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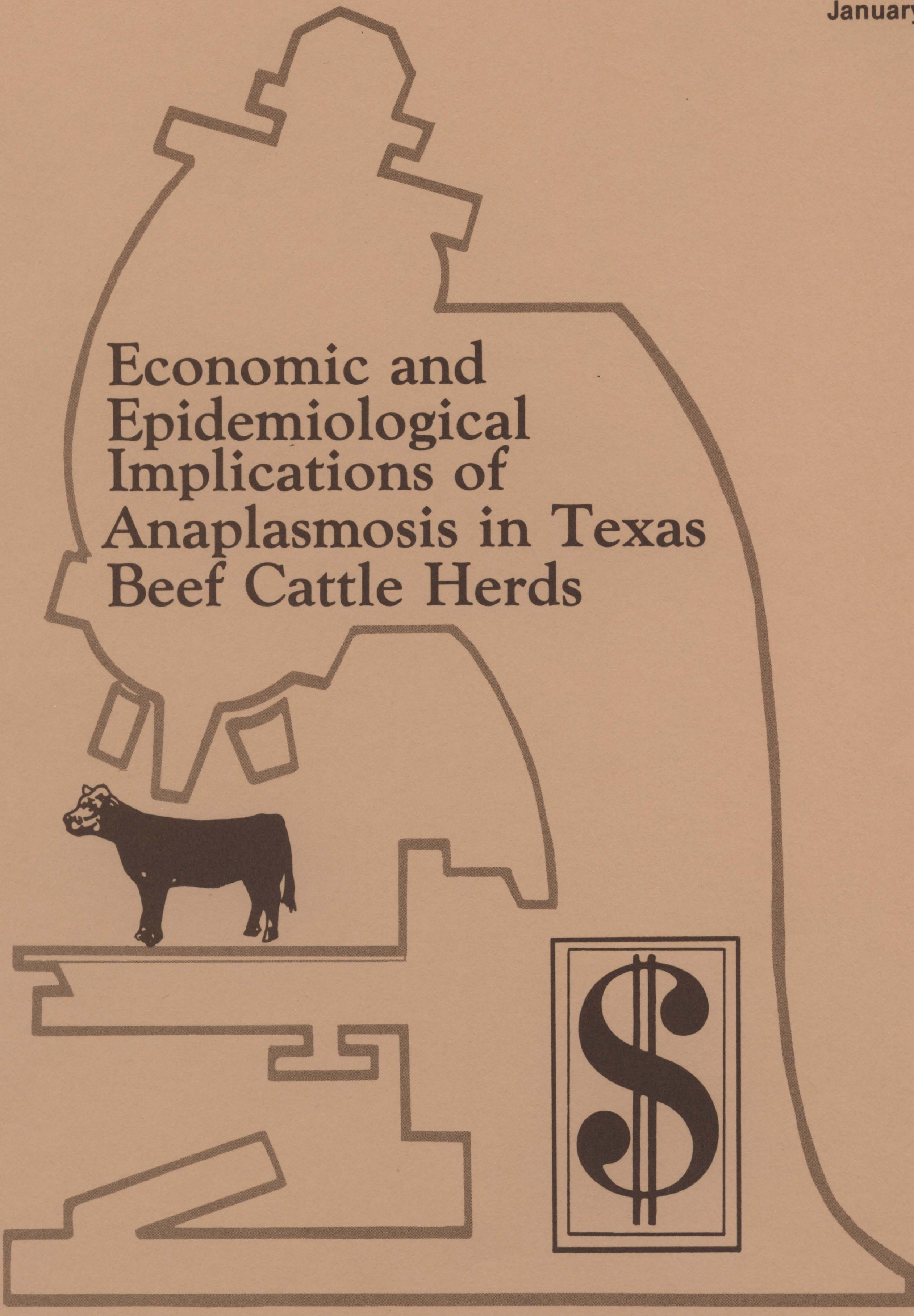
Economic and Epidemiological Implications of Anaplasmosis in Texas Beef Cattle Herds



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In cooperation with Veterinary Services, APHIS, U.S. Department of Agriculture.

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SUMMARY

Anaplasmosis is a bovine disease that creates physical and financial losses for some Texas cattle producers. The incidence of anaplasmosis, the extent of loss, the regions of the state where loss occurs, and the value of preventive measures have not been documented previously. This study was designed to provide benchwork data for analyzing the anaplasmosis problem in Texas.

Two questionnaire surveys, one mailed to veterinarians and one to beef cow/calf producers, provided the basic data for this study. Tabulation determined that Texas could be divided into three areas with respect to the incidence of anaplasmosis: (1) where clinical cases of anaplasmosis were not reported or rarely reported, (2) where clinical cases were few to moderate in number, and (3) where there was a high number of cases. In 1980, the incidence of clinical cases of anaplasmosis in Texas was estimated to be 0.276 percent of the adult breeding cattle. The occurrence of anaplasmosis peaked in the summer season in Texas, but the seasonal occurrence of the disease varied considerably among regions within Texas. Survey results indicated that winter ticks, horseflies, and, to some extent, mosquitoes were the vectors transmitting anaplasmosis. Losses sustained by the producer survey respondents averaged $424 per clinical case as a result of death, weight loss, chronic cases, and/or abortion. The direct cost of anaplasmosis to Texas beef producers during 1980 was estimated to be $6.37 million. Preventive measures costing $2.59 million made the total cost of the disease equal to $8.96 million.

The three most common alternative preventive measures used by producers in 1980 included (1) vaccination, (2) low-level chlortetracycline, and (3) vector control. Estimated benefit/cost ratios, which show the dollars returned per dollar expended, ranged from 3.8 to 4.0 for vaccination, low-level chlortetracycline, and vector control. The exception was the benefit/cost ratio of 2.2 for low-level chlortetracycline when used in herds of more than 300 head.

KEYWORDS: Anaplasmosis/beef cattle/physical loss/economic losses/treatment costs/preventive measures/benefit-cost ratios/vectors/clinical cases

Economic and Epidemiological Implications of Anaplasmosis in Texas Beef Cattle Herds

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INTRODUCTION

Anaplasmosis is a disease in cattle that creates physical and financial losses for cattle producers. *Anaplasma marginale,* the primary micro-organism causing the disease, parasitizes erythrocytes of cattle. Transmission of the disease agent is accomplished by vectors transferring minute amounts of blood from infected to susceptible cattle. Incubation is usually four to six weeks. When the host's immune response to the infected erythrocytes destroys some of its red blood cells, clinical signs of anaplasmosis become evident: anemia, marked fatigue, jaundice, anorexia, and fever. The hosts of known importance of *Anaplasma marginale* in the U.S. are cattle and the Columbian black-tailed deer.

Physical losses from anaplasmosis in cattle include death and, in survivors, weight loss, chronic cases, and abortion. The extent of these losses is dependent on the annual incidence[1] of anaplasmosis. Incidence is affected by the vectors and the reservoir of infection. The primary vectors of anaplasmosis in Texas are certain species of ticks, horseflies, and mosquitoes. The number and activity of these vectors is related to weather and associated ecological factors. Consequently, incidence varies from year to year and among different ecological regions. Control measures often used by producers against anaplasmosis include vaccination, feeding of low-level chlortetracycline, vector control, and oxytetracycline injections.

The Problem

Published information concerning physical and economic losses attributable to anaplasmosis is sketchy in scope; often it includes undocumented estimates. McCallon (1973) estimated that annual losses due to anaplasmosis in U.S. cattle herds totaled $100 million. Vaughn (1973) reported a $10 million loss in Texas in 1968. Neither of these figures was based on formal research, but on the best opinions of experts in the field.

This study was designed to develop detailed information on the economic costs of anaplasmosis to Texas cattle producers. The study also was designed to determine the incidence of anaplasmosis within Texas, associated physical and economic losses, preventive measures and costs, and estimates of benefits from applying various preventive measures.

Source of Data

Two mail questionnaires, one to practicing veterinarians and one to cattle producers, were designed to obtain the necessary data for this study. A random sample of 307 veterinarians was selected by using a random number table. The veterinarians sampled were licensed practitioners whose practice included 50 percent or more large animals. A random sample of 2,297 producers was drawn in cooperation with the Texas Department of Agriculture and the U.S. Department of Agriculture. The questionnaires were designed to include only cattle two years and older since cattle under two years of age either do not show clinical anaplasmosis, or show only mild disease with minimum loss.

The data obtained from the survey were retrospective in type. The producer responses were divided into two categories: (1) herds with a recent history of anaplasmosis and (2) herds with no recent history of anaplasmosis. Herds with a recent history of anaplasmosis were defined as herds with clinical cases[2] during 1978-80. Therefore, herds with no clinical cases in 1980 were classified as having an anaplasmosis problem if they had cases in 1978 or 1979. However, estimates of clinical cases, death loss, abortions, chronic cases[3], and costs for treatment and prevention reported by producers were based on calendar year 1980 to develop annual estimates. The veterinarian responses were based on what they considered to be historically a typical year during 1978-80.

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[1]*Incidence* as used in this Bulletin is the percent of the cattle over two years of age diagnosed as becoming clinically affected with anaplasmosis during the period of one year.

[2]Clinical cases were determined by the veterinarian in their survey and by the producer's veterinarian or the producer in the producer survey. Subclinical cases are cases that can be detected by serology, but do not show overt signs of disease and consequently no noticeable economic loss.

[3]Survivors normally recover in one to three months. Chronic cases are defined as survivors that require more than three months to regain lost weight.

TABLE 1. COMPARISON OF VETERINARIAN AND PRODUCER RESPONDENTS TO THE RANDOM FOLLOW-UP SAMPLE OF NONRESPONDENTS, BY GEOGRAPHIC AREA OF INCIDENCE, TEXAS, 1980

Variable	Veterinarians[a]		Producers[b]	
	Respondents	Follow-up Sample	Respondents	Follow-up Sample
Number of usable responses	83	16	499	67
Number of respondents reporting anaplasmosis	58	12	78	6
Number of responses from Area 1[c]	12	3	107	18
Number of responses from Area 2[d]	45	8	280	35
Number of responses from Area 3[e]	26	5	112	14
Total cases reported	1,290	198	231	2
Total cases reported from Area 1 & 2	315	67	42	0
Total cases reported from Area 3	975	128	189	2

[a]Veterinarian chi-square statistic = 0.5636.
[b]Producer chi-square statistic = 3.425.
[c,d,e]Geographic areas of incidence as delineated in Figure 3.

Eighty-three veterinarians returned usable questionnaires for a response rate of 27% (Table 1). The 2,297 cattle producers surveyed returned 580 questionnaires, of which 499 were usable, for a response rate of 21.7%. The unusable responses were almost all from producers who had quit the cattle business or only had feeder cattle for grazing purposes. The lone dairy respondent was deleted, making this a survey of beef producers only.

A follow-up survey of the nonrespondents accomplished by telephone determined the respondents were representative of the two random samples. The follow-up samples were composed of 24 veterinarians and 88 producers. Both follow-up samples were selected from the nonrespondents by using a random number table to insure randomness. The correlation with respect to location of anaplasmosis between the respondents and nonrespondents with a history of anaplasmosis during 1978-80 was very close (Table 1). In additon, respondent and nonrespondent characteristics with respect to herd size were also very similar.

EPIDEMIOLOGICAL RESULTS

The three factors necessary for clinical cases of anaplasmosis to occur are: (1) the disease agent, (2) susceptible hosts, and (3) a vector to transmit the agent. Any one of the factors alone or their interrelationship affects the incidence of clinical cases and accompanying economic costs to the producer. The seasonal occurrence of disease losses affects producers financially due to the seasonal price variation for cattle. The relationship between epidemiology and economic costs of anaplasmosis holds especially when methods of control are considered. Different preventive measures have different epidemiological effects on disease because they vary as to which factor for disease occurrence they are designed to control. For this reason, each preventive method may have a different effect on incidence; however, each method also has a different economic cost to the producer. The economics and epidemiology of the disease are inseparable.

Areas of Anaplasmosis

The incidence of anaplasmosis varied greatly among regions within Texas during 1980. Both the distribution and area delineation of clinical anaplasmosis reported by practicing veterinarians (Figure 1) closely resembles the survey results reported by producers (Figure 2). In general, the northeast region of Texas and the eastern portion of the Edwards Plateau had a heavy concentration of veterinarian-diagnosed anaplasmosis cases and a high number of producer farms on which the disease occurred. Producer response from the northern section of the Gulf Coast was low, but half of the producers who did respond reported a problem with the disease. These results support the high concentration of cases per year as reported by veterinarians on the north Gulf Coast.

The remainder of Central and East Texas shows scattered locations of clinical cases (Figures 1 and 2). Apparently, a much higher proportion of cattle and ranches are free of losses from anaplasmosis here than in Northeast Texas and the eastern Edwards Plateau. West Texas, part of South Texas, and a small region southeast of the Edwards Plateau were almost devoid of the problem.

Texas can be divided into three major areas by incidence with respect to the concentration of anaplasmosis cases as reported by veterinary practitioners and producers (Figure 3). These are classified as follows: Area 1: clinical cases not reported or rarely reported; Area 2: clinical cases less than 1 percent incidence; and Area 3: high number of cases, ranging from 0.6 percent to 2.2 percent incidence.

Incidence by Areas

The population base of individuals at risk is necessary to calculate incidence figures. Since veterinarians were unsure of the number of cows in their practice area, the veterinarian survey was not used to

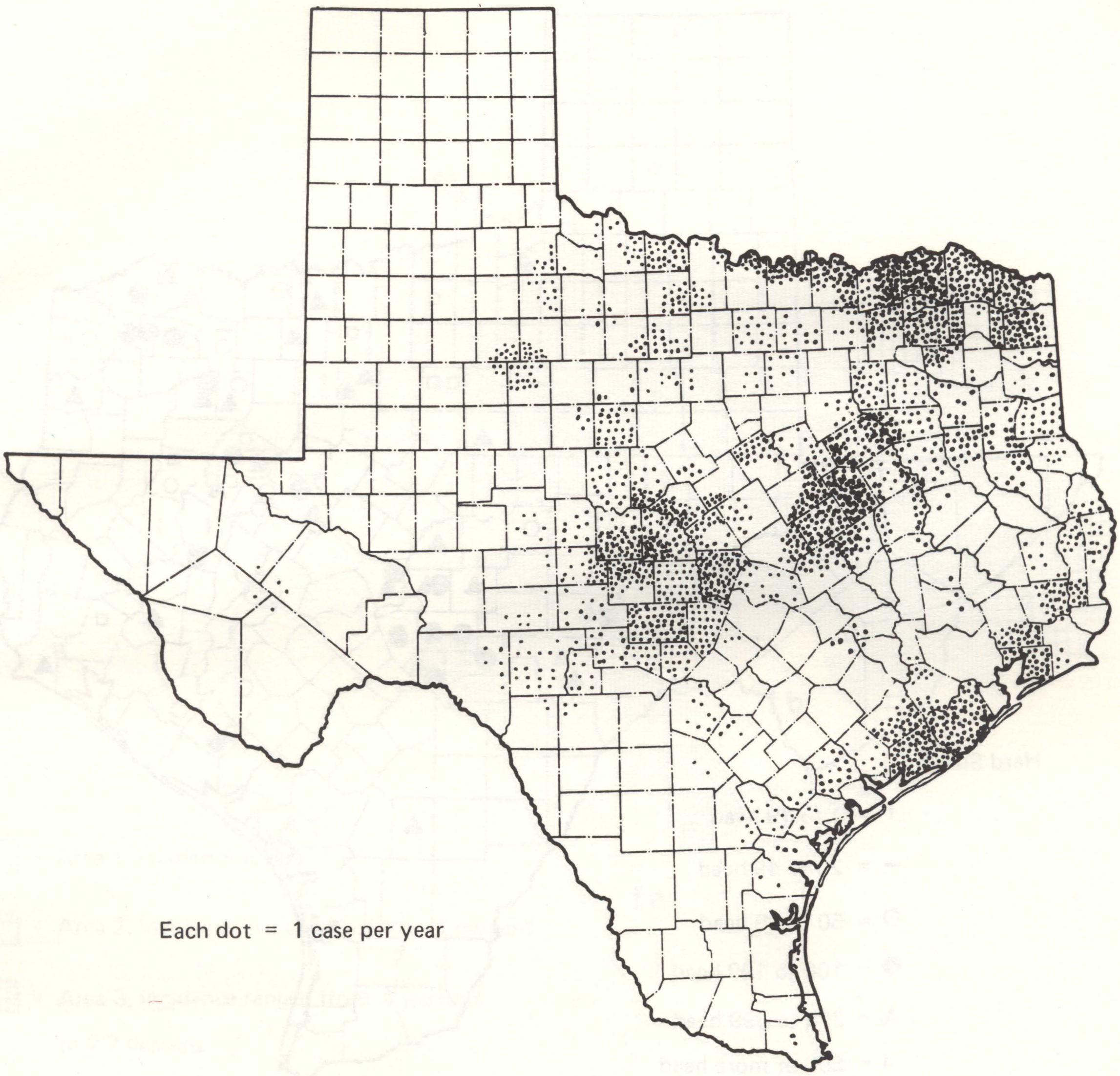


Figure 1. Distribution of clinical anaplasmosis cases during 1978-80 as reported by a random survey of 83 veterinary practitioners and a telephone survey of 65 veterinary practitioners, Texas, 1980[a].

[a]The 65 veterinarians were selected to include parts of Texas not covered by the random survey and to determine the boundaries of the areas with a high number of cases.

determine incidence. Therefore, all incidence figures are derived from the random producer survey.

Total producer survey respondents reported 231 clinical cases of anaplasmosis during 1980 in 90,903 head of cattle at risk to the disease, or an overall incidence of 0.254 percent (Table 2). Producer and veterinarian surveys concurred on variation of incidence in the three areas shown in Figure 3. The white Area 1 (including Subareas 1a and 1b) shows the regions from which veterinarians and producers reported no clinical cases of anaplasmosis except for two small localities in West Texas and the Panhandle, indicated by shaded areas. Subarea 1b, which has a high concentration of beef cows (Figure 4), had no reports of any clinical cases. With the increased exchange of cattle within Texas today, however, carrier cattle from infected areas have very likely been moved into Subarea 1b. Insufficient vector numbers and vector activity is the most logical explanation for the lack of reported clinical cases in this subarea.

The overall incidence in Area 2 is less than 0.1 percent of the cattle population two years and older in that area (Table 2). Portions of Area 2 adjoining boundaries of Area 3 have more reported cases (see Figure 1 for distribution of cases).

Area 3 with its high incidence of 1.2 percent is divided into four subareas (Table 2 and Figure 3), which are different in ecology and geographically separated. Area 3 contained 81.8 percent (189 of 231) of the clinical cases of anaplasmosis reported by the

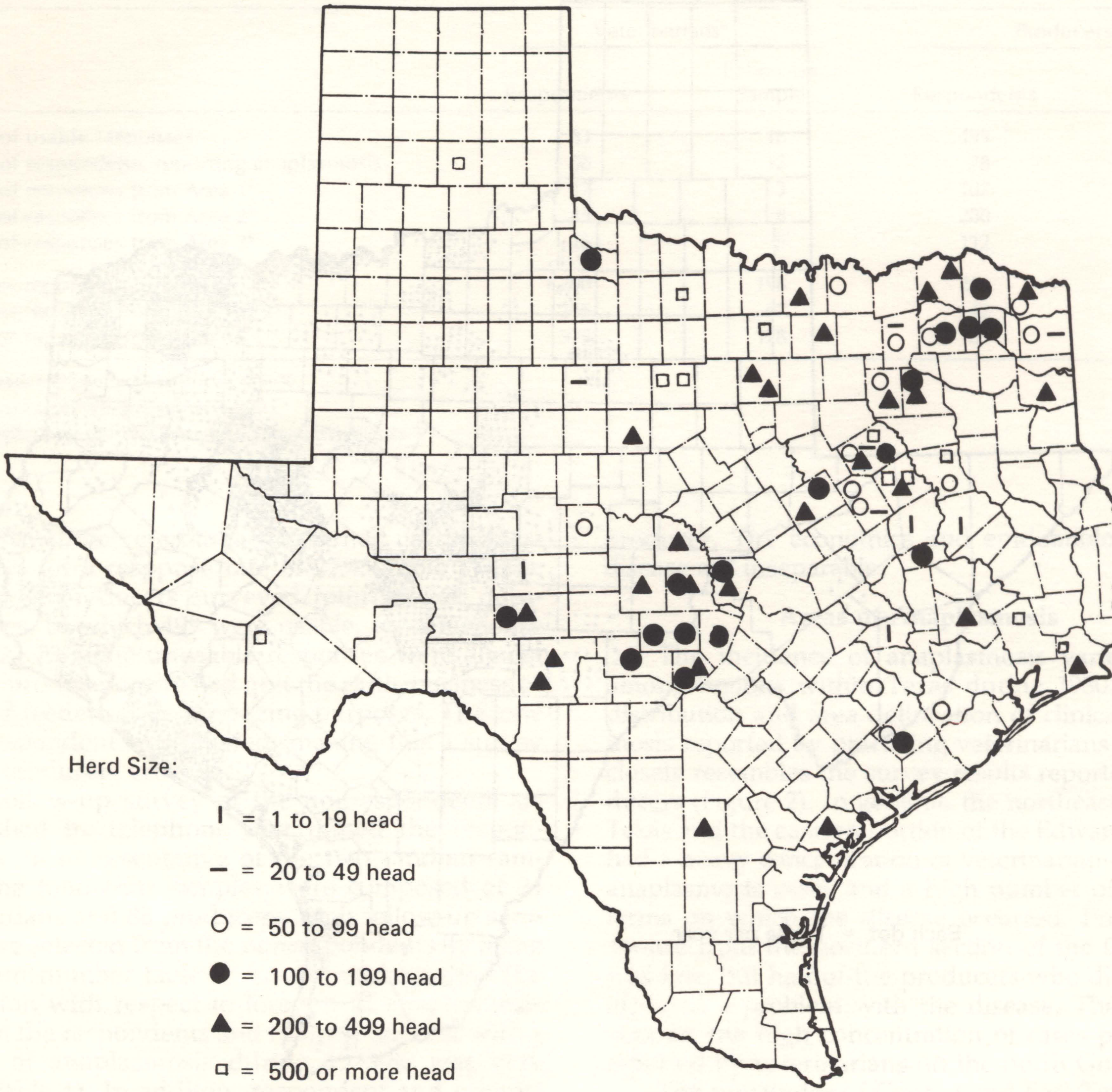


Figure 2. Location and herd size of 78 beef producers from a random survey of producers reporting an anaplasmosis problem, Texas, 1980.

producer respondents (Table 2). Subarea 3 represents the eastern half of the Edwards Plateau, which has relatively rough terrain and an arid climate. At 2.2 percent, Subarea 3a has the highest incidence in the state (Table 2). Producer operations in that area are range type and quite dispersed. Subarea 3b, which has an incidence of 0.6 percent, is in the Blacklands with extensive cropland and concentrated livestock operations. Northeast Texas, Subarea 3c, with a relatively high concentration of livestock, has approximately a 1 percent incidence of anaplasmosis. The northern part of the Gulf Coast, Subarea 3d, has a subtropical climate and heavy rainfall, and relatively heavy stocking rate. It revealed an incidence of slightly more than 1 percent.

The percent of herds reporting anaplasmosis and the incidence within herds reporting clinical cases follow the same pattern as area incidence; both were higher in Area 3 than in Area 2 (Table 3). This was to be expected. The incidence within herds reporting clinical cases in Area 2 and Subarea 3b (1.2 percent and 1.0 percent, respectively) is similar to the incidence Safford (1965) and Utterback *et al.* (1973) reported. Herds with clinical cases in Subareas 3a, 3c, and 3d reported an incidence of 3 to 5 percent (Table 2).

Incidence by Herd Size

Larger herds appear to sustain anaplasmosis infection more persistently than smaller herds, as the

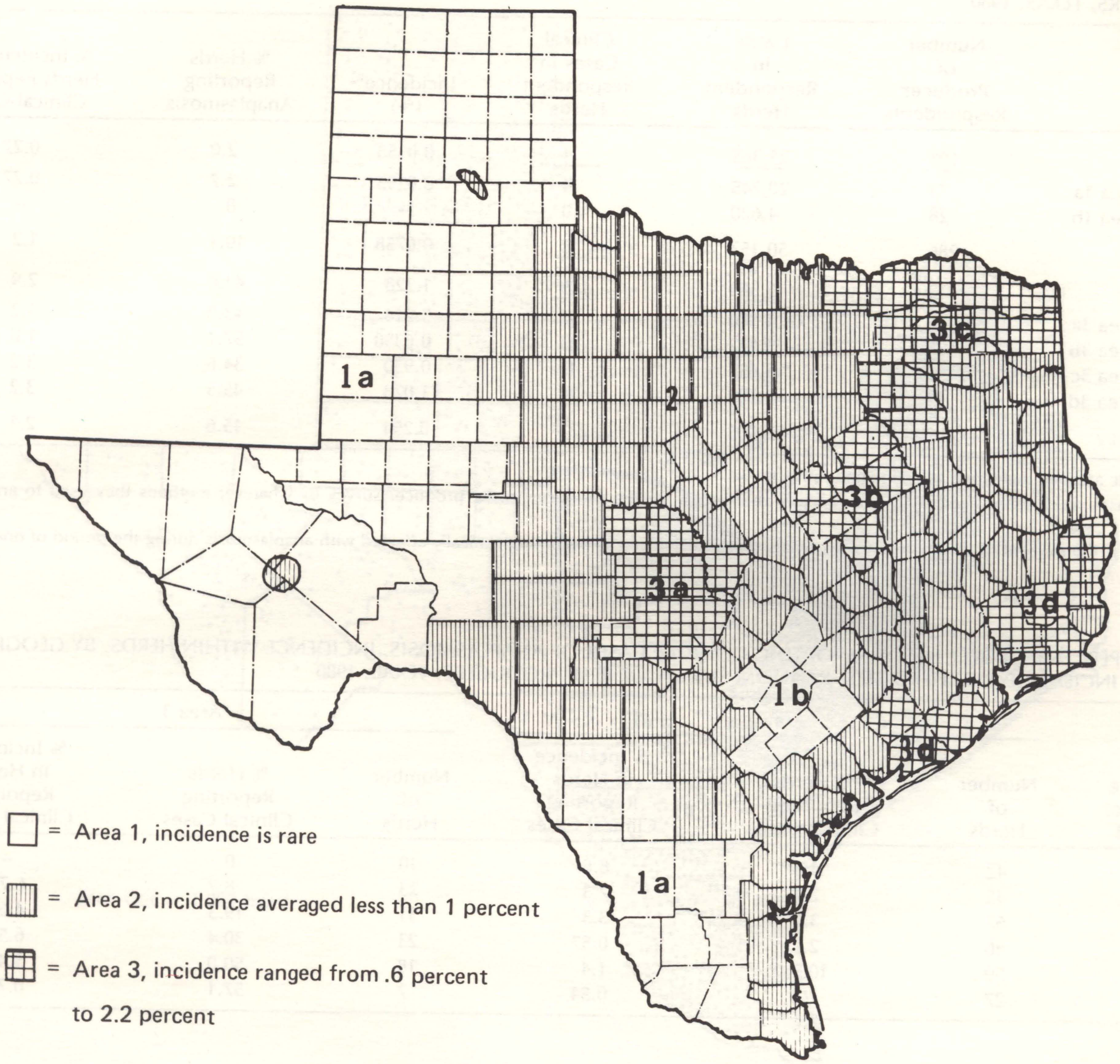


Figure 3. Delineation of anaplasmosis areas according to number of clinical cases, Texas, 1980.

percent of herds reporting clinical cases increased as herd size increased (Table 3). In Area 2, herd infection rates[4] averaged 3 percent in herds with less than 200 head, but it ranged from 7 to 10 percent in herds with 200 or more head. In Area 3, the proportion of herds reporting the disease was much greater than in Area 2. Herd infection rates ranged from 9 to 30 percent in herds with less than 200 head while herd infection rates were 50 percent or higher in herds with 200 or more head. High absolute numbers of carriers in a herd probably increases the odds of transmission of *Anaplasma marginale* from carriers to susceptible individuals. For example, 40 percent carriers in a herd of 400 (160 head) would provide a much larger reservoir of infection than would 40 percent in a herd of 40 (16 head).

Incidence and herd size, however, had a negative relationship as larger herds revealed lower incidence than smaller herds. Incidence in herds in Area 3 averaged 6 percent in herds under 200 head, whereas it decreased to less than 1 percent in herds over 500 head (Table 3).

Seasonal Occurrence

In order to attribute clinical cases to the season in which transmission by the vectors occurred, several months were taken out of traditional context. For

[4]Herd infection rate is the percent of the herds reported to have clinical cases of anaplasmosis during 1980.

TABLE 2. NUMBER OF BEEF HERDS AND BEEF CATTLE, NUMBER OF CLINICAL CASES OF ANAPLASMOSIS, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

Area[a]	Number of Producer Respondents	Cattle In Respondent Herds	Clinical Cases In Respondent Herds	Incidence[c] (%)	% Herds Reporting Anaplasmosis	% Incidence in Herds Reporting Clinical Cases
Area 1	101	25,365	4	0.0158	2.0	0.27
Subarea 1a	73	20,745	4	0.0193	2.7	0.27
Subarea 1b	28	4,620	0	--	0	--
Area 2	286	50,153	38	0.0758	10.1	1.2
Area 3	112	15,385	189	1.228	42.0	2.9
Subarea 3a	28	4,110	91	2.214	43.0	5.2
Subarea 3b	21	3,622	23	0.6350	57.1	1.0
Subarea 3c	52	5,055	47	0.930	34.6	3.2
Subarea 3d	11	2,598	28	1.078	45.5	3.2
Total Survey	499	90,903	231	0.254	15.6	2.1

[a]Geographic areas of incidence as delineated in Figure 3.

[b]Clinical cases were determined by the producer's veterinarian or the producer in the producer survey by whatever methods they used to arrive at a diagnosis.

[c]Incidence is the percent of the cattle over two years of age diagnosed as becoming clinically affected with anaplasmosis during the period of one year.

TABLE 3. PERCENT OF BEEF HERDS REPORTING CLINICAL CASES OF ANAPLASMOSIS, INCIDENCE WITHIN HERDS, BY GEOGRAPHIC AREA OF INCIDENCE AND HERD SIZE, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

	Area 2			Area 3		
Herd Size in Number of Head	Number of Herds	% Herds Reporting Clinical Cases	% Incidence in Herds Reporting Clinical Cases	Number of Herds	% Herds Reporting Clinical Cases	% Incidence in Herds Reporting Clinical Cases
1-19	42	4.8	8.6	10	0	--
20-49	45	2.2	2.3	23	8.7	6.7
50-99	67	3.0	3.3	31	19.3	4.6
100-199	46	2.2	0.57	23	30.4	6.5
200-499	59	10.2	1.4	18	50.0	3.4
500+	27	7.4	0.54	7	57.1	0.78

example, September was declared a summer month so the cases diagnosed during that month would be assigned to the horseflies responsible for transmission of *Anaplasma marginale* during August. Cases occurring in October and November (fall) were the result of transmission in September and October when mosquitoes were suspected as the primary vector. March was designated a winter month because cases occurring during this month were most likely the results of winter tick activity in February.

The data from the veterinarian survey showing the seasonal occurrence of anaplasmosis in Texas is summarized in Table 4. Summer was the peak season for anaplasmosis in Area 2 and most of Area 3 during 1978-80, followed by fall, spring, and winter. The peak season in the Edwards Plateau (Subarea 3a), in contrast, occurred in winter. The extent of the winter concentration of cases in the Edwards Plateau is highlighted by the fact that the Plateau accounted for

TABLE 4. SEASONAL OCCURRENCE OF CLINICAL CASES OF ANAPLASMOSIS DURING A TYPICAL YEAR, RANDOM SAMPLE OF VETERINARIANS, TEXAS, 1978-80

Season	Cases Occuring in Edwards Plateau (Subarea 3a)		Cases in Area 2 and Areas 3b-d		Total Cases Reported	
	Number	%	Number	%	Number	%
Winter[b]	103	49.2	72	6.7	175	13.6
Spring[c]	39	18.7	131	12.1	170	13.2
Summer[d]	44	21.1	619	57.3	663	51.4
Fall[e]	23	11.0	259	23.9	282	21.8
Total	209	100.0	1,081	100.0	1,290	100.0

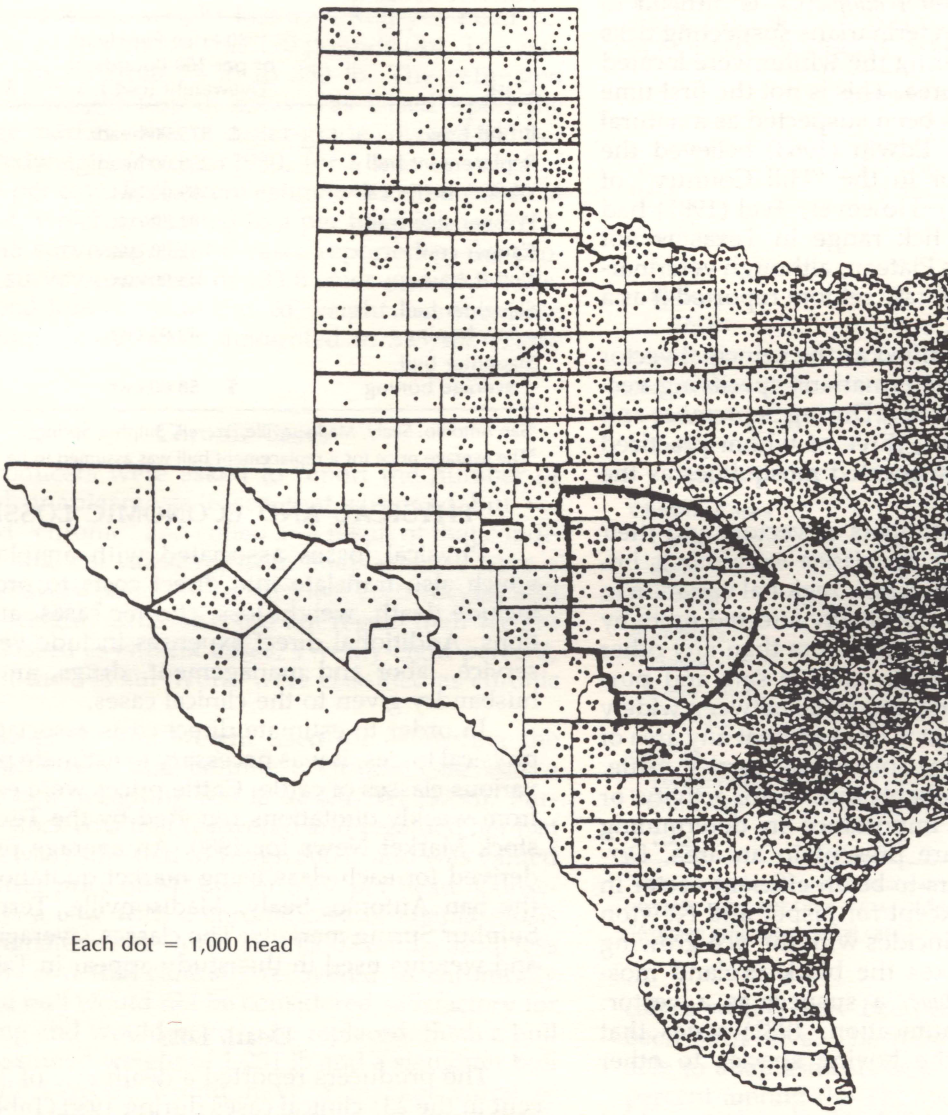
[a]Months in which clinical cases occurred were assigned to the season of vector transmission of *Anaplasma marginale*.

[b]Winter = December, January, February, March.

[c]Spring = April, May, June.

[d]Summer = July, August, September.

[e]Fall = October, November.



Source: 1980 Texas Livestock Dairy and Poultry Statistics of Texas Crop and Livestock Reporting Service.

Figure 4. Distribution of beef cows that have calved, Texas, January 1, 1980[a]

[a]*The eastern Edwards Plateau is outlined in the center of Texas.*

about 9 percent of the Texas beef cows in 1980, but accounted for 50.9 percent of the clinical cases diagnosed in Texas during the winter months. By contrast, the Plateau accounted for only 6.6 percent of the summer cases in Texas.

The Gulf Coast, in contrast to other regions of Texas, represents a region where more cases occurred in the fall than any other season. Veterinarians from the Gulf Coast reported 1, 10, 15, and 18 cases in the winter, spring, summer, and fall, respectively.

In areas of Texas that experienced clinical cases of anaplasmosis during the winter in the absence of the winter tick, *Dermacentor albipictus*, veterinarians often reported stress as a factor causing asymptomatic carriers to break into clinical symptoms. The causes of stress most commonly implicated were parturition, severe malnutrition, and heavy lactation.

The producer survey corroborated the veterinarian survey as to seasonality of anaplasmosis. Of the 36 producers reporting the months during which the majority of their cases occurred, 21 designated the summer months. Of the seven producers who designated winter as the severe anaplasmosis season, five were from the Edwards Plateau. None of the 21 producers designating the summer months ranched in the Edwards Plateau.

Vectors

Because all other practical vectors of *Anaplasma marginale* are inactive during the winter (except for humans), the circumstantial evidence incriminating the winter tick, *Dermacentor albipictus*, is difficult to refute. Seven of twelve veterinarians suspecting ticks as the primary vector during the winter were located in the Edwards Plateau area. This is not the first time *Dermacentor albipictus* has been suspected as a natural vector of anaplasmosis. Edwin (1963) believed the winter tick was a vector in the "Hill Country" of Texas (Edwards Plateau). However, Teel (1981) had found that the winter tick range in Texas is not restricted to the Edwards Plateau, although veterinarians in other areas of the state seldom reported it as a vector.

Horseflies were identified as the principal vector by three-fourths of the veterinarians specifying vectors for June through October. During September and October, six veterinarians, three of whom practiced in the Gulf Coast area, suspected mosquitoes as the main vector.

Since the absolute numbers of vectors and their efficiency in transmitting *Anaplasma marginale* is important with regard to incidence, regional variation in incidence over the state is probably affected more by the numbers and activities of vectors than any other factor. With transfer of cattle due to sale and purchaser, and to ranchers moving cattle between widely separated land holdings, it is unlikely that any area of the state is devoid of anaplasmosis carrier cattle. Therefore, it is highly probable that vector activity, or lack of it, is of prime importance in determining whether clinical cases are present in an area. *Dermacentor albipictus* appears to be an efficient vector in the Edwards Plateau. Except for Jasper and Newton Counties, Subarea 3d coincides with the rice-growing area of Texas. This makes the black riceland mosquito, *Psorophora columbiae*, a suspect as a vector. Olson[5] (personal communication, 1981) states that this mosquito prefers the bovine species to other mammals as its host.

Davis (1981) reported *Tabanus abactor* comprised over 97 percent of the horsefly species present in approximately a four-county-wide strip on the west side of Area 2 (Figure 3). This strongly incriminates *T. abactor* as the only summer vector in that region. According to Thompson (1977), *Tabanus sulcifrons* is a common species in the central part of Area 2, including Subarea 3b. *Tabanus fusicostatus* and *T. lineola* (Thompson, 1974) are present in high numbers in the Pineywoods area of Northeast Texas. The greenhead, *T. nigrovittatus* (Thompson, 1973), is the dominant species along the coast; however, in a transmission study by Wilson it failed to transmit *Anaplasma marginale*. Thompson (1977, 1974, 1973) recorded the presence of many other tabanid and *Chrysops* spp. (deerflies) in these areas.

Vector activity, relatively low in most of Subarea 1a, is postulated as low or ineffective in transmission of the disease agent in Subarea 1b.

[5]Jimmy K. Olson, Toxicology and Entomology Research Laboratory, College Station, Texas: USDA.

TABLE 5. CATTLE CLASSES, AVERAGE PRICES, AND WEIGHTS FOR FIVE MARKETS[a]

Class	1980 Price Per Head or per 100 Pounds of Liveweight (cwt.), $	Weight, lb.
Brood Cow	$ 575.00/head	900
Replacement bull	1,250.00/head[b]	NA
Weaner heifer calf	69.00/cwt.	350
Weaner steer calf	81.50/cwt.	425
Canner cow	32.00/cwt.	800
Cutter cow	43.00/cwt.	900
Slaughter bull, low boning	49.00/cwt.	1,250
Slaughter bull, average boning	$ 58.00/cwt.	1,425

[a]San Antonio, Sealy, Madisonville, Terrell, Sulphur Springs.
[b]The average price for a replacement bull was assumed to be $1,250.

PHYSICAL AND ECONOMIC LOSSES

Physical losses associated with anaplasmosis, which also translate into direct costs to producers, include death, weight loss, chronic cases, and abortions. Additional direct expenses include veterinary service, labor and management, drugs, and added husbandry given to the clinical cases.

In order to estimate direct costs associated with physical losses, it was necessary to estimate prices for various classes of cattle. Cattle prices were estimated from weekly quotations reported by the Texas Livestock Market News for 1980. An average price was derived for each class using market quotations from the San Antonio, Sealy, Madisonville, Terrell, and Sulphur Spring markets. The classes, average prices, and weights used in this study appear in Table 5.

Death Loss

The producers reported a death rate of 35.9 percent in the 231 clinical cases during 1980 (Table 6). Of the 83 deaths reported, 75 were cows and 8 were bulls. Therefore, bulls comprised 9.6 percent of the death losses although they made up only 4 percent of the adult bovine population.[6] This suggests that bulls are more susceptible to anaplasmosis than cows, which may be due to a sex difference or to a lack of exposure to *Anaplasma marginale* when young, an exposure that local heifers are more likely to experience. For example, producers in Area 3 may purchase breeding bulls from breeders in nonanaplasmosis areas (Area 1). Heifers retained in herds located in anaplasmotic areas develop a natural immunity to anaplasmosis in contrast to bulls obtained from nonanaplasmotic areas.

Replacement bulls for breeding were valued at $1,250 per head in this study. The average brood cow in 1980 was estimated to weigh 900 pounds (lb) and was valued at $575 per head. Death losses attributed to anaplasmosis by producers responding to the survey were estimated to total $53,125 in 1980 (Table 6).

[6]Assumes a 25 to 1 cow/bull ratio.

Weight Loss

The average weight loss reported per head because of anaplasmosis was 190 pounds (lb). The estimates ranged from 75 lb to 350 lb. The estimated value of weight loss in cows was based upon the average market value of cutter-grade cows of $43 per hundredweight (cwt) in 1980, for a loss in value of $81.70 per cow. Bulls were estimated to lose 300 lb at $58/cwt, which amounted to a per head loss of $174. The 148 surviving clinical cases reported in the producer survey consisted of 133.8 cows and 14.2 bulls. The total loss in value due to weight loss for these surviving clinical cases amounted to $13,402 (Table 6).

Chronic Cases

Producers were asked to report the number of clinical anaplasmosis cases that survived but remained "chronic" and culled as a result of that condition. Cattle convalescing from anaplasmosis have a long recovery period to replace lost erythrocytes and regain weight. Cattle that did not regain their weight were classed as chronic cases. Twenty-eight percent, or 42 of the 148 survivors, were classified as chronic cases.

The grade and weight used for estimating the value of a cow that became a chronic case was a canner cow weighing 800 lb at $32/cwt ($256). Further, a stock cow that recovered and regained her lost weight was estimated to weigh 900 lb and was valued at a cutter price of $43/cwt or $387 per head. Consequently, a cow with a chronic case of anaplasmosis was estimated to be worth $131 ($387 minus $256) less than the cow that clinically recovered. A chronically affected bull would not be considered satisfactory for breeding and would have to be replaced. Such a bull at an assumed weight of 1,251 lb and a slaughter bull price of $49/cwt would have a market value of $612.50. A bull with a chronic case was estimated to be worth $637.50 ($1,250 minus $612.50) less than the replacement breeding bull. The 42 chronic cases were composed of 4 bulls and 38 cows. Producer losses as a result of anaplasmosis cases becoming chronic for cows was $4,978 and for bulls was $2,550, for a total loss of $7,528 (Table 6).

Abortions

It was noted previously that producers surveyed reported 231 clinical cases in 1980 which resulted in 83 deaths. The 148 survivors were estimated to consist of 133.8 cows. The Texas Crop and Livestock Reporting Service statistics revealed an 84 percent calf crop average during 1976-80 in cows that had calved. Thus, of the 133.8 surviving cows, 84 pecent or 112 would normally be carrying a calf. The 32 reported abortions resulted in an abortion rate of 28.6 percent among the 112 pregnant cows.

The 1980 Texas Livestock Statistics indicate mortality between birth and weaning in Texas beef calves averaged 5 percent. Therefore, 2 of the 32 aborted

TABLE 6. NUMBER OF CLINICAL CASES OF ANAPLASMOSIS, BY TYPE OF PHYSICAL LOSS, ASSOCIATED DOLLAR LOSS AND TOTAL DOLLAR LOSS, AND TREATMENT COST, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

Item	Number of Clinical Cases and Physical Losses	Value Per Case or Physical Loss	Total Survey Losses and Costs[a]
Death Loss			
Cows	75	$ 575.00	$43,125
Bulls	8	1,250.00	10,000
Totals	83		53,125
Survivors	148	--	--
Weight Loss			
Cows	133.8	81.70	10,931
Bulls	14.2	174.00	2,471
Totals	148.0		13,402
Chronic Cases			
Cows	38	131.00	4,978
Bulls	4	637.50	2,550
Totals	42		7,528
Abortions			
Heifer calves	15	241.50	3,622
Steer calves	15	346.00	5,190
Totals	30		8,812
Cost of Treatment and Labor	231	65.44	15,117
Total	231	$ 424.17[b]	$97,984

[a]Total survey losses and costs are an intermediate calculation to obtain the average value per clinical case of $424.17.
[b]Average value per clinical case.

calves would have been expected to die if they had been born alive. The reduction in calf crop attributable to anaplasmosis-induced abortion, then, is 26.8 percent among the 112 surviving pregnant cows estimated from the producer survey. Economic losses for these 30 calves were estimated as follows, assuming a sex ratio of 50:50. For heifer calves: 15 heifer calves at an average weight of 350 lb × $69/cwt = $241.50, or a total loss of $3,622. The value of steer calves was estimated using an average weight of 425 lb × $81.50/cwt = $346 for a total of $5,190 for 15 steer calves. The total value of the calves lost by the respondents to anaplasmosis-attributed abortion was $8,812 (Table 6).

TREATMENT AND PREVENTIVE MEASURES AND COSTS

Treatment Costs

Four variables that were used to estimate the cost of treatment are (1) cost for veterinary service, (2) drug costs, (3) owner-estimated value of labor and management required to handle the sick and dead, and (4) the number of head treated and/or handled. Twenty-one producers reported cost data for all four variables as follows:

Total cost of veterinary service	$2,434
Total drug cost	1,988
Total labor and management cost	3,955
Total cost of treatment	$8,377

These 21 producers had 128 cases for an average per head treatment and labor cost of $65.44. The treatment and labor cost for the 231 clinical cases reported in this study was estimated to total $15,117 (Table 6).

Preventive Measures and Costs

The three alternative methods commonly used by producers to prevent anaplasmosis included (1) vaccination, (2) feeding low levels of chlortetracycline, and (3) vector control. Oxytetracycline injections were used to a lesser extent. The method or combination of methods chosen by a producer depends on which method is more adaptable to his ranch operation, economics, and his personal preference.

Only data from herds with a reported anaplasmosis problem were used to evaluate the different control methods. Herds were assigned to the principal control method utilized. For example, herds in which vaccination was the primary method of control, although spraying was also used to control horn flies, were assigned to vaccination only and not to vector control. Similarly, herds using intensive vector control measures and vaccination of bulls for anaplasmosis were not included in the vaccinating category but were placed under vector control. Further, respondents assigned to the control program listed used the program for more than one year.

Vaccination

The seven herd owners who relied predominantly on vaccination, vaccinated 1,472 head in 1980 at a cost of $2.91 per dose of vaccine and $1.32 per head for labor, for a total cost of $4.23 per head vaccinated. However, these producers did not vaccinate all their susceptible cattle annually. The seven herds consisted of 3,593 head that were protected by a $6,225 annual vaccination cost. This lowered the annual cost per head protected to $1.73 (Table 7). The total amount of vaccine used by respondents, whether it was the primary control method or not, was 2,071 doses for a total cost of $9,008.85 for the vaccine and labor.

Anaplaz[7] was the only vaccine used by the producers surveyed. Premunition with infected blood as a vaccination method was not reported by any of the respondents.

Low-Level Chlortetracycline

Twenty-two producers, most of whom resided in Northeast Texas (Subarea 3c), used low-level chlortetracycline in a feed or mineral mix as the primary method of control. Brock (1957) was one of the first to demonstrate that clinical anaplasmosis is effectively prevented at the 1.1 milligram per kilogram of body weight per day (0.5 mg/lb/day) level of chlortetracycline ingested daily. The 22 producers using the low-level chlortetracycline as the primary method of control reported an annual cost of $2.88 per head for a total cost of $11,013 during 1980 (Table 7). Some respondents fed low-level chlortetracycline to selected animals in the herd which increased the reported cost of this preventive measure to $12,499. However, the total cost of low-level chlortetracycline for all respondents using it (the 22 producers plus those using it in a more incidental manner) totaled $12,499.

Vector Control

From the survey data, it was determined that vector control that cost less than $3 per head annually had limited effectiveness in reducing the incidence of anaplasmosis cases. This level of usage was designated "Vector Control 1" (Table 7). Vector control at a cost of $3 or more per head per year was designated "Vector Control 2." Both Steelman (1977) and Turner (1972) determined that insect or tick control — by relieving cattle of the pain, worry, and blood loss — increases production more than enough to compensate for the labor and overhead required to spray or dip cattle. Therefore, only the cost of the insecticide was considered a liability of anaplasmosis control. Of the 16 producers using Vector Control 2 as the principal preventive measure, 9 ranched in areas where the winter tick was the most likely vector and 7 where horseflies were the most probable vector. This suggests that both of these vectors may have their anaplasmosis transmission efficiency reduced by an ectoparasite control program.

For extrapolation purposes, vector control at an average annual cost of $1.95 per head will not be considered as a means to control anaplasmosis, but

TABLE 7. ANAPLASMOSIS CONTROL METHODS UTILIZED, BY NUMBER OF HERDS, NUMBER OF BEEF CATTLE, AND ANNUAL COST PER HEAD, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

Control Method	Number of Herds[a]	Number of Cattle	Annual Cost per Head
No control[b]	20	5,761	NA
Vaccination	7	3,593	$1.73
Low-level chlortetracycline	22	3,824	2.88
Oxytetracycline injections	6	820	2.04
Vector control			
Vector Control 1[c]	8	1,290	1.95
Vector Control 2[d]	16	2,794	$4.53

[a]Only herds in which the specified method was the principal means of anaplasmosis control are included in this column.

[b]No control includes herds using vaccine in a minor way such as vaccinating bulls only, plus herds on low-level chlortetracycline or vector control each at a cost equal to or less than $1.00 per head annually.

[c]This category of producers spent from $1 to less than $3 annually per head for vector control.

[d]This category spent $3 or more annually per head for vector control.

[7]*Anaplaz* is the proprietary name for the vaccine produced by Fort Dodge Laboratories, Fort Dodge, Iowa.

rather to reduce the other economic losses attributable to ectoparasites such as bite worry and blood loss. The $3 and greater per head cost for insect and tick control will be utilized for estimating state-wide costs since control at these cost figures provided desired protection levels. The total expenditure for vector control to prevent anaplasmosis reported by the survey respondents was $12,650 or $4.53 per head per year.

Oxytetracycline Injections

The survey results of oxytetracycline injections as a control measure appear questionable mainly because the number of producers (six) reporting using it as their primary method of control was low. Also, the average cost per head injected at $2.04 appears low (Table 7). Subtracting $1.05 per head for labor to inject the cattle results in only a $1.00 per head cost for the oxytetracycline.

Oxytetracycline injections are used two ways. One method is to inject the herd every 29 to 30 days during the vector season. This method takes advantage of anaplasmosis' long incubation period, which is usually four to six weeks. One injection will subdue the infection in an animal that has been exposed and is incubating the disease. If this animal is reinfected a few days after the injection, theoretically it would not become ill until 30 to 40 days later. However, if the animal receives another injection of oxytetracycline prior to the end of the 30- to 40-day incubation period, it would be protected from clinical disease for another month.

Another technique for using oxytetracycline as a preventive measure is to wait until the first clinical case appears in the herd and then inject the entire herd. If the first clinical case appears early in the vector season, injections will have to be repeated at 30-day intervals. If the first case appears toward the end of the vector season, the herd will need to be treated only once.

A practical application of this method may be used where the horsefly, *Tabanus abactor*, is the primary vector of *Anaplasma marginale*. This horsefly, known as the cedar fly, is a dryland horsefly observed by Sanders[8] (personal communication, 1981) which apparently does not emerge from its puparium without adequate rainfall. If the summer has average rainfall, the cedar fly emerges regularly in rather constant numbers. But often in the Rolling Plains of Texas, there are dry spells broken by a sudden heavy rain. When this happens, the cedar fly is thought to emerge in very small numbers during the dry spell. Then, a few days after the rain, it emerges in swarms, often with counts of over 100 flies feeding on each cow. When rainfall occurs after a dry spell, it may be possible to control anaplasmosis by giving the first injection of oxytetracycline to the herd approximately 30 to 35 days after the rainfall. This would save injecting the cattle during a dry summer before the first good rain.

A combination of vaccination and oxytetracycline injections is often used on herds that have had no previous history of anaplasmosis and are experiencing their first outbreak. The oxytetracycline provides immediate protection, and the vaccine will provide immunity within three weeks. These herds were not included in either the vaccination or the oxytetracycline injection programs in Table 7.

The survey results indicated 12 cattle producers used oxytetracycline injections as a primary means of control or in conjunction with another control method. These 12 producers reported a drug cost of $3,175 along with $1,365 for administering the drug for a total of $4,540.

[8]Darryl P. Sanders, Department of Entomology, Texas Tech University, Lubbock.

TOTAL CLINICAL CASES, ANAPLASMOSIS LOSSES, AND COSTS

Total Estimated Clinical Cases

When the area incidences from the producer survey are weighted by the number of cattle at risk for each area, the incidence for Texas during 1980 was 0.276 percent (Table 8). Further, anaplasmosis clinical cases are estimated to have totaled 15,015 in Texas during 1980.

Total Anaplasmosis Losses and Costs

Extrapolation of Disease Costs

The total physical loss to producers which includes death, weight loss, chronic cases, and abortions totaled almost $5.4 million in 1980 (Table 9). The death loss of more than $3.4 million accounted for almost 64 percent of this loss. The cost of treatment which included veterinary service, drugs, and labor, approached $1 million and when added to the physi-

TABLE 8. ESTIMATED TOTAL CLINICAL CASES OF ANAPLASMOSIS, BY GEOGRAPHIC AREA OF INCIDENCE, TEXAS, 1980

Geographic Area of Incidence	1978 Cow Census Adjusted for Bulls[a]	Incidence %	Estimated Clinical Cases
Area 1	1,465,578	--	4
Subarea 1a	1,093,567	--	4
Subarea 1b	372,011	--	0
Area 2	2,839,419	0.0758	2,152
Area 3	1,137,765	1.130	12,859
Subarea 3a	202,911	2.214	4,492
Subarea 3b	213,287	0.635	1,354
Subarea 3c	516,930	0.930	4,807
Subarea 3d	204,637	1.078	2,206
State Total	5,442,762[b]	0.276	15,015

[a]The Bureau of the Census "beef cows and heifers that have calved" were expanded to include bulls by assuming that Texas beef cattle herds contained one bull per 25 cows.

[b]This total does not include 152,424 beef cows which were in the category, "farmers not on mail list," of the 1978 Livestock Census, Bureau of the Census.

TABLE 9. TOTAL ESTIMATED ANAPLASMOSIS LOSSES, BY TYPE OF PHYSICAL LOSS, ASSOCIATED DOLLAR LOSS AND TOTAL DOLLAR LOSS, AND TREATMENT COST, BEEF PRODUCERS, TEXAS, 1980

Item	Total Estimated Clinical Cases and Physical Losses[a]	Value per Case or Physical Loss	Total Estimated Losses and Costs
Death Loss			
Cows	4,873	$ 575.00	$2,801,975
Bulls	517	1,250.00	646,250
Totals	5,390		3,448,225
Survivors	9,625	--	--
Weight Loss			
Cows	8,701	81.70	710,872
Bulls	925	174.00	160,776
Totals	9,625		871,648
Chronic Cases			
Cows	2,463	131.00	322,653
Bulls	261	637.50	166,387
Totals	2,724		489,040
Abortions			
Heifer calves	993	241.50	239,809
Steer calves	993	346.00	343,578
Totals	1,986		583,387
Cost of Treatment and Labor	15,015	65.44	982,582
Total	15,015	$ 424.57	$6,374,882

[a]The same proportion of physical losses to clinical cases was used as reported by the random survey of beef producers (Table 6). The total cases were derived in Table 8.

cal losses resulted in a total loss and treatment cost of almost $6.4 million.

Extrapolation of Prevention Costs

Producers used four control methods in attempting to prevent anaplasmosis, including vaccination, feeding low-level chlortetracycline, injecting oxytetracycline, and vector control. Producers using these four control methods expended almost $2.6 million on preventing anaplasmosis in Texas during 1980 (Table 10). Survey respondents from Area 1 did not incur any of this expense; therefore, it is all attributable to prevention measures used in Areas 2 and 3. Feeding low-level chlortetracycline accounted for the largest statewide expenditure for prevention at almost $900,000. Vector control placed second and vaccination third in the estimated amount spent by beef producers on preventive measures during 1980.

The sum of the losses due to anaplasmosis and cost of treatment ($6,374,882, Table 9) and the prevention costs ($2,589,411) resulted in an estimated total direct cost to Texas beef cattle producers equal to $8,964,293 during 1980.

TABLE 10. ESTIMATED TOTAL EXPENDITURES FOR ANAPLASMOSIS PREVENTIVE MEASURES, BY METHOD OF CONTROL AND GEOGRAPHIC AREA OF INCIDENCE, TEXAS BEEF HERDS, 1980

Control Method	Costs From Producer Survey	Estimated Total Cost by Area[a]
Vaccination		
Area 2	$ 5,463.60	$ 309,322
Area 3	3,545.25	262,181
Totals	9,008.85	571,503
Low-level chlortetracycline		
Area 2	1,797.70	101,737
Area 3	10,701.00	791,370
Totals	12,499.00	893,107
Oxytetracycline injections		
Area 2	408.00	23,099
Area 3	4,132.00	305,573
Totals	4,540.00	328,672
Vector control[b]		
Area 2	8,160.00	461,979
Area 3	4,490.00	332,048
Totals	$12,650.00	794,027
State Total		$2,587,411

[a]Estimated cost by area = cost from producer survey X area expansion factor. Area expansion factor = area cattle population (Table 8)/area cattle population surveyed (Table 2). Area 2 expansion factor = 56.6151 = 2,839,419/50,153.

[b]Vector control is the same as the Vector Control 2 of Table 6.

CONTROL PROGRAM COMPARISONS AND BENEFIT/COST RATIOS

The data from this study show the results of the control methods as used by the producers responding to the questionnaire. The producers apparently selected control programs dependent upon their management situation, available physical facilities, economics, and personal preference.

Three prevention methods were compared in herds with an anaplasmosis problem by using the specified herd sizes of 122 and 553 head. The average size for herds less than or equal to 300 head is 122 head; 553 is the average for herds greater than 300 head. Vaccination revealed a slight advantage over low-level chlortetracycline feeding in the over-300-head herd-size group in Area 3 (Table 11). The results of the producer survey also showed that vaccination as a control method was equal to or slightly better than vector control in reducing incidence of clinical cases in both herd size groups in Area 2 (Table 12). The herds less than or equal to 300 head in Area 3 in which vector control was used had an incidence of 0.659, considerably lower than the incidence of 1.549

TABLE 11. ANAPLASMOSIS CONTROL METHODS UTILIZED IN AREA 3, BY NUMBER OF HERDS, NUMBER OF BEEF CATTLE, NUMBER OF CLINICAL CASES AND INCIDENCE, AND BY HERD SIZE AND ESTIMATED CLINICAL CASES IN TWO SPECIFIED HERD SIZES, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

	Herd Size ≤ 300					
Method	Number of Herds[a]	Total Cattle	Number of Cases	Incidence	Estimated Cases in a 122 Head Herd[b]	% Reduction in Cases From No Control in a 122 Head Herd
No control	5	532	19	3.571	4.357	NA
Vaccination	0		-		-	-
Low-level chlortetracycline	16	1,549	24	1.549	1.891	56.6%
Oxytetracycline injections	4	510	4	0.392	-	-
Vector control[c]	7	910	6	0.659	0.804	81.5%
	Herd Size > 300					
Method	Number of Herds[a]	Total Cattle	Number of Cases	Incidence	Estimated Cases in a 553 Head Herd[d]	% Reduction in Cases From No Control in a 553 Head Herd
No control	4	1,950	28	1.436	7.941	NA
Vaccination	2	1,250	3	0.240	1.327	83.8%
Low-level chlortetracycline	4	1,725	6	0.348	1.924	75.8%
Oxytetracycline injections	0	-	-		-	-
Vector control[c]	0					

[a]Number of herds represents the number of producers using the method specified as their principal method of control.

[b]Herd size of 122 head is the average size of all herds ≤ 300 head using a control method or no control.

[c]Vector control is the same as the Vector Control 2 of Table 7.

[d]Herd size of 553 head is the average size of all herds > 300 head using a control method or no control.

TABLE 12. ANAPLASMOSIS CONTROL METHODS UTILIZED IN AREA 2, BY NUMBER OF HERDS, NUMBER OF BEEF CATTLE, NUMBER OF CLINICAL CASES AND INCIDENCE, AND BY HERD SIZE AND ESTIMATED CLINICAL CASES IN TWO SPECIFIED HERD SIZES, RANDOM SURVEY OF BEEF PRODUCERS, TEXAS, 1980

	Herd Size ≤ 300					
Method	Number of Herds[a]	Total Cattle	Number of Cases	Incidence	Estimated Cases in a 122 Head Herd[b]	% Reduction in Cases From No Control in a 122 Head Herd
No control	8	1,279	24	1.876	2.289	NA
Vaccination	3	493	1	0.203	0.247	89.2%
Low-level chlortetracycline	1	50	0	-	-	-
Oxytetracycline injections	2	310	3	0.968	-	-
Vector control[c]	6	709	2	0.282	0.344	85.0%
	Herd Size > 300					
Method	Number of Herds[a]	Total Cattle	Number of Cases	Incidence	Estimated Cases in a 553 Head Herd[d]	% Reduction in Cases From No Control in a 553 Head Herd
No control	3	2,000	5	0.250	1.3825	NA
Vaccination	2	1,850	0	0	0	100%
Low-level chlortetracycline	1	500	0	-	-	-
Oxytetracycline injections	0	-	-	-	-	-
Vector control[c]	3	1,175	0	0	0	100%

[a]Number of herds represents the number of producers using the method specified as their principal method of control.

[b]Herd size of 122 head is the average size of all herds ≤ 300 head using a control method or no control.

[c]Vector control is the same as the Vector Control 2 of Table 7.

[d]Herd size of 553 head is the average size of all herds > 300 head using a control method or no control.

sustained by the herds on low-level chlortetracycline.

Estimating the percent reduction in number of cases from no control that occur in herds of 122 and 553 head when using one of the three control methods provides further comparison of the preventive measures. The effectiveness of vaccination and vector control are similar as revealed by a reduction of clinical cases of 80 to 100 percent in both herd sizes compared to herds not using control measures (Tables 11 and 12). Low-level chlortetracycline feeding as estimated in 553-head herds in Area 3 showed a 76 percent reduction of clinical cases while the 122-head herd size showed a 57 percent reduction compared to the no controls (Table 11). Vaccination and vector control as reported by the producers in this study were almost equally effective in controlling anaplasmosis. The number of clinical cases reported by respondents using low-level chlortetracycline puts it in third place relative to effectiveness in reducing incidence.

Comparison of the returns to the anaplasmosis control methods reported by respondents was accomplished by calculating benefit/cost ratios and net benefits to each method when used in the two specified herd sizes in Area 3. Benefit/cost ratios are designed to estimate the dollars of benefits per dollar of total expenditure for each preventive method employed. The reduction in production costs and increase in output provided by each of the three control programs were compared to no control by applying the incidence to anaplasmosis occurring under each control program as reported by producers (Table 13).

Low-level chlortetracycline and vector control had similar benefit/cost ratios of 4.02 and 3.84, respectively, in the 122-head herd size (Table 13). However, the higher cost of vector control over feeding low-level chlortetracycline had less effect on the net benefit from each control method than on the benefit/cost ratio, which resulted in a $500 advantage to vector control in net benefits. This amounts to $6.80 more return per head in the 122-head herd when using vector control instead of low-level chlortetracycline.

Comparison of vaccination and low-level chlortetracycline in the 553-head herd indicated vaccination had higher returns as measured by both benefit/cost ratio and net benefit. This advantage is largely due to the lower per head cost of vaccination as compared to low-level chlortetracycline. Vaccination and vector control could not be compared directly because no producers in Area 3 with herds of 300 head or less reported using vaccination and likewise none with herds more than 300 head reported using vector control.

Data on the 553-head herd size in Area 2 showed a benefit/cost ratio for both vaccination and vector control of less than 1 and a net dollar loss to both programs (Alderink, 1982). The total loss due to anaplasmosis in herds larger than 300 head in Area 2 was too small for a control method to show positive returns. Ranchers with the larger herds in Area 2 appeared to use vaccination as insurance against the risk of occasional years when the incidence of anaplasmosis may be high due to increased vector activity. The calculated returns to control programs using Area 3 data may be more applicable since more than 80 percent of the losses due to anaplasmosis in Texas occurred in Area 3.

Benefits to each preventive measure other than the benefit of controlling anaplasmosis vary among

TABLE 13. BENEFIT/COST RATIOS AND NET BENEFIT ASSOCIATED WITH THREE ANAPLASMOSIS PREVENTIVE METHODS IN BEEF HERDS OF 122 HEAD AND OF 553 HEAD IN AREA 3 WITH AN ANAPLASMOSIS PROBLEM, TEXAS, 1980

Control Method	Reduction of Production Costs[a]	Increase in Total Value Product[b]	Returns to Control Method	Cost of Control Method	Benefit/ Cost Ratio[c]	Net Benefit[d]
	$					$
			122 Head Herd			
Vaccination[e]	-	-	-	-	-	-
Low-level chlortetracycline	951.09	461.22	1,412.31	351.36	4.02	1,060.95
Vector control	1,370.46	750.51	2,121.95	552.66	3.84	1,569.31
			553 Head Herd			
Vaccination	2,499.88	1,237.11	3,736.99	956.69	3.91	2,780.30
Low-level chlortetracycline	2,321.07	1,125.38	3,446.45	1,592.64	2.16	1,853.81
Vector control[f]	-	-	-	-	-	-

[a]Production costs include losses due to death loss, weight loss, chronic cases, and the cost for veterinary service and labor used on the clinical cases.

[b]Increase in Total Value Product = increase in feeder calves sold as result of reduced abortion rate and reduced replacement calves required to replenish losses due to death and culled poor doers.

[c]Benefit/Cost Ratio = Returns to Control Method/Cost of Control Method.

[d]Net Benefit = Returns to Control Method − Cost of Control Method.

[e]No producer with a herd size ≤ 300 head (average 122 head) reported using vaccination as the principal anaplasmosis control method in Area 3.

[f]No producer with a herd size > 300 head (average 553 head) reported using vector control as the principal anaplasmosis control method in Area 3.

the three methods. Vaccination has no external benefit in addition to the benefit of reducing the incidence of anaplasmosis. Low-level chlortetracycline has very little external benefit, but vector control has value to producers other than for anaplasmosis control (by relieving cattle of pain, worry, and blood loss associated with insect bites). Producer respondents with no anaplasmosis problem substantiated this as 54 producers said they used ectoparasite control measures while only four volunteered the fact they fed low levels of chlortetracycline. By contrast, ranchers using one of these two programs with the goal of minimizing anaplasmosis losses were evenly divided; 24 used ectoparasite control and 24 fed a low level of chlortetracycline.

The benefit/cost ratio of 3.84 for vector control would likely be substantially higher if the benefit of reduced worry, irritation, and blood loss was included with decreased incidence of anaplasmosis.

CONCLUSIONS

This study supports the observation that anaplasmosis has a marked, adverse economic impact on producers with infected herds. Producers, veterinarians, and others closely allied with the beef cattle industry and acquainted with the disease, agree with this observation. Anaplasmosis is common over much of Texas, with certain areas having a greater problem. Other diseases may be more costly, but few command more attention. Symptoms and associated losses due to anaplasmosis border on the dramatic, quickly alerting producers, in contrast to insidious losses, which usually remain unnoticed. This explains in part why most producers with first-hand experience with the disease institute control programs.

The following 11 statements briefly summarize the findings of this research.

1. Forty-two of the 254 counties in Texas sustained more than 80 percent of the anaplasmosis losses in the state.
2. Texas producers experienced more than 15,000 clinical cases of anaplasmosis during 1980.
3. The overall incidence of anaplasmosis in Texas was 2.76 head per 1,000 head adult breeding cattle per incidence area.
4. Incidence within herds has a negative relationship to herd size.
5. Each clinical case of anaplasmosis averaged direct costs to Texas producers of $425.
6. The components of the direct cost of anaplasmosis are: death, weight loss, chronic cases, abortions, cost of treatment, and cost of prevention.
7. The total direct cost in Texas due to anaplasmosis was $8.96 million in 1980.
8. The benefit/cost ratios at 1980 price levels for vaccination, vector control, and low-level chlortetracycline when used in areas of high incidence ranged from 3.8 to 4.0. The exception was low-level chlortetracycline which, when used in herds of over 300 head, had a benefit/cost ratio of 2.2.
9. Vaccination reduced incidence more than or equal to the other control programs and was used predominantly by ranchers with larger herds.
10. Vector control afforded good protection from clinical cases whether horseflies or winter ticks were the vector.
11. Low-level chlortetracycline was used by more producers than any of the other control methods.

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