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SHORT COMMUNICATIONS

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Nasal Bots and Lice from White-tailed Deer in Southern Alberta, Canada

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ABSTRACT: Heads of 64 white-tailed deer (*Odocoileus virginianus*) fawns, harvested in the vicinity of Magrath, Alberta, Canada, (49°24′782″N, 112°52′113″W) were examined for the presence of nasal bots and lice. The deer were collected between 8–30 January 2004 as part of a government-approved herd reduction protocol. The entire surface of each head was scanned visually for the presence of lice. Each head was split longitudinally, and the nasal passages, sinuses, and ethmoid region were washed for recovery of nasal bots. First instar *Cephenemyia* spp. were recovered from 17 heads (27%). Intensity of infestation ranged from 1–18 larvae (mean intensity 4.8). Among fawns, there were no significant differences in prevalence or mean intensity between the sexes. Two species of nasal bots were identified. Smaller larvae, tentatively identified as *C. jellisoni*, were present in 16 of 17 infested deer while larger specimens, tentatively identified as *C. phobifera*, were found in four deer; and in three of the four it co-occurred with *C. jellisoni*. The presence of *C. phobifera* in Alberta would represent a range extension for this species, which has not been known to occur west of North Dakota. Thirty-one fawns (48%) were infested with the sucking louse *Solenopotes ferrisi*. One infested fawn also had one specimen of the chewing louse, *Tricholiopeurus lipeuroides*.

Key words: Bot flies, *Cephenemyia* spp., lice, concurrent infection, *Solenopotes ferrisi*, *Tricholiopeurus lipeuroides*.

Larvae of *Cephenemyia* spp. are found commonly in the nasal cavities and pharyngeal regions of cervids from the Northern Hemisphere (Colwell et al., 2006), although infestations in wild cervids are rarely associated with major pathologic changes. However, harassment by larvipositing flies can have quantifiable impacts (Nilssen and Haugerud, 1995; Weladji et al., 2003; Anderson, 2006), which are largely attributed to altered activity patterns (Hagemoen and Reimers, 2002).

Detailed surveys for the presence and abundance of *Cephenemyia* spp. in wild populations, particularly in North America, are sporadic and often based on small samples. Recent data on prevalence of infestations are lacking, and since it has been proposed that these parasites are potentially connected with the epidemiology of transmissible spongiform encephalopathies (Lupi, 2003, 2005, 2006), this information could be of value in assessing this possibility. The likelihood of some role in the epidemiology of chronic wasting disease (CWD) has been enhanced by recent experiments, showing the disease can be transferred to uninfected deer with whole blood or saliva from infected deer (Mathiason et al., 2006). Larval *Cephenemyia* spp. are in locations that would allow exposure to, and ingestion of, prions present in saliva and mucous secretions, and there is evidence for transstadial persistence of infectious agents such as bacteria (Rochon et al., 2004, 2005). These studies provide a theoretical basis for these maggots to act as vectors in the transmission of CWD.

Ectoparasites, particularly chewing lice (Mallophaga), can transfer from exotic game to indigenous ungulates (Bildfell et al., 2004) and have been associated with disease states in the new hosts (Foreyt et al., 2004). There have been no recent surveys of white-tailed deer for lice in western Canada, and there is no

information on the identity of the species present.

This study reports the prevalence and intensity of nasal bots and louse infestations in white-tailed deer fawns (*Odocoileus virginianus*), from one population in southern Alberta, in January 2004.

White-tailed deer heads were obtained from hunters during a herd-reduction program conducted by the Fish and Wildlife Division of Alberta Sustainable Resources Development. The program involved a localized cull in the vicinity of Magrath, Alberta, Canada (49°24′782″N, 112°52′113″W: UTM zone 12U 0364466W 5475051N) during January 2004. All animals were killed by hunters and presented to Fish and Wildlife staff on the same day. Heads were removed, and either examined on the day of collection or bagged individually, and stored frozen until they could be examined.

Each head was examined thoroughly for ectoparasites by parting the hair over the entire available surface. Visual inspection was aided by use of supplementary lighting. Specimens were removed and stored in 95% ethanol for later identification. Lice were identified using the keys in Price and Graham (1997).

Heads were bisected longitudinally, exposing sinuses, ethmoid region, and the nasal turbinates. All surfaces were vigorously flushed with saline, and washings were examined under a stereomicroscope at 15–60× magnification. Recovered larvae were stored in 95% ethanol prior to measurement. Larvae were mounted in Hoyer's medium and examined with a compound microscope for identification and measurements. Identification was attempted using the key in Bennett and Sabrosky (1962) and with the assistance of personal communication from J. R. Anderson, University of California, Berkeley (retired).

Sixty-four white-tailed deer fawns were examined. Eleven of 39 (28%) male, and six of 25 (24%) female, fawns were positive for larvae of *Cephenemyia* spp. Intensity ranged from 1–18 larvae, with male and female fawns having mean intensity of 3.9 (±0.7) and 7.2 (±2.4), respectively. The intensity values were not significantly different ($t=1.662$, df=15) between the sexes.

All of the bot specimens recovered were first instar. The specimens ranged in length from 1.5–4.0 mm and in width from 0.5–1.0 mm. Size of the recovered first instars varied significantly ($F=3.099$, df=16, 66, $P=0.001$), with four deer having larvae larger than the remainder. The larger larvae measured 3.2 (±0.2) mm long by 1.0 (±0.02) mm wide ($n=8$). The smaller larvae measured 1.9 (±0.1) mm long by 0.7 (±0.1) mm wide ($n=62$). Sixteen of the infested hosts harbored the smaller larvae, while four harbored the larger specimens. Three of the four hosts with the larger specimens were concurrently infested with smaller specimens.

Thirty-one fawns (48%), including 18 males (46%) and 13 females (52%), were positive for lice. All infested animals harbored *Solenopotes ferrisi*. One animal harbored a mixed infestation of *S. ferrisi* and *Tricholipeurus lipeuroides*.

Positive identification of *Cephenemyia* spp. first instars is difficult, and there is an error in the only available key for North American species (Bennett and Sabrosky, 1962). In their key, the characters for *C. apicata* and for *C. jellisoni* are reversed. This was determined by J. R. Anderson, after comparing numerous larvae obtained from positively identified females caught in baited traps (J. R. Anderson, pers. comm.). Size, location in the host, and morphologic characteristic comparisons for the two types of specimens found in this study, and those reported in Bennett and Sabrosky (1962), Cowan (1943), and Anderson (unpubl.), are presented in Table 1.

Based on morphologic observations, coupled with the location in the host, we have tentatively identified the smaller larvae as *C. jellisoni*. The difference in larval size between this study and the data

TABLE 1. Summary of morphologic observations on first instar *Cephenemyia* spp. from white-tailed deer in Alberta, Canada, and comparison with observations from identified specimens.

Character	This study: large specimens	This study: small specimens	*C. jellisoni* (J. R. Anderson, pers. comm.)	*C. jellisoni* (Bennett and Sabrosky 1962)	*C. jellisoni* (Cowan 1943)	*C. phobifera* (Bennett and Sabrosky 1962)	*C. apicata* (J. R. Anderson, pers. comm.)
Length	3.2 mm (3.0–4.0)[a]	1.9 mm (1.5–2.5)[a]	0.8–0.95 mm[b]				1.0–1.2 mm
Width	1.0 mm	0.7 mm					
Spines on anal pecten	12–13	9–11	7–11	16	10–14	12	10–16
Ventral rows of spines	13	7–8	4–7	12–14	12–14	5–6	6–12
Ventral spine shape	Blunt	Pointed			Pointed		
Site in host	Nasal cavities	Nasal cavities			Nasal chambers		Bronchi and trachea
Hosts	White-tailed deer	White-tailed deer		White-tailed deer, mule deer, elk, moose	Black-tailed deer	White-tailed deer, moose	Black-tailed deer
Range	Southern Alberta, Canada	Southern Alberta, Canada		Western North America	Vancouver Island	Eastern North America to North Dakota	

[a] Mean (range).

[b] Measurements and morphologic observations based on first instars recovered from females captured in Mendocino County, CA, USA.

of Anderson (pers. comm.) can be the result of growth. Our identification would be consistent with the known distribution of this species.

The larger larvae were tentatively identified as *C. phobifera*. This identification would represent a range extension by this species, as it is known to have a primarily eastern distribution that does not extend west of the state of North Dakota, USA (Bennett and Sabrosky, 1962).

In a previous survey of a large number of white-tailed deer from southeastern USA, over a 13–yr period, Nettles and Doster (1977) reported a low prevalence (4.4%) of *Cephenemyia* spp., although mean intensity was higher than observed in the current study (9.0 vs. 5.5), and a few deer were infested with >30 larvae. Those authors did not report the species involved.

The above observations are in contrast with those of McMahon and Bunch (1989), who reported that the prevalence of *Cephenemyia* spp. was 100% in all age classes of mule deer (*Odocoileus hemionus*) from Utah. Intensity varied among age classes; fawns and adults were most heavily infested, but there was no sex effect noted. Again, no species identification was reported.

The survey of white-tailed deer in Ontario, reported by Bennett (1962), found a prevalence of *C. phobifera* in animals under 6 mo of age that was higher than in our current study. Bennett recorded the highest number of first instars between November and January, with second instars present in pharyngeal pouches during late January or early February. Second instars may have been missed in the current survey, because in most instances, the pouches were not available for examination; this could result in the prevalence and intensity of this species being underestimated.

Concurrent infestations by *Cephenemyia* spp. have only been reported once in North America. Anderson (1986) reported the concurrent infestation with *C. apicata* and *C. jellisoni* in Columbian black-tailed deer (*Odocoileus hemionus columbianus*) in northern California. The relative paucity of reports on co-occurrence may reflect the absence of accurate identifications, perhaps the result of cautionary comments by Bennett and Sabrosky (1962) regarding the difficulty of using larval characteristics. Despite the confusion in the key of Bennett and Sabrosky (1962), the first instars of the two species recovered in the current study were easily distinguished on the basis of the shape and number of the terminal group of spines.

In Spain, dual infestations of the nasopharyngeal bots *C. auribarbis* and *Pharyngomyia picta* in Iberian red deer (*Cervus elaphus hispanicus*) have been described (Vicente et al., 2004). The authors suggested that there were significant interactions among the species of bot, interactions that may have influenced survival of one species. Differences in chronology of the two red deer bot fly lifecycles tended to reduce the amount of competition, but where both species were present, there was a reduction in the number of third instar *P. picta*. This implies that competition for resources in the pharyngeal pouch may have reduced the survival of one species. While there is no evidence, from the current study, of competitive interactions between first instars of *C. jellisoni* and *C. phobifera,* it is possible that space and resources may become limiting as the larvae move to the pharyngeal pouches.

The impact of these infestations on white-tailed deer is likely to be minimal, considering the low intensity. However, some of the small first instars may have been missed, so the actual number of larvae may be higher.

The potential for these larvae to act as mechanical vectors of CWD prions is purely speculative. The evidence for direct transmission of prions between cervid hosts is compelling (Miller et al. 2004, Grear et al. 2006), although some small

role for bot flies and blood-feeding arthropods remains a possibility that needs to be addressed.

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