Tabanid vectors of the arterial nematode, Elaeophora schneideri in southwestern Montana
by Rolando Humberto Espinosa

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Biological Sciences
Montana State University

Abstract:
A survey of Tabanidae was done during 1984 and 1985 to determine the species acting as vectors of the arterial nematode Elaeophora schneideri Wehr and Dikmans,1935 in southwestern Montana.

Tabanids were trapped with modified Manitoba traps in the Gallatin National Forest. Flies were kept alive in a cooler, and transported to Bozeman for dissection. The head, thorax, and abdomen of each tabanid was cut open and examined for larval forms of the arterial nematode. The ovaries were removed,teased apart,and dilatations of the ovarioles recorded to determine parity. Intensity of fat bodies present in the abdominal coelom was noted.

A total of 1122 tabanids was collected, representing thirteen species. Hybomitra osburni was the most abundant species, 50.0%, followed by H, tetrica, 25.3% , and H.

rupestris, 19.5%. These three species comprised 95.0% of the total tabanids collected. Hybomitra osburni emerged in late June with numbers peaking in late July. Hybomitra rupestris and H. tetrica peaked shortly after emergence in early July. The latter species were rarely trapped after mid July.

Elaeophora schneideri larvae; were present in 0.8% of the tabanids dissected. Three first stage larvae (L1) were recovered from H. osburni in 1984 and 51 larvae (L1 to L2) from H. rupestris and H. tetrica in 1985. Percent infection of infected flies was 50.0% for H. tetrica, 37.5% for H. rupestris, and 12.5% for H osburni. The latter two species. were new hosts records for Elaeophora schneideri.

Parity data, together with fat body intensities, suggested that H. osburni is an autogenous species and is not a major vector of Elaeophora. The infection percentages and possible anautogeny of Hybomitra rupestris and H. tetrica suggests that these species are involved in the transmission of the arterial nematode in southwestern Montana.

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SOUTHWESTERN MONTANA

by

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APPROVAL

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Rolando Humberto Espinosa

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date March 6, 1987

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ABSTRACT

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INTRODUCTION

Elaeophora schneideri Wehr and Dikmans, 1935 (Nematoda: Onchocercidae) is a nematode that lives in the arterial system of native wild and domestic ruminants (elk, moose, mule deer, white-tailed deer, domestic sheep and goats) in North America (Adcock et al., 1965; Hibler et al., 1968, 1969, 1971; Hibler and Adcock, 1971; Anderson and Weinmann, 1972; Prestwood and Ridgeway, 1972; Worley et al., 1972, Worley, 1975). Other ruminant species (sika deer, barbary sheep and ibex) introduced to North America also serve as a definitive host for the arterial nematode (Robinson et al., 1978; Pence and Gray, 1981; Hibler and Prestwood, 1981).

Elaeophora schneideri was originally found in the mesenteric, iliac, and carotid arteries of sheep from Catron County, New Mexico in 1933 (Kemper, 1938). In 1935, Wehr and Dikmans of the Zoological Division of the Bureau of Animal Industry, U.S.D.A., named the nematode found by Kemper Elaeophora schneideri in honor of Dr. F. L. Schneider of the Field Inspection Division, Albuquerque, New Mexico.

Kemper's initial find was followed by Huffman's discovery of the arterial worm in mule deer in Utah (Wehr and Dikmans, 1935). Arizona Fish and Game Department personnel observed blindness of unknown etiology in elk from 1944 to 1961. Eventually the arterial nematode was implicated as the causative agent (Adcock et al., 1965).

In New Mexico, the first record of the arterial worm in elk was in 1964 (Hibler et al., 1969). Elaeophora was not reported from mule deer in New Mexico until Hibler et al. found the worm in mature mule deer in 1968, although reports of the nematode in mule deer in other states and Canada were confirmed prior to 1968 (Hibler et al., 1969).

Flies (Diptera) belonging to the families Tabanidae (horse and deer flies) and Rhagionidae (snipe flies) were found infected with a nematode that resembled E. schneideri (Hibler et al., 1969). Dissection of horse flies captured in the Gila National Forest in New Mexico permitted collection of the infective stages of the arterial worm that were injected into mule deer and domestic sheep. Recovery of adult E. schneideri from the arterial system of these hosts confirmed the biological cycle of the arterial nematode and incriminated horse flies as the natural intermediate host (Hibler et al., 1970).

Hibler et al. (1971a) found two genera of the Tabanidae, Hybomitra sp. and Tabanus sp., acting as vectors of the arterial worm. Later studies in the Gila National Forest identified the following tabanid species as vectors of E. schneideri : Hybomitra laticornis, H. phaenops, H. tetrica rubilata, Tabanus abditus, T. eurycerus, and T. gilanus (Clark, 1972). At the same time H. procyon and T.

monoensis were incriminated as vectors of the arterial worm in black-tailed deer in California (Anderson and Weinmann, 1972).

Studies in Vermego Park, New Mexico showed four species of horse flies (H. aatos, T. punctifer, T. subsimilis subsimilis and T. stoni) were naturally infected with larval forms of E. schneideri (Davies, 1979).

Clinical elaeophorosis in white-tailed deer has been reported from Florida, Georgia, and South Carolina (Prestwood and Ridgeway, 1972; Hibler and Prestwood, 1981). The intermediate hosts of E. schneideri and the life cycle were reconfirmed in South Island, South Carolina (Couvillion et al., 1984). Tabanids found infected with the larval stages of the arterial worm in South Carolina included Tabanus lineola hinellus, and T. nigrovittatus (Couvillion et al., 1984).

The pathogenesis of elaeophorosis varies with the host infected. Kemper (1938) described "filarial dermatosis" on the poll of the head in sheep, and Dikmans (1948) reported lesions on domestic sheep caused by the arterial nematode. Similar lesions described as "scabbing" were reported on the face, muzzle, ears, and crown of Barbary sheep (Ammotragus lervia), an introduced species from North Africa (Pence and Gray, 1981). Wild ungulates in western states show marked muzzle necrosis, ear cropping, antler deformity, and blindness (Jensen and Seghetti, 1955; Hibler and Adcock, 1970). Reviews of the pathogenesis of elaeophorosis are present in the literature and will not be repeated here (Hibler and Adcock, 1971; Davies, 1979; Hibler and Prestwood, 1981)

Elaeophorosis in Montana

The first reported case of elaeophorosis in Montana was from Kalispell, (Wilkins, 1951). Three domestic sheep imported from Idaho were found with lesions in the poll area of the head. Laboratory examination of skin scrapings showed microfilariae present, and the lesions matched the description of elaeophorosis in sheep from Catron County, New Mexico (Kemper, 1938).

In 1971, a moose was observed staggering and moving in circles in the Boulder River drainage, in Sweetgrass County, Montana. The animal died shortly after Montana Fish and Wildlife biologists arrived at the scene (Worley et al., 1972). Necropsy revealed eight immature arterial worms in the right common carotid artery and numerous "fifth stage nematodes in the arteries of the optic nerve sheath and sclera" (Worley et al., 1972).

Three additional moose infected with *E. schneideri* were collected from other areas in southwestern Montana. A mature cow with 28 arterial worms was found in Park County in November of 1971, and a cow moose from the Bridger mountains had eleven adult worms. A young female moose found with the previous cow was infected with one adult worm (Worley et al., 1972).

Later surveys in wild ruminants from Montana found additional moose and, for the first time, mule deer infected with E. schneideri (Worley, 1975). The data indicated that moose have a "lack of resistance" to the arterial nematode while mule deer showed lower worm burdens and presumably are asymptomatic (Worley, 1975; Worley et al., unpublished). These surveys indicate that the arterial worm exists in isolated areas in the foothills and mountaineous areas above 1950 meters in southwestern Montana (Worley, 1975).

To date, elaeophorosis in elk has not been reported in Montana (Worley, 1975; Worley et al.,unpublished). Efforts to survey the potential intermediate hosts and vectors of the arterial worm showed that a number of tabanids are sympatric with wild and domestic ruminant populations in southwestern Montana (Murray, 1972; Worley, 1975).

Although tabanid species have been incriminated as vectors of Elaeophora schneideri in the southeastern and southwestern United States (Hibler et al., 1969, 1971; Clark, 1972; Davies, 1979; Couvillion et al., 1984) the vectors of the arterial worm in Montana are unknown.

Because 82.4% of the mule deer found infected with E. schneideri were from the Bridger Range north of Bozeman, the study was concentrated on the west and east side of the Bridger Range. The purposes of this study were 1) to collect and identify species of the family Tabanidae occurring in southwestern Montana; 2) to dissect tabanids collected to determine which species serve as intermediate host for the immature forms of *E. schneideri*; and 3) to collect data on the parity (oviposition history) of the female tabanids at intervals during the horse fly season to analyze the seasonal aspects of *Elaeophora* transmission and if possible clarify the restricted host range of the parasite.

MATERIALS AND METHODS

The Bridger Range is located in the northeastern corner of Gallatin county north of Bozeman, Montana (Figure 1). The range lies in a northwest-southeasterly direction and extends from approximately 8-9 km northeast of Bozeman, 40 km northwest to Blacktail Mountain (Figure 1). The range covers approximately 345.6 km^2. Study areas were located on the east and west slopes of the northern Bridger range (Figure 1), 40 km north of Bozeman, and comprised 12.8 km^2 of the total Bridger range area.

The study site on the west slope was located 3.2 km south of Flathead Pass in the North Cottonwood drainage northwest of the Armstrong ranch. Trap sites in 1984 and 1985 were located 7.2 km northeast from the ranch boundary along North Cottonwood Creek (Figure 2).

In 1984, trap locations on the east slope of the Bridger range included the middle fork of Brackett Creek and the Fairy Lake area . Additional trap sites were located on the Carrol Creek drainage and the Middle fork of Brackett Creek during the 1985 collecting season. Trapping was also done in the Gallatin mountains, approximately 25 km south of the main study area in the vicinity of Rat Lake (Figure 3).

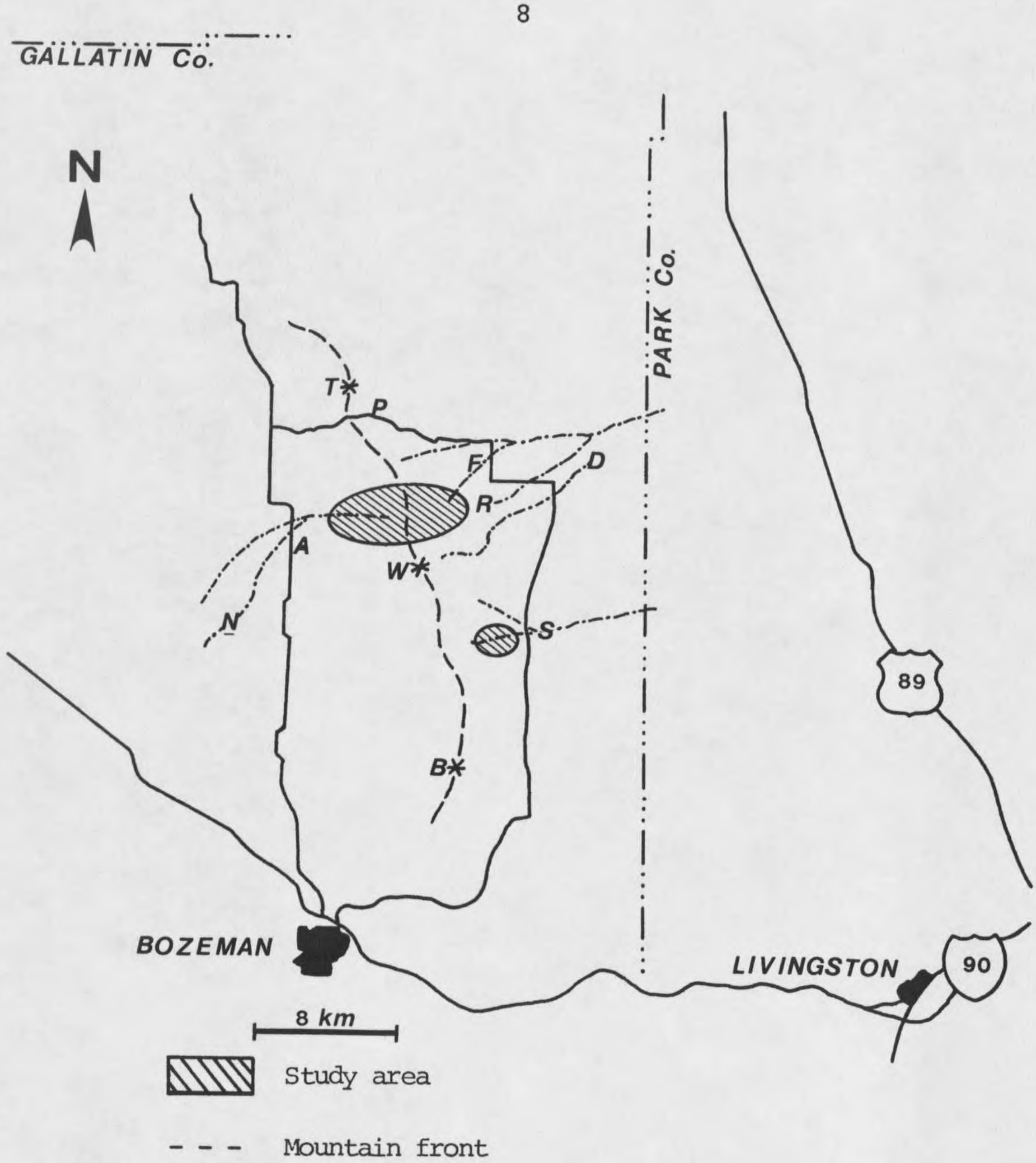

Figure 1. Study area in the Bridger Range, summers 1984 and 1985. A, Armstrong Ranch; B, Baldy Mt; R, Carrol Creek; D, Fairy Creek; S, Brackett Creek, F, Frazier Creek; N, North Cottonwood Creek; P, Flathead Pass road; T, Blacktail Mt; W, Sacajawea Peak.

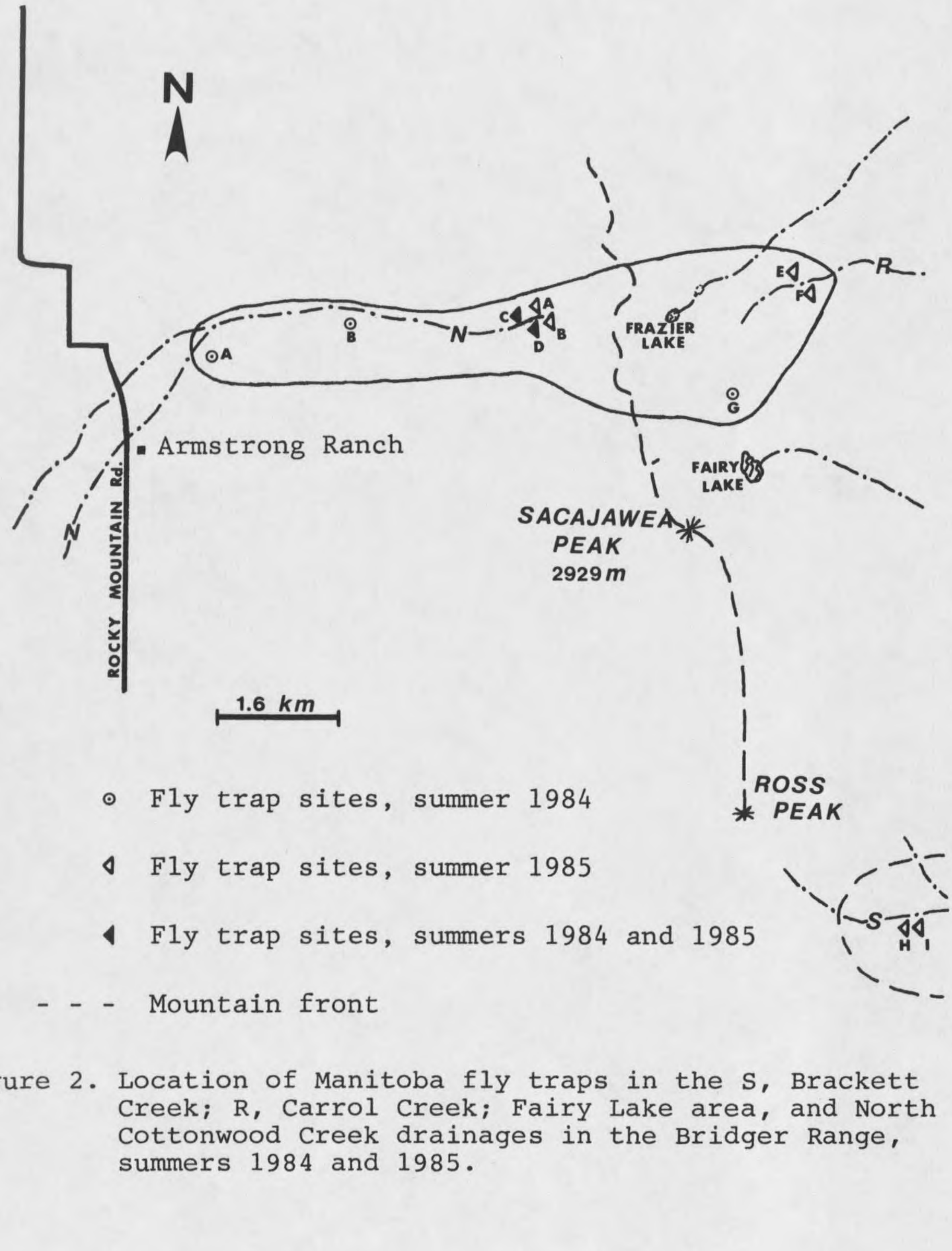

Figure 2. Location of Manitoba fly traps in the S, Brackett Creek; R, Carrol Creek; Fairy Lake area, and North Cottonwood Creek drainages in the Bridger Range, summers 1984 and 1985.

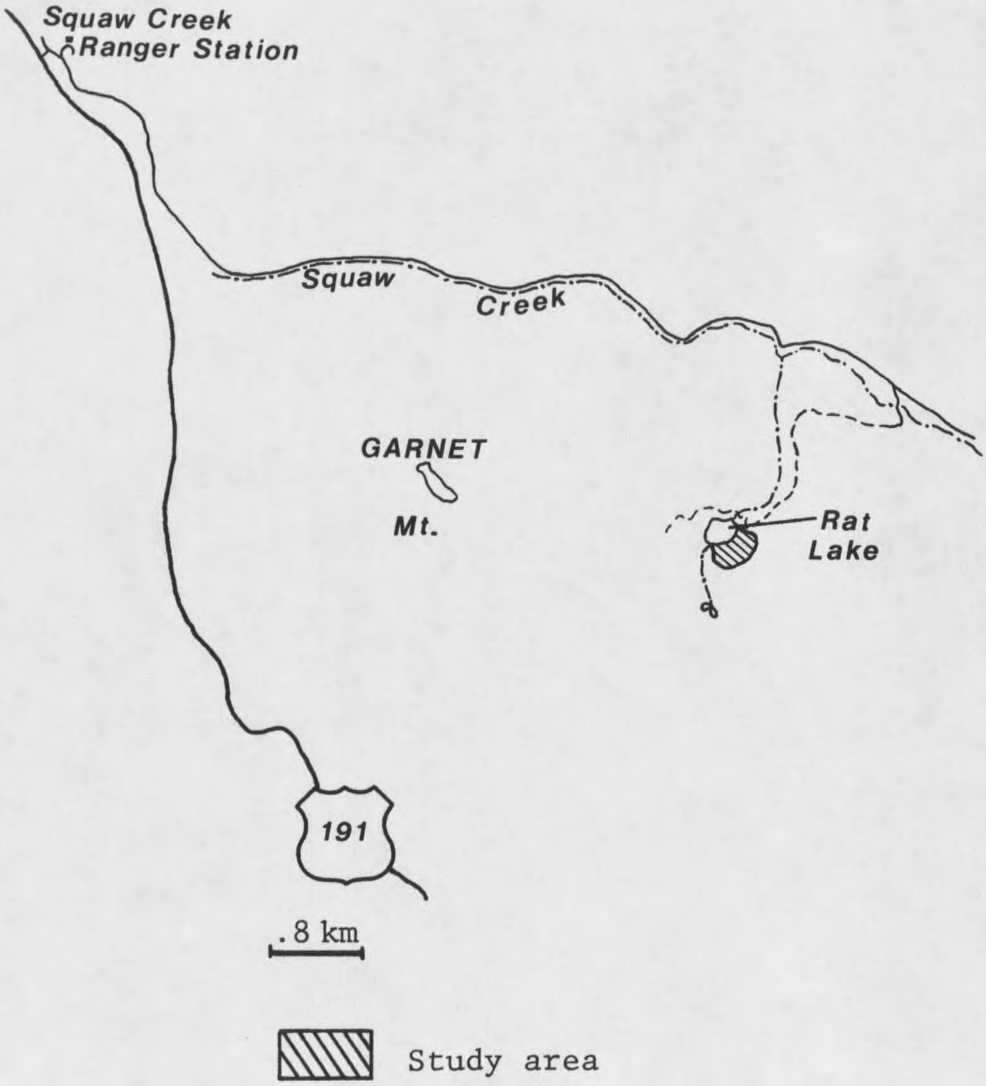

Figure 3. Collecting area in the Rat Lake campground in the Gallatin Range, summer 1985.

Tabanids were collected with modified Manitoba fly traps (Thompson 1969; Catts 1970, Adkins et al.,1972). The traps were made of fiberglass screening (CCS Hanover, Hanover, PA). Flat sheets of the material were cut into four identical trapezoids with the following dimensions : base, 175 cm, top edge, 12.5 cm, and sides of 187.5 cm. The sides of the individual trapezoids were sewn together to form a three dimensional structure (Figure 4) that had a 175 cm^2 bottom opening and a 12.5 cm^2 top opening.

Canvas webbing was sewn to the lower third of the trapezoid seams (Figure 4) and to the apex of the trapezoid for reinforcement (Figure 5,A).

The trap collar, located in the apex of the trapezoid served to hold an inverted acetate funnel, provide an attachment area for the top canister, the fiberglass trap body and the adjustable pole (Figures 5, A,B,C).

An inflatable vinyl beach ball (60 cm, diameter), painted with black glossy vinyl spray paint, was suspended from the pole with a nylon rope, so that 2/3 of the ball was below the edge of the canopy when viewed from a distance (Figure. 4). The black color served to concentrate heat on the surface of the ball and thus attract tabanids (Thorsteinson, 1958). The edge of the canopy was 60 cm from the ground.

Use of fiberglass screening to build the trap canopy and insect holding container eliminated weight and

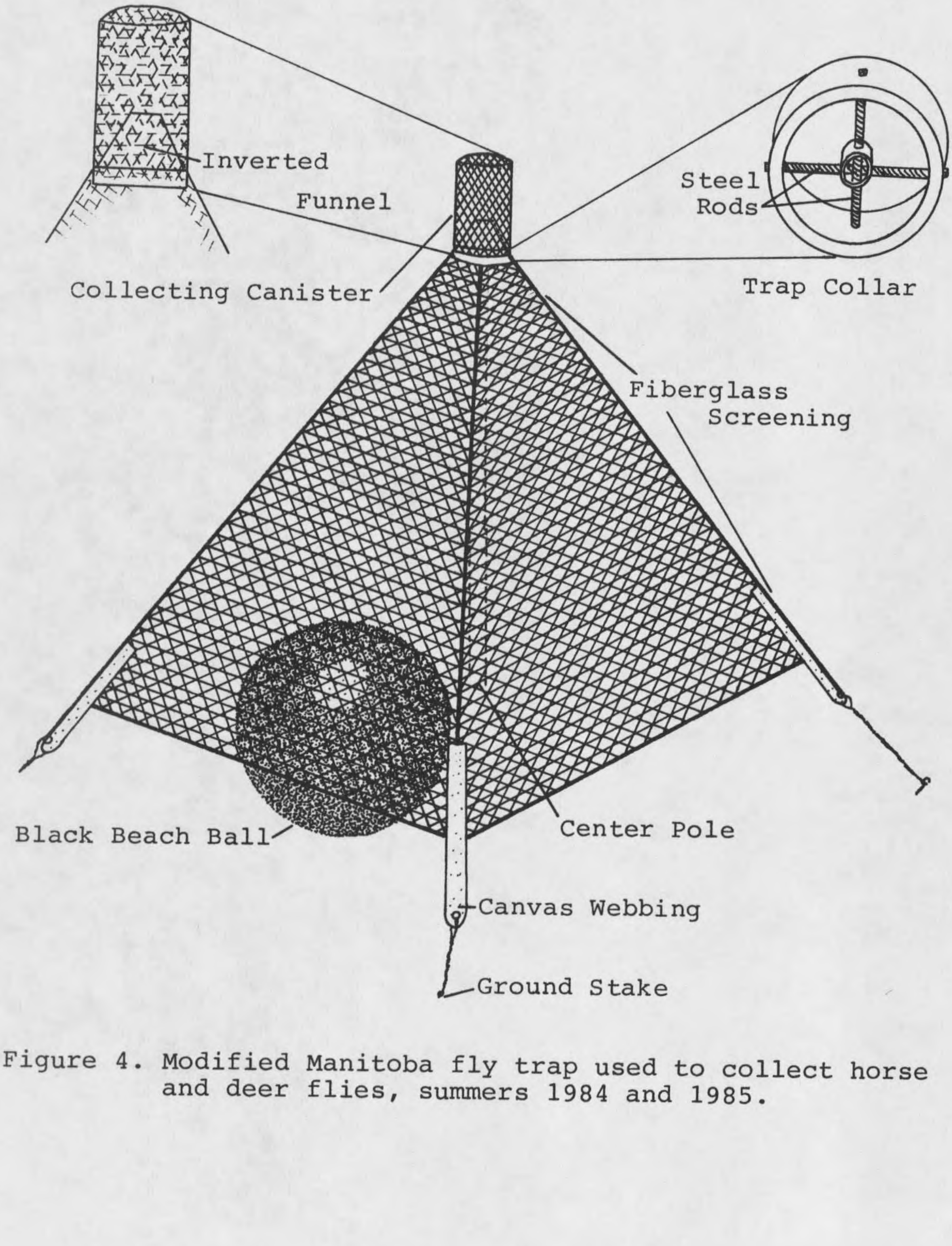

Figure 4. Modified Manitoba fly trap used to collect horse and deer flies, summers 1984 and 1985.

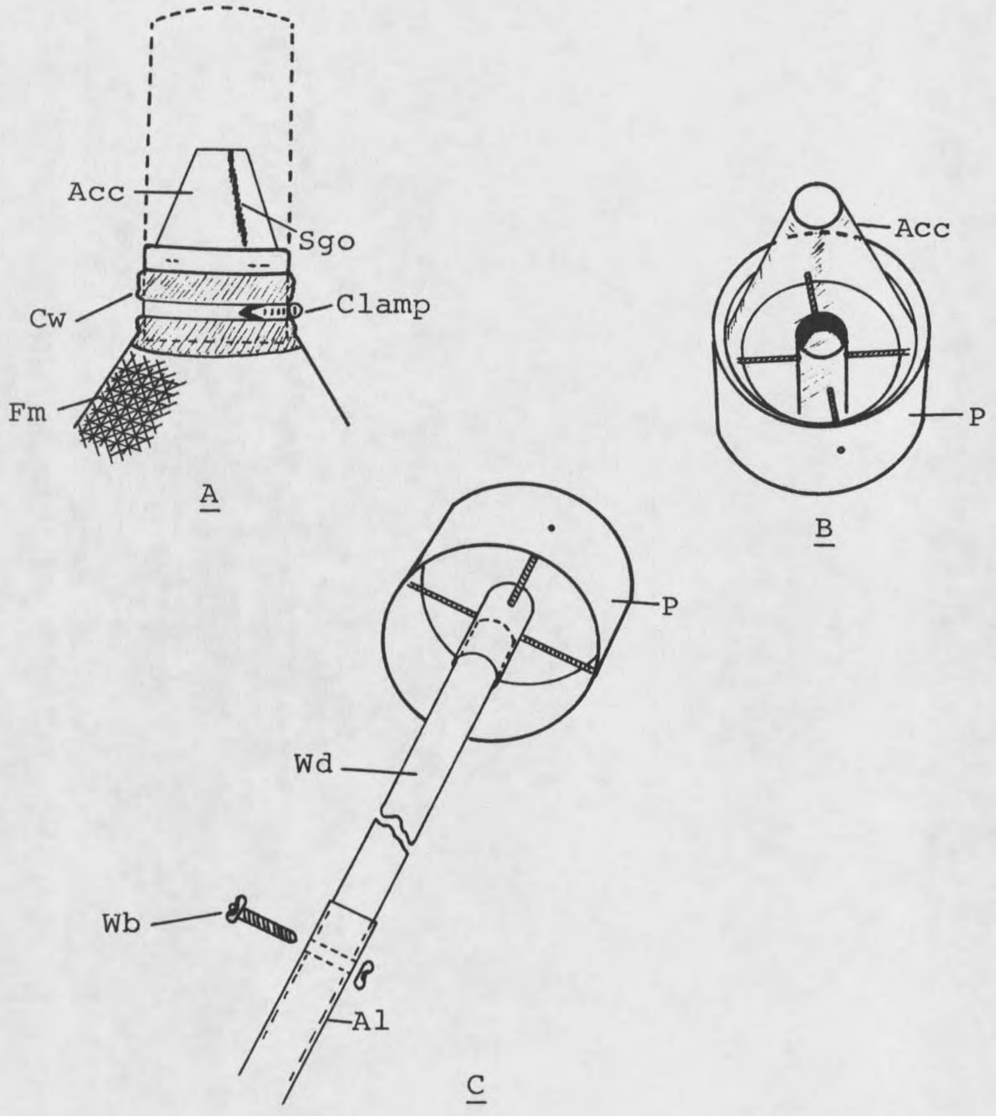

Figure 5. Detailed view of the (A) collar, (B) collecting funnel, (C) aluminum tube, wood dowel, and attachment to the trap collar. Fm, fiberglass mesh; Acc, inverted acetate funnel; Sgo, ShooGoo sealer; Cw, canvas webbing; P, collar with center support; Wd, wood dowel; Al, aluminum tube; Wb, wing bolt and nut.