Technote

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Tick Fever Survey in the Northern Territory

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INTRODUCTION

Protection of native cattle against tick fever in the tick endemic area of the Northern Territory has always been presumed to be high. Tick fever cases are rarely reported from endemic tick areas. Known tick fever outbreaks have been limited to tick incursions into tick free areas, often associated with inadequate tick control in droving mobs during the 1950s and early 1960s.

In recent years, with a number of dry seasons and the major change in breed composition from shorthorn to brahman and brahman cross cattle in the tick endemic and marginal areas, there has been a major decline in the distribution of ticks and in the tick burdens on cattle. This has led to concern about lack of protection against tick fever in native cattle in the tick endemic area because of inadequate exposure to the disease.

There is no data on the antibody status of cattle in the Northern Territory for either of the main tick fever organisms - *Babesia bovis* or *Anaplasma marginale*. This 1992 to 1994 survey was carried out to try to establish the antibody status of cattle from selected Northern Territory properties within the current gazetted Tick Restricted (Infected) Area (Figure 1), which is the tick endemic area. The Southern Protected Area is tick free, with rare tick incursions. The Central Protected Area (marginal area) has not been tick infested since the early to mid 1980s.

Properties in the southern part of the Tick Restricted Area have had little or no evidence of ticks in recent years. It is suspected that tick fever may be enzootically unstable (ie not constantly present). Consequently, stock from this area may be susceptible to tick fever if ticks re-establish with better seasons, or when cattle are exported to South-East Asia, or are moved to properties in higher rainfall areas with a higher tick burden.

MATERIALS AND METHODS

A serological survey of 19 properties (Figure 2) was conducted from August 1992 to December 1994, and is described below.

A survey of stock inspectors to determine tick status of properties was also carried out. This collated retrospective information on whether ticks had been observed on properties from 1991 to 1993.

Design

The serological survey was conducted on properties running extensive beef cattle operations. In 1992 and 1993 properties in the southern and central parts of the tick endemic area were sampled. It was extended to the northern areas during 1993 and in 1994, as the seroprevalence in the central area was lower than expected. Particular herd selection on the property was organised by the local field officer, for logistical reasons.

Two age groups were sampled on most properties - i) weaners and ii) "young" stock (mainly 2 to 3 years, but ranged up to 5 years of age). Older animals were not sampled, due to reduced sensitivity of the test in older cattle (de Vos, personal communication).

The sample size of 19 stations was chosen to estimate a herd prevalence of 10% disease with 90% confidence (sampling frame of 80 stations) and 10% confidence limits (Cannon and Roe, 1982).

About fifty head were sampled from each age group. This sample size is greater than that required (35) to estimate 10% within herd disease prevalence at a 95% confidence level and 10% confidence limits (Cannon and Roe).

Field Sampling Procedure

Blood samples were collected from the jugular or coccygeal vein into plain vacutainers. As required for the *Anaplasma marginale* test, samples were not refrigerated straightaway. Specific treatment of blood samples by field staff for each submission is not known. Samples were then forwarded to Wacol Tick Fever Research Centre in 1992 and to Berrimah Veterinary Laboratories (BVL) in 1993 and 1994.

Laboratory Procedure

For the majority of submissions, the serum was removed after arrival at the laboratory. Sera were stored either in the fridge or freezer until tested.

Testing for antibodies to *Babesia bovis* was done by the immunofluorescent antibody test (IFAT). The card agglutination test (CAT) was used to test for antibodies to *Anaplasma marginale*. The results were categorised as positive if the test reading (IFAT or CAT) was 2+ or 3+, and negative if the test reading was 1+ or negative.

Although haemolysed samples are not recommended for use in the CAT, it was necessary at BVL to use all but the most severely haemolysed samples.

RESULTS

The details of age, breed, date bled and results for 1992, 1993 and 1994 are shown in Appendix 1.

Tables 1 and 2 summarise results from the young stock in 1993 and 1994, classified into five groups depending on seroprevalence. Any effect of season, breed or sex has not been included. Tables 3 and 4 summarise in a similar way the results from 1992, 1993 and 1994 for weaners.

Table 1. Summary of seroprevalence by property to *B. bovis* in young stock

	Seroprevalence				
	0%	**1-25%**	**26-50%**	**51-75%**	**76-100%**
1993	0	4	2	1	0
1994	1	1	4	1	1
Total	1	5	6	2	1

NB: one property has results for 1993 and 1994, and results for property 12 in 1993 have been combined

Table 2. Summary of seroprevalence by property to *A. marginale* in young stock

	Seroprevalence				
	0%	**1-25%**	**26-50%**	**51-75%**	**76-100%**
1993	0	2	2	2	1
1994	0	2	1	1	4
Total	0	4	4	2	5

NB: one property has results for 1993 and 1994, and results for property 12 in 1993 have been combined

Table 3. Summary of seroprevalence by property to *B. bovis* in weaners

	Seroprevalence				
	0%	**1-25%**	**26-50%**	**51-75%**	**76-100%**
1992	4	1	0	0	0
1993	2	2	1	0	0
1994	0	2	5	0	0
Total	6	5	6	0	0

NB: one property has results for 1992 and 1993

Table 4. Summary of seroprevalence by property to *A. marginale* in weaners

	Seroprevalence				
	0%	**1-25%**	**26-50%**	**51-75%**	**76-100%**
1992	3	2	0	0	0
1993	2	2	1	0	0
1994	0	1	3	0	3
Total	5	5	4	0	3

NB: one property has results for 1992 and 199

Wet season rainfall data for some NT centres are shown in Table 5. The rainfall zone of the properties where young stock were sampled are shown in Table 6.

Table 5. Wet season rainfall (1st October to 30th April)

Error! Bookmark not defined.	**YEAR**		
	1991/92	**1992/93**	**1993/94**
Darwin	1038.2	1508.0	1132.8
Katherine	614.8	957.4	1005.0
Tennant Creek	149.6	632.0	216.0
Brunette Downs	125.1	544.2	189.4
Wollogorang	352.6	1199.5	417.7

(Information from the Bureau of Meteorology, Northern Territory Regional Office)

Table 6. Distribution of properties where seroprevalence >25% according to annual rainfall zone

Error! Bookmark not defined.**Rainfall Zone**	**Young stock *B. bovis***	**Young stock *A. marginale***	**Young stock, total properties surveyed**	**Weaners *B. bovis***	**Weaners *A. marginale***	**Weaners, total properties surveyed**
Low (<600mm)	2	3	4	1	1	5
Medium (600-1000mm)	4	5	7	2	3	9
High (>1000mm)	3	3	4	3	3	3

The survey of property tick status by stock inspectors indicated that the majority of properties had the same tick status for the three years. Five properties (two adjacent) were noted as being ticky in 1991, but not in 1993.

DISCUSSION

As expected, properties from the higher rainfall areas generally had more positive results to both *B. bovis* and *A. marginale*. This is presumed to be associated with greater cattle tick (*Boophilus microplus*) numbers in higher rainfall areas.

Exceptions to this general principle were property 19 in the Darwin region and property 18 in the southern Katherine region. It was reported that ticks had not been seen on property 18 for 3-4 years. On property 19, ticks are rarely seen and cattle are grazed on the floodplains during the dry season and on upland country during the wet season. Cattle are dipped when moving from one to the other. The floodplains obviously flood and the upland country is burnt, reducing tick survival, in addition to pasture spelling. Unpublished reports suggest cattle tick larval survival is from 2-6 months, depending on the season.

A factor causing variation in the distribution and population of cattle tick between years is the annual rainfall. Wet season rainfall data for some NT centres are presented in Table 5, but local conditions between and within properties also vary tremendously. It is not uncommon for ticks to persist in certain paddocks.

It is worth noting that the comments in Appendix 1 on the numbers of ticks seen on herds sampled are very subjective, with variation between field staff and times of the year.

Weaners from the same paddock as young stock tend to have a lower seroprevalence. Colostral antibody could have declined, with the weaners being sampled prior to developing their own antibodies as a result of exposure to ticks infected with tick fever. Mahoney *et al* (1981) state that colostral antibodies for *B. bovis* are detectable for 2-3 months from birth. Up until the age of about 9 months cattle affected with *B. bovis* have an innate immunity to tick fever, and will develop resistance without severe disease (Trueman and Blight, 1978; Levy *et al*, 1982; Mahoney *et al*, 1981). Rogers (1971) also states that the severity of clinical disease due to anaplasmosis has been shown to increase with age. However, weaners may be susceptible to tick fever infection and possibly clinical disease during their second wet season.

Mahoney *et al* (1981) reported that to maintain enzootic stability for *B. bovis*, a minimum daily inoculation rate with the organism is needed. The inoculation rate must be sufficient to infect all calves within 270 days of birth. Factors affecting the inoculation rate are environmental stresses on the development and survival of tick eggs and larva, cattle breed resistance to cattle tick and tick fever infection, efficiency of tick control and proportion of ticks infected with *B. bovis*. They concluded that Zebu cross calves need an annual mean infestation of 35 ticks/day/head to ensure stability of babesiosis. This hypothesis is not supported by observation of tick infestations in brahman cattle in northern and eastern Australia.

Some of the samples tested at BVL were sent to the Wacol Tick Fever Research Centre for duplicate testing. There were also samples tested twice, several months apart, at BVL. Although known control results were

satisfactory, repeatability of some test results was not consistent. This may have been due to length of storage time - long term storage at -4^{o}C may affect repeatibility of the CAT (Bock, pers. comm.).

The low level of antibodies to *B. bovis* in this survey indicates enzootic instability in much of the tick endemic area. Low (or nil) tick numbers due to dry seasons, efficient tick control and resistance to cattle tick in brahman cross cattle may have caused a reduction, or even disappearance, of *B. bovis* from the cattle population.

Data is lacking on the infection of cattle tick in the Northern Territory with the cattle tick organisms. There is no local data on immunological and pathological response in brahman cross cattle in the Northern Territory to exposure with tick fever infected ticks.

Although the cattle tick is considered the major vector for *A. marginale* in Australia (Callow, 1984), this survey indicates there may well be other efficient vectors in the Northern Territory. This is suggested by the positive results to *A. marginale* with no evidence of *B. bovis* on a number of properties, including absence of cattle tick for a number of years on one property. A recent study (Allingham et al, 1994) could not transmit *A. marginale* by buffalo fly (*Haematobia irritans exigua*). However, other blood sucking insects may be successfully transmitting the organism.

The reported cases of clinical tick fever in the endemic tick area is very low. However, this study indicates that some herds in the tick endemic area appear to have low levels of antibodies to tick fever organisms, and may be at risk of tick fever infection.

It is very difficult to assess the risk of tick fever from these results. Assessing the level of tick fever antibodies will not give an indication of the numbers of animals that may be clinically affected by tick fever infection. Whether animals become sick or die from a tick fever infection is influenced greatly by the level of *Bos indicus* blood, and also by the species of tick fever parasite and its virulence (Bock, pers. comm.). It appears that as the level of *Bos indicus* blood increases, there is less chance that animals will need treatment for a tick fever infection (Bock, pers. comm.).

Recent work in Queensland suggests that there may be differences in the level of seroconversion between males and females (Bock, pers. comm.), with males generally seeming to have higher seroconversion rates. The sex of animals sampled in this survey was not recorded for the weaner groups, whilst more females than males were sampled in the older group.

The findings of the survey to assess levels of tick fever antibodies are:

- overall there was a lower level of antibodies to *Babesia bovis* in the tick endemic area than expected
- there was a low level of antibodies to *Babesia bovis* in the southern parts of the tick endemic area
- generally there was a positive association between higher rainfall and higher level of antibodies to *Babesia bovis* and *Anaplasma marginale*
- due to the small number of shorthorn cattle remaining in the tick endemic area, it was not possible to make any conclusions regarding breed effect in relation to cattle tick burden.

It is concluded that there is a risk of infection with tick fever if young cattle from the tick endemic area of the NT are exposed to high burdens of tick fever infected cattle ticks. It has not been possible in this survey to assess the risk of disease or death due to tick fever. The pathogenesis of tick fever infection in braham/brahman cross cattle in northern Australia is unknown, and needs further investigation. It is possible that low mortality would not be detected, but is of a level that may make vaccination cost effective. Vaccination of weaners will provide protection against tick fever. Vaccination of cattle for export to Asia will provide assurance to buyers.

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APPENDIX 1

1992 RESULTS

Prop #	Tick comments	Age	Breed	No. head	Date bled	*B. bovis* positive	*A. marginale* positive
1	none since 87	wnr	7/8Brah	40	Sep 92	0.0	0.0
2	ticky 92	wnr	7/8Brah	50	Aug 92	0.0	6.0
3	last seen 90	wnr	7/8Brah	47	Aug 92	0.0	2.1
4	not seen on controlled cattle for 2-3 yrs. Occ on bush S/horn	wnr	7/8Brah	8	Aug 92	0.0	0.0
			1/2Brah	19		5.3	0.0
			S/horn	5		0.0	0.0
5	not seen this mob	wnr	7/8Brah	7	Aug 92	0.0	0.0
			1/2Brah	35		0.0	0.0
			S/horn	9		0.0	0.0

wnr = weaner

1993 RESULTS

Prop #	Tick comment	Age	Breed	No. head	Date bled	*B. bovis*		*A. marginale*		Other
						Date tested	%pos	Date tested	% pos	
5*	-	weaner	Brah X	52	18/04/93	22/11/93	0.0	29/11/93	0.0	stored >6mos
		y brdr	Brah X	53		01/02/94	9.4	07/02/94	17.0	stored >6mos
6*	Tick free 90-92. Moderate nos. 92/93 wet	weaner	3/4Brah ¼Charbry	51	25/05/93	21/01/94	39.2	24/01/94	31.4	stored >6mos
		heifer	Brah X	56		15/02/94	55.4	07/02/94	75.0	stored >6mos
7	Low	heifer	Brah X	54	04/06/93	21/02/94	24.1	21/02/94	31.5	stored >6mos
8	low91 few92 none93	weaner	Brah X	49	07/06/93	04/10/93	4.1	01/11/93	0.0	
9	Poss 5-6 yrs none	weaner	Brah	50	10/07/93	06/09/93	0.0	-	4.0	
10	-	y brdr	Brah X	45	?	02/09/93	26.7	15/09/93	28.9	not frozen
2	-	y brdr	Brah X	107	19/08/93	20/09/93	5.6	22/09/93	8.4	
10	-	weaner	Brah X	50	07/09/93	14/09/93	4.0	15/09/93	24.0	not frozen
11	Marginal	heifer	Brah	28	08/10/93	15/11/93	7.2	15/11/93	89.3	not frozen
12*	Very ticky	y brdr	Brah	32	27/11/93 & 28/11/93	06/12/93	34.4	29/11/93	46.9	not frozen
		yrling	Brah	19		06/12/93	47.4	29/11/93	57.9	not frozen

NB * indicates both age groups were from the same paddock

y brdr = young breeder

yrling = yearling

1994 RESULTS

Prop #	Tick comment	Age	Breed	No. head	Date bled	*B. bovis*		*A. marginale*		Other
						Date tested	% pos	Date tested	% pos	
13	not many	3-5 yrs	Brah	44	25/05/94	31/05/94	34.1	30/05/94	70.5	not frozen
	very few	6-8 mo	Brah X	46	18/08/94	05/10/94	30.4	06/10/94	38.5	8d to lab. Frozen. 39 CAT only,haemolysd
14	not many	4 yrs	Brah	50	25/05/94	02/06/94	38.0	3031/05/94	84.0	not frozen
	not many	wnrs	Brah	50	24/06/94	18/07/94	36.0	14/07/94	96.0	
15*	light	y cows	SantaX	50	28/05/94	23/06/94	50.0	31/507/6/94	84.0	not frozen
	light	wnrs	SantaX	50	29/05/94	03/06/94	20.0	07/06/94	46.0	not frozen
16*	light	3 yrs	Brah X	61	31/05/94	20/07/94	68.9	28/07/94	88.5	frozen
	light	wnrs	Brah X	52	31/05/94	15/06/94	34.6	15/06/94	38.5	frozen
17*	moderate	y stck	BrahX/ShX	34	02/11/94	11/11/94	82.4	11/11/94	97.1	not frozen
	moderate	wnrs	BrahX/ShX	32	02/11/94	11/11/94	37.5	11/11/94	81.2	not frozen
18	None 93/94	y hfrs	Brah X	56	30/10/94	16/11/94	3.6	16/11/94	1.8	frozen
	none on parents for 3-4 yrs	wnrs	Brah	56	24/11/94	07/12/94	1.8	07/12/94	3.6	not frozen
12		wnrs	Brah	46	10/06/94	25/11/94	39.1	25/11/94	95.7	frozen
ex 11	not seen	3y str	Brah X	42	16/06/94	29/11/94	35.7	24/10/94	40.5	frozen. 12 re-bled 14/10.CAT & IFAT 75.0%
19	no-dipped into pdks, plain floods, high burnt	18m hfr	Brah X	70	24/07/94	14/12/94	0.0	14/12/94	11.4	frozen (63 only done for IFAT)

NB * indicates both age groups were from the same paddocks

mo = months, wnrs = weaners, y cows = young cows, y stck = young stock, y hfrs = young heifers, 3y str = 3year old steers, 18m hfr = 18 month old heifers

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FIGURE 1 GAZETTED TICK AREAS

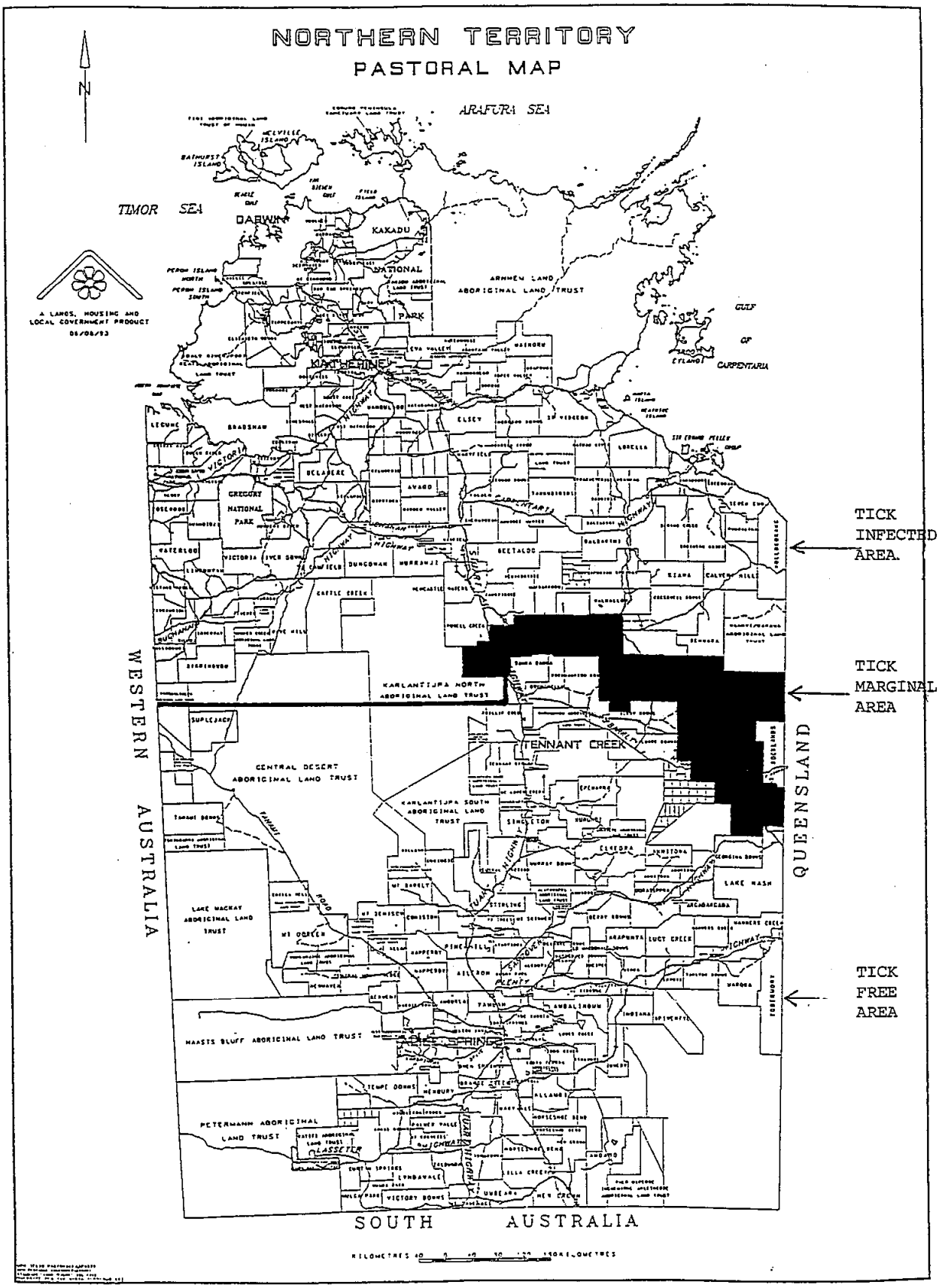

FIGURE 2

TICK FEVER SURVEY

PROPERTIES SURVEYED