ing devices plan to offer built-in printers for their machines, but the information provided will be limited to raw sample data and VMD. Therefore, programs for personal computers are necessary for more detailed analyses of droplet size distribution data.

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PRESUMED *DIROFILARIA IMMITIS* INFECTIONS FROM FIELD-COLLECTED MOSQUITOES IN NORTH CAROLINA[1]

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Canine *Dirofilaria immitis* (Leidy) infection is prevalent in North Carolina (Rowley 1977[2], Butts 1979, Falls and Platt 1982), especially in coastal areas. A. R. Johnson (D.V.M., Countryview Animal Clinic, Bayboro, Pamlico County, NC, pers. commun.) has found the filarial worm in 80% of the 3-yr-old dogs examined from Hobucken, Pamlico County (35° 15'N latitude). Data are lacking on specific local vectors, but several species of mosquitoes are incriminated since they are among those (summarized by Buxton and Mullen 1980) found naturally infected with *D. immitis* in other regions of the U.S. However, the vector potential of a mosquito species may differ geographically (Christensen and Andrews 1976, Magnarelli 1978, Buxton and Mullen 1980). This investigation was conducted to determine potential mosquito vectors of *D. immitis* and extent of infections in a coastal area of North Carolina.

The study area was the community of Hobucken, located on South Goose Creek Island in northeast Pamlico County. Mosquitoes were collected in the yard of a residence near the edge of the salt marsh in southeast Hobucken and near a hunting dog kennel 3.2 km (2 mi.) inland from the edge of the salt marsh. The salt marsh was irregularly flooded, primarily by wind tides.

Adult female mosquitoes were collected on August 3 and 14, September 9 and 30, October 7, 15 and 28, and November 26 with CO_2 baited CDC light traps and by the human-bait method. Ninety percent of *Aedes sollicitans* (Walker), the most numerous species collected, were captured by the human-bait method and near the edge of the salt marsh. *Anopheles bradleyi* King was most abundant in light trap collections near the edge of the salt marsh. Collected mosquitoes were taken to the laboratory and stored at −15°C until identified to species and examined for filarial worms.

After legs and wings were removed, the head, thorax and abdomen of each adult female mosquito were separated on a glass slide with the aid of a dissecting microscope, teased apart with insect pins in a drop of *Aedes* saline (Hayes 1953), then examined with 100 or 150X magnification of a compound microscope. The number of parasites in infected individuals was counted, recorded and measured with an ocular micrometer. Filarial worms were presumed to be *D. immitis* if their size range, structure, and developmental site in the mosquito were similar to those reported by Iyenger (1957) and Taylor (1960).

A total of 2,885 mosquitoes, comprising 10 species in 4 genera, were examined for filarial worms. Presumed *D. immitis* filarial worms were found in 19 (0.7%) of the mosquitoes examined. Four of 10 species of mosquitoes were parasitized (Table 1). The infective stage of the parasitic worm (L_3 larva) was found in 3 species, *Ae. sollicitans, Aedes taeniorhynchus* (Wiedemann), and *Culex salinarius* (Coquillett) (Table 2). Only first-stage filarial worms (within the Malpighian tubules) were found in parasitized *An. bradleyi* (Table 2). Infective stage larvae of *D. immitis* apparently have not been reported from field-collected *An. bradleyi.*

Natural infections of presumed *D. immitis*

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[2] Rowley, B. J. 1977. The prevalence of heatworm, *Dirofilaria immitis* (Leidy, 1856), infection in privately owned and free-ranging dogs in Wake, Durham, and Orange counties, North Carolina. M. S. thesis, North Carolina State University, Raleigh. 22 pp.

have been reported in each of the species found infected with L_3 larvae (Crans and Feldlaufer 1974, Magnarelli 1978, Sauerman and Nayer 1983) and in two of the species, *Aedes canadensis* (Theobald) (Crans and Feldlaufer 1974) and *Culex quinquefasciatus* Say (Villavaso and Steelman 1970, Sauerman and Nayer 1983), found not to harbor filarial worms. The small number (65) of females examined precludes an assessment of the vector potential of *Ae. canadensis* in the study area. *Culex quinquefasciatus* females feed primarily on birds (Tempelis and Reeves 1964) and vector potential in the area may have been influenced by the availability of avian hosts.

Aedes taeniorhynchus and *Ae. sollicitans* were the most commonly found infected and may represent important potential vectors in the study area.

The technical assistance of Angelia Barnes and the cooperation of Pamlico County Health Department are gratefully acknowledged.

Table 1. Extent of presumed *Dirofilaria immitis* infections in mosquitoes collected in Hobucken, Pamlico County, North Carolina, 1983.

Species	No. examined	% of total	No. positive	Percent positive
Aedes atlanticus	65	3	0	0
Ae. canadensis	101	3.5	0	0
Ae. mitchellae	1	0.1	0	0
Ae. sollicitans	1,021	35.4	10	1
Ae. taeniorhynchus	139	4.8	4	2.9
Anopheles bradleyi	801	27.8	3	0.4
Culex salinarius	354	12.2	2	0.6
Cx. spp.[a]	401	13.9	0	0
Psorophora confinnis	2	0.1	0	0
Totals	2,885	—	19	0.7

[a] Includes *Cx. quinquefasciatus* and *Cx. restuans.*

Table 2. Developmental stages of presumed *Dirofilaria immitis* isolated from adult female mosquitoes of four species collected in Hobucken, Pamlico County, North Carolina, 1983.

		Developmental stages, location and number of *D. immitis*		
Host	Date collected	Stage[a]	Location[b]	Number
Anopheles bradleyi				
1[c]	Oct. 15	L_1	MT	20
2[c]	Oct. 15	L_1	MT	11
3	Oct. 28	L_1	MT	10
Aedes sollicitans				
1	Sept. 30	L_2	MT	4
2	Sept. 30	L_3	T	1
3	Sept. 30	L_3	T	3
4	Sept. 30	L_1	MT	5
5	Sept. 30	L_1	MT	20
6	Sept. 30	L_1	MT	14
7	Oct. 7	L_3	T	4
8	Oct. 15	L_3	T	1
9	Nov. 26	mf	Gut	49
10	Nov. 26	mf	Gut	7
Aedes taeniorhynchus				
1	Sept. 30	L_1	MT	14
2[c]	Oct. 15	L_3	T	1
3[c]	Oct. 15	mf	Gut	3
4[c]	Oct. 15	mf	Gut	24
Culex salinarius				
1	Oct. 28	mf	Gut	10
2	Oct. 28	L_3	H	3

[a] mf = microfilariae, L_1, L_2, L_3 = larval stages 1 to 3.
[b] MT = Malpighian tubules, T = Thorax, H = Head.
[c] Collected with a CDC light trap near the hunting dog kennel.

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LABORATORY EVALUATIONS OF FORMULATIONS OF AROSURF® MSF AND *BACILLUS SPHAERICUS* AGAINST LARVAE AND PUPAE OF *CULEX QUINQUEFASCIATUS*[1]

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Formulations of the mosquito larvicide and pupicide Arosurf® MSF (Sherex Chemical Company, Inc., P. O. Box 646, Dublin, OH 43017) and commercial preparations of the mosquito larvicide *Bacillus thuringiensis* var. *israelensis (B.t.i.)* were shown by Levy et al. (1984) to generally enhance the mosquito-controlling efficacy over each of the formulation components. This dual component self-spreading formulation was shown to improve field coverage of *B.t.i.* as well as broaden the range of developmental stages that could be rapidly controlled from a single application. The rationale for these formulations as well as the mixing procedures and techniques for field application are further discussed by Levy et al. (1984), Burgess et al. (1985) and Hertlein et al. (1985).

This report summarizes the results of similar efficacy testing with joint formulations of Arosurf MSF and an experimental commercial formulation of the mosquito larvicide *Bacillus sphaericus* (Biochem Products, P. O. Box 264, Monchanin, DE 19710). The efficacy of *B. sphaericus* as a biological control agent for a variety of mosquito species has been reviewed by the World Health Organization (Anonymous 1985).

The *B. sphaericus* formulation used in these tests was coded as BSP-1 (Strain 2362) and contained 12.3% fermentation solids and 87.7% inert ingredients. This product is currently registered under an EPA Experimental Use Permit (EPA Est. No. 43382-BL-1). Recommended application rates of 0.5–3.0 pt/acre were based on water quality (organic content), concentration of larvae, larval instar and the density of vegetative cover.

Formulations of Arosurf MSF and *B. sphaericus* were prepared for bioassay against laboratory-reared larvae and pupae of *Culex quinquefasciatus* Say for testing as water-base and

[1] Mention of a brand name or proprietary product does not constitute a guarantee or warranty by Lee County Mosquito Control District, and does not imply its approval to the exclusion of other products that may also be suitable.