ANEMIA AND WEIGHT LOSS IN LOUSE INFESTED RANGE CATTLE

by

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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vii</td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. LITERATURE REVIEW</td>
<td>4</td>
</tr>
<tr>
<td>A. Specific Effects</td>
<td>4</td>
</tr>
<tr>
<td>B. Biology</td>
<td>6</td>
</tr>
<tr>
<td>C. Seasonal Population Variation</td>
<td>7</td>
</tr>
<tr>
<td>III. MATERIALS AND METHODS</td>
<td>10</td>
</tr>
<tr>
<td>IV. RESULTS</td>
<td>14</td>
</tr>
<tr>
<td>V. DISCUSSION</td>
<td>18</td>
</tr>
<tr>
<td>A. Population Estimates</td>
<td>18</td>
</tr>
<tr>
<td>B. Anemia and Weight Loss</td>
<td>19</td>
</tr>
<tr>
<td>C. Treatment Justification</td>
<td>20</td>
</tr>
<tr>
<td>VI. APPENDIX</td>
<td>22</td>
</tr>
<tr>
<td>VII. LITERATURE CITED</td>
<td>27</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>The effect of varying degrees of louse infestation on mean PCV in purebred</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>two-year-old Hereford cattle</td>
<td></td>
</tr>
<tr>
<td>II.</td>
<td>The effect of varying degrees of louse infestation on average winter weight</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>loss (lb per head) in purebred two-year-old Hereford cattle</td>
<td></td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>I</td>
<td>A heavy infestation of <em>H. eurysternus</em> on a Hereford heifer on the left side of the neck and dewlap</td>
<td>23</td>
</tr>
<tr>
<td>II</td>
<td>An animal relatively free of lice showing the area examined; left side of the neck and dewlap</td>
<td>23</td>
</tr>
<tr>
<td>III</td>
<td>A heavy infestation of <em>H. eurysternus</em> on the tailhead, around the anus and twist of a Hereford bull</td>
<td>24</td>
</tr>
<tr>
<td>IV</td>
<td>A heavy infestation of <em>H. eurysternus</em> eggs in the tail of a Hereford bull</td>
<td>24</td>
</tr>
<tr>
<td>V</td>
<td>The egg of <em>H. eurysternus</em> attached to the hair of a cow. x 62</td>
<td>25</td>
</tr>
<tr>
<td>VI</td>
<td>Adult <em>H. eurysternus</em>. x 62</td>
<td>26</td>
</tr>
</tbody>
</table>
ABSTRACT

Packed red blood cell volume (PCV) and winter weight loss (November 3 to March 4) were determined individually on 137 heifers and 66 bulls. Louse infestation on each animal was rated as either relatively free, light, moderate, or heavy, and correlated with the PCV and weight loss data.

Heavy infestations reduced mean PCV to 59.4% of normal in the heifers and 76.6% of normal in the bulls. All heavily infested animals displayed clinical signs of anemia including extreme weakness, anoxia, and pale mucosal membranes. Light and moderate infestations had no significant effect on the mean PCV.

The moderately infested heifers lost 24.5 lb more per head while the heavily infested heifers lost 81.8 lb more per head than the louse-free heifers. The heavily infested bulls lost 54.6 lb more per head than the louse free bulls. Light infestations on heifers and light to moderate infestations on bulls had no significant effect on weight loss.

These data indicate that louse control is economically justified on at least the moderately infested heifers and all heavily infested animals. The high fecundity of cattle lice and management practices, however,
probably justify louse control on a herd basis when coupled with systemic cattle grub control.
I. INTRODUCTION

Cattle lice are a major economic problem to the livestock industry. Estimates of losses to all classes of livestock range from $30 million to $52 million in the United States alone (Haeussler 1952, USDA, ARS 1954). These are conservative estimates because of the difficulty of assessing the effects of lice on cattle, especially on large western ranches where close management is impractical. For example, louse infestations are probably a major contributing factor in winter death losses by lowering the resistance and vitality of the host animal.

Little critical evidence is available concerning the specific effects of lice on cattle. The literature is replete with generalizations that they lower vitality, weight gains, milk production and cause anemia (Monro and Telford 1943, Kemper and Peterson 1953, Smith and Roberts 1956). These statements are seldom supported by data. Knowledge of specific effects is essential to proper control recommendations. For example, quantitative relationships are necessary to determine economic thresholds. It is possible that complete eradication is necessary, or conversely, that only very high numbers of lice cause economic damage.
Five species of lice infest cattle in North America. These are *Haematopinus eurysternus* (Nitz.) (Anoplura: Haematopinidae), the short-nosed sucking louse; *Haematopinus quadripertussus* (Fahrenholz) (Anoplura: Haematopinidae), the cattle tail louse; *Solenopotes capillatus* (Enderlein) (Anoplura: Linognathidae), the little blue cattle louse; *Linognathus vituli* (Linn.) (Anoplura: Linognathidae), the long nosed cattle louse; and *Bovicola bovis* (Linn.) (Mallophaga: Trichodectidae), the cattle biting louse. The buffalo louse, *Haematopinus tuberculatus* (Burmeister) (Anoplura: Haematopinidae) infests buffalo in India and bison in North America but cannot be made to infest cattle (Chaudhuri and Kumar 1960). Ferris (1951) does not recognize *H. quadripertussus* as a valid species, although it is listed in the approved common names by the Entomological Society of America. The four species of Anoplura are the most harmful as they suck blood and irritate the host. *B. bovis* is less harmful as it feeds only on epithelial debris (Lapage 1962). In Arizona, *H. eurysternus* is considered to be the dominant and most damaging species of Anoplura infesting native cattle (Dewhirst 1964).

Many Arizona ranchers do not give supplemental feed to their cattle during the winter, other than a cottonseed.

1. Common name not approved by the Entomol. Soc. Amer.
meal and salt mixture. Because of this and the poor grazing conditions, these cattle may lose weight over the winter. Cattle lice are most abundant during this period when the animals are already under the stress of a sub-maintenance diet and cold weather. The purpose of this study was (1) to assess the effects of varying intensities of louse infestation (Anoplura) on these cattle in terms of producing anemia and increasing the winter weight loss, (2) to determine if these effects are different in male and female cattle, and (3) to ascertain if louse control is economically justified under these conditions.
II. LITERATURE REVIEW

A. Specific Effects

Kemper (1950) found that heavy infestations of *H. eurysternus* could cause anemia in adult cattle. He artificially infested a cow in mid-April and determined packed blood cell volume (PCV) at various intervals as a measure of anemia. The PCV remained normal (40%) until October when it dropped to 9% in mid-January just before death. Shavings from 6 areas on this cow at death revealed an average of 234 motile lice per square inch and a calculated total of 1,213,000 lice.

Peterson, et al. (1953), found similar results in three cows and a bull. The red blood cell (RBC) volumes were reduced to such an extent that it was necessary to destroy the lice to prevent the hosts from dying. These animals recovered rapidly after destruction of the lice, the RBC volume increasing from 11.2 to 28.0% in 27 days on one animal. Clinical evidence of anemia (pale mucosal membranes) was observed at an RBC volume of 24 to 30%. The condition of these animals could not be improved by additional feed or care. Destruction of the lice was the only thing that improved the anemic condition of the host.
Shemanchuk, Haufe, and Thompson (1960) compared the blood picture of heavily infested cows (*H. eurysternus*) with louse-free cows. They found a highly significant reduction in erythrocytes and hemoglobin in the infested group. Leucocytes were only slightly lower in the infested group and the reduction could not be attributed to the infestation. No significant difference was observed in the differential counts. Blood transfusions were not of therapeutic value. Destruction of the lice returned the hematological condition to normal in 36 to 50 days. Over the 15 week period the louse-free cows gained 0.41 lb more per day than the infested group. These investigators attributed six cases of abortion and five deaths to the louse-caused anemia.

Scharff (1962), in Montana, conducted a study of louse infestation and feed lot weight gains. He observed no weight gain advantage in controlling light to moderate louse infestations. In a slaughter house survey, he found only 2% of the animals over a 3 year period to have moderate to heavy infestations. The majority of these were Herefords, particularly Hereford bulls, and the dominant species on the heavily infested animals was *H. eurysternus*. Older cattle were more frequently infested. This phenomenon was also reported by Roberts (1938) and Munro and Telford (1943). Montana cattlemen surveyed by Scharff indicated a 1% death loss attributable to heavy louse infestations. On
population observations in January, he found less than 1% heavily infested out of 600 animals from six different herds.

B. Biology

Although the biologies of the Anoplura infesting cattle are somewhat different, they are sufficiently similar to consider them together here. Since H. eurysternus was the dominant and most important species in this study, it is used as the example with minor variations noted for the others as they occur or are known. The primary sources for this review were Craufurd-Benson (1941), Matthysse (1946), Lancaster (1951), and personal observations. Other sources are noted where applicable.

The egg of H. eurysternus is, unlike the others, hard shelled and usually brownish-white in color. They are glued on hairs in clusters close to the skin. The main breeding areas are the top and sides of the neck, tail, head, dewlap, and brisket. Average incubation period for all species is 11-12 days. Oviposition rate for all species is one to two per day with 30-50 eggs being laid by one female. The complete life cycle, egg to egg, averages 28 days (20-41) for H. eurysternus and 25 days (23-30) for L. vituli. The actual sex ratio of H. eurysternus computed from counting the total number of lice on eight animals is 1:3 to 1:6.6, male to female. The female appears to enjoy
a longer adult life span, 10 days to 16 days. Parthenogenesis has not been observed in the sucking lice but is the usual method of reproduction of B. bovis. The males can fertilize more than one female.

Any humidity short of 100% or more than 0% does not affect egg hatching. The incubation period increases as the temperature decreases, the hatching threshold being 27.5°C.

All cattle lice are obligate parasites and cannot survive away from the host. The maximum survival time away from the host is 96 hours for nymphal H. eurysternus. Other species die in less time. Eggs, however, will remain viable up to 21 days away from the host, when exposed to low temperatures (35-45°F). These eggs will hatch if replaced on the host, indicating a possible means of transmission.

C. Seasonal Population Variation

Many authors have observed that cattle lice increase in the winter to very heavy infestations and decrease until they are nearly nonexistent during the summer (Lamson 1918, Imes 1940, Craufurd-Benson 1941, Matthysse 1946, Scharff 1962). This phenomenon is explained by a combination of factors. Craufurd-Benson believes that the lower light intensity during the winter is responsible for the increase because cattle lice are negatively phototropic.
Increased length and density of the winter hair coat further obstructs light and provides insulation for a favorable microclimate.

Lowered resistance, coupled with the age of the host are probably important. Generally, animals are on a lower level of nutrition during the winter and are therefore more susceptible to heavy infestation (Collins and Dewhirst 1965).

Lamson (1918) suggests that the dry skin and lack of oil during the winter cause lice to increase. This could be interrelated with diet.

Matthysse (1946) states that sunlight, raising the skin temperature of the host is the primary reason for the decline of *B. bovis* during the summer. Skin temperature rose to the lethal level of 125 F in two hours exposure to direct sunlight at 78 F air temperature.

Lancaster (1957) attempted to maintain a constant year-round infestation by placing an animal in a refrigerator at 55.5 F with a constant artificial light source. The infestation followed its normal cycle similar to a control animal allowed to remain outside under normal conditions. This suggests that neither temperature nor light intensity are directly responsible, but that there is a physiological change in the host-parasite relationship which accompanies or is caused by the change in seasons.
How all these various factors affect the individual louse is not known. There appears to be no lethal effect from the sunlight (Lancaster 1951), except for raising the skin temperature (Matthysse 1946). No change in the sex ratio occurs at the different seasons (Craufurd-Benson 1941). Fecundity and length of life at the various seasons have not been studied. There must be some catastrophic mortality factor to cause the rapid decline of very high populations. One obvious factor is that many eggs are lost with the shedding of the hair coat in the spring.

In summary, there appears to be little justification for stating that one factor is more important than another but that all are interrelated.
III. MATERIALS AND METHODS

Native registered Hereford cattle owned by the San Carlos Apache Indian Tribe, located in Graham County, Arizona, were utilized for this study. This herd numbers approximately 600 head and is maintained on short-grass rangeland at an elevation of 5,000 feet. This ranch has no regular supplemental feeding program during the winter and had no louse control program prior to the winter of 1964-1965.

A study of the effects of lice on a herd requires a method of determining the number of lice on each animal. Obviously, the most accurate method would be to count all the lice on each animal. This is done for various ecological studies but is practical only when very few animals are utilized. Counting the number of lice on several small body regions would provide an accurate estimation of louse populations (Shemanchuk, Haufe, and Thompson 1963). This procedure was also too time consuming to use in this study.

Craufurd-Benson (1941) adopted a point system utilizing visual inspection. He stated that "by experience it became possible to assess the density of any population in one of five categories . . . ." He used very light, light, moderate, heavy and very heavy infestations. This method was adopted by Scharff (1962). As a result of the
limited amount of time available to examine each animal and the large number of animals utilized, it was necessary to adopt a similar method of visual inspection.

To gain experience in estimating louse populations within the test herd, 150 yearling heifers were examined on March 3, 1964, prior to the examination of the test animals. These heifers were maintained on the same pastures and under the same conditions as the test animals. All examinations were made on the right side of the neck (Figures I and II). In each case the animal's head was held around to the left and the hair parted to allow for a close examination of the skin. The side of the neck, jaw, dewlap and brisket were the principle areas examined. Care was taken to include only H. eurysternus nymphs and adults in the counts as some B. bovis and eggs of both species were present. These examinations indicated that four degrees of louse infestation could be quite accurately determined by visual inspection. When no lice were observed in the examined area the animal was considered to be relatively free of lice and designated as 1 (Figure II). When a few lice were observed, the animal was considered to be lightly infested and designated as 2. A moderately infested animal, designated as 3, had many lice in the examined area but the infestation was not apparent from several feet away. A heavily infested animal had many lice in the examined area and the infestation was apparent from several feet away as
dark, greasy blotches over various body regions, particularly the neck, brisket, dewlap, twist, and tailhead (Figures I, III, and IV). This condition was designated as 4.

Specimens of lice were collected in 75% ethanol. The clearing and mounting technique used was a modification of the method described by Galigher and Kozloff (1964).

1. Fixation in 95% ethyl alcohol overnight.
2. Boil in 10% KOH until specimens are clear.
3. Dehydration in absolute ethyl alcohol three to four hours.
4. Creosote xylene for two hours.
5. Xylene for one hour.

The microhematocrit method was used to determine anemia in these animals. Hepranized blood samples were drawn into capillary tubes and centrifuged at 11,500 rev/min for 5 minutes. The packed red blood cell volume (PCV) was read as a percent of total blood sample. This method was chosen because of its speed, simplicity, and accuracy. In comparison, hemoglobin determination and red blood cell counting are far less accurate (Bauer 1963).

Blood samples were drawn from the jugular vein and the PCV was determined on 137 two-year-old heifers and 66 two-year-old bulls on March 4 and 5, 1964 respectively.

To determine the winter weight loss of the test animals, each animal was weighed on November 6, 1963 and again when the blood samples were drawn. Each individual was identified by an ear tattoo number so that weight change,
degree of louse infestation, and PCV could be obtained for each individual animal.

This procedure was repeated in 1964-1965 on 51 two-year-old bulls, 125 two-year-old heifers, 102 heifer calves and 92 bull calves. During the fall and winter of 1964, the manager of this herd sprayed most of the heavily infested animals with a mixture of DDT and Lindane. Because of this, the data obtained were not comparable to the previous data and were not considered valid for the purposes of this study.
IV. RESULTS

In 1964, the only species of lice observed was *H. eurysternus*. Eggs (Figure V), nymphs, and adults (Figure VI) were identified. Twenty-five specimens were cleared and mounted for identification. An additional seventy-five were identified without using the clearing and mounting procedure.

In 1965, *B. bovis*, eggs, nymphs, and adults were present in large numbers along with *H. eurysternus*. Apparently these infestations had built up within one year. The yearling heifers examined in the spring of 1964 had no noticeable *B. bovis* but when examined again as two-year-olds in 1965, several were supporting moderate infestations.

The normal mean PCV for mature Hereford cattle is 38.4% and ranges from 31.0 to 47.0% (Schalm 1961). Peterson, et al. (1953) stated that clinical evidence of louse-caused anemia manifested as pale mucosal membranes, was observed when the PCV was reduced to 24-30%.

It is apparent that the mean PCV for both heavily infested groups was significantly lower than this; 22.2 and 25.8% for the heifers and bulls respectively (Table I). The PCV ranges for heavily infested groups were 14.5 to 30% for the heifers and 21.5 to 28.0% for the bulls. The heavily infested cattle of both sexes showed clinical signs
Table I. The effect of varying degrees of louse infestation on mean PCV in purebred two-year-old Hereford cattle.

<table>
<thead>
<tr>
<th>Degree of louse infestation</th>
<th>Free</th>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of heifers</td>
<td>66</td>
<td>50</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Mean PCV</td>
<td>37.9</td>
<td>38.3</td>
<td>36.6</td>
<td>22.2</td>
</tr>
<tr>
<td>No. of bulls</td>
<td>39</td>
<td>16</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Mean PCV</td>
<td>33.7</td>
<td>34.4</td>
<td>31.6</td>
<td>25.8</td>
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of anemia including anoxia, extreme weakness, pale mucosal membranes and extremely poor condition. Light and moderate infestations had no statistically significant effect on mean PCV as compared to the normal mean PCV or the mean PCV of the relatively free groups.

Analysis of variance revealed highly significant correlations between degrees of louse infestation and mean PCV in both sexes. To test for individual differences between groups, Duncan's method was applied (Steel and Torrie 1960). In both sexes, the differences in mean PCV between the first three groups and the heavily infested groups were highly significant. Significant differences in mean PCV were not observed between groups 1 and 2, 1 and 3, and 2 and 3.

Both moderate and heavy louse infestations significantly increased winter weight loss in the heifers, while
only heavy infestations significantly increased weight loss in the bulls (Table II). The heavily infested heifers lost

Table II. The effect of varying degrees of louse infestation on average winter weight loss (lb per head) in purebred two-year-old Hereford cattle.

<table>
<thead>
<tr>
<th>Degree of louse infestation</th>
<th>Free</th>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulls</td>
<td>84.9</td>
<td>96.8</td>
<td>80.9</td>
<td>139.5</td>
</tr>
<tr>
<td>Heifers</td>
<td>26.2</td>
<td>28.2</td>
<td>59.7</td>
<td>108.0</td>
</tr>
</tbody>
</table>

an average 81.8 lb more per head, or four times as much weight as the heifers relatively free of lice. The moderately infested heifers lost an average of 24.5 lb more per head, or nearly twice as much as the relatively louse-free heifers. The heavily infested bulls lost an average of 54.5 lb more per head than the relatively louse-free bulls. Light infestations on the heifers and light to moderate infestations on the bulls had no significant effect on weight loss over the test period.

The weight loss data were submitted to the same analyses as the PCV determinations. The correlations between winter weight losses and degrees of louse infestation were highly significant in both sexes. There were highly significant differences between the first three groups and the heavily infested group in both sexes. With
the heifers significant differences (5% level) were observed between groups 1 and 3, 2 and 3, and 3 and 4.
V. DISCUSSION

A. Population Estimates

The visual inspection method of estimating louse populations is subjective and contains several inherent sources of error. First, louse populations on an animal are not uniform. Inspection of a single area on an animal might not reveal the actual extent of infestation. The area examined in this study, however (side of neck, jaw, dewlap, and brisket), is known to be a preferred area for *H. eurysternus* (Matthysse 1946). Also, each animal was additionally inspected from several feet distant which revealed heavy infestations on other body areas such as around the tailhead and twist. Second, lice tend to congregate on top of each other in one area. This frequently occurs in heavy infestations so that the actual number of lice can not easily be determined.

The difficult choice in this system was deciding between groups 2 and 3. The weight loss of the moderately infested heifers indicated that this was done with at least a fair degree of accuracy.
B. Anemia and Weight Loss

The findings that heavy infestations of *H. eurysternus* cause severe anemia in adult cattle is consistent with that reported by other investigators. These animals were extremely weak and scarcely able to walk. The ranch manager estimated that the majority would die during the winter. The anemia appeared to be more pronounced in female than in male cattle. If the mean PCV of the relatively louse-free animals are considered as normal under these conditions, then the PCV of the heavily infested heifers was reduced to 59.4% of normal, compared to 79.6% of normal for the bulls. The mean PCV of the louse-free heifers was higher than that of the louse-free bulls (37.9 to 33.7%), but the mean PCV of the heavily infested heifers was lower than of the heavily infested bulls (22.2 to 25.8%). Light to moderate infestations had no effect in terms of producing anemia in either sex. Although the PCV of the moderately infested bulls was somewhat less than the louse-free bulls, 33.7 vs. 31.6%, this was insignificant upon statistical analysis. Cattle are apparently able to compensate by accelerated hematopoiesis, for the reduction in blood volume caused by light to moderate infestations of *H. eurysternus*.

The additional stress factor of moderate to heavy louse burdens greatly increases the winter weight loss in
unsupplemented animals. Heifers appear to be more affected than bulls as their weight loss is doubled by moderate infestations. Bulls seem to be more affected by the unfavorable weather and grazing conditions than the heifers. If the weight loss of the bulls relatively free of lice is compared to the relatively louse-free heifers, it can be seen that the bulls lost an average of 58.7 lb more per head than the heifers, although their initial average weights on November 6, 1963 were nearly the same.

C. Treatment Justification

The evidence from this study indicates that treatment is economically justified on all heavily infested animals and on moderately infested heifers. Cattle in these categories comprised 12.3% of the total test population and lost an average combined weight of 1078.3 lb more than the animals relatively free of lice. This evidence indicates that treatment on a herd basis for louse control alone is not economically justified. If management practices allow, the moderate to heavily infested animals can be treated separately. Many ranches, however, are operated such that the cattle are rounded up only twice each year. Under these conditions, treatment for lice could be coupled with cattle grub control using a systemic insecticide on a herd basis.
Only two-year-old cattle were used in this study. These animals are in their prime and do not have the added stress of reproduction. It is likely that a similar study utilizing production animals would reveal that louse infestations would have a more pronounced effect.

Anemia and weight loss are two readily measured effects of lice on cattle. Equally important but more difficult to assess are the effects on milk production, conception rate and predisposition to other diseases. It should be stressed that the high fecundity of *H. eurysternus* allows light to moderate infestations to rapidly become heavy during the winter.
VI. APPENDIX
Figure I. A heavy infestation of *H. eurysternus* on a Hereford heifer on the left side of the neck and dewlap.

Figure II. An animal relatively free of lice showing the area examined; left side of the neck and dewlap.
Figure III. A heavy infestation of *H. eurysternus* on the tailhead, around the anus and twist of a Hereford bull.

Figure IV. A heavy infestation of *H. eurysternus* eggs on the tail of a Hereford bull.
Figure V. The egg of *H. eurysternus* attached to the hair of a cow. $\times 62$. 
Figure VI. Adult *H. eurysternus*. x 62.


Dewhirst, L. W., 1964. Personal communication.


