFITHS, M. & BARTON, A. A. (1966) The ontogeny of the stomach in the pouch young of the red kangaroo. *CSIRO Wildl. Res.* **11**: 169-185.

HOLMES, J. C. (1973) Site selection by parasitic helminths: Interspecific interactions, site segregation, and their importance to the development of helminth communities. *Canad. J. Zool.* **51**, 333-347.

MOIR, R. J., SOMERS, M. W. & WARING, H. (1956) Studies in marsupial nutrition. I. Ruminant-like digestion in a herbivorous marsupial (*Setonix brachyurus* Quoy & Gaimard). *Aust. J. Biol. Sci.* **9**, 293-301.

MYKYTOWYCZ, R. (1964) A survey of the endoparasites of the red kangaroo *Megaleia rufa* (Desmarest). *Parasitology* **54**, 677-693.

PETTER, A. J. (1963) Equilibre des especes dans les populations de nematodes parasites du colon des tortues terrestres. C.r. hebd. Seanc. *Acad. Sci.* Paris **257**, 2152-2154.

PETTER, A. J. (1966) Equilibre des expeces dans les populations de nematodes parasites du colon des tortues terrestres. *Mem. Mus. Natn. Hist. nat., Paris, Serie A. Zool.* **39**, 1-252.

SCHAD, G. A. (1963) Niche diversification in a parasitic species flock. *Nature,* Lond. **198**, 404-406.

SMALES, R. L. & MAWSON, P. M. (1978) Nematode parasites of the Kangaroo Island Wallaby, *Macropus eugenii* (Desmarest). I. Seasonal and geographical distribution. *Trans. R. Soc. S. Aust.* **102**(1), 9-15.

BATHYMETRY OF LAKE EYRE

BY J. A. T. BYTE, P. J. DILLON, J. C. VANDENBERG AND G. D. WILL

Summary

The bathymetry of Lake Eyre has been contoured from depth soundings obtained on six expeditions, and one land tranverse of the dry lake. The lowest region of Lake Eyre North (the lowest land area of the Australian continent) appears to lie in Belt Bay, and to have the elevation of – 15.2 m A.H.D. The lowest region of Lake Eyre South (–13.2 m A.H.D.) occurs in the far southwest. From the bathymetry, the surface area and volume of Lake Eyre as a function of water level have also been calculated.