Summer 1985

A Survey of Cattle Ectoparasites and a Study of Psoroptic Mange in Southeast Georgia

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A SURVEY OF CATTLE ECTOPARASITES AND A STUDY OF PSOROPTIC MANGE IN SOUTHEAST GEORGIA

by

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B.S., Wofford College, 1983

A Thesis Submitted to the Graduate Faculty

of Georgia Southern College in Partial Fulfillment

of the

Requirement for the Degree

MASTER OF SCIENCE

STATESBORO, GEORGIA

1985

ACKNOWLEDGEMENTS

I would like to thank my major professor, Dr. Frank French for all his help in organizing this project, and guiding me through to its completion. I would also like to thank Dr. Richard Osburn and Dr. Wayne Krissinger, members of my committee, for their time spent editing this thesis, and Dr. Rafter for his help with the statistics involved.

Special thanks is expressed to Karen Corsetti for assisting in the field, and to the others who assisted when Karen was unable to: Robby Brinson, Laura Fox, David Lavender and George Magnon. To Chuck Waters for his help with the experimental calves. To Brian Odom for his help with the plates and printing. And to the Department of Biology faculty, who offered advise and suggestions throughout my work here.

Finally, I would like to thank my parents for their encouragement and support, both morally and finacially.

ABSTRACT

A comparison of traditional scrapings vs. a vacuum cleaner method of collecting cattle ectoparasites determined the vacuum method to be as efficient as the scraping method for collecting Psoroptes ovis, and possibly as effective for collecting Bovicola bovis.

In a survey of cattle ectoparasites in southeast Georgia, using the vacuum method, B. bovis were collected from cattle in a sales barn with an average of 15% parasitism from January 21 to March 18, 1985. Private herds sampled by the vacuum method, showed no ectoparasites. Cattle grubs (Hypoderma lineatum) were found on cattle in a sales barn from January to early March, 1985, while 4 private herds were virtually grub-free. One private herd of 16 calves was examined regularly for grubs from November, 1984 through March, 1985 with a peak of 73% parasitized and an average of 14 grubs per parasitized animal. The cattle grub season for southeast Georgia seems to begin by November and end around mid-March.

Sixteen Hereford heifers, divided into 2 groups (5 stanchioned and 11 unstanchioned) were infested 3 times with P. ovis over 5 weeks, December, 1984 through January 2, 1985. All unstanchioned claves showed no clinical signs of P. ovis 5 weeks after the last innoculation with mites. All 5 stanchioned calves developed psoroptic mange. Considerable variation in the progression of the disease was noted. When stanchioned calves with psoroptic mange were released and allowed

to self groom, lesions were rapidly removed, indicating self grooming a
a natural host control of P. ovis.

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Part I. Survey of cattle ectoparasites

INTRODUCTION

Traditionally, animal ectoparasites have been detected by scraping, palpation and observation (Roberts 1963). Bronswijk and de Kreek (1976) developed a vacuum cleaner method that was used routinely on domestic animals suspected of carrying ectoparasites which cause human dermatitis. This system had a linen fabric placed between the collector and the vacuum hose. Animals were vacuumed over their entire body for 10 minutes, and samples were subjected to a floatation procedure to obtain the ectoparasites. Using this method, Bronswijk and de Kreek (1976) detected light infestations of a mite, Cheyletiella.

Klayman and van Veen (1981) were concerned with detecting low numbers of parasites and skin damage inflicted by multiple scrapings. These workers modified a vacuum cleaner with a filter inserted in the hose. This vacuum was used to vacuum animals for 10 minutes, and the filter was removed and examined under a microscope. In the animals tested, mainly dogs, several species of mites were found, along with fleas and lice. Klayman and van Veen (1981) concluded that the vacuum cleaner was faster, less stressful to the animal and superior to traditional observation and skin scrapings.

My study had 2 main objectives: (1) to develop a fast and efficient vacuum cleaner sampling method to detect cattle ectoparasites in the field, especially in sales barns, and (2) to survey the cattle ectoparasites in southeast Georgia.

Cattle lice spend their entire life on the host. Bovicola bovis (L.) eggs hatch in about 7 days and nymphs mature 15 to 18 days later (Smith & Roberts 1956). The life cycle of the cattle grub Hypoderma lineatum (de Villers) takes approximately 1 year. Adult flies deposit eggs on cattle hair, especially hair on the host's legs. Eggs hatch in 3 to 4 days and larvae penetrate the skin where they migrate throughout the animal's system for about 8 months. Larvae finally migrate to the skin of the host's back where they embed, cut an air hole, and remain for 1 to 3 months. The grub emerges and falls to the ground where it pupates. The adult fly emerges in the spring (Roberts et al. 1964).

Roberts (1963) surveyed cattle lice and grub populations of cattle herds in 19 counties in Georgia. Of 23 herds surveyed, 15 herds were infested lightly to heavily with the lice Linognathus vituli (L.) and/or Solenopotes capillatus Enderlein. B. bovis was found in 2 herds, with 1 rated as a heavy infestation. Roberts et al. (1964) stated that degree of louse infestations and area of state were not related. Cattle grubs (H. lineatum) were found in 11 of 18 herds. The average number of grubs per animal ranged from 0.33 in Clarke County to 8.8 in Spalding County. Cattle grub populations were higher in the Piedmont and upper and middle Coastal Plains than in other parts on Georgia (Roberts et al. 1964).

MATERIALS AND METHODS

Sampling

The apparatus for collecting cattle ectoparasites consisted of 5 elements: (1) a household vacuum cleaner, Eureka[R] model 3335, 3 horsepower peak, (2) a flexible hose 3.8 m long, (3) a metal wand 0.48 m long with a wire mesh screen flush at the end distal to the vacuum motor, (4) a clear plastic cylinder (98 mm long, 33 mm id) made by cutting off the end of a Drosophila culture tube, and (5) Whatman[R] #4 filter paper (55 mm dia). The collection unit was assembled by placing the filter paper on the mesh screen of the wand (Fig 1). The plastic cylinder was slipped over the end of the wand, thereby crimping the filter paper and holding it in a snug pressure fit (Fig 2). After the sample was taken, both the cylinder and the filter paper were removed from the wand, and both ends of the cylinder were plugged with foam stoppers covered with Saran [R] wrap (Fig 3).

Vacuum samples were collected while cattle were in a narrow alley leading to a squeeze chute or in the squeeze chute. The plastic cylinder on the end of the wand was placed on the withers of the animal, and moved against the hair to allow skin contact. The vacuum was allowed to pull for 30-45 seconds. Collected samples were closed, labeled and placed on an ice pack in a cooler for temporary storage (Fig 4). The following data were recorded: sale tag or ear tag number, animal weight, sex, breed, areas vacuumed and length of time vacuumed. Lesions, bare patches and flaking skin were noted and recorded.

Skin scrapings were made by trimming a 25 mm^2 area of hair with scissors. The area was scraped (without causing bleeding) into a 2 oz wide-mouth jar using a #22 scalpel blade. Collected samples were cooled and transported to the laboratory to be processed.

Laboratory procedures

Procedures for microscopic examination of vacuum and scrapings samples were modified from the previous work of Meleney (1982) and Meleney, Wright and Guillot (1982). Meleney (1982) strained the contents of collections through an 80-mesh nylon screen in a Buchner funnel. The contents on the nylon screen were then washed onto a black filter paper, with white lines drawn 10 mm apart, in a Buchner funnel. In the procedure of Meleney, Wright and Guillot (1982), each skin scraping was placed in jar and soaked with alcoholic eosin stain stock solution and tap water for 15-30 minutes. The contents of the jar were filtered through black filter paper in a Buchner funnel.

In the procedure for this study, filter paper, 70 mm dia (either Whatman^R #4 white or S&S^R #551 black) was stamped with yellow paint on a rubber stamp made with parallel lines spaced 5 mm apart to facilitate identification during microscopic examination. Filter paper was soaked in water, and placed in Buchner funnel. The sample was rinsed off the collecting filter paper into the funnel with an eosin rinse. The rinse solution consisted of equal parts 70% ethyl alcohol and stock solution. The stock solution was 1 g eosin Y C.I. No. 45380 and 5 ml glacial acetic acid in 1000 ml of 70% ethyl alcohol (Meleney 1982). After a sample was submerged in the eosin rinse for at least 10 minutes, the rinse was pulled through the Buchner funnel by a water faucet aspirator. The filter paper was examined using a dissecting microscope at 10-12X

power. The number of lice, mites and eggs was recorded, and representative specimens were mounted in Hoyer's medium for positive identification.

Sampling comparison: vacuum vs. scraping

The vacuum cleaner sampling method was compared with the standard scraping method. Selected areas on cattle infested with Psoroptes were sampled by the vacuum method and subsequently, the same area was scraped. The topline of the animals was sampled to simulate sampling in sales barns and private herds.

Survey

Cattle were sampled by the vacuum method every two weeks in a sales barn from January 21, 1985 to April 2, 1985. The withers area, and areas extending along the topline to the tail, of these animals were sampled.

Owners of private herds in the area were contacted and 6 private owners consented to sampling of their cattle. Representatives of these herds were sampled by the vacuum cleaner method.

The number of cattle grubs per animal was estimated by back palpation as recommended by Bram (1978). Either the entire back between the withers and the hips was palpated, or 1 side of the back was palpated and this number multiplied by 2 to approximate the total number of cattle grubs present. The second method was used in situations where only 1 side on the animal could be reached.

Cattle in a sales barn were palpated for cattle grubs every two weeks from January 21, 1985 to March 18, 1985. Four of the private herds sampled for ectoparasites were also palpated for cattle grubs. Ten cattle in each of these herds were examined. One additional private

herd was examined for cattle grubs from November 19, 1984 to March 13, 1985. Five to 16 calves were palpated per inspection.

RESULTS

Sampling comparison: vacuum vs. scraping

A total of 61 paired samples (vacuum sample paired with a subsequent scraping of the same area) were taken. Ten of the 61 paired samples contained lice and the remaining 51 paired samples contained the mite, Psoroptes ovis (Hering). The vacuum cleaner method collected the louse, B. bovis and the mite, P. ovis. The scraping method collected these same ectoparasites and also the louse, L. vituli.

Of the 10 paired samples in which lice were collected, 5 pairs, or 50% of the total paired samples contained B. bovis in both vacuum and scraping samples (Table 1). The samples from the vacuum method contained only B. bovis, but 4 of the scraping samples contained B. bovis and L. vituli (Table 2). Two paired samples contained lice collected by vacuuming but not by scraping, and 2 other sample pairs contained lice collected by scraping but not by vacuuming (Table 1). While the scraping method seemed to collect a greater number of B. bovis than the vacuum method (Table 3), the Wilcoxin paired sample test (Zar 1984) showed the numbers not to be significantly different at the 0.05 level.

The remaining 51 paired samples were taken after Psoroptes populations began to spread. Forty-eight of the 51 paired samples, or 94% of the paired samples, were in agreement as to the presence or absence of mites: 37 pairs positive for both methods, and 11 pairs negative (Table 4). The confidence interval at the 95% level is between

84% and 99% (Lentner 1982), indicating both methods will detect P. ovis at least 84% of the time. There were 3 occasions when one method failed and the other collected mites (Table 4). Two of the paired samples collected mites by scraping but not by vacuuming and once the vacuum method collected mites when the scraping method did not. There was no significant difference in numbers of mites collected by vacuum and scrape methods at the 0.05 level according to the Wilcoxin paired sample test (Zar 1984).

Survey

B. bovis were present in vacuum samples collected from cattle in sales barn. All cattle that tested positively for B. bovis had light infestations using the criteria established by Bram (1978). Less than 25% of cattle examined were infested per collection date (Table 5). Of the adult lice collected, about half of them were intact, while the remaining adults were fragmented. Most of the lice eggs collected were empty, but a few contained embryos. The viability of the embryos was not determined. The percent of animals parasitized varied over the first 8 weeks and dropped from a high of 24% on March 18, 1985 to zero on April 1, 1985.

Six private herds were sampled by the vacuum cleaner method. No ectoparasites were collected in 190 samples.

Sales barn cattle were examined for cattle grubs. The percent of cattle with grubs peaked at 65% on February 4, 1985, and then declined in late February through March (Table 6). The average number of cattle grubs per animal was relatively constant from January until early March. Then it dropped and finally reached zero by March 18, 1985 (Fig 5). Grub counts may have been high because in March it was difficult to

determine, under sales barn conditions, the difference between the presence of a grub and a lesion left by a grub that had already dropped from the host.

Of 4 private herds examined for cattle grubs, only 1 of 40 animals was infested and it had only 2 grubs. One other private herd, I, was examined for cattle grubs from late fall to early spring. The percent of cattle with grubs remained relatively constant through the end of January and peaked at 73.3% on January 29, 1985 (Table 7). During February and March, the number of cattle with grubs declined. The average number of grubs per parasitized animal peaked at 14.5 on January 29, and then declined until no grubs were detected by March 13, 1985 (Fig 6). With these calves, each grub site could be examined more closely and we could determine whether the grub had dropped.

DISCUSSION

Sampling comparison: vacuum vs. scraping

Results of collections from paired vacuum and scraping methods showed that the vacuum cleaner method was as efficient as the scraping method in collecting *P. ovis* and possibly as effective in collecting the biting louse, *B. bovis*. The vacuum cleaner was usually unable to collect the sucking louse, *L. vituli*. *B. bovis* and *L. vituli* adults and nymphs grasp the hair of the host, making it difficult to remove them with the vacuum unless the hair is loose and is also vacuumed into the collecting cylinder. Lice eggs attach to the hair by a gluey substance (Smith & Roberts 1956), which also made them difficult to remove with the vacuum. This may account for the low number lice found by using the vacuum method.

In the paired samples in which the vacuum method collected lice or mites and the scraping method did not, the vacuuming may have removed the ectoparasites from the sampled area, leaving none for the scraping to collect. The ectoparasites may have been trapped under the hair close to the skin in the paired samples where scraping collected lice and mites but vacuuming did not.

The vacuum cleaner method was faster, more convenient to the sampler, and less stressful to the animal, since multiple scrapings can cause skin irritation. This agrees with the findings of Klayman and van Veen (1981). From our tests, the vacuum method collected *P. ovis* and indicated that *B. bovis* populations had been present recently.

Survey

The vacuum cleaner method was a faster and more feasible method to sample cattle in a sales barn situation. Prior to sales, lots or groups of cattle were crowded into an alley way leading to a squeeze chute. A veterinarian recorded or applied a state ear tag and took a blood sample from each potentially reproductive animal. This process took less than 1 minute, which made it unfeasible to examine cattle in the chute. In the alley way, cattle were unrestrained, and scraping was difficult. However, the vacuum cleaner method could be used while cattle were in the alley way. The long hose and wand gave the sampler a longer reach and more mobility in which to sample unrestrained cattle.

B. bovis were collected by the vacuum method from cattle in a sales barn. No P. ovis were collected and we are confident that none were present on the withers of these cattle. By April 1, 1985 no lice were collected on cattle at the sales barn. This finding agrees with reports (Lewis & Christenson 1962 and Lewis, Christenson & Eddy 1967) that cattle lice increase during fall and winter months. Differentiation between live and dead lice was not easily determined and about half of the louse specimens collected were broken and judged to be dead prior to the vacuuming. All lice in the 6 positive samples collected March 18 were judged to be dead before sampling. Intact lice, with apparent internal contents, were judged to have been alive before sampling. Vacuum sampling will not accurately determine if the louse population is active, but will indicate that lice populations were present at some time during the season.

No ectoparasites were detected on the 6 private herds with the vacuum method. Owners indicated that cattle were treated for

ectoparasites 3-4 months prior to sampling.

Cattle grubs appeared on cattle in sales barns by January 21, 1985. Grubs may appear by early September in extreme southern states and as late as March in northern states with mature grubs dropping from cattle about 6 weeks after they first appear (Roberts & Lindquist 1956). Sales barn cattle followed this general pattern; i.e. grubs were present in the first sample in January and were gone by mid-March (Fig 5). Mean number of grubs per infected animal did not decrease until early March (Table 6).

The private herd (designated herd I) used for seasonal grub count was bought through a local stock yard from various herds, which accounted for some of the variability in the herd. Cattle grubs were present by November, 1984 with a mean of 5.6 grubs per infected animal. In January and February, counts generally agreed with grub counts in sales barn cattle. However, the private herd varied from the sales barn cattle in average number grubs per infected animal (Fig 6); the private herd average grubs per animal peaked at 14.5, and sales barn cattle average grubs per animal peaked at 10.5. Mean number of grubs declined by late February in the private herd and by early March in sales barn cattle. Roberts (1963) and Roberts et al. (1964) conducted their studies of cattle grubs in January, February and March of several years, which suggests no grubs were present to study in April and other months of the year. Our survey indicates that cattle grubs in the back appear as early as mid-November in southeast Georgia. By mid-March, no cattle grubs remained (Fig 7), suggesting that the end of the southeastern Georgia cattle grub season is around mid-March.

PART II. Psoroptic mange

INTRODUCTION

Psoroptes ovis is responsible for cattle scabies (Sweatman 1958), also known as psoroptes mange. The disease spreads rapidly in groups of cattle in close body contact. The mites live on the skin and feed on tissue fluids by piercing the skin with their minute chelicerae. Serum, which exudes from the feeding site wounds, hardens and forms a scab. The disease advances as the mites leave scabby areas and migrate to healthy skin. Lesions irritate the host and attempts for relief include licking, biting and scratching (Harwood & James 1979 and Krantz 1978). Condition of infested cattle declines because of irritation, skin damage and secondary infestations (Meleney & Christy 1978). Psoroptic infestations have been shown to retard weight gain (Fisher & Wright 1981a and Meleney & Roberts 1979), thereby causing economic losses in feedlot and range cattle (Meleney & Christy 1978 and Meleney & Roberts 1979).

The life cycle of P. ovis is completed in 10-12 days. Females lay their eggs on or close to the skin, and the eggs hatch in about 3 days. Larvae feed 24-36 hours, inter a resting stage and molt to become protonymphs. Protonymphs feed for 24 hours, inter another resting stage and molt to become adult males or tritonymphal females. Males form an attachment pair with a tritonymph but copulation does not occur until ecdysis of the tritonymph into an adult female. The female feed 1-2 days before laying her eggs (Evans et al. 1961, Guillot & Wright 1983

and Kemper & Peterson 1953).

Psoroptic mange was probably brought to North America in the early 1900's by imported cattle and sheep (Meleney & Christy 1978). States with diseased animals were quarantined and psoroptic mange was nearly eradicated. Over the last 15 years, outbreaks of this disease have increased, especially in the mid-west. Outbreaks of P. ovis were reported in Georgia in 1976 by Meleney and Roberts (1979). Generally, psoroptic mange outbreaks are confined to mid-western states and California (Meleney & Christy 1978 and Meleney & Roberts 1979).

While opinions for this distributional phenomenon have been ventured, no conclusive studies have been made. One possible explanation attributes the absence of mites in the southeast to climatic conditions, which vary greatly from central and mid-west regions (Guillot, Research Entomologist, Kerrville, TX, 1984, pers commun). P. ovis populations decline in the summer months on feedlot and pastured cattle. In Texas, stanchioned cattle, restrained from grooming, have produced large, active populations of P. ovis year-round, implicating self grooming as a natural method of controlling psoroptic infestations (Fisher & Wright 1981b and Guillot 1981a & 1981b). It is possible that P. ovis may exist in low, undetected populations under climatic conditions of the southeast with hot summers and cool, not cold winters.

The objectives of this study were: (1) to determine if populations of P. ovis could be established on cattle in the southeast and (2) to study the progression of the disease.

MATERIALS AND METHODS

Sixteen Hereford heifers were purchased from a local stock yard during November, 1984. On December 5, the calves weighed between 300-485 lbs and were divided into 2 groups: 5 stanchioned under an open shed and 11 unstanchioned in a corral (approximately 1300 ft^2). Each calf was fed approximately 6 lbs of a 12-14% protein, custom-ground feed per day and bermuda hay, free choice.

Experimental infestation

Calves were experimentally infested with *P. ovis* shipped via air express from the USDA Insects Laboratory in Kerrville, Texas. Mites were shipped in rice paper packages resembling tea-bags (Wright & Riner 1979), and were placed in glass jars kept cool by dry ice or an ice pack. Each tea-bag contained approximately 200 mites. A tea-bag was opened and emptied onto the withers of each of the 16 Hereford heifers. Approximately 100-200 mites were placed on each calf.

Mites were applied on December 19, 1984. Three weeks after initial infestation, calves were sprayed with 0.05% lindane to control large populations of biting and sucking lice: *B. bovis* and *L. vituli*. Calves were reinfested with *P. ovis* one week after the lindane treatment and again 13 days after the second infestation. Lice, *L. vituli*, were detected on the 5 stanchioned calves, and calves were sprayed with 0.5% malathion, 11 days after the third and last application of *P. ovis*.

Lesion types

Meleney and Roberts (1979) rated the extent of lesions on animals on a scale on 0 to 5: 0=no lesions, <1=small lesions, 1=lesion up to 150 X 130 mm with live mites, 2=up to 1/4 of body with lesions, 3=1/4 to 1/2 body with lesions, 4=up to 3/4 of body with lesions, and 5=more than 3/4 body with lesions. We modified this system, and rated types of lesions by visual appearance. Type A lesions were new, small (<15 mm dia), and detectable by palpation but not easily seen with scabs under the hair still attached to the skin. Type B lesions were larger (15-40 mm dia) and visible as scabs began to spread and rise from the skin (Fig 8). As psoroptic populations increased and mites spread, inner zones of the lesions became type C lesions, large (>40 mm dia) and crusty with scabs that had risen to the top of the hair (Fig 9). Type D lesions were tough and wrinkled with bare patches of skin which appeared subsequent to type B or C lesions (Fig 10). Scrapings of 25 mm^2 areas were taken from each type of lesion, transported to the laboratory and processed as described in Part I, and the number of mites per life stage recorded.

Mapping

Psoroptic mange lesions were mapped weekly on the 5 stanchioned calves from March 19 (soon after lesions first appeared) through June 5, 1985, when the calves were treated and sold. Mapping followed the procedures of Guillot (1981a & 1981b) using a drawing of a cow with squares marked to represent body area. Percent of body covered per lesion type and percent of body covered with all lesions was determined by the number of squares within the lesion area.

Skin temperature

Skin temperature of the calves was recorded by a Bailey Microprobe Thermometer^{R} Model BAT-4. The microprobe had a right angle bend 6 mm from the tip called the foot. The foot of the probe was pressed against the skin for 30 seconds and the maximum temperature reading was recorded in degrees Celsius. Temperature measurements were paired with lesion vs. non-lesion areas and the center of lesion vs. the periphery of lesion.

RESULTS

Experimental infestation

Unstanchioned calves, allowed to self groom, showed no clinical signs of P. ovis. We detected a few dead mites, by scraping, 2 weeks after the first innoculation on 2 unstanchioned calves. No living mites were collected off unstanchioned calves up to 5 weeks after the final mite innoculation. However, all stanchioned calves developed observable lesions by 7 weeks after the last innoculation with P. ovis.

Lesion types

On 5 stanchioned calves, the first lesions (type A) that appeared were small and scattered along the topline of the back, near the site where the mites were applied, and along the shoulder line. Later, other type A lesions developed along the lower sides and hips (Fig 11a & 12a). As the mite populations increased, type A lesions spread to become type B and then type C lesions (Fig 11b & c & 12 b & c). Only a few type D lesions appeared while the calves were stanchioned. By the final mapping of each calf, most lesions were type C. When calf I was released, more than half the lesions on her body were type C. Type C lesions covered 27% of her body while total percent of body covered with all lesions was 41%. Calf II had 48.8% of her body with type C lesions, while total percent of body covered with lesions was 54.9% (Table 8). When a calf was released and allowed to groom, most scabs and hair in the infested areas were removed, thus leaving large areas of type D

lesions. These areas healed and hair grew back rapidly. On all calves, mite populations increased and lesions spread, covering the body and upper legs, not the head and neck. Final lesions were type C and a few type D lesions.

Lesion types were compared by number of mites per lesion in scrapings. This was done to determine if number of mites per lesion type could be used to distinguish lesion types from one another. Type A lesions had an average of 19.7 mites per sample (Table 9). Three samples contained mites of each life stage counted; adult males and females, nymphs, attached pairs (male and tritonymph) and eggs (Table 10). Type B samples had as average of 42.5 mites per sample with 4 of 9 samples containing all life stages. Type C lesions contained an average of 15.8 mites and 6 of 14 samples had all life stages. Only 4 type D samples were collected, with an average of 6.8 mites per sample. These averages were not significantly different using standard deviations and range of each lesion type (Fig 13). Thus, mite counts were not used to distinguish the lesion types from one another.

Mapping

Progression of mite infestations varied with each of the 5 stanchioned calves. Calf I showed only a few, scattered lesions the first 15 weeks after the final innoculation with mites. The mite population then increased and 18 weeks after the final innoculation 41% of calf I's body was covered with lesions (Table 11), and she was unstanchioned on June 5, 1985.

Psoroptic infestation on calf II developed slowly the first 10 weeks after final innoculation. Lesions involved a maximum of 10% of the body (Table 11). During the next 3 weeks, the mite population

exploded, with the percent of body lesions increasing from 10% to 55%. Calf II was unstanchioned on May 1, 1985, 13 weeks after the last innoculation with mites.

Lesions appeared on calves III and IV seven weeks after the last innoculation, and proceeded similarly in percent of body with lesions over the next 4 weeks (Table 11). On the fifth week, a secondary infestation of fly maggots (Phormia sp.) was detected under the scabs of calf III. This calf was released on April 22, 12 weeks after the final innoculation with mites, with approximately 60% of her body with lesions. One week later, 13 weeks after the last innoculation, 60% of calf IV's body was covered with lesions and she was released into the corral on May 1, 1985.

Calf V showed lesions 5 weeks after the final innoculation. After 8 weeks almost 70% of the animal's body was covered with lesions and she was unstanchioned (Table 11). After 4 weeks in the corral, only type 3 type A lesions remained and calf V was restanchioned on April 22, 1985. The mite population immediately began to increase and 6 weeks after being restanchioned, 13 weeks after the final innoculation, 46% of calf V's body had lesions.

Skin temperature

Skin lesion types B and C had an average temperature that was 0.98 ℃ higher than non-lesion temperature (Table 12). These temperatures were significantly different at the 0.05 level from the non-lesion temperatures by the paired t-test (Zar 1984). Type C lesions were an average of 0.03°C higher than the type B lesions (Table 13), and the two lesion types were not significantly different at the 0.05 level by the paired t-test (Zar 1984). Type A lesions were too small to accurately

measure the temperature with the foot of the probe. The tip of the microprobe did not yield reproducible results.

DISCUSSION

Experimental infestation

Psoroptic mange of cattle, caused by P. ovis, is rare in the southeast. Unstanchioned calves, with 3 innoculations of mites, showed no clinical signs of psoroptic mange January through March 5, 1985. In northern Texas and throughout the mid-western states, clinical psoroptic mange usually occurs during the most severe portion of the winter, which coincides with the longest, densest hair coat topped by snow/ice crusted hair (Guillot, Research Entomologist, Kerrville, TX, 1984, pers commun).

Guillot (1981a) found that psoroptic mange declined during the summer months in unstanchioned cattle, and the only significant difference between the stanchioned and unstanchioned calves was that stanchioned calves were restricted from self grooming. This indicates that self grooming plays an important role in controlling psoroptic mange except during winter conditions.

Initial mite innoculation did not produce infestations; lindane may have adversely affected the populations of P. ovis as reports indicate some control of P. ovis by lindane (Kemper & Peterson 1953 and Wright 1980). However, lindane is not considered highly effective and is not currently recommended for treatment of psoroptic mange. Malathion treatment for lice on the 5 stanchioned calves, after final mite innoculation, was not considered effective against mites and this is supported by the work of Meleney and Roberts (1979) and Wright and Riner (1979). Whatever the reason (climate, lindane, lice or low

mite viability), mites were applied on 2 more occasions, and it was 5 weeks (=3.5 generations of P. ovis) after the last innoculation before a lesion was confirmed as active psoroptic mange.

Psoroptic mange subsequently developed on 5 stanchioned Hereford heifers in Statesboro, Georgia. The disease developed slowly and advanced to life-threatening stages during the spring. Development to the stage where mite lesions involved at least 40% of the body varied from 8 to 18 weeks after final innoculation of mites.

While in stanchions, all calves developed psoroptic mange. When a calf was released from the stanchion, between 41%-70% of the calf's body was covered with lesions. While unstanchioned, condition of the calves improved rapidly. When calf V was restanchioned, she developed new lesions (Table 12). The only apparent difference between stanchioned and unstanchioned calves was the ability to groom. Climatic conditions were similar for both groups. Fisher and Wright (1981b) found that while P. ovis would develop on stanchioned and unstanchioned Hereford calves, it would not develop on Brahman calves unless they were stanchioned, suggesting resistance to psoroptic infestations was behavioral (grooming). Our study agrees with the previous study and with Guillot (1981a & 1981b) and indicates self grooming as a strong factor in host control of P. ovis infestations.

Lesion types

Visible lesions showed distinctive variations during progression of the disease. Description of lesion types followed the general description of Kemper and Peterson (1953), who described the progression of lesions, but did not catagorize lesions into different types by description or number of mites per lesion type. They described

progression of psoroptic mange with early stages being difficult to detect, but as mites move to healthy skin, scabs increase and become visible. These lesions become dry and dull and eventually areas of bare skin appear as the disease progresses.

Lesions, when rated by number of mites per scraping, showed no significant difference between types, but the sample size was small. Fisher and Wright (1981b) stated that lesions with all life stages present indicate a reproducing population. Lesion types A, B and C were active populations, with samples that contained all life stages. No type D samples had all life stages present, suggesting a less active population, and that the area had become unsuitable for large mite populations. On stanchioned calves, type D lesions may have resulted from the calves rubbing on the stanchion side bar which was parallel to the animal's side. Calves with extensive type C lesions and a few type D lesions, when allowed to self groom, promoted type C to type D lesions by grooming and rubbing against the corral. Type D lesions healed rapidly and hair grew back, indicating return of healthy skin.

Mapping

Individual mapping of 5 stanchioned calves showed variation in the progression on psoroptic mange. This variation may be a result of individual susceptibility to activity of P. ovis. Susceptibility of calves exposed to psoroptic mange is discussed in several reports (Fisher & Wright 1981b, Meleney & Fisher 1979 and Meleney & Roberts 1979). Meleney and Fisher (1981b) designated groups of calves as "highly susceptible", "moderately susceptible" and "refractory". However, explanations for varying susceptibilities were not discussed. While all mites were subjected to the same conditions, viability of mite

populations may have varied. One or both of these factors may have been responsible for the slow development of P. ovis populations on calf I.

Skin temperature

Temperature comparison in this experiment showed type B lesions were not significantly higher than type C lesions. However, temperature at a lesion site was significantly higher than that of a non-lesion site. This suggests that mite activity increases skin temperature, possibly from inflammation. P. ovis feed by piercing the skin and causing an inflammatory reaction (Harwood & James 1979). A cardinal sign of inflammation is an increase in temperature (Runnells, Monlux & Monlux 1967). Calf I, with only 5% body lesions at the time of temperature readings, had a lower overall skin temperature. This suggests that psoroptic infestations may cause an increase in overall body temperature, not just at the lesion site.

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Figure 1. Vacuum cleaner wand showing metal screen for supporting filter paper.

Figure 2. Vacuum cleaner wand with collecting cylinder and filter paper assembled as collecting apparatus.

Figure 3. Collecting cylinder closed with Saran^{R} wrap covered foam stoppers.

Figure 4. Samples in an ice chest for temporary storage before transporting to laboratory.

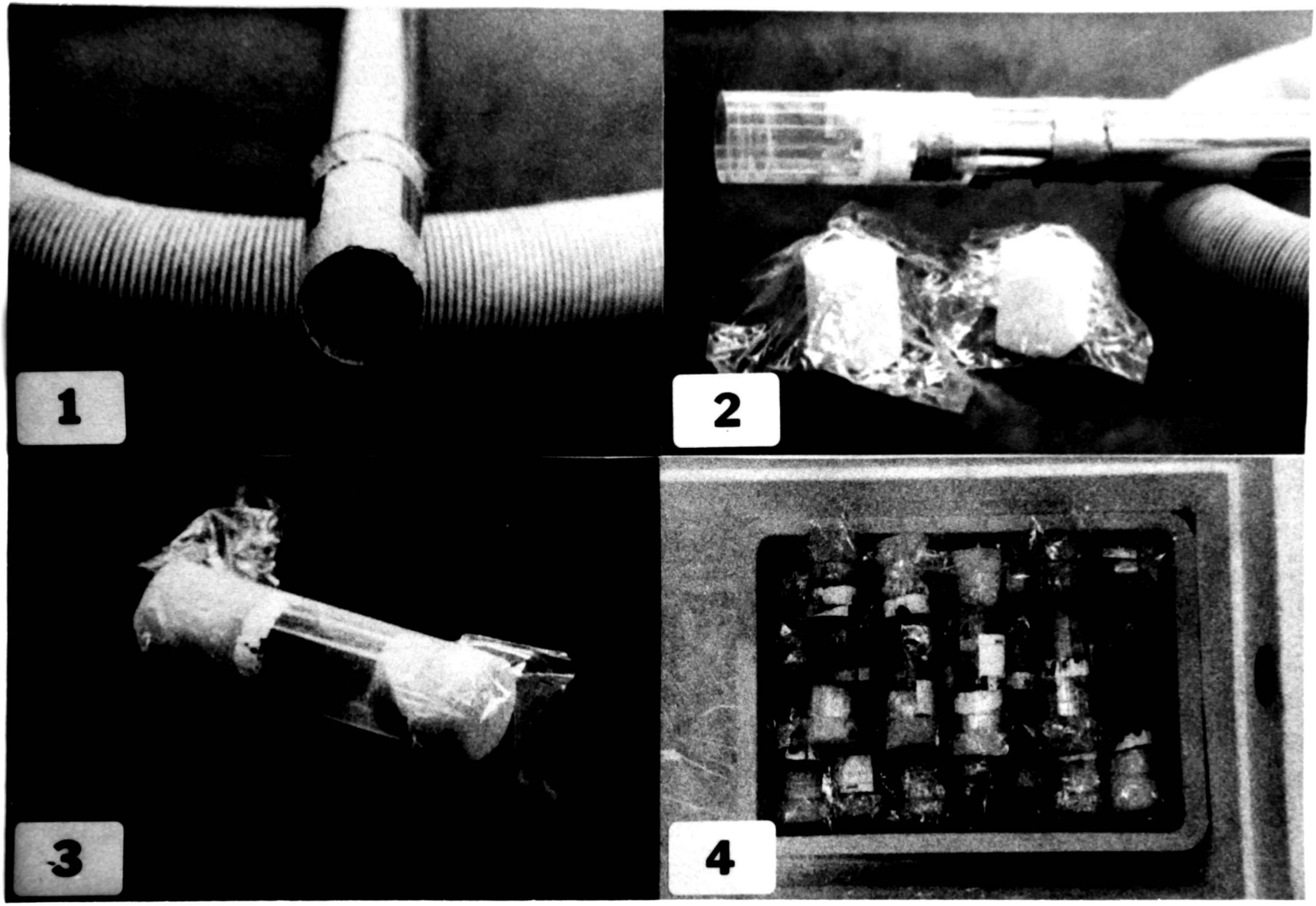
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Figure 5. Cattle grub counts of cattle in sales barns; percent of cattle parasitized and mean number of grubs per animal parasitized vs. time.

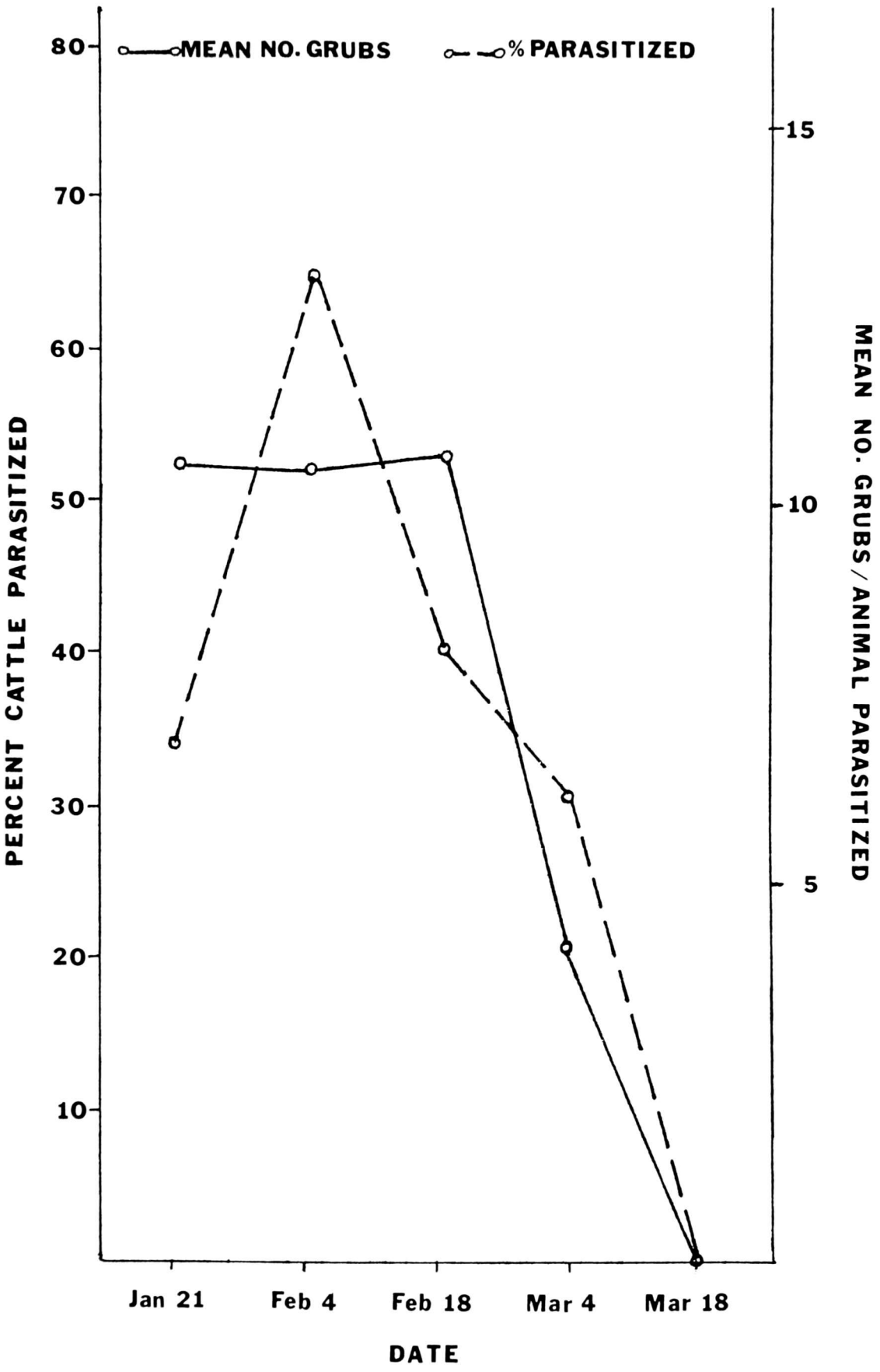
MEAN NO. GRUBS
% PARASITIZED
80
70
60
50
40
30
20
10
15
10
5
PERCENT CATTLE PARASITIZED
MEAN NO. GRUBS / ANIMAL PARASITIZED
Jan 21
Feb 4
Feb 18
Mar 4
Mar 18
DATE

Figure 6. Mean number of cattle grubs per animal parasitized fo cattle in a sales barn and private herd I vs. time.

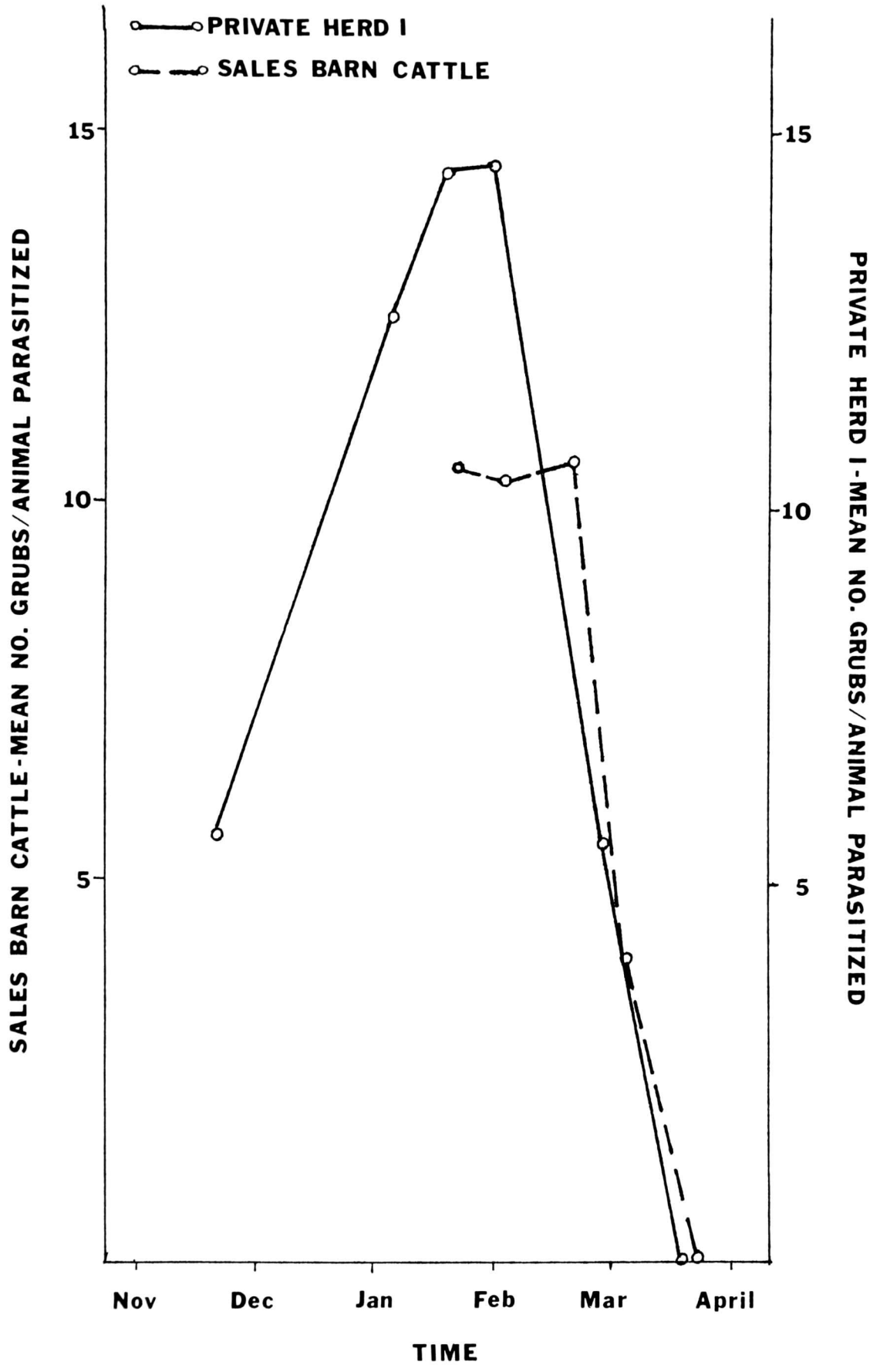
PRIVATE HERD I
SALES BARN CATTLE
15
10
5
SALES BARN CATTLE-MEAN NO. GRUBS/ANIMAL PARASITIZED
PRIVATE HERD I-MEAN NO. GRUBS/ANIMAL PARASITIZED
Nov
Dec
Jan
Feb
Mar
April
TIME

Figure 7. Private herd I; percent of cattle parasitized and r
number of grubs per animal parasitized vs. time.

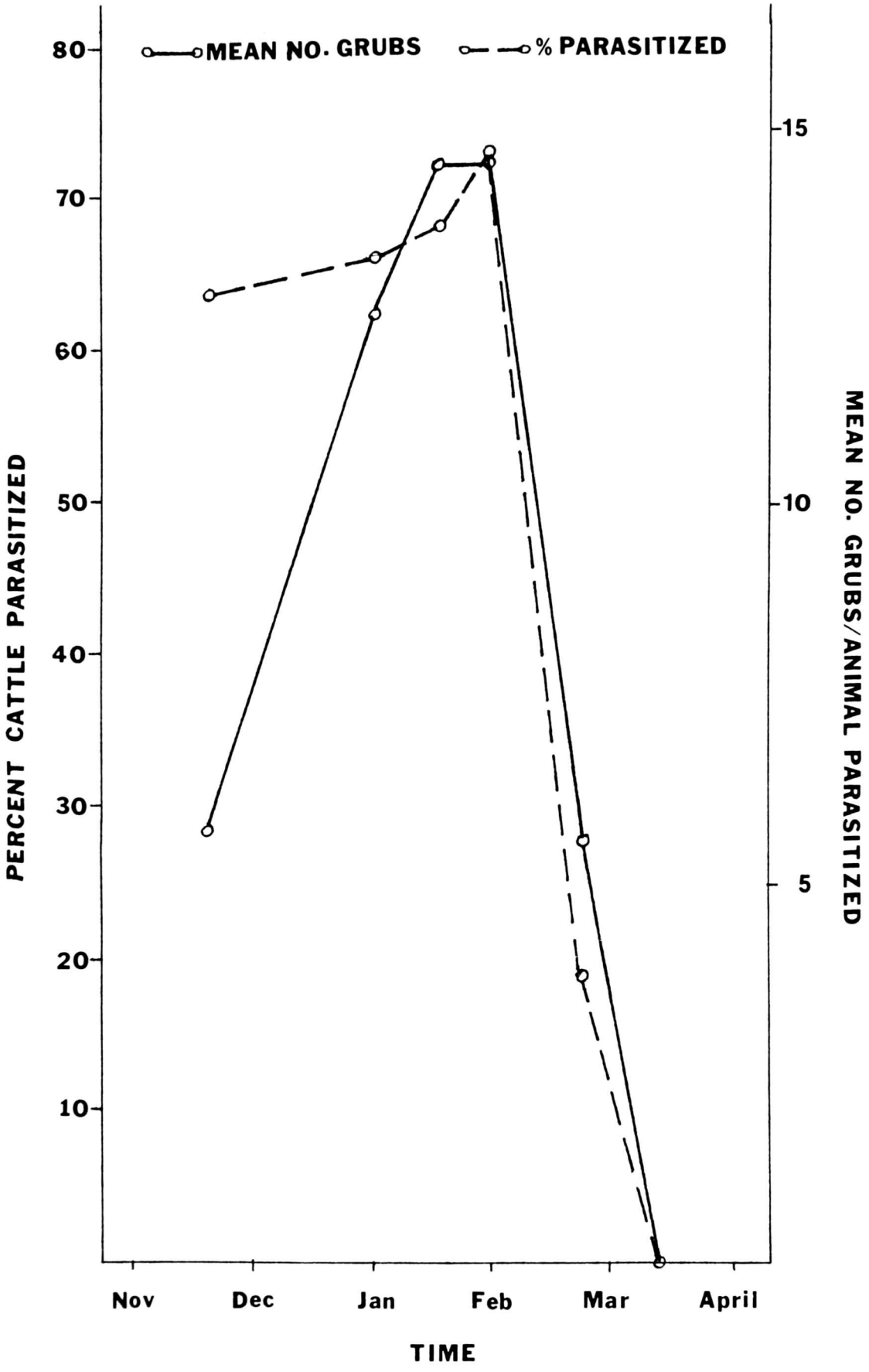
MEAN NO. GRUBS
% PARASITIZED
80
70
60
50
40
30
20
10
15
10
5
PERCENT CATTLE PARASITIZED
MEAN NO. GRUBS/ANIMAL PARASITIZED
Nov
Dec
Jan
Feb
Mar
April
TIME

Figure 8. Type B lesions.

Figure 9. Type C lesions.

Figure 10. Type D lesions.

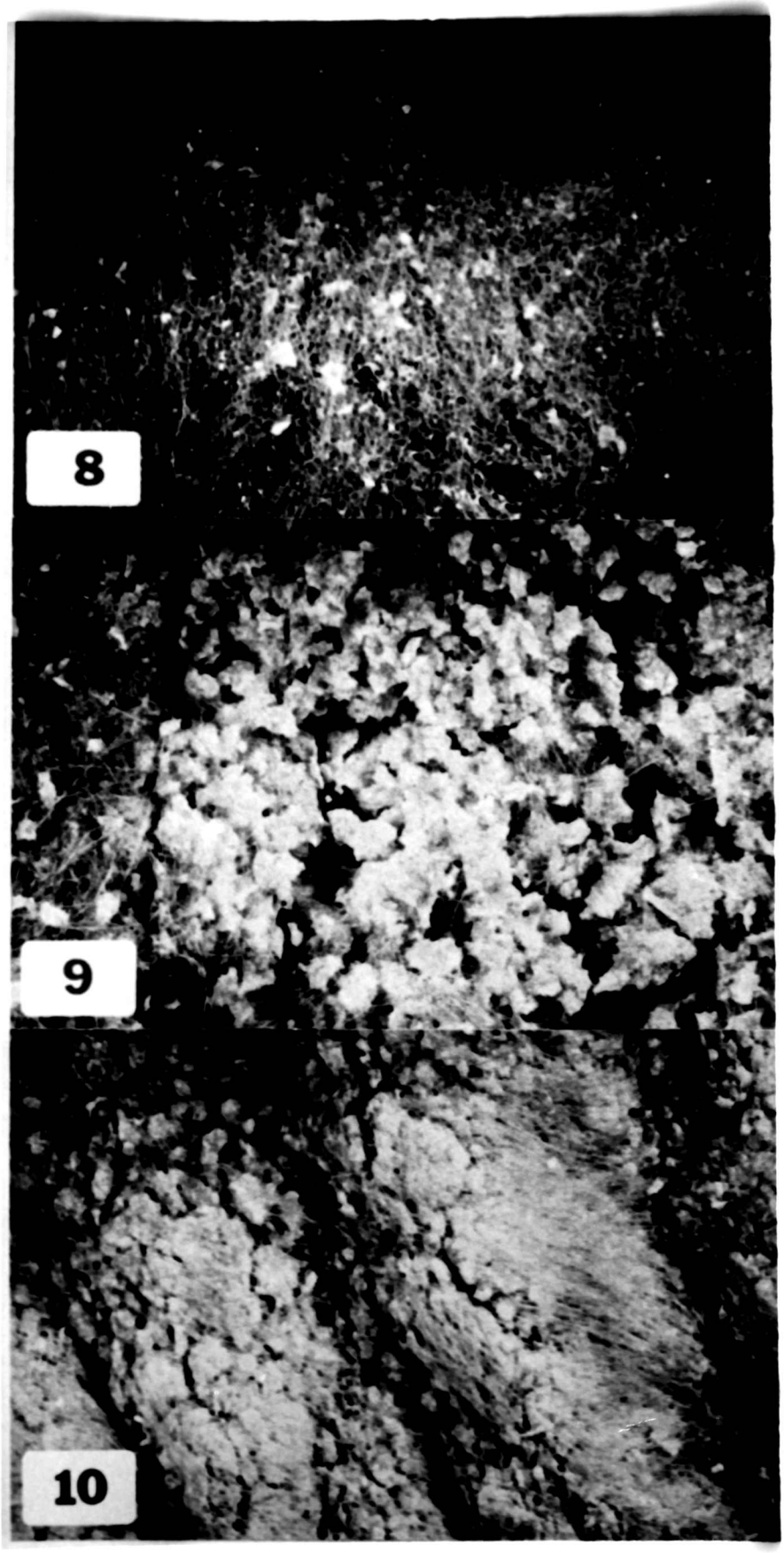
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Figure 11. Mapping of lesion types on calf I.
a. March 19, 1985
b. April 24, 1985
c. June 30, 1985

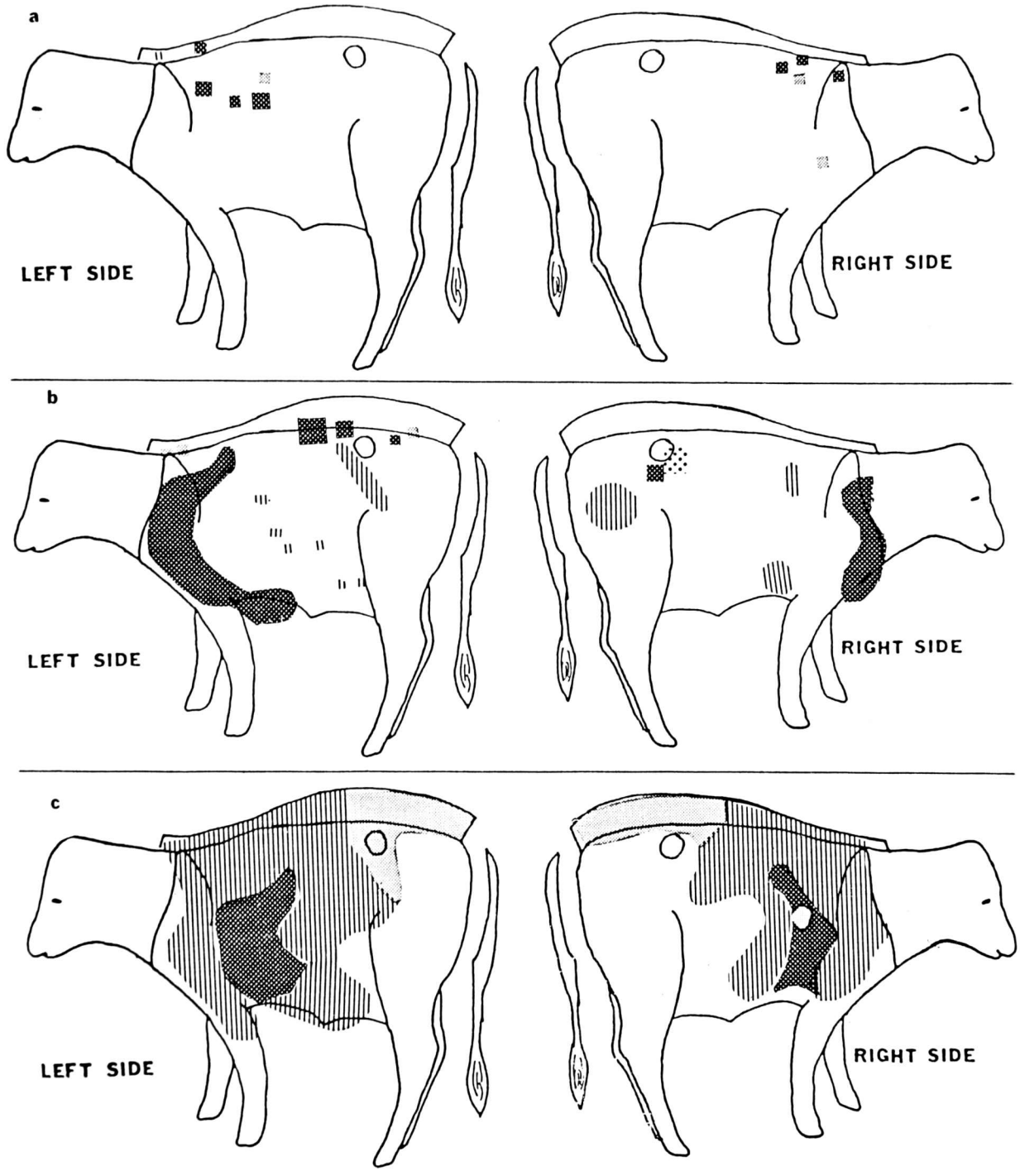
a
LEFT SIDE
RIGHT SIDE
b
LEFT SIDE
RIGHT SIDE
c
LEFT SIDE
RIGHT SIDE

Figure 12. Mapping of lesion types on calf II.
a. March 19, 1985
b. April 9, 1985
c. April 30, 1985

Lesion type A  C 

B  D 

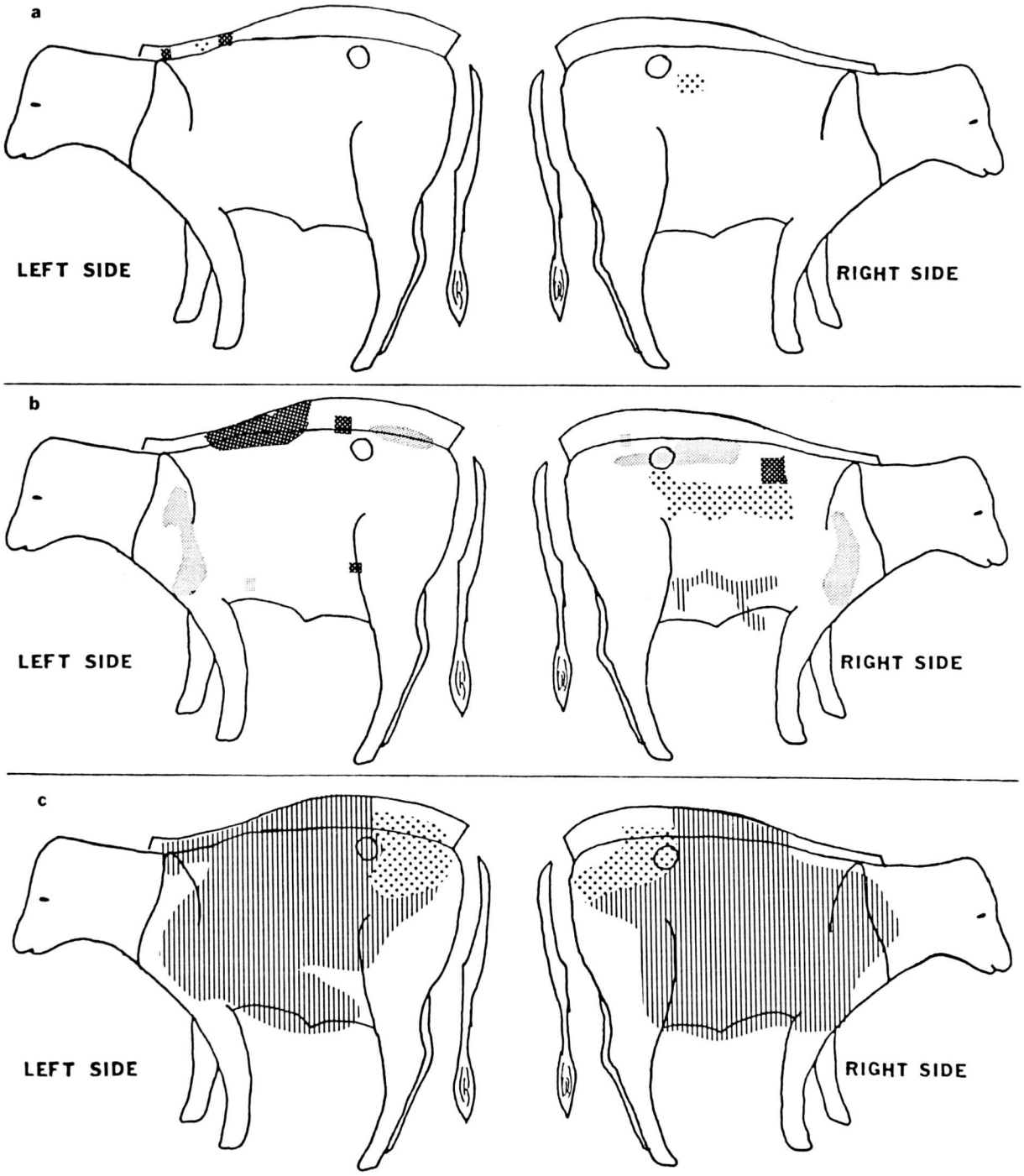
a
LEFT SIDE
RIGHT SIDE
b
LEFT SIDE
RIGHT SIDE
c
LEFT SIDE
RIGHT SIDE

Figure 13. Average number of mites per lesion type ± standard deviation ranges.

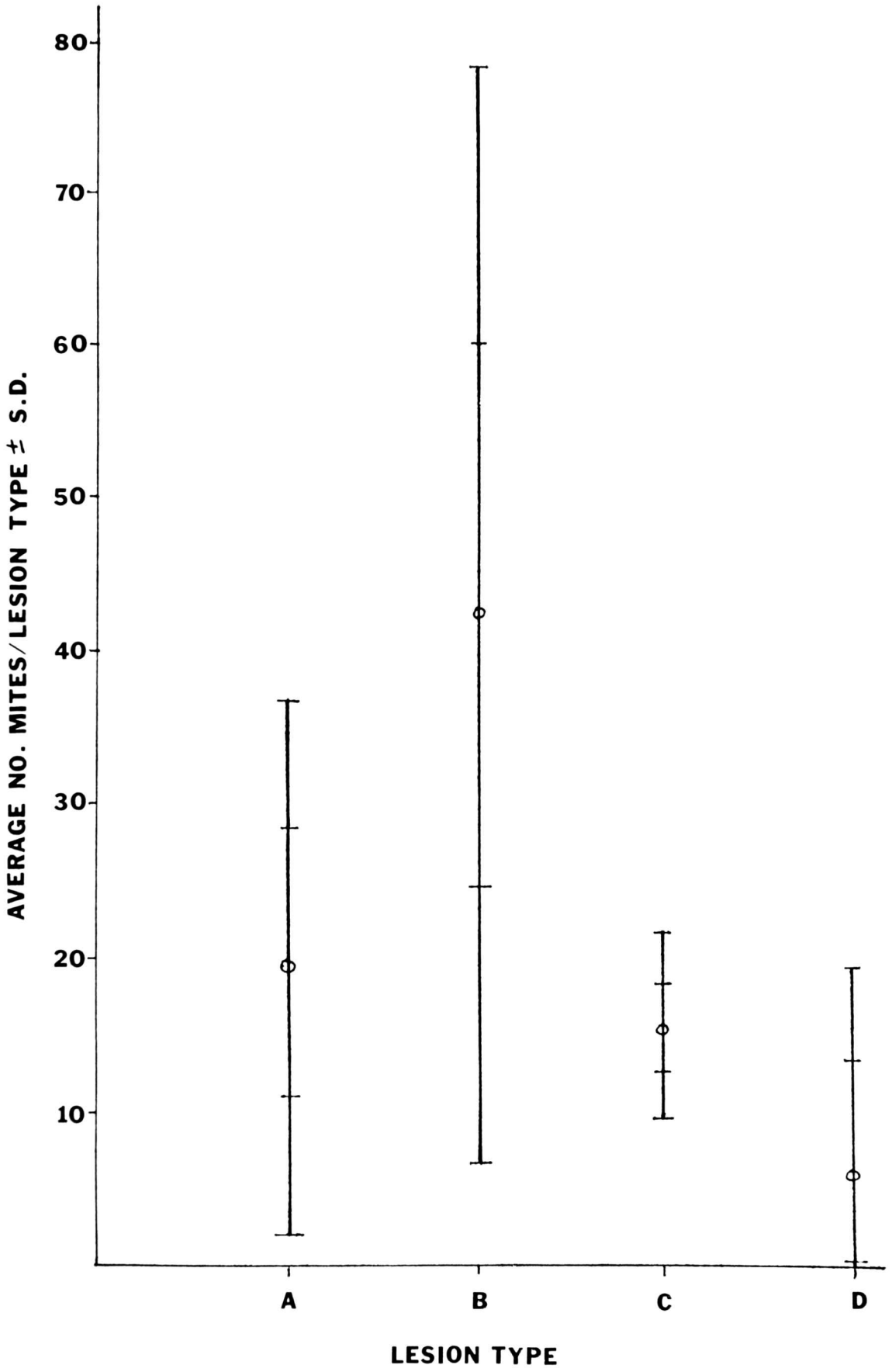
80
70
60
50
40
30
20
10
AVERAGE NO. MITES/LESION TYPE ± S.D.
A
B
C
D
LESION TYPE

Table 1. Comparison of vacuum and scrape methods in detecting Bovicola bovis.

		VACUUM	
		Positive	Negative
SCRAPE	Positive	5	2
	Negative	2	1

Table 2. Lice species present in vacuum and scraping paired samples from 5 cows.

Diagnostic Method	Number Parasitized	Number Cattle Parasitized with Species
vacuum	5	5 B. bovis
scrape	4	2 B. bovis
		2 B. bovis & L. vituli
vacuum	2	2 B. bovis
scrape	3	1 B. bovis
		2 B. bovis & L. vituli

Table 3. Lice per sample of paired vacuum and scraping methods of adjacent areas.

Vacuum	Scrape
3	12
2	3
1	26
1	0
3	42
0	0
3	0
3	2
0	1
0	1

Table 4. Comparison of vacuum and scrape methods for detecting Psoroptes ovis.

		VACUUM	
		Positive	Negative
SCRAPE	Positive	37[a]	2
	Negative	1	11[a]

[a] 95% confidence level that both methods will agree on presence or absence of P. ovis at least 84% of the time

Table 5. Incidence of *Bovicola bovis* in vacuum samples collected from sales barn cattle during January-April, 1985.

Collection Date	Number of Cattle Sampled	Number of Cattle Parasitized	Percent Parasitized
Jan 21	23	3	13.0
Feb 4	30	6	20.0
Feb 18	30	2	6.7
Mar 4	25	2	10.0
Mar 18	25	6	24.0
April 1	20	0	0.0

Table 6. Incidence of cattle grubs in sales barn cattle during January-March, 1985.

Date	Number of Cattle Examined	Percent of Cattle with Grubs	Number of Grubs/Infested Host	
			Mean	Range
Jan 21	12	33.3	10.4	2-16
Feb 4	20	65.0	10.3	2-46
Feb 18	10	40.0	10.5	2-22
Mar 4	13	30.8	4.0	2-6
Mar 18	10	0.0	-	-

Table 7. Incidence of grubs in a selected private herd which was monitored November, 1984 through March, 1985.

Date	Number Examined	Percent with Grubs	Count on Animals with Grubs	
			Mean	Range
Nov 19, 1984	11	63.6	5.6	2-9
Jan 4, 1985	15	66.7	12.5	2-40
Jan 16, 1985	16	68.8	14.4	2-33
Jan 29, 1985	15	73.3	14.5	2-27
Feb 26, 1985	11	18.2	5.5	3-8
Mar 13, 1985	5	0.0	-	-

Table 8. Percent of body covered per lesion type for 2 stanchioned calves.

Calf I

Lesion type	% Body covered/lesion type		
	Mar 19	April 24	June 5
A	0.4	0.5	7.0
B	1.0	5.7	6.7
C	0.3	2.8	27.0
D	0.0	0.3	0.3

Calf II

Lesion type	% Body covered/lesion type		
	Mar 19	April 9	April 30
A	0.0	4.1	0.0
B	0.3	2.6	0.0
C	0.0	1.3	48.4
D	0.5	2.1	6.4

Table 9. Mites per lesion type.

Lesion Type	Number Sampled	Average No. Mites ± s.d.	Samples Positive	Samples with all Stages	Positive Samples Average No. Mites ± s.d.
A	14	19.7 ± 8.7	8	3	32.0 ± 13.0
B	11	42.5 ± 17.8	9	4	51.9 ± 20.6
C	17	15.8 ± 3.1	14	6	19.2 ± 3.0
D	4	6.8 ± 6.4	2	0	13.5 ± *

* accurate s.d. not computed with only 2 samples

Table 10. Lesion types with life counts.

Lesion type	M*	F	N	P	E	T
A	1	3	0	0	2	6
	1	6	1	0	1	9
	0	2	0	0	5	7
	1	6	3	0	13	23
	2	82	17	8	11	120
	4	22	6	1	3	36
	6	17	6	1	12	42
	0	7	4	0	2	13
	-	-	-	-	-	0
	-	-	-	-	-	0
	-	-	-	-	-	0
	-	-	-	-	-	0
	-	-	-	-	-	0
B	13	25	22	0	22	82
	0	13	2	0	0	15
	2	22	7	0	3	34
	24	53	44	11	74	206
	1	8	1	1	20	31
	0	0	0	0	1	1
	2	23	6	5	3	39
	3	13	5	1	7	29
	3	14	7	0	6	30
	-	-	-	-	-	0
	-	-	-	-	-	0
C	-	-	-	-	-	0
	3	3	2	0	3	11
	-	-	-	-	-	0
	1	4	0	0	0	5
	-	-	-	-	-	0
	1	10	2	3	18	34
	1	18	3	0	5	27
	2	4	1	1	2	10
	1	9	0	0	6	16
	1	10	6	0	6	23
	4	19	2	2	1	28
	1	15	6	3	1	26
	0	6	5	0	0	11
	0	6	2	1	0	9
	4	7	3	1	1	16
	2	4	3	1	0	10
	2	16	11	2	12	43

* M=male, F=female, N=nymph, P=attached pairs, E=egg, T=total

Table 10 (cont). Lesion types with life stage counts.

Lesion type	M*	F	N	P	E	T
D	0	0	1	0	0	1
	-	-	-	-	-	0
	-	-	-	-	-	0
	2	12	8	0	4	26

*M=male, F=female, N=nymph, P=attached pairs, E=eggs, T=total

Table 11. Percent of body with lesions for 5 stanchioned calves, 1985.

Date	I	II	III	IV	V
Mar 19	1.6	0.8	8.8	7.0	24.6
Mar 27	2.9	1.8	24.4	15.0	68.7
April 2	4.9	3.1	28.0	25.9	-*
April 9	5.2	10.1	40.7	36.0	-
April 16	5.7	29.8	58.6	51.8	-
April 24	9.3	47.9	-	53.9	0.5
April 30	10.4	54.9	-	57.8	3.4
May 7	12.2	-	-	-	9.6
May 14	14.5	-	-	-	17.1
May 21	18.9	-	-	-	18.1
June 5	40.9	-	-	-	45.6

* calves unstanchioned

Table 12. Temperature of lesion type B and C vs. non-lesion temperature, °C.

Lesion type	Temperature		Lesion minus non-lesion
	Lesion	Non-lesion	
B	34.5	34.6	(-0.1)
	35.2	34.2	1.0
	35.4	34.8	0.6
	36.9	35.0	1.9
C	34.1	34.9	(-0.8)
	35.0	34.2	0.8
	36.8	35.0	1.8
	36.3	34.9	1.4
	37.0	35.0	2.0
	37.1	35.9	1.2

Table 13. Temperature of type C lesion vs. temperature type B lesion, °C.

Temperature		Type C minus
Type C	Type B	Type B
33.2	33.4	(-0.2)
34.2	36.0	(-1.8)
35.0	35.2	(-0.2)
36.2	37.0	(-0.8)
37.0	36.9	0.1
37.5	35.6	1.9
37.6	36.4	1.2