

## OBSERVATIONS ON THE DISTRIBUTION OF WARBLE FLIES IN OHIO.

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The following discussion is based on a study of the numbers, dates of occurrence, and distribution in Ohio of the Ox Warble flies (*Hypoderma bovis* and *Hypoderma lineata*) as determined from an examination of 628 grubs and 15 adult flies collected for the most part during the years 1914 and 1916. The general object of the study is to determine (1) whether both species

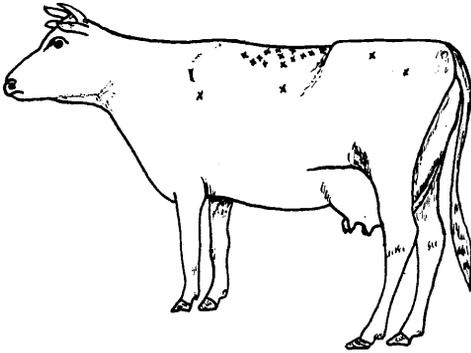


FIG.1. Larvae were taken from the backs of different cattle at the positions marked X.

The part of the animal in which the grubs are found during their last stages is the back. Here they may be found distributed for the most part from the loin to just back of the shoulder. Less frequently they may be found on the rump, or some distance down on the side or on the shoulder. The choice of the back region to go through the last stages has some advantages. Here they are less likely to be injured; there is less play of the muscles, and the animal itself is less likely to receive serious injury.

occur within the state; (2) which of them are numerous enough anywhere and at any time to be notably injurious in the grub stage to dairying and the beef cattle industry; (3) the local and regional distribution of the grubs; and (4) to learn, if possible, what are the conditions favoring the increase or decrease in numbers of the species in the not unreasonable hope that this knowledge may help in the solution of the problem of combatting these parasites.

**Location of Collections.**—Of the 32 counties throughout the state from which collections were obtained, 10 were in northeastern, 10 in northwestern, 10 in southwestern, and 2

in southeastern Ohio. If reports of the occurrence of warble fly grubs not accompanied by specimens are included, then the number of counties infested reach 57; 8 additional counties in northeastern, 5 in northwestern, 1 in southwestern and 9 in southeastern Ohio.

COUNTIES IN WHICH COLLECTIONS OR REPORTS WERE MADE.  
Numbers of each.

NORTHEASTERN COUNTIES			NORTHWESTERN COUNTIES			SOUTHWESTERN COUNTIES			SOUTHEASTERN COUNTIES		
Counties	Col.	Rpts.									
Ashtabula...	2	...	Wood.....	1	...	Miami.....	1	...	Fairfield....	1	...
Lake.....	2	...	Williams....	1	...	Franklin....	2	...	Perry.....	1	...
Cuyahoga...	2	...	Seneca.....	1	...	Clarke.....	1	...	Muskingum 1	...	...
Lorain.....	1	7	Hancock....	2	2	Greene.....	2	3	Guernsey....	1	...
Huron.....	4	...	Van Wert....	1	1	Montgom'y	2	3	Noble.....	1	...
Medina.....	2	...	Mercer.....	1	...	Preble.....	1	...	Belmont....	2	...
Summit....	3	...	Allen.....	3	...	Clinton....	2	...	Hocking....	1	...
Portage....	1	2	Auglaize....	1	1	Highland...	3	5	Washington	2	...
Trumbull...	2	2	Hardin....	1	2	Brown.....	1	...	Athens.....	2	...
Columbiana	2	2	Marion....	1	...	Clermont...	1	3	Meigs.....	1	...
Stark.....	1	2	Delaware...	1	2	Hamilton...	1	...	Jackson....	1	...
Wayne.....	6	7	Union.....	1	1						
Richland...	1	2	Logan.....	1	...						
Knox.....	3	1	Shelby....	1	1						
Holmes....	1	1	Darke.....	1	1						
Coshocton...	3	...									
Tuscarawas	1	1									
Harrison...	1	1									
Totals...	20	44		11	16		15	16		2	12

The localities within these counties from which specimens were obtained were 20 in northeastern, 2 in southeastern, 15 in southwestern and 11 in northwestern Ohio—a total of 48 separate points or farms. If the reports not accompanied by specimens are included, then 44 additional localities in northeastern, 16 in northwestern, 16 in southwestern, and 12 in southeastern Ohio may be added—making a total of 136 herds or farms infested with ox warble flies.

Early in the investigations the two species of warble flies (*H. bovis* and *H. lineata*) were recognized. Contrary to expectation, *H. bovis* was much more abundant. The number of representatives of *H. bovis* was 404, or 83.5 per cent of the total collection.



material at hand, concluded that the older Ox-bot fly, *H. bovis*, hitherto supposed to be the common species of both America and Europe, is in reality either a very rare insect in this country or possibly does not occur at all. Aldrich (Cat. N. America Diptera, 1905) states that *H. bovis* is not positively reported from North America.

Later investigators have become accustomed to refer to the North American warble fly as *H. lineata*.

*H. lineata* was first described by DeVilliers from Europe. It was later described by Brauer from grubs taken from the back of a Buffalo in Colorado. According to Brauer, the species occurs throughout Europe, having been taken in Switzerland, Norway, Crimea, the Balkans, the Caucasus, England, Ireland, Lower and Upper Austria. *H. bovis* likewise occurs in these regions and also in Styria and Hungary.

In June, 1910, C. W. Johnson (*Psyche*, Vol. XVII, p. 231, Dec., 1910) reared an adult fly of *H. bovis* from a larva collected at Manchester, Vt. In 1912, Dr. S. Hadwen (*Bulletin 16, Health of Animals Branch, Canada Department of Agriculture*, pp. 20, plate 9) announced the common occurrence of *H. bovis* at Agassiz, B. C., and in 1914, Dr. C. Gordon Hewitt (*Canadian Entomology*, Vol. XLVI, pp. 1-2) reported that he had examined specimens of this species from Nova Scotia, Quebec, Ontario, Alberta and Saskatchewan, thus indicating a distribution from the Atlantic to the Pacific in Canada.

In 1915, Bishopp (*Annals Ent. Soc. of America*, Dec. 1915) reports that probably *H. lineata* occurs in every state in the Union, although it appears to be more abundant in the southern and central western states; while the so-called European species, *H. bovis*, predominated over *H. lineata* both in distribution and abundance in the northeastern states. In the western two-thirds of the United States, *H. bovis* appears to be found in rather restricted and well separated areas.

While the warble flies are seen to be very generally distributed over the world, they are not prevalent in every country. Some countries are taking measures to prevent the introduction of warble flies. Australia, for instance, has issued a proclamation relating to the importation of cattle from warble infested countries. In order to prevent the introduction of the warble flies, "no cattle shall be imported into Australia from Great Britain, Ireland, the United States of America, or Canada, except those shipped between October and May."

**Discussion of *H. bovis*.**—*Hypoderma bovis* appears to be much the most abundant species in the state, comprising nearly 83.5 per cent of all the specimens. In the northeastern section, 257 specimens, or nearly 53 per cent of all the specimens were obtained. This should not be taken to indicate that the northeastern section is more heavily infested than any other. When the collections made in the vicinity of the Ohio Station are excluded, the northeastern and northwestern collections of *H. bovis* specimens are about equal, that of the latter comprising 106 grubs. It may be pointed out, however, that the fly seems to be more generally distributed in the northeastern section. A study of the map shows much larger number of herds free from infection in the northwestern section than in any other section of the state.

As only one collection of 3 specimens came from Southeastern Ohio, very little can be said of the distribution of *bovis* in that section. In southwestern Ohio, *bovis* was taken in five counties. Eight separate collections were made from these five counties, comprising 38 specimens.

It was hoped that a sufficient number of specimens could be obtained to compare the relative annual abundance. But the number of localities represented and specimens obtained the first year are too meager for such a comparison. Many stockmen, however, claim that there were fewer grubs during the late winter and spring of 1916 than of 1915.

The earliest collections containing fourth stage grubs were received early in March from northeastern Ohio. The earliest specimen (one fourth stage grub) came from Ashtabula County. At this date it was the only grub to be found in the cattle's backs. Later (May 3) most of these cattle were reported to be infested. The latest collections were received on June 6 and 10, from southwestern Ohio. In the Ohio Station herd one warble was observed on July 14. On July 20, the grub had emerged. As only *H. bovis* grubs have been taken from the Station herd for more than three years, it is assumed that this specimen was a representative of *H. bovis*. Thus *H. bovis* grubs may be emerging from the first of March until the middle of July. The greatest number of fourth stage grubs were received during April and the next largest number during May. The length of the season in which the grubs make their appearance is of very great importance in deciding what time of year is best to undertake the eradication of the grubs.

**Hypoderma lineata.**—Only eighty specimens of lineata are represented in the collections, or 16.5 per cent of the total number obtained. This species is most abundantly represented in northeastern and southwestern Ohio, only 2 collections of 1 and 8 individuals coming from the other sections. Eight localities, just as many as is represented by bovis, are represented in the collection from southwestern Ohio, the total number of specimens received being 27. Seven localities are represented in northeastern Ohio, the total number of specimens amounting to 44.

The earliest lineata collection came from Highland county, on March 25. The latest collection, consisting of 2 specimens, came from Brown county on May 11. The largest number of collections and specimens were received during April, only one collection being received after April 20, the one from Brown county.

**Seasonal Succession of the Species.**—That *H. bovis* is generally later in emerging from the backs of cattle in the spring than *H. lineata*, is a fact noted by several investigators. This order of their succession is borne out by a study of the data collected in Ohio. It should be stated that in view of the fact that the grubs were squeezed out, many of them were removed at an earlier date than they would have come out naturally. The figures, then, in Table II do not represent the total number of grubs received or removed from cattle, as many of the grubs were not in the fourth stage and hence could not be classified. However, *H. lineata* is apparently the earlier fly, as only two fourth stage grubs were received after April 20, and an adult fly has been taken as early as May 16. In the *H. bovis* life history experiments at Wooster, when the grubs were allowed to come out naturally, 17 out of 21 came out in May.

TABLE II.

SPECIES OF WARBLE GRUBS	MARCH	APRIL	MAY	JUNE	JULY
<i>H. lineata</i> .....	8	70	2*	...	...
<i>H. bovis</i> .....	42	231	115	16	1†

\*Prof. Hine has a specimen of an adult fly, *H. lineata*, taken at Columbus, May 16, 1915. In life history experiments, adults of *H. bovis* have been obtained in April under laboratory conditions at Columbus, and not until June under natural conditions at Wooster.

†This grub was observed in the back of a dairy cow on July 14. On July 20 it was discovered to have emerged. As none but bovis have been found in these cattle for several years, it is assumed that this grub belonged to *H. bovis*.

**Comparison of Sections of the State.**—Perhaps there is little justification for dividing the state into four sections and comparing the warble-fly population of each section. The differences in the number of cattle in each section is not excessive. Northeastern Ohio returned according to the assessors' 1915 report, 414,954 cattle, an average of 17,289 per county. More than 50 per cent of the cattle in this section are dairy cattle, while 17,957 are classed as beef cattle. The total number of cattle in the Northwestern section is 403,140, an average of 14,931 per county, of which 213,295 are classed as dairy cows and 27,786 as beef cattle. More beef cattle are found in the Northwestern section than in any other section, while more dairy cattle are raised in the Northeastern section of the state. The Southwestern section returned a total of 296,000 cattle, an average of 14,800 per county, of which 155,166 are dairy cows, 20,147 beef cattle, and 120,722 other cattle. In the Southeastern section 252,668 cattle were found, an average of 14,862 per county, of which 108,659 were dairy and 11,422 were beef cattle.

As has been shown, the warble fly population, based upon the reports and specimens, is greater for Northeastern Ohio, with Northwestern Ohio a close second. However, a more intensive survey would need be made before drawing any general conclusions. One striking feature brought out by a study of the data is shown in the map, page 171. There appears to be a greater per cent of free herds in Northwestern Ohio than in any other section, especially is this true of the Northwestern tier of counties. At present there is no suitable way of accounting for this, as other factors as well as good care must be at work. Dr. Sheets, of Van Wert county, reports that as a general rule, native cattle are free, only imported cattle being infested. Some stockmen report that they never have had grubs in their cattle, while others state that their cattle have had grubs in the past, but are now free, due to a systematic campaign of squeezing them out.

**Relative Attractiveness of Young and Old Cattle.**—It is a common observation among stockmen that young stock are more heavily infested than older animals. Whether this is due to the selective action of the flies, or whether the young stock are more accessible, or whether there is any very great

difference, are questions that arise in this connection. Many of the reports read as follows: "All cattle infested save those kept in the barn;" or, "all young cattle and dry cows turned out to pasture during spring and summer." It is a general practice to turn young dairy stock out in the spring and leave them out all summer.

The following is a list of animals upon which notes were taken, giving the number of warbles appearing on each animal and the age of the animal:

TABLE III.

NUMBER	AGE	NUMBER OF GRUBS	NUMBER	AGE	NUMBER OF GRUBS
1	15 years.....	17	1*	2 years.....	2
2	12 years.....	1	2	2 years.....	17
3	10 years.....	4	3	1 year, 9 months	13
4	10 years.....	5	4	1 year, 9 months	5
5*	9 years.....	15	5	1 year, 9 months	5
6	7 years.....	3	6	1 year, 6 months	4
7	6 years.....	4	7	1 year, 4 months	2
8	5 years.....	9	8	1 year, 4 months	1
9	4 years.....	1	9	1 year, 3 months	2
10	3 years.....	2	10	1 year.....	14
11	3 years.....	12	11	1 year.....	10
12	3 years.....	3	12	1 year.....	8
13	3 years.....	1			
14	3 years.....	11			
	Total.....	88			73
	Average.....	6.2			6.0

With the exception of two, Nos. 5\* and 1\*, all the animals belong to one herd. If those animals 2 years old and under are considered young stock, and those over 2 years, old stock, then the reader will note that there is very little difference in warble infestation. However, if the animals in the one herd only are considered, then the infestation is slightly heavier in the young animals.

**Date of Publication, March 10, 1917.**