THE MOOSE FLY, *HAEMATOBOSCA ALCIS* (MUSCIDAE) AND SKIN LESIONS ON *ALCES ALCES*

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Abstract: Large numbers of the moose fly, *Haematobosca alcis* (Snow, 1891), were present on the rump and posterior aspect of the hind legs of a captive, 3-year-old, female moose from mid-May to early September. Few were collected off a calf moose or woodland caribou housed nearby. Sweep-net collections over the rump of the moose at 0900 hr contained equal numbers of males and females; females predominated in collections at 1600 hr.

Open skin lesions first appeared in mid-June on the female moose in the postero-lateral region of both hind legs about 10-18 cm above the tibio-tarsal joint (the hock). Throughout July and August, up to twelve spherical, wet, pinkish wounds were present on each hind leg. Individual lesions were up to 1.5 cm in diameter, while some coalesced forming larger lesions. Persistent skin lesions resulted from clusters of *H. alcis* feeding, possibly at the site of bite wounds made initially by the larger tabanid flies. The wounds were enlarged over summer by moose flies feeding or drinking at the periphery and were prevented from healing until September when fly numbers declined.

The little known moose fly, *Haematobosca alcis* (Snow, 1891), has been mentioned only sporadically in the scientific literature since the original description of specimens from moose (*Alces alces*) in northern Minnesota (Snow 1891). The taxonomic history of this small muscid fly has been confused. Two former generic designations, *Haematobia* and *Lyperosiops*, are no longer accepted (see Burger and Anderson 1974 for details). The horn fly, *Haematobia irritans*, its closest relative in North America, is a pest of cattle (Burger and Anderson 1974). In Europe, a congener, *Haematobosca stimulans*, is also associated with cattle and apparently not with cervids (Hammer 1941, Kuzina 1950).

In addition to the type locality in northern Minnesota, *H. alcis* was reported by Murie (1934) on Isle Royale, Minnesota; by Peterson (1955) on St. Ignace Island, Ontario; by Stone *et al* (1965) in Michigan, Newfoundland and Alaska and by Pledger et. al. (1979) in Alberta. Burger and Anderson (1974), studying the biology of flies off moose in Yellowstone National Park, Wyoming, suggested *H. alcis* probably occurs throughout North America wherever moose are found. *Haematobosca alcis* does not occur in Eurasia (Pont 1986).

The moose fly is presumed to be haematophagous (Burger and Anderson 1974). Both males and females occur on the host. As many as 500 *H. alcis* may be seen resting or feeding on the animal's hind quarters. When a moose moves suddenly and quickly, the flies momentarily take flight but follow and re-alight. Stimulated perhaps by gases released at defecation, gravid females descend upon the fresh feces within 30 seconds (Burger and Anderson 1974). Eggs are deposited singly at a rate of about 10/min. into fissures in the fecal pad. Rapid, jerky movement from one spot to another completes oviposition within 3 minutes. Flies then leave the feces, presumably in search of their host. In the laboratory at 21°C, adults emerge from pupae as early as 14 days after oviposition and the

emergence of most is complete by 23 days. The moose fly overwinters in the pupal stage. Pupae are in the soil as most larvae leave the feces after reaching maturity. In Yellowstone, Burger and Anderson (1974) observed *H. alcis* on moose throughout summer and early fall.

In our study, the availability of a 3-year-old female moose and a female calf provided an opportunity to further observe the habits of this much maligned but neglected companion of moose. Of particular interest was the origin of skin lesions on the hind legs of moose which have been attributed by earlier authors (Murie 1934; Peterson, 1955) to *H. alcis*.

METHODS

Captive moose were maintained at the Kakabeka Falls Game Farm located 34 km north-west of Thunder Bay, Ontario. Other ungulates held on the 28 hectare area in large fenced compounds or wandering free,included: 11 woodland caribou (*Rangifer tarandus caribou*), 2 moose, 3 white-tailed deer (*Odocoileus virginianus*), 12 fallow deer (*Dama dama*), 4 sika deer (*Cervus nippon*), 4 horses, 7 cows and 7 llamas. Up to 5 moose had been kept each year at this location during the preceding 5 years.

Flies were collected by a series of sweeps on, around and in the vicinity of untethered animals using a 30 cm diameter, long-handled,insect net. One collection included three separate sequences each of 6, 6, and 8 sweeps. Often it was not possible to obtain a total of 20 sweeps from an animal and these collections were excluded from analyses. Collections were attempted at standard times of 0900 and 1600 hr every third day provided rain or strong wind did not restrict fly activity. Flies were killed using ethyl-acetate and frozen in labelled plastic bags until identified.

The focal animal sampling technique (Altmann 1974) was used to quantify the

responses of moose and caribou to fly activity. A randomly selected animal termed the focal animal, was observed directly or using binoculars for a period of 10 minutes. Responses observed were noted using an audio tape recorder and were later transcribed.

RESULTS

Of the 4,317 flies collected by systematic or random net sweeps off moose and caribou from 15 May to 28 Aug., 94% were muscids including *H. alcis* (64%) and stable flies, *Stomoxys calcitrans* (30%). Black flies (Simuliidae), horse flies and deer flies (Tabanidae) and mosquitos (Culicidae) comprised the remainder. Mosquitos were the first biting flies captured and were active 15 May when the study began. Moose flies were first collected 16 May; blackflies, 23 May; horse flies, 28 May; and deer flies, 7 June. Horse flies were not collected after 13 August. It was our impression that tabanids were much less abundant in 1984, the year of this study, than in previous summers.

For comparison, the numbers of diptera collected from the female and calf moose as well as from a yearling woodland caribou are presented (Table 1). Only counts of flies in a limited number of samples which were collected in the same manner and on the same day are compared. The moose fly was numerous on the female moose but few were collected off the calf. Only two *H. alcis* were collected from the yearling caribou. Stable flies were most numerous on the calf moose and were rarely collected off the female. Although not collected, stable flies were constantly present on caribou calves.

Table 1. Numbers of biting flies in 13 comparable sweep-net collections off captive moose and caribou.

Fly	Sample animals: Cow moose	Calf moose	Yearling caribou
Haematobosca alcis	2230	13	2
Stomoxyx calcitrans	2	352	96
Simuliidae	11	70	25
Tabanidae	16	1	8
Culicidae	7	16	2
Total	2266	452	153

The most common avoidance reaction exhibited by both female and calf moose was flicking of the ears (Table 2). A calf and yearling woodland caribou included for comparison commonly stomped their feet while moose seldom did so. In addition, yearling and adult caribou were frequently observed running when flies were active. Before taking flight, caribou were seen standing with the front legs splayed and head held low in the insect harassment stance (often while standing in shallow water). However, neither running nor the harassment stance were recorded in any 10 min, focal animal observation period. The female moose commonly bedded down in mid-afternoon in a few wet areas where the lower limbs were covered with mud and wet grass.

Haematobosca alcis was first collected off moose on 16 May. They were abundant in the first week of June (Fig. 1). Regular collections suggest the flies were less numerous in late June but increased in numbers by 30 July. After 30 July the female moose became difficult to approach and regular collections could

Table 2. Mean number and frequency (%) of occurrence of insect avoidance behaviours observed 28 May to 23 Aug. during 10 minute, focal animal, sampling periods.

Behavioural Response	Cow Moose (16) *	Calf Moose (4)	Yrlg. Caribou (21)	Calf Caribou (7)
Ear flicks	61.4 **	33.0	18.6	22.5
	97.9%	91.0%	56.6%	26.9%
Foot stomps	0.1	0.0	5.6	37.0
	0.1%	0%	16.9%	51.6%
Head shakes	0.3	2.3	2.7	5.1
	0.5%	6.2%	8.2%	7.2%
Head tosses	0.8	1.0	2.5	0.0
	1.2%	2.8%	7.7%	0%
Body shakes	0.0	0.0	1.1	6.6
	0%	0%	3.2%	9.2%
Totals	62.7	36.3	30.5	71.2

* number of 10 minute, focal animal, sampling periods.

** mean/moose/10 min.

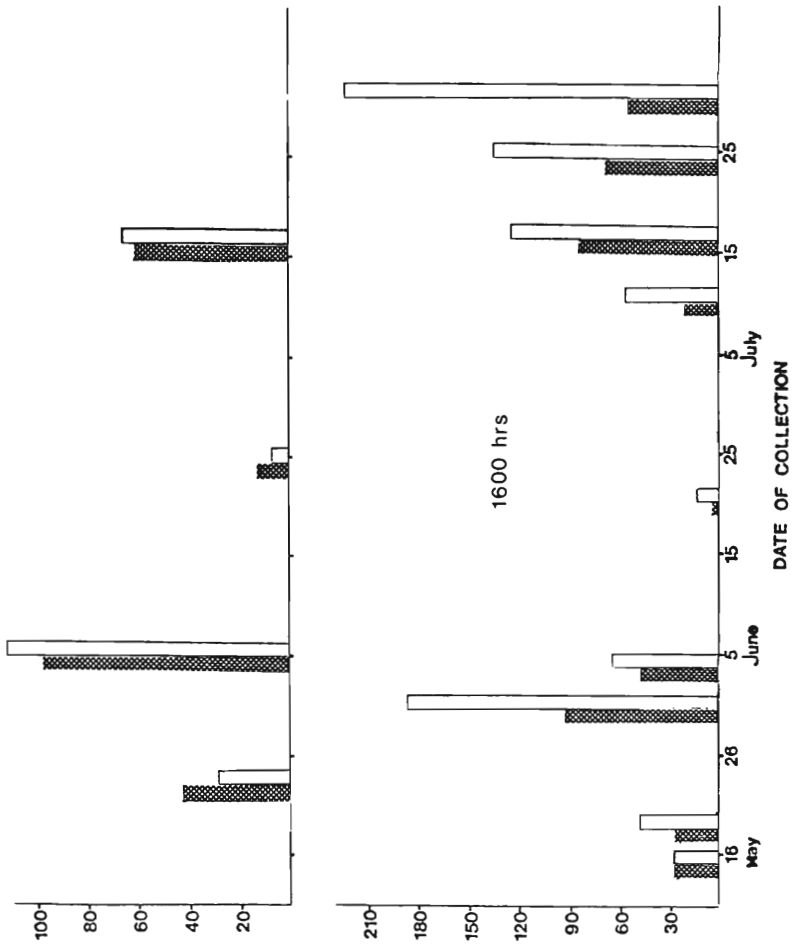
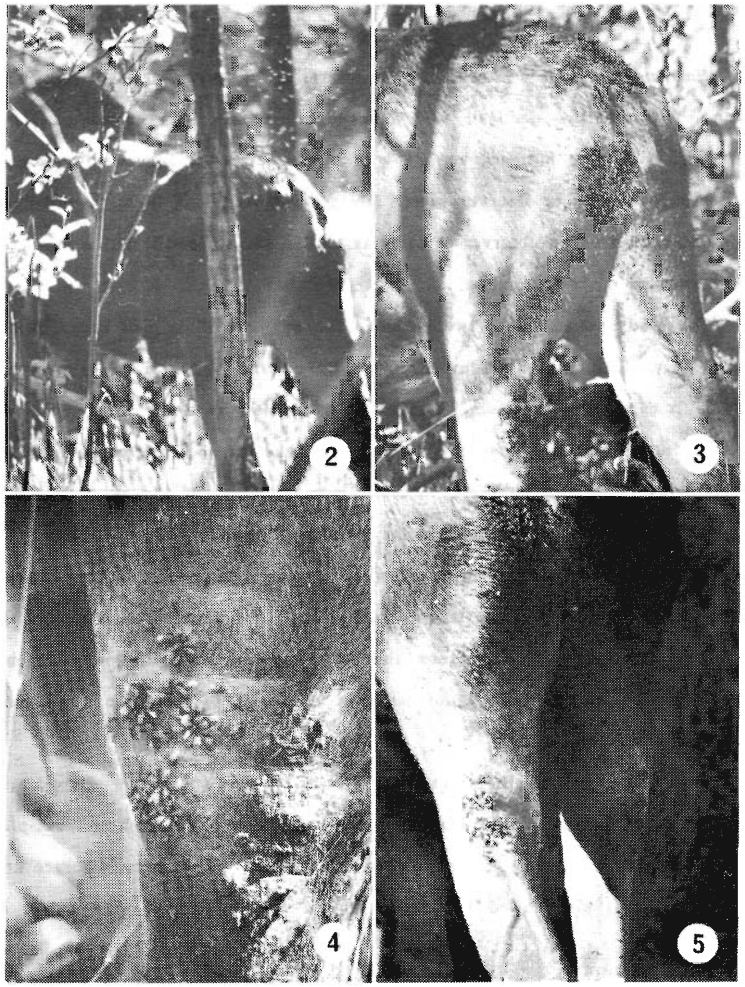


Figure 1. Number of *Haematobosca alcis* collected off a cow moose in morning (0900 hr) and afternoon (1600 hr) (shaded = male flies; unshaded = female flies).

no longer be made. Nonetheless, *H. alcis* remained present throughout August but decreased sharply in numbers in early September following a few nights with temperatures dropping to -3 and -5°C.

Specimens were present on the female moose in all weather conditions, including rain. They were collected as early as 0845 hr and as late as 2230 hr. Their presence in light frost on the hairs of moose in the early mornings in fall suggests they remain on moose during the night. Equal numbers of male and female *H. alcis* were present in sweeps off moose at 0900 hr but females predominated (67%) in collections at 1600 hr ($X^2 = 19.25$) (Fig. 1).

Moose flies were found primarily on the posterior of the female moose (Figs. 2 and 3). Large numbers occurred on the rump and on the back of the legs 10-18 cm above the calcaneum or hock region. They also occurred on the medial-lateral aspects of the front legs, on the neck and rostrum, but in fewer numbers. Flies were numerous in the hock region on 28 May. By 18 June, tight, circular clusters or whorls of *H. alcis* were seen on the skin over the distal end of the gastrocnemius muscle. The flies were arranged radially in whorls with their heads close together at the site of a small skin lesion (Fig. 4). By early August, open, pink, wet skin lesions were up to 1.5 cm in diameter and numerous *H. alcis* fed at their margin with their bodies oriented radially outward (Fig. 5). Some of the sores coalesced forming larger lesions. A dried scab did not form over the pink to red granulation tissue until *H. alcis* became less numerous in early September. A few unidentified muscid flies were also observed on the open skin wounds. Tabanids, particularly horseflies, fed in the same area on the back and side of the hind legs above the hock from 28 May to 13 August. Blood sometimes flowed freely from bite wounds when the tabanids departed. Skin lesions were not seen on the hocks of the calf moose.



Figs. 2-5. Haematobosca alcis on a captive female moose. Fig. 2. A swarm of *H alcis* following a moose that had just begun to run. Fig. 3. Flies on rump and around anus and skin lesions visible above hock. Fig. 4. Moose flies arranged radially in whorls feeding at the site of skin lesions above hocks Fig. 5. Flies on skin lesions above hocks.

DISCUSSION

Haematobosca alcis was present on moose from 16 May until early September when their numbers declined with over-night frost. In Yellowstone Park, Wyoming, flies were not observed on wild moose before 24 June despite several earlier opportunities to observe animals (Burger and Anderson 1974). Adult flies, however, landed on an observer as early as 8 June and were still active on moose in Yellowstone on 24 September.

Our study suggests that two peaks in the numbers of *H. alcis* occur by the end of July. Estimating a 30-day life cycle, Burger and Anderson (1974) predicted the fly is capable of producing 3 generations per year in Yellowstone. If adult flies are not particularly long-lived and the 2 peaks seen here reflect generations of maturing flies, then our data suggest 3 generations could also occur by early September in northwestern Ontario in the vicinity of Thunder Bay.

Both male and female moose flies may remain on moose 24 hrs per day. Why females predominate in afternoon collections is not understood. Possibly the sexes are not evenly distributed on the body of their host. In the afternoon, proportionately more females could occur in the region of the rump where most survey samples were taken.

This study confirms the strict specificity of *H. alcis* for moose. Only a few possibly stray specimens were collected off caribou and although not sampled closely, the fly was never noticed on other ungulates held nearby. Burger and Anderson (1974) also failed to see *H. alcis* on cervids other than moose in Yellowstone.

Few *H. alcis* were collected off the calf moose. Pledger *et al* (1979) also noted that fewer blackflies were attracted to a penned moose calf then to older animals. Stable flies, on the other hand, were most abundant in our study on both the calf moose and caribou calves. The straw bedding and shelters provided

for the young animals may have encouraged a local abundance of *Stomoxys*. The calf moose did not stomp her feet even when subjected to numerous stable flies whose bite is painful to humans. Pledger *et al.* (1979) noted that calf moose reacted less to the presence of biting flies than did older animals, possibly because flies apparently were not induced to feed on calves. The cow moose flicked her ears frequently, mostly in response to the large, noisy tabanids. Bedding down in wet muddy spots may have been in an attempt to seek comfort from flies biting the lower legs as suggested by Shiras (1935). Both the female and calf moose generally appeared fairly inured to biting flies while caribou exhibited frequent and more vigorous avoidance responses.

Several accounts describe moose entering the water to seek relief from biting flies (Lugger 1896; Flook 1959; Wolfe 1974; Peek *et al.* 1976; Kelsall and Telfer 1974). Mr. S. Duzinski, the farm owner, had seen moose in previous years continually dunking their heads under water, apparently in attempts to remove tabanids from their rostrum (pers. comm.). There are other reports of moose being fed upon heavily by tabanids but failing to enter water that in some cases was close by (Wormer 1972; Cobus 1972; DeVos 1958; Peterson 1955). Peterson (1955) believed that moose seldom entered water other than to cross or to feed on aquatic plants. The same conclusion was reached by Murie (1934) with the exception of one instance of intense insect harassment.

It is difficult to asses the significance of biting flies in relation to the summer movements and general well-being of moose. Smith *et al.* (1970) concluded that moose are not unduly stressed by tabanid flies. Pledger *et al.* (1979) in a study of black flies, felt that the responses of moose increased with increased fly activity. Although Peterson (1955) considered *H. alcis* the most serious pest of moose, the opinion of Burger and Anderson (1974) and our own observations do not support the notion that moose make strenuous efforts to

discourage this fly. Although the bite of the moose fly is painful to humans (Burger and Anderson 1974; Mr. Ian Thompson, pers. comm.), only a small percentage of flies may feed at one time and moose may have become accustomed to their constant presence (Burger and Anderson 1974). A review of the literature and our limited experience leads us to conclude that moose are not overly bothered by flies and the appearance of moose at roadsides in spring, for example, may instead be explained more fully by their interest in salt and new vegetation as already suggested by Fraser (1980).

Bleeding, open lesions and scars above the hocks of moose have been reported by several authors (Murie 1934; Shiras 1935; Peterson 1955; Peek *et al.* 1976; and Rue 1978). Both Murie (1934) and Peterson (1955), believed the wounds probably resulted from the persistent feeding of the moose fly while Peek *et al.* (1976) suspected the larger tabanids. As a result of the present study, we suggest both groups of flies may be involved.

It is tempting to suggest that the site of a skin lesion may be determined initially by the bite of a tabanid fly. Tabanids were active 2 weeks before lesions were visible on moose. Aggregations of moose flies were first seen around a confined spot but as the wound increased in diameter they fed only at its peripheral margin. The advanced skin lesion observed constitutes an area of exposed granulation tissue. Blood does not flow at the wound site and feeding moose flies presumably are taking only tissue fluids or lymph. Although moose flies have robust, piercing, mouth parts like other Stomoxyinae and are capable of biting, flies engorged with blood were not seen. In the later part of May and early June, moose flies may bite randomly in the hock region and consume only small amounts of blood. After mid-June, wet skin lesions may provide supplemental fluids and protein or may become the primary source of nutrients required for egg-laying. The dissection of flies of both sexes captured before and

after lesions appear would provide evidence needed to support this speculation.

ACKNOWLEDGEMENTS

We wish to thank Dr. Stephen M. Smith, Department of Biology, University of Waterloo who provided helpful suggestions and assistance in identifying flies. Dedication by Mr. Steve Dudzinski, Kakabeka Falls Game Farm, Kakabeka Falls, Ontario to good animal husbandry is also gratefully acknowledged.

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