Many of the nematodes had become entwined among themselves and debris, and others found harborage in hollow plant stems and seed hulls. This behavior impeded the processing of soil samples (Walker and Meek 1983). Croll (1970) indicated that aggregations of nematodes are common and evidence suggests that aggregation behavior is associated with quiescence and resistance to adverse environmental conditions. Of the 30 samples processed in the earlier studies, approximately 50% of the nematodes recovered were found in the upper 2 cm of soil surface (Walker and Meek 1983).

Superparasitism, defined as ≥2 parasites of the same species in a single host, was commonly observed in this study. It occurred in 54.9% of all parasitized mosquito larvae. Eleven percent of the larvae had > 5 parasites per host.

Romanomermis culicivorax oviposits in the top 4–6 cm of the soil that is common to Louisiana ricelands. However, the majority of the nematode eggs are found in the uppermost 2 cm. Although the nematode eggs are subjected to soil cultivation practices during seedbed preparation of rice fields, parasitism by overwintering *R. culicivorax* can still occur in spring broods of susceptible riceland mosquito species.[2]

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MOSQUITOES FEEDING ON SHEEP IN SOUTHEASTERN WYOMING

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Little is known about the species of mosquitoes that attack sheep in the United States. In the high plains region and the Rocky Mountain region, only a few researchers (Beadle 1959, Shemanchuk et al. 1963) have used serology to demonstrate the presence of ovine blood in mosquitoes collected from light traps. In Australia, Muller and Murray (1977) aspirated feeding mosquitoes from the legs of restrained ewes, and observed mosquitoes feeding on the face, ears, bare areas of the breech and udder.

Pennington and Lloyd (1975) surveyed mosquitoes that attacked cattle in a flood irrigated area near Laramie, Wyoming, and captured 161,127 culicine mosquitoes on 16 collection dates from June 16 to August 10, 1971. Since that time, mosquito control programs have been implemented in the region (Hulett 1977, Lloyd and Kumar 1979) and numbers of adult mosquitoes have been reduced. The objectives of this study were to determine which mosquito species in this intermountain meadow region of Wyoming were ovine feeders and to make a preliminary examination of the prevalence of that feeding.

Traps were established at the 199.3 ha Paradise unit of the University of Wyoming Farms, 4.7 km west of Laramie in Albany County, Wyoming (elevation 2,184 m). The land is flood-irrigated for crop production and is inundated by overflow from the Laramie River during runoff in May and June. Depressions in fields and along the river remain filled with standing water after irrigation and as spring runoff recedes. In 1978, both cattle and

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sheep were pastured at this site, numbers varied as husbandry decisions were made, and some animals were sent to summer pasture at higher elevations. No mosquito control procedures were implemented on this property.

Two methods were used to survey adult mosquitoes. A sheep-baited Roberts (1965) trap was set for 12 hr (1930 to 0730 hr) on 12 dates from July 15 to 31, 1978. Bait animals, 5- to 6-month old Columbia or Rambouillet ewes, were held singly in the trap with food and water available. In the morning, mosquitoes were removed by a modified car-vacuum powered by a 12 volt battery. A CO_2-baited CDC miniature light trap (Sudia and Chamberlain 1962) was used concurrently on five nights when ovine-baited trap collections were made. A 6 volt battery-operated light trap was suspended 1.2 m from the ground and baited with 4.5 kg of dry ice suspended in a 1.37 kg coffee can with four 3 mm holes in the bottom for CO_2 escape. This volume of dry ice would release an amount of CO_2 similar to that released by an adult bovine sized animal (Morris and DeFoliart 1969). The CDC and the sheep-baited traps, approximately 300 m apart, were visually separated by a knoll. Within an hour of collection, mosquitoes from the CO_2-baited trap were placed in a freezer and held for identification.

Adult mosquitoes were collected via vacuum powered aspirator from open sheds between cattle and sheep pastures on June 27, July 8 and July 15 for blood meal analysis made using the technique of Crans (1969). Antisera, rabbit antibovine IgG and rabbit antisheep IgG (Miles-Yeda, Ltd.), were passed over glutaraldehyde columns with fixed sheep or bovine immunoglobulin attached, to remove immunoglobulins with common determinants (Avrameas and Ternynck 1969). Antisera so obtained were tested for specificity against known blood meals from colonized *Aedes aegypti* (Linn.) females. Mosquito abdomen contents, mixed in physiological saline, were tested against antisera in a 10% Special Noble Agar matrix.

Nine species of mosquitoes wee collected from the ovine-baited trap and the CO_2-baited CDC miniature light trap (Table 1). Eight of the species were collected in 1971 (Pennington and Lloyd 1975, Lloyd and Pennington 1976) using bovine-baited and CO_2-baited CDC miniature light traps. *Culiseta incidens* (Thomson), represented by a single specimen captured by light trap, was collected only in 1978. Seven species listed in Table 1 were collected from both traps in 1978. Seven specimens of *Aedes fitchii* (Felt and Young) were captured in the sheep-baited trap but none in the light trap. *Culiseta inornata* Williston, the most frequently captured species in simultaneous CO_2 and sheep-baited traps, were more common in larval and adult collections made by the city of Laramie in 1978 than in previous years (D. Forcum, personal communication). In 1971 (Pennington and Lloyd 1975, Lloyd and Pennington 1976) *Cs. inornata* was the third most common species caught in a bovine baited trap, and the sixth most common species caught in a CO_2-baited CDC miniature light trap. During July 1971, the CO_2-baited CDC miniature light trap capture was nearly 25/night for this species, whereas in 1978 the nightly catch was less than 15. *Culiseta inornata* is reported to feed primarily on cattle and horses (Tempelis et al. 1967, Washino et al. 1962) and occasionally is attracted to other mammals or to birds (Shemanchuk 1969). *Culex tarsalis* Coquillett is primarily ornithophilic (Carpenter and LaCasse 1974), and only 4 blooded specimens were captured in the sheep-baited trap.

Of *Aedes* species, *Aedes dorsalis* (Meigen) and *Aedes melanimon* Dyar together comprised 52.8% of the catch from the ovine-baited trap. These same species comprised 79% of the catch by Pennington and Lloyd (1975) from a bovine-baited trap. In the current study, the CO_2 and the ovine-baited trap both captured less than 1% of the total number of mosquitoes captured in the study of Pennington and Lloyd (1975). This discrepency may be attributed, in part, to lower numbers of mosquitoes as a result of mosquito control measures in the city of Laramie and on nearby ranches. The present study was performed after the usual time of peak emergence for these two species as well as *Aedes campestris* Dyar and Knab and *Ae. fitchii*. Since mosquitoes were trapped from 1930 to 0730 hr, numbers of species known to feed

Table 1. A comparison of the number and species of mosquitoes collected from CO_2-baited CDC miniature light traps and sheep-baited traps in July, 1978, in Albany County, Wyoming.

	5 nights of simultaneous trapping		12 nights
Species	Sheep-baited trap	CO_2-baited trap	Sheep-baited trap
Culiseta inornata	46	71	116
Cs. incidens	0	1	0
Aedes melanimon	34	17	127
Ae. dorsalis	19	15	68
Ae. campestris	1	4	17
Ae. spencerii idahoensis	5	4	26
Ae. flavescens	0	2	4
Ae. fitchii	1	0	7
Culex tarsalis	2	23	4
TOTAL	108	137	369

primarily during daylight hours, such as *Aedes spencerii idahoensis* (Theobald) (Carpenter and LaCasse 1974) should have been reduced. However, with CO_2-baited CDC light traps set on July 12 and 26, the aforementioned authors caught >20,000 *Ae. dorsalis* and >49,000 *Ae. melanimon*.

Two flocks of sheep and two herds of cattle were in the area from which engorged mosquitoes were collected. Of the 34 blood-fed mosquitoes captured in the sheds, 17 had fed on sheep, 9 on cattle, and 8 on unidentified sources (Table 2). The two *Ae. campestris* specimens taken from the sheds had ingested bovine meals. Specimens of each of the other four species captured in the sheds had fed on ovines.

Table 2. Blood-meal sources of mosquitoes captured from resting sites during July, 1978 in Albany County, Wyoming as determined by agar-gel diffusion tests.

	Blood-meal Source		
Species (number tested)	Bovine	Ovine	Other
Culiseta inornata (6)	0	5	1
Aedes melanimon (13)	4	5	4
Ae. dorsalis (7)	2	3	2
Ae. campestris (2)	2	0	0
Ae. spencerii idahoensis (5)*	1	4	1

* One specimen had taken both bovine and ovine blood.

We believe that mosquito density differences between 1971 and 1978, as reflected by CO_2 trap catches, had substantial impact on the numbers of mosquitoes captured at ovine traps. In high mosquito periods or regions, significant numbers of mosquitoes would be expected to obtain blood meals from sheep if they are present. The effects of large populations of blood-feeding mosquitoes on sheep production remain to be studied. The role of *Aedes* and *Culex* mosquitoes in transmission of Rift Vally Fever and Wesselsbron (Howell 1969) viruses demonstrate that a knowledge of the mosquitoes feeding on sheep can be of epidemiological significance as well. All of the mosquitoes captured in this study are virtually ubiquitous to the Rocky Mountain states (Darsie and Ward 1981), a region with nearly 5 million sheep.

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