

THE USE OF AN ANIMAL-BAITED NET TRAP FOR COLLECTING MOSQUITOES DURING WESTERN EQUINE ENCEPHALITIS INVESTIGATIONS IN ARGENTINA

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ABSTRACT. A large net trap was used to sample mosquito populations attracted to horses at three sites each in Santa Fe and Rio Negro Provinces, Argentina, during the austral summer of 1984. These provinces, as well as others in Argentina, were affected by a severe epizootic of western equine encephalitis (WEE) during 1982–83. Totals of 2,752 and 6,929 mosquitoes were collected in Santa Fe and Rio Negro Provinces during five and three trap nights, respectively. *Culex* mosquitoes of the subgenus *Culex* were predominant (45.8% of total) in the Santa Fe collections, although *Aedes albifasciatus* also was prevalent (21.7%). The latter species was predominant (95.7% of total) in the Rio Negro collections. The mosquito fauna was less complex (minimum of 6 species) in Rio Negro Province as compared to Santa Fe Province (minimum of 18 species). The advantages of the net trap indicate that this trap can become a useful tool in arbovirus ecology studies in other areas.

INTRODUCTION

During 1982–83, a severe epizootic of western equine encephalitis (WEE) occurred in Argentina, with an epicenter in Santa Fe Province. The epizootic extended southward to Viedma (40° 48 min. S. lat., 63° 0 min. W. long.), Rio Negro Province, where a few cases in humans also were documented (M. Sabattini, unpublished data). A major objective of follow-up investigations conducted during the austral summer of 1984 was to determine which mosquito species were biting horses in the area most seriously affected (Santa Fe Province) and in Viedma, the southernmost focus of documented arboviral encephalitis in South America (Fig. 1). Also, it was anticipated that the mosquito fauna would be less complex in the more temperate southern area and that the vector relationships of WEE virus might be more easily defined.

Entomologists have used human-baited bed-nets since near the turn of the century for collecting anopheline mosquitoes during malaria investigations. Bed-nets also have been used with other animal bait, and larger versions have been designed to accommodate a variety of large animals such as horses and water buffalo (Service 1976). To our knowledge, this type of trap had not been used in equine encephalitis investigations prior to our study. Experience with a Magoon-type stable trap in Argentina (Mitchell et al. 1985) suggested that a large net-trap baited with a horse might offer advantages in portability and ease of use. Mos-

quitoes were collected with this type of trap at three study sites each in Santa Fe and Rio Negro provinces during February and March 1984, respectively. This report presents information on the composition of the mosquito fauna and the relative abundance of species biting horses at these study sites.

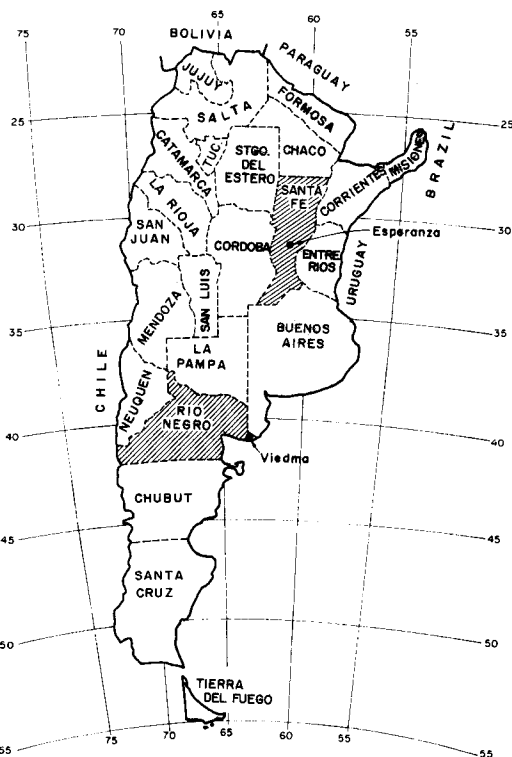


Fig. 1. Map of Argentina: Mosquitoes were collected near Esperanza, Santa Fe Province, and Viedma, Rio Negro, Province.

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MATERIALS AND METHODS

DESCRIPTION OF TRAP. The animal-baited net trap (Fig. 2) is designed to accommodate large animals, such as adult cows and horses. It was constructed from bolts of lightweight nylon tulle. The trap is 360 cm wide, 360 cm long, and 210 cm high. A one-meter wide door-flap was fabricated in the middle of one side.

When in use, the trap is suspended by ropes attached to the top corners of the trap and appropriately spaced trees or other elevated structures. The suspension ropes were tightened so that the base of the trap was raised 30 to 46 cm above the ground while the bait animal was inside (usually from just before dusk until 1 or 2 hr after sunrise). The horse used as bait was tethered inside the trap to a stake driven into the ground. The following morning the trap was lowered so that the base came into contact with the ground, and the horse was removed by opening one side of the door-flap.

The trap was used one night in Rio Negro Province with human bait. A bed enclosed in a bed-net made from bedsheets was placed inside the trap. A man remained inside from shortly before dusk until approximately 1 hr after sunrise. Otherwise, operation of the trap was the same as when equine bait was used.

COLLECTING AND PROCESSING MOSQUITOES. After removing the bait animal and refastening

the door flap, mosquitoes were collected with mechanical aspirators, placed in small cages, and transported to the field laboratory for processing. The specimens were anesthetized with CO_2 , placed in glass tubes with rubber stoppers, and transported on dry ice to the Centers for Disease Control (CDC) laboratory in Fort Collins. Mosquitoes were sorted and identified in the laboratory on a chill table; classified as deplete, engorged, or gravid; and pooled according to species or other taxonomic group in lots of 1 to 50 for virus testing. The results of these tests will be reported separately.

DESCRIPTION OF STUDY SITES AND EQUINE BAIT. The collection sites in Santa Fe Province are located in Las Colonias Department (County), 25 to 50 km northeast of Santa Fe City. This area, which is part of the Espinal Zone (Cabrera and Willink 1973), is characterized by a preponderance of trees in the genus *Prosopis*. This genus is typical of semi-arid areas and is an indicator of a deep water table.

Esperanza: It was operated one night on the campus of the veterinary college 1 km west of Esperanza ($31^\circ 27$ min. S. lat., $60^\circ 56$ min. W. long.). It was placed outside and baited with a small pony weighing approximately 175 kg.

La Celina: This large estancia (farm) is located on the west bank of the Rio Salado and is bordered on the south by Route 166 which connects the towns of Esperanza to the west with



Fig. 2. Animal-baited net trap constructed of lightweight nylon tulle.

Recreo to the east. The trap was operated outside on February 26 and 28, but on February 27 it was suspended inside a large, covered hay barn open on the east and west sides. The trap was baited with a mare (ca. 410 kg) and her untethered foal (ca. 100 kg).

Criadero Murillo: This is a nutria farm located approximately 5 km north of Recreo on the east side of Route 11. The trap was operated inside a large covered shed open on three sides and was baited with a horse weighing approximately 550 kg.

The collection sites in Rio Negro Province are located 10 to 20 km west of Viedma and south of the Rio Negro. This area is part of the Monte Zone, which extends from Salta Province in the northeast to Chubut Province in the southwest (Cabrera and Willink 1973). The Zone is characterized by an arid climate and desert-scrub vegetation. The composition of plant associations varies in different parts of the Zone; however, some species of *Larrea* usually are present. The area surrounding Viedma where our collections were made has been greatly modified by the development of irrigated agriculture under the aegis of the Instituto de Desarrollo del Valle Inferior (IDEVI) del Rio Negro.

IDEVI Experiment Station: The station is located approximately 10 km west of Viedma and grows a variety of fruits, nuts, vegetables, corn and hay. The station, as well as most of the chacras (small farms) in the area, has rows of poplars planted as windbreaks along the irrigation canals. The trap was operated one night at the station underneath a large circle-top barn open on both ends and partially open on each side. The trap was baited with a horse weighing approximately 450 kg.

IDEVI assigns numbers to the chacras in the development scheme; these are given here, in addition to the owners' names, for future reference.

Chacra No. A-93, Luppi Premise: This is a typical truck farm approximately 4 km south of the IDEVI Experiment Station. The trap was positioned between a row of poplars on the south and a storage shed on the north side. The horse used for bait weighed approximately 410 kg.

Chacra No. A-261, Avendaño Premise: This also is a typical truck farm, approximately 10 km west of the IDEVI Experiment Station and bordered on the north by Route 3, which connects Viedma with San Antonio Oeste to the east. The trap was placed at the intersection of two rows of poplars planted along small irrigation canals. The horse used for bait weighed approximately 600 kg. It was at this site that human bait was used for one night, as described above.

RESULTS

Rain fell each time the trap was operated in Santa Fe Province. Rainfall was not measured at the collection sites, so statements about the relative amounts of rainfall are subjective. Few mosquitoes were collected in Esperanza on February 21, when the trap was operated outside, and at La Celina on February 27, when the trap was suspended inside a covered barn open on two sides (Table 1). It rained heavily both nights and also on the night the trap was operated inside at Criadero Murillo when 742 mosquitoes were collected. The largest collection (1,289 mosquitoes) from Santa Fe Province was obtained at La Celina on February 28, when the rain did not begin until we were removing the horse from the trap in the morning.

At least 18 species of mosquitoes were collected in the trap in Santa Fe Province (Table 1). *Culex* (*Culex*) mosquitoes made up 45.8% of the total. Most of these (82.0%) could not be identified beyond subgenus. *Aedes albifasciatus* (Macquart) also was prevalent (21.7%) in the collections. Almost all the mosquitoes that entered the trap subsequently took a bloodmeal, except at La Celina on February 28, when 11.5% of the mosquitoes did not feed.

Rain fell the first two nights the trap was operated in Rio Negro Province. The trap was operated outside at the Luppi chacra the first night and yielded 2,271 mosquitoes (Table 2). The second night the trap was placed beneath the roof of an open circle-top barn at the IDEVI Experiment Station. That evening the rain was accompanied by strong winds, and few mosquitoes (67) were collected. The following night was calm and without rain, and we obtained the largest collection (4,591 mosquitoes) of the entire study at the Avendaño chacra. The trap was operated the following night in the same location with human bait as described above, but only nine *Ae. albifasciatus* (3 engorged and 6 deplete) were collected.

Aedes albifasciatus was the predominant mosquito (95.7%) in the horse-baited collections in Rio Negro Province (Table 2). Only two other species of *Aedes* and three species of *Culex* were recorded. Almost all (99.8%) the mosquitoes that entered the horse-baited trap subsequently engorged.

DISCUSSION

A number of variables such as weather conditions (especially wind, rainfall and temperature), size of the bait animal, and location of the trap (inside or outside) undoubtedly affected our results. Therefore, collections from different sites or collections made at the same site

Table 1. Relative abundance of mosquitoes collected in a horse-baited net trap in Santa Fe Province, Argentina, February, 1984.

Species	Esperanza		La Celina				Criadero Murillo		Total by species	Percent of total		
	Feb. 21		Feb. 26		Feb. 27		Feb. 28				Feb. 29	
	E*	D*	E	D	E	D	E	D			E	D
<i>Aedes (Och.) albifasciatus</i>	1		27		35		199	33	301		596	21.7
<i>scapularis</i>			7				14				21	0.8
<i>stigmaticus</i>			1						1		2	0.1
spp.			9	1			12				22	0.8
<i>Aedeomyia (Ady.) squamipennis</i>							1				1	<0.1
<i>Anopheles (Nys.) albitarsis</i>			3		3		5		7		18	0.7
spp.			3				4		9		16	0.6
<i>Culex (Cux.) apicinus</i>							3				3	0.1
<i>bidens</i>			45		15		117**	15	13		205	7.4
<i>pipiens</i> complex	1		3		1		7	5	2		19	0.7
spp.			123		48		658	63	137	4	1,033	37.5
<i>Culex (Mel.) spp.</i>								29			29	1.1
<i>Mansonia (Man.) titillans</i>			12				11		6		29	1.1
spp.							2				2	0.1
<i>Psorophora (Gra.) confinnis</i>			4		1		3		15		23	0.8
<i>dimidiata</i>			1								1	<0.1
<i>paulli</i>			1								1	<0.1
<i>varinervis</i>			6		1		9		74		90	3.3
<i>Psorophora (Jan.) cyanescens</i>			43		2		18	1	30		94	3.4
<i>ferox</i>					1						1	<0.1
<i>Psorophora (Pso.) ciliata</i>			124		5		44		111		284	10.3
<i>pallescens</i>			153		10		20		15		198	7.2
<i>Psorophora</i> spp.	1		30				14	2	17		64	2.3
Totals	3	0	595	1	122		1,141**	148	738	4	2,752	

* E = engorged, D = deplete.

** Includes 1 gravid *Cx. (Cux.) bidens*.

on different nights cannot be quantitatively compared. Nonetheless, the results are clearly superior to those obtained with a Magoon-type stable trap in Santa Fe Province during February 1979. In that study only 112 mosquitoes were collected in 3 nights (37.3 mosquitoes/trap

night) (C. J. Mitchell, T. P. Monath, and M. S. Sabattini, unpublished data). During the present study, we collected 2,752 mosquitoes during 5 nights (540.4 mosquitoes/trap night). *Culex* mosquitoes in the subgenus *Culex* made up 45.8% of the total collection from Santa Fe

Table 2. Relative abundance of mosquitoes collected in a horse-baited net trap in Rio Negro Province, Argentina, March, 1984.

Species	Luppi Chacra		IDEVI Expt. Sta.		Avendaño Chacra		Total by species	Percent of total
	March 2		March 3		March 4			
	E*	D*	E	D	E	D		
<i>Aedes (Och.) albifasciatus</i>	2,190	7	25		4,411		6,633	95.7
<i>scapularis</i>			1				1	<0.1
<i>serratus</i>	13						13	0.2
spp.	20				5		25	0.4
<i>Culex (Cux.) spinosus</i>			1	1			2	<0.1
sp. A			2		22		24	0.3
sp. B			3		57		60	0.9
spp.	36	5	31	3	96		171	2.5
Totals	2,259	12	63	4	4,591		6,929	

* E = engorged, D = deplete.

Province in 1984 (Table 1) and 81.3% of the limited collection from the Magoon-type trap in 1979.

As expected, the mosquito fauna was less complex in Rio Negro Province (a minimum of 6 species collected compared with a minimum of 18 species in Santa Fe Province). The predominance of *Ae. albifasciatus* in the Rio Negro collections and its prevalence in the Santa Fe collections may be significant. This species obviously becomes abundant in both areas and is an important pest of horses (Tables 1 and 2). The fact that few *Ae. albifasciatus* were collected in the single human-bait collection at the Avena chakra in Rio Negro Province may have been influenced by the makeshift bed-net which probably restricted the dissemination of CO₂, body heat and other attractants. From personal experience in the field, we observed that this species is an aggressive biter and feeds avidly on man. Also, WEE virus was isolated from *Ae. albifasciatus* in Las Colonias Department, Santa Fe Province, during December 1982 (C. J. Mitchell, T. P. Monath, M. S. Sabbatini and J. Daffner, unpublished data).

Studies conducted 30 to 35 years ago suggested that *Coquillettidia perturbans* (Walker) might be a vector of eastern equine encephalitis in the United States (Howitt et al. 1949, Chamberlain et al. 1954). Interest in this possibility has renewed, especially in Michigan and New Jersey. Horse-baited net traps probably could be used advantageously in these investigations. The ease with which this trap can be transported and set, plus its superior performance in comparison to previous trials in Santa Fe Province with a portable but somewhat cumbersome Magoon-type trap, indicate that it can become a useful tool in arbovirus ecology studies in many parts of the world.

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References Cited

- Cabrera, A. L. and A. Willink. 1973. Biogeografia de America Latina. Serie Biologia, Monografia No. 13, Organizacion de los Estados Americanos, pp. 1-120.
- Chamberlain, R. W., R. K. Sikes, D. B. Nelson and W. D. Sudia. 1954. Studies on the North American arthropod-borne encephalitides. VI. Quantitative determinations of virus-vector relationships. *Am. J. Hyg.* 60:278-285.
- Howitt, B. F., H. R. Dodge, L. K. Bishop and R. H. Gorrie. 1949. Recovery of the virus of eastern equine encephalomyelitis from mosquitoes (*Mansonia perturbans*) collected in Georgia. *Science* 110:141-142.
- Mitchell, C. J., T. P. Monath, M. S. Sabbatini, C. B. Cropp, J. F. Daffner, C. H. Calisher, W. L. Jakob and H. A. Christensen. 1985. Arbovirus investigations in Argentina. II. Arthropod collections and virus isolations from mosquitoes, 1977-1980. *Am. J. Trop. Med. Hyg.* (in press).
- Service, M. W. 1976. Mosquito ecology: Field sampling methods. John Wiley and Sons, New York, Toronto, 583 pp.