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Bot Fly Larvae (*Cephenemyia* spp., Oestridae) in Mule Deer (*Odocoileus hemionus*) from Utah

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ABSTRACT: Ninety-nine mule deer (*Odocoileus hemionus*) from four Utah counties (Cache, Utah, Sanpete and Sevier) were examined for larvae of *Cephenemyia* spp. in 1985 and 1986. Numbers of first, second and third stage bot fly instars were related to age, sex, year and geographic location of the mule deer. Fawns and adult deer ≥5.5 yr had a significantly ($P \leq 0.05$) higher intensity ($\bar{x} = 37$ and $\bar{x} = 68$, respectively) of infection than the 1.5- and 2.5-yr-old age groups ($\bar{x} = 19$ and $\bar{x} = 26$, respectively). Infection by larvae was not significantly different between sexes. Infection was 100% in both years, but the mean intensity was significantly lower in 1986 ($P < 0.05$). The decline may be related to differences in soil moisture between the 2 years. In 1985, 82% of the deer examined were infected with all three instars. Seventy-seven percent of all first instar larvae were observed in the trachea, usually in the fold immediately posterior to the epiglottis and corniculate cartilages. This new site of attachment for first instar larvae has not previously been recognized.

Key words: Bot fly larvae, *Cephenemyia* spp., mule deer, *Odocoileus hemionus*, Oestridae survey, host and locality factors.

Five species of the genus *Cephenemyia* occur in North America. At least one species is found in nearly all areas of the United States and most of Canada (Bennett and Sabrosky, 1962; Johnson et al., 1983). Three species of bot flies (*C. apicata, C. pratti* and *C. jellisoni*) have been reported in Utah (Bennett and Sabrosky, 1962).

Cases of *Cephenemyia* spp. larvae causing extreme discomfort and/or death in deer have been reported in Colorado (Walker, 1929), California (McLean, 1940), Nebraska (Johnson et al., 1983), New York (Cheatum, 1951), and Minnesota (Fitch, 1928).

The prevalence of *Cephenemyia* spp. infection varies geographically, ranging from a low of 25% (all years) in New York (Cheatum, 1951) to 62% in Ontario (Bennett, 1962), 74% in Texas (Samuel et al., 1971), and 75% in Montana (Capelle and Senger, 1959). There are no reports of these bot fly larvae in deer from Utah. The present study of bot fly larvae from mule deer (*Odocoileus hemionus*) in the Rocky Mountain region of the western United States complements the study of Capelle and Senger (1959).

Ninety-nine mule deer (53 females and 46 males) were sampled from their winter range in northern and central Utah counties ($n = 37$ from Cache located at 41°75′N, 111°70′E; 21 from Sanpete located at 39°40′N, 111°60′E; 18 from Sevier located at 38°70′N, 111°60′E; and 23 from Utah located at 40°15′N, 111°60′E) in 1985 and 1986 for presence of *Cephenemyia* spp. larvae.

The mule deer examined were vehicle kills with the exception of three in 1985 that died from unknown causes. In 1985, mule deer were collected from December through April, and in 1986, due to the mild winter, they were sampled from December and January. Following January 1986, most of the deer had moved back onto their summer range and they were no longer susceptible to being killed by vehicles on the roads.

The head and neck were removed, placed in plastic bags, and stored in a freezer until they could be examined. Necropsies were performed on four deer where they were found; the lungs, broncheal tubes, heart and trachea were examined for bot fly larvae. A mid-sagittal cut was made through the skull with a band-saw to expose the nasal turbinates, ethmoid olfactory area, retropharyngeal pouches, mouth and trachea. Also, a transverse cut was made to open the ethmoid olfactory area for further examination. All areas were examined under a magnifying glass, and

the number of first, second and third larval instars of *Cephenemyia* spp. were recorded. The instars were identified and separated by their relative sizes (first, 1 to 4 mm; second, 5 to 18 mm; and third, >18 mm) and color (the first and second instars are white, third instars are creamy yellow) (Bennett and Sabrosky, 1962). Voucher specimens were deposited in the Utah State University insect collection (Logan, Utah 84322, USA), and in the U.S. National Parasite Collection (Beltsville, Maryland 20705, USA; accession number 79799). The lower right section of each deer jaw was removed and labeled, and age was determined by noting teeth replacement and wear, following the methods of Taber and Larson (1980).

Mule deer were grouped by age into age classes of 0.5 (62), 1.5 (12), 2.5 (12), 3.5 (4) and ≥5.5 (9) yr. Total number of first, second and third instars per animal was related to age, sex, year and location where deer were sampled. Fawns ($\bar{x}$ = 36) and adult deer ≥5.5 yr of age ($\bar{x}$ = 68) had significantly (ANOVA, $P \leq 0.05$) higher numbers of larvae than deer in the 1.5-yr-old age group ($\bar{x}$ = 28). There was no significant difference (ANOVA, $P \leq 0.05$) in the numbers of larvae between sexes ($\bar{x}$ = 36 for females and $\bar{x}$ = 35 for males). We noted a significant (ANOVA, $P \leq 0.05$) decrease in total number of larvae between 1985 ($\bar{x}$ = 46) and 1986 ($\bar{x}$ = 23). This decline may be a response to differences in environmental conditions, such as soil moisture, between the 2 years (1986 was a drought year).

All deer were infected with bot fly larvae. The mule deer from Utah County had the highest numbers of larvae ($\bar{x}$ = 65). This was followed by deer from Cache ($\bar{x}$ = 38), Sanpete ($\bar{x}$ = 37) and Sevier ($\bar{x}$ = 22) counties.

In 1985, 70% of the deer sampled contained all three instars, while only 8% were similarly infected in 1986. This difference was attributed to sampling intervals. Larvae develop rapidly from first to third instars in March and April, while in 1986, due to the mild winter, no deer were sampled after 15 January.

Seventy-seven percent of all first instar larvae were observed in the trachea, usually in the fold immediately posterior to the epiglottis and corniculate cartilages. Because of the small size of the opening, this region prevents third instars from migrating back to the trachea and lungs. These observations indicate that the first instar larvae remain attached in the upper region of the trachea prior to molt in late February. This site of attachment for first instar larvae has not previously been reported. Larvae may then migrate into the retropharyngeal pouch, dorsal to the epiglottis in the nasopharynx. Once the larvae attach their oral hooks they cannot be expelled by coughing. Cuticular spines in larval stages differ in size, number of bands per segment and size and shape (Bennett and Sabrosky, 1962). The spines help the parasite from being dislodged from its host. Inside the retropharyngeal pouch larvae feed on mucus and fluids from the inflamed cells until they mature and migrate out of the host. Histologic examination of the affected pouch has revealed extensive pitting and erosion of epidermal cells (Cogley, 1987). The first instar also attach themselves in the olfactory region of the nasal passage: 12% of the larvae were found here. This site of attachment, however, presents problems to deer, since first instar larvae may molt to second and third instars in this region. As third instars, we have observed they often become trapped in folds of the olfactory region and become necrotic and calcified, causing localized abscesses in the host.

Abnormal migrations of third instar larvae were observed at the entrance of the auditory tube, in the bronchioles, lungs, and esophagus, and muscles of the neck. One third instar was lodged against a vertebra and another had penetrated the tracheal wall. Such migrations were uncommon and most probably were the result of the larval migration after death of the deer. Abnormal migration in response to declin-

ing body temperature has been reported by Cogley and Anderson (1981) and Capelle and Senger (1959).

Normally third instar bot fly larvae migrate from the nostrils of the host and pupate in the soil. This period of pupation varies with species and with climatic conditions from 16 to 56 days (Hadwen, 1927). Abnormal pupation was also observed within several mule deer, which could be a response to adverse environmental conditions whereby third instars increase their chance of survival.

Cephenemyia spp. larvae may occasionally penetrate the skull and enter the brain. There have been numerous accounts of *Cephenemyia* spp. larvae causing pain and death in deer. Walker (1929) reported seven such cases at winter feeding grounds in Colorado. Similar cases have also been reported in California (McLean, 1940), New York (Cheatum, 1951) and Minnesota (Fitch, 1928). Little information is available to support these claims. In most of the cases deer were sampled during severe winters and were weakened and emaciated. *Cephenemyia* spp. infection may not have been the primary cause of death. In healthy deer, the presence of *Cephenemyia* spp. larvae rarely causes harm to the deer.

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