CITY OF NEW ORLEANS

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NEW ORLEANS MOSQUITO CONTROL BOARD

ANNUAL REPORT

1988

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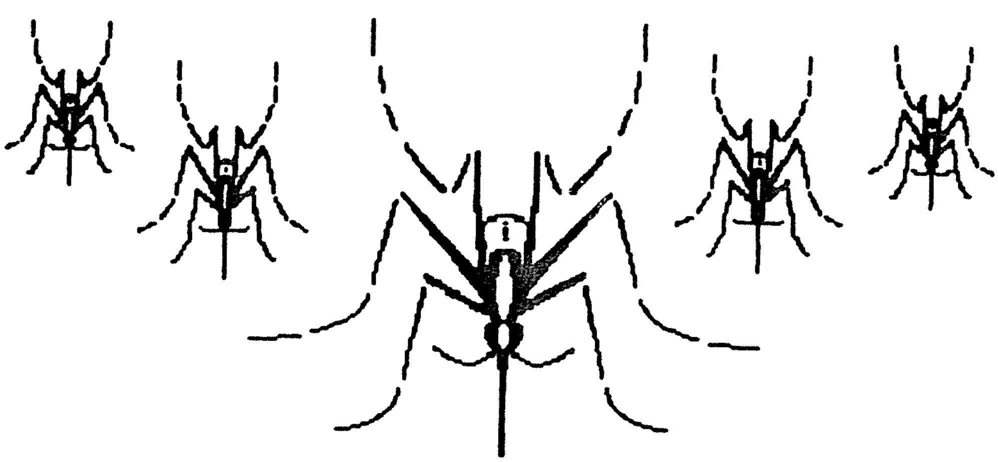

NEW ORLEANS MOSQUITO CONTROL BOARD / EDGAR S. BORDES, JR., ADMINISTRATOR
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DIRECTOR'S REPORT

EDGAR S. BORDES

The Division of Vector-Borne Infectious Diseases of the Centers for Disease Control in conjunction with the New Orleans Mosquito Control Board continued their research into the biology, distribution and control of *Aedes albopictus*. For this purpose, Dr. Jerome E. Freier conducted a series of field and laboratory studies which focused on: oviposition behavior; experimental infection with *Dirofilaria immitis*; evaluation of the efficiency of various trap designs for capturing *Aedes albopictus* adults; mating behavior among *Aedes albopictus* and *Aedes aegypti*; the effect of tire and tree hole habitats on adult body size; collection of adults for virus isolation; and evaluation of the effectiveness of larvicides, including permethrin sand core granules, *Bacillus sphaericus*, and *Bacillus thuringiensis israelensis*.

Another collaboration between the Centers for Disease Control and New Orleans Mosquito Control Board explored the competence of copepods as biological control for *Aedes albopictus*. Dr. Gerald G. Marten conducted field and laboratory experiments with various species of cyclops. Cyclops are small predatory crustaceans in the order Copepods. Dr. Marten's efforts included: isolation and colonization of cyclops species from their natural habitats in the New Orleans area; studies on the natural occurrence of cyclops in tires and the simultaneous presence of *Aedes albopictus*; introduction of cyclops species into *Aedes albopictus* infested tires for long-term survival studies; and studies of the effect of light condition and food supply on the larvivorous ability of cyclops species. Dr. Marten found that *Macrocyclops albidus* and *Mesocyclops* sp. usually consumed 100% of *Aedes albopictus* larvae. *Acanthocyclops vernalis*, and *Mesocyclops edax* are promising, but further research is needed to assess their efficacy.

Encephalitis surveillance commenced in May and continued through September. Bird trapping efficiency was improved by limiting sparrow trap operation to areas where they have previously proved to be most effective. Neting was implemented in those areas in which the sparrow traps had been unsuccessful. Our trapping activities were hampered by excessive rainfall and hurricane warnings in August and September. During the months of operation, 751 birds were captured. Blood samples were submitted to the State Laboratory for Hemagglutination Inhibition testing. All results were negative.

Both the Grumman Ag-Cat and Britten Norman Islander aircraft received their annual FAA inspections. In preparation for the 1988 spray season, several improvements were made on both airplanes. Improvements on the Islander aircraft included: installation of a freon air-conditioning system; installation of landing light deflectors on both wings to aid the pilot's vision during night spraying operations; overhaul of the propellers; and painting the exterior. Maintenance work on the Grumman Ag-Cat aircraft involved complete renovation of the spray-system hopper installation. Gravity loading is now facilitated through reconstruction of our special dual pump/pallet mounted pressurized loading assembly.

Source reduction is an important key to long term effective mosquito control. Areas of concentration were the inner city, City Park, and New Orleans East. Our source reduction efforts focused primarily on construction of new drainage ditches and ditch maintenance through clearance of obstructive vegetation. Area S-21 was drained by installation of a 6" drain pipe via subsurface drainage on Alvar. The W-2 wetland project has been placed on hold again.

This year's public education campaign encouraged the New Orleans community to participate in the control of container-breeding mosquitoes through elimination of unnecessary water-holding containers from their yards. For this purpose, the New Orleans Mosquito Control Board prepared a series of Public Service Announcements which were aired by several local television stations during prime time hours. Other education efforts continued to focus on school children because their habits are more malleable than those of adult populations. Cooperation with the School Board Channel enabled us to reach a larger number of schools than in previous years.

The public education program expanded into the realm of international training through the production of 15 video training programs (two of which are available in Spanish) and the establishment of training agreements with the U.S. Agency for International Development, Tulane University and several foreign Governments. Fees were set for these training courses and the system will continue to generate funds for the coming years. The following is a list of the foreign visitors that received varying degrees of training here at New Orleans Mosquito Control (excluding several hundred international university students):

1988 International Visitors

Name	**Title**	**Country**
Dr. Peter Tallos	Oncologist	Australia
Dr. Richard C. Russell	Dept. of Public Health	Australia
Fred C. Smith	Ministry of Health	Belize
Doreen Gabourel	Ministry of Health	Belize
George Lamb	Ministry of Health	Belize
Dr. Milton Moura Lima	Entomologist Sucam	Brazil
Dr. Myint Myint Soe	Sr. Research Officer	Burma
Dr. Francisco Paniagua	Microbiologist	Costa Rica
Juan Acevedo Nova	Assistant Entomologist	Dominican Republic

Jose Rafael Perez Maximibiano	Assistant Entomologist	Dominican Republic
Teofilo Alt. Santana Raminez	Assistant Entomologist	Dominican Republic
Rafael Trejo Taveras	Medical Corp.	Dominican Republic
Dr. Nelson Espinosa	Coordinator, Malaria Dept	Ecuador
Dr. Gonzalo Macias	Chief, Malaria Dept.	Ecuador
Dr. Luis Trivino	Director	Ecuador
Dr. Dyna de Navarro	Medical Supervisor	El Salvador
Dr. Francisco Zaldivar	Regional Supervisor	El Salvador
Dr. Michael W. Service	Medical Entomologist	England
Dr. Mario Rodolfo Gatica	Director, Malaria Div.	Guatemala
Dr. Carolos Palacios Lima	Medical Director	Guatemala
Dr. Pedro Marcelino Yax	Malaria Epidemiology	Guatemala
Mercedes Herrera	Vector Control	Honduras
Dr. Hector Escoto	Chief Physician	Honduras
Dr. Indra Vythilingam	Vector Control	Malaysia
Dr. Eduardo Fernandez	Chief, Public Health	Mexico
Dr. Ir. Cees Raven	Director	Netherlands
Dr. Pedro Leiva	Director	Nicaragua
Chaudhry A.A. Mujahid	Director, Malaria Control	Pakistan
Sardar Mohd Saleem Chughtai	Director, Health Services	Pakistan
Matin-Ul-Haque Kahn	Director, Health Services	Pakistan
Sadruddin Sumar	Malaria Control	Pakistan
Sardar Ahmad Sheikh	Health Department	Pakistan
Ali Ahmed	Malaria Control	Pakistan
Gulzar Ali	Malaria Control	Pakistan
Abdur Razzaq	Health Services	Pakistan
Mushtaq Ahmed	Health Department	Pakistan
Gloria Davila de De Obaldia	Entomologist	Panama
Mr. Suleiman Al-Seghayer	Director, Malaria Control	Saudi Arabia
Mr. Mohammed Rajeh	Director of Training	Saudi Arabia
Mr. Ibrahim Siam	Malaria Control	Saudi Arabia
Stephen Hall	Hippocrates Magazine	United States
Milena Beatriz Mazarri	Vector Control	Venezuela
Dr. Baldassare Rugeri	Public Health Physician	Venezuela
Kiyombo Mbela Kitata	Public Health	Zaire

It was hoped that the construction of the new *Toxorhynchites* research facility would commence this year. Unfortunately, delays in the planning and design stages have pushed this date into mid-1989. However, *Toxorhynchites* research and rearing have progressed in spite of these delays. Several methods for the shipping of *Toxorhynchites amboinensis* were evaluated. The most successful method consisted of storing 100 pupae in 1-pint plastic cups containing 100 ml of water during shipping. This procedure seemed to cause the least amount of damage and mortality. The development times for *Toxorhynchites* have been decreasing from ca. 12 days to 10 days. Cannibalism has been reduced through maintenance of optimum predator/prey ratios. We also noted an increase in fecundity; however, the egg hatch remained erratic for much of the year.

During the field studies on biological control agents we discovered wide-spread coexistence of cyclops and *Toxorhynchites rutilus septentrionalis* in tires. This finding astonished us, because we had assumed that Toxorhynchites would not tolerate co-existence with other predators. We attempted to establish a colony of our native Toxorhynchites rutilus septentrionalis to evaluate their potential for controlling container breeding mosquitoes, but our efforts were unsuccessful.

CDC REPORT - J. E. FREIER

Efforts to study the biology of Aedes albopictus during 1988 included field and laboratory experiments on oviposition behavior, dog heartworm infections, tests of traps for adult mosquitoes, mating behavior, tire and tree hole habitat studies, body size measurements, larvicide studies, and collection of mosquitoes for virus isolation. The following information is a summary of field and laboratory activities for 1988. Technical details about each project can be found in individual monthly reports.

A. Oviposition Behavior

1. Color Preference Experiment

Laboratory experiments focused primarily on determining factors that influence the choice of a container as an oviposition site. This work was pursued as a preliminary step in the development of a gravid trap for Ae. albopictus. Two types of experiments were conducted: a color preference study and a container choice experiment.

In the color choice experiments, 5-day-old female Ae. albopictus or Ae. aegypti females were bloodfed on a rabbit and about 500 engorged females were transferred to an 8 cubic foot cage. Oviposition cups containing fiberboard strips were added to the cage on the day after blood feeding. Seven 3-oz oviposition cups, painted different colors, were arranged randomly on each of 3 trays. Each tray represented a replicate of the colors employed. The colors used were: black, red, orange, yellow, green, blue, and white. In addition, every color painted had a glossy finish. Ovistrips were exchanged daily for the first 7 days following blood feeding. Table 1 shows the results of 2 experiments with Ae. albopictus NEW ORLEANS-87 and 2 experiments with Ae. aegypti NEW ORLEANS-87. A repeated measures one-way analysis of variance (ANOVA) showed that, although the means differed, variation among replicates was extensive and no statistically significant differences ($p > 0.05$) could be observed for the colors tested. The only exception was for experiment 1 in which red was significantly more attractive than the other colors. Containers painted darker colors (black, red, and blue) generally collected more eggs than those of lighter colors (orange, yellow, green, and white).

Table 1. Results of oviposition color choice experiments.

Exp. no.	Species	Replicate no.	Color of oviposition container						
			Black	Red	Orange	Yellow	Green	Blue	White
1	Ae. albopictus	1	1481	2615	406	414	3730	1631	759
		2	997	5289	439	153	335	907	51
		3	2384	3980	672	771	571	1500	719
2	Ae. aegypti	1	2331	1962	1204	492	251	630	384
		2	740	472	502	315	640	2396	169
		3	2595	1302	991	784	703	1260	601
3	Ae. albopictus	1	1204	985	386	1438	495	1162	560
		2	587	501	552	271	350	1628	155
		3	1761	1951	713	486	886	1351	423
4	Ae. aegypti	1	1833	1041	1414	290	739	606	463
		2	798	581	437	1020	584	674	536
		3	1346	1442	423	428	702	590	226

2. Container Type Preference

In the container choice experiment, approximately 500 recently bloodfed (rabbit) 5-day-old female Ae. albopictus mosquitoes were introduced into an 8 cubic foot cage. After 4 days, six different types of containers were added to the cage. The containers used in this study were: small tire (15 in dia.), an enclosed black box (9 x 8 x 6 in) with circular side ports for mosquito entrance, standard little black jar (LBJ)(17 oz), small LBJ (3 oz), small white jar (LWJ), and a bamboo pot (16 oz). Fiberboard ovistrips (1 x 5 in) were placed, one per container, in each vessel and these strips were exchanged daily for 4 days, beginning on the fifth postprandial day. The order of preference of the first trial of this experiment was: Regular LBJ - tire - bamboo pot - black box - small LBJ - small LWJ. While relatively few eggs were collected on ovistrips placed in the bamboo pot, inspection of the inner walls showed that a large number of eggs had been placed there. The number of eggs on the inside wall of the bamboo pot could not be counted. In the second trial, the order of preference for oviposition was: Regular LBJ - black box - small LWJ - tire - small LBJ - bamboo pot. While the standard LBJ garnered the greatest share of eggs, the small LBJ was selected by only a few females as an oviposition site. It is interesting to note that at least a few females entered ports on the black box, since earlier experiments with host seeking females indicated a reluctance to enter small openings. These results indicate that when ovistrip dimensions are held constant, container size, in addition to color, may be a factor in determining oviposition site selection.

3. Effect of Aedes albopictus Males on Oviposition by Females

The effect of *Ae. albopictus* males on oviposition by females was examined in an experiment in which 30 blood engorged females were combined with varying numbers of males. Eggs were collected daily between days 3-7 after the blood meal. After the seventh postprandial day, females were dissected to determine the proportion inseminated and the number of eggs retained in each ovary. The results of this experiment are shown in Table 2. As the density of males increased there was an increase in the number of eggs laid. A calculation of Pearson's R showed a correlation coefficient of 0.82, indicating that the presence of males was accompanied by an increase in the number of eggs laid. Consequently, the presence of male mosquitoes appears to influence oviposition. The factors responsible for this increase in oviposition remain unknown.

Table 2. Effect of male density on oviposition by *Aedes albopictus* females.

No. males	No. females	No. females surviving	Total no. eggs	Mean no. eggs/day	SD	Mean no. eggs/female	No. females retaining eggs / No. examined	Mean no. eggs retained
0	30	20	162	27.0	± 36.3	8.1	0/20	—
10	30	22	502	83.7	± 52.3	22.8	0/22	—
30	30	23	565	94.2	± 183.3	35.3	7/23	63.0
60	30	24	889	148.2	± 126.9	37.0	1/24	55.0
90	30	19	743	123.8	± 91.9	39.1	0/19	—

4. Influence of Larval Exuviae and Rearing Water on Oviposition

An experiment was conducted to determine whether larval exuviae and larval rearing water have an influence on oviposition by *Ae. albopictus* females. For this test, fifty 5-day old female *Ae. albopictus* of the NEW ORLEANS-1987 strain were blood fed on a rabbit and transferred to an 8 cu. ft. cage. Twenty-one oviposition jars lined with blotter paper were setup such that 3 containers held one of each of the following: deionized water only, rearing water without exuviae, water with 1 exuviae, and water with 5, 10, 25, or 50 exuviae. Oviposition jars were randomly arranged within the cage. Female mosquitoes were allowed to lay eggs during the 7 days following the blood meal. Afterwards, the number of eggs laid on an oviposition substrate was determined. The results of this experiment are shown in Table 3. These statistics suggest that rearing water alone was more attractive than either the deionized water control or any of the exuviae-deionized water combinations. An analysis of variance employing the Newman-Keuls multiple comparisons showed that the number of eggs laid in the rearing water containers was significantly greater than the number obtained from any of the other jars ($p<0.05$). No significant differences were observed among any of the other containers. A repetition of this experiment confirmed these findings. Corresponding studies by other investigators with other mosquito species have shown that bacteria are, at least in part, responsible for the attractiveness of rearing water suspensions.

Table 3. Effect of larval exuviae and rearing water on oviposition.

	Deionized water	Rearing water	Number of exuviae				
			1	5	10	25	50
Total eggs	757	2,830	779	193	258	265	628
Percent of total	13.3	49.6	13.6	3.4	4.5	4.6	11.0
Mean no. eggs/strip	252.3	944.7	259.7	64.3	86.0	86.3	209.3
Std. dev.	285.5	110.0	147.3	29.7	35.7	37.9	105.1
Number of samples	3	3	3	3	3	3	3

B. Dog Heartworm Studies

A series of experiments was conducted to study the susceptibility of Ae. albopictus to infection with Dirofilaria immitis.

1. In vitro Feeding Method

The goal for the first set of experiments was to determine the response of mosquito hosts to infection with microfilaria at a parasite density equal to that present in a dog with a typical infection. This investigation was performed at the Tulane Primate Center in collaboration with Dr. Robert Lowrie. Our procedure for experimental infections was described in the August, 1987, monthly report. In the present experiment, strains of Ae. albopictus from MEMPHIS and NEW ORLEANS were tested along with a VERO BEACH strain of Ae. taeniarhynchus. Blood, recently drawn from an infected dog, was used undiluted and the concentration of microfilaria in the blood mixture at the time of feeding was 474 mf/20 ul. Mortality observed during the 14 day incubation period is summarized in Table 4. Except for unexplained mortality in the MEMPHIS strain, there was greater mortality among females feeding on the blood-parasite mixture. Greatest mortality for all mosquitoes feeding on the infected blood occurred on the fourth day after infection. The mean number of microfilaria ingested by each group of mosquitoes is shown in Table 5. Also shown here are the results of our dissections at 14 days after infection. As noted previously, each species was capable of supporting the development of D. immitis larvae to the infective LL_3 stage. Although infection rates varied between species and strains, the infectivity rates were similar.

Table 4. Mortality among species and strains of mosquitoes infected with Dirofilaria immitis.

Species/strain	Bloodfed		Unfed	
	No. dead/total	% mortality	No. dead/total	% mortality
Ae. albopictus MEMPHIS	324/442	73.3	93/113	82.3
NEW ORLEANS	308/373	82.6	23/102	22.5
Ae. taeniorhynchus VERO BEACH	148/214	69.2	20/111	18.0

Table 5. Experimental infection of two Ae. albopictus strains with Dirofilaria immitis.

Species/strain	Mean no. mf ingested per mosquito	Individual dissections No. inf./no. examined	Percent infected	No. mosq. with L_3 larvae	No. L_3 larvae	Infectivity rate in percent*
Ae. albopictus						
MEMPHIS	21.1	14/52	26.9	13	92	8.4
NEW ORLEANS	14.7	10/65	15.4	10	53	5.5
Ae. taeniorhynchus						
VERO BEACH	36.6	45/50	90.0	45	239	13.1

* Infectivity rate (host efficiency) = mean no. L_3 larvae/mean no. microfilaria ingested.

2. Feeding on Infected Intact Host

Another set of experiments was designed to determine the susceptibility of Ae. albopictus to infection with Dirofilaria immitis when mosquitoes are allowed to feed on an infected intact host. These experiments were conducted in collaboration with Dr. Robert C. Lowrie of the Tulane Delta Primate Center and carried out in the vivarium of the Tulane University Medical School. All experimental procedures followed a protocol approved by the University's Animal Care Committee. In the first experiment, we measured the uptake and development of microfilaria ingested by female mosquitoes of three different Ae. albopictus strains and a strain of Ae. taeniarhynchus used for comparison. The mean microfilaremia in the peripheral circulation of the infected canine host was 507 mf/20 ul. Each cage contained about 75 female mosquitoes. It was placed over a shaved area on either the midsection or hind quarters of the animal. Unfed mosquitoes were separated from engorged ones soon after feeding. An aliquot of engorged mosquitoes was examined soon after feeding to determine the mean number of microfilaria ingested. Females from fed and unfed groups were examined daily to determine mortality rates. Results of mosquito mortality comparisons between fed and unfed groups are shown in Table 6 which presents the cumulative mortality obtained after 14 days' incubation at 27° C and 85% relative humidity. High levels of mortality were observed among all strains tested; however, a few survivors were available for dissection on day 14. The results of these dissections are shown in Table 7. Since mortality was high, it is likely that surviving females either did not feed and were not separated from engorged mosquitoes, or ingested only a low number of microfilaria. With the low number of survivors information on infection and infectivity is inconclusive. In this experiment we did observe that although large numbers of microfilaria were ingested by all three strains of Ae. albopictus, the variation in microfilaria counts seemed to be associated with the order of feeding. This possibility was addressed in the next experiment.

Table 6. Mortality among species and strains of mosquitoes infected with Dirofilaria immitis.

Species/strain	Bloodfed		Unfed	
	No. dead/total	% mortality	No. dead/total	% mortality
Ae. albopictus MEMPHIS	187/195	95.9	30/101	29.7
NEW ORLEANS	188/208	90.4	66/124	53.2
HOUSTON	131/153	85.6	24/78	30.8
Ae. taeniorhynchus VERO BEACH	25/27	92.6	ND	

Table 7. Experimental infection of three *Ae. albopictus* strains with *Dirofilaria immitis*.

Species/strain	Mean no. mf ingested per mosquito	Individual dissections No. inf./no. examined	Percent infected	No. mosq. with L_3 larvae	No. L_3 larvae	Infectivity rate in percent*
Ae. albopictus						
MEMPHIS	36.0	0/8	0.0	0	0	0.0
NEW ORLEANS	94.6	4/20	20.0	4	10	5.5
HOUSTON	15.8	3/22	13.6	2	5	15.8
Ae. taeniorhynchus						
VERO BEACH	7.0	1/2	50.0	0	0	0.0

* Infectivity rate (host efficiency) = mean no. L_3 larvae/mean no. microfilaria ingested.

3. The Effect of Mosquito Feeding on a Particular Canine Body Location

A third experiment was conducted to determine if the sequence of feeding on a particular body site had any effect on the number of microfilaria ingested. In this experiment, female mosquitoes in 6 cages were allowed to feed for 10 minute intervals and, within an hour after feeding, an engorged female was removed from each of the six cages and examined in simultaneous dissections. Dissections continued until six or more specimens from each cage had been examined. Results of dissections for microfilaria are shown in Table 8. A Newman-Keuls multiple comparisons analysis of variance showed that there were no significant differences in the number of microfilaria ingested by females in each cage. Therefore, within a one hour time span the sequence of feeding did not appear to affect the number of microfilaria taken up with the blood meal.

Table 8. Effect of sequential feeding by mosquitoes on the uptake of microfilaria from a canine host.

Species	Strain	Cage no.	Mean no. mf/mosquito
Aedes albopictus	MEMPHIS	1	17.0
		2	36.7
		3	27.7
		4	24.2
		5	62.8
		6	46.8
Aedes taeniorhynchus	VERO BEACH	1	83.5
		2	67.4
		3	32.8
		4	94.0
		5	70.4
		6	67.4

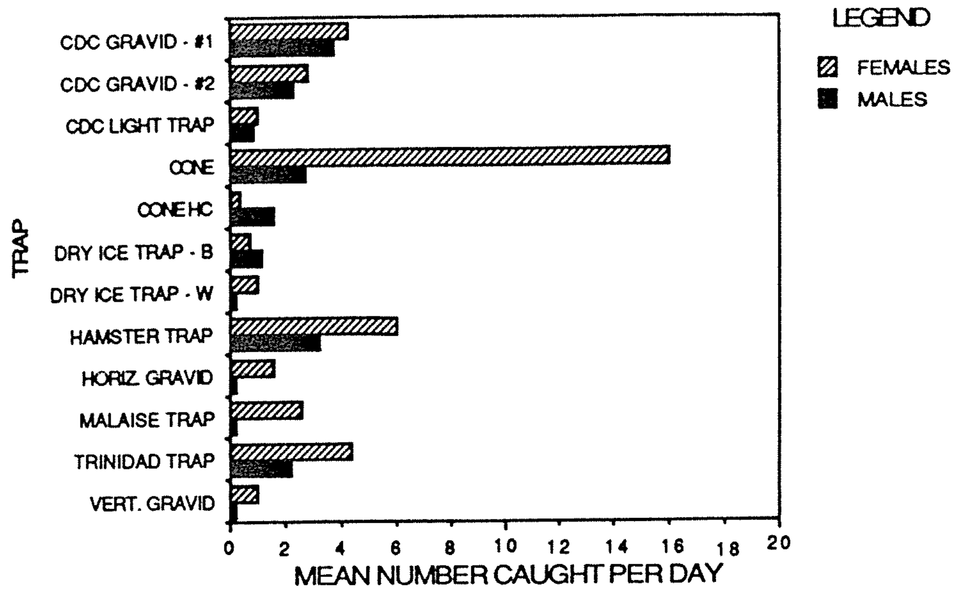
C. Trap Tests for Aedes albopictus Adults

At the present time, the most effective way to collect relatively large quantities of *Ae. albopictus* adults is to capture mosquitoes attracted to human bait. Since this type of collection is restrictive biologically and labor intensive, much research effort has been directed toward the development of sampling devices that are more suitable for trapping *Ae. albopictus* mosquitoes. Throughout the season, trap evaluations were conducted at the Grant Street study site located in Eastern New Orleans. Within this woodlot, 12 trap stations were established. Each position was about 50 feet apart from the next nearest station. Tests were conducted 3 days a week and, on each sampling day, individual traps were assigned randomly to a particular station. Traps were operated between 0900 and 1500 hours. Specimens caught in traps were returned to the laboratory for species identification, wing length measurement, and ovarian dissection.

The traps tested were: (1) CDC GRAVID TRAP - this device used the updraft design of Dr. Reiter, except that a 1 liter container with diluted hay infusion (diluted 1:2 with water) was placed beneath the trap opening. (2) CDC LIGHT TRAP - this standard trap was used without dry ice. (3) DUPLEX CONE TRAP - this trap consists of a central cone (56 cm high with a 61 cm base) fabricated from aluminum sheeting. Thirty 2.5 cm diameter holes were cut around the base and the entire central cone was painted gloss black. Surrounding about two-thirds of the central cone was a partially overlapping outer cone elevated by steel legs. The base of the outer cone was 28 cm above the ground. Also, the outer cone was left unpainted so that the shiny aluminum surface would serve as a contrast with the black inner cone. Attached to the apex of the outer cone is an updraft blower motor. This trap was designed so that mosquitoes, attracted to CO_2 sublimating from the inner bait cone, are caught in an air current flowing between the two cones. Mosquitoes were caught in a net bag placed above the motor housing. (4) DRY ICE TRAPS - these traps were obtained from Bioquip Products and consisted of a dry ice chamber suspended above a 4.5 volt, 4500 RPM, motor that created a downdraft of air that propels mosquitoes into a net bag. The motor assembly on one trap was painted black while the other assembly remained white. (5) HAMSTER TRAP - this trap is essentially a CDC light trap with two cages that contained one hamster apiece suspended on each side of the trap opening. (6) HORIZONTAL GRAVID TRAP - this trap was constructed from an automobile tire in which seven 6.4 cm diameter holes were cut along the center of the tire tread. The tire was placed horizontally on the ground. Over the rim center was placed a platform with a 10.2 cm diameter collection shaft to hold a 0.5 liter cage for capturing mosquitoes caught in the airflow. Anterior to the collection cage was a set of pivoting baffles that prevent mosquito escape when the airflow ceased. Posterior to the cage and the central collection shaft was a flexible plastic hose (10.2 cm in diameter). This hose was attached to a blower motor that was placed about 2 or more meters from the trap entrance. The motor was controlled by a timer relay and solenoid combination that permitted the motor to run for 5 minutes and be off for 10. Also, this gravid trap is baited with a pan of hay infusion diluted 1:2 with water. (7) VERTICAL GRAVID TRAP - this device is similar to the horizontal trap except that 3 automobile tires were bolted together and placed in an upright position. One opening is covered with an aluminum sheet that funnels mosquitoes to a 0.5 liter cage. An airflow is created and timed in the manner described above. This trap is also baited with diluted hay infusion. (8) MALAISE TRAP - a 1.8 meter high trap in olive drab color was used. Padded envelopes containing dry ice were attached to the trap ceiling and positioned about 3 feet from the collection tube. (9) TRINIDAD TRAP - this ingress style trap was baited with dry ice and suspended about 0.5 meters above the ground.

Figure 1 summarizes the results of trap tests from June 17th to August 24th for *Ae. albopictus* collections. A combined total of 991 female and 388 male *Ae. albopictus* were caught, during about 134 hours of trap operation. The most effective trap for collecting females was the duplex cone which captured 40.5 percent of the total number of females. The hamster and CDC gravid traps were most effective in collecting *Ae. albopictus* males with each catching about 22.5 percent of all males. However, the overall effectiveness of even the most successful traps was poor, since, at best, only 3 females per hour were caught. A low rate of capture was obtained even though traps were placed in an area with a high natural population. Adults of both sexes were observed to hover near many of the traps, including the duplex cone.

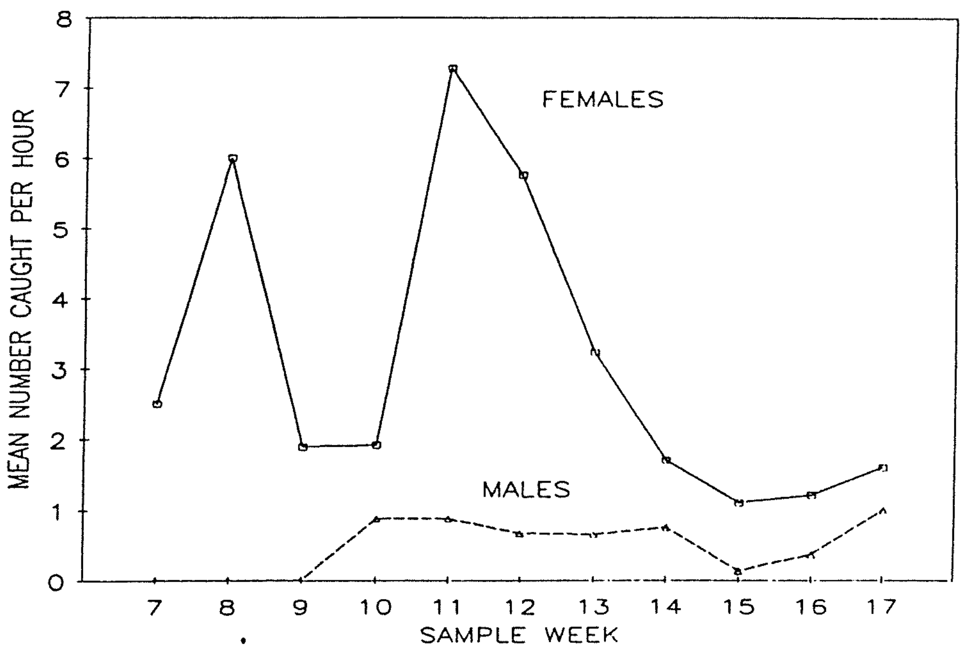
FIGURE 1. RESULTS OF AEDES ALBOPICTUS TRAP COLLECTIONS FOR 1988



The seasonal distribution of <u>Ae</u>. <u>albopictus</u> adults caught in the duplex cone is shown in Fig. 2. The population density of males and females is represented as the mean number caught per hour for each sample week. Two population peaks were observed for females, but no regular oscillations could be discerned for the males captured. Trap collection peaks for females caught during sample weeks 8 and 11-12 corresponded with two natural abundance peaks observed in our emerging adult population study. Although these results are for one duplex cone trap, it is possible that this device may be useful for monitoring population fluctuations in spite of the fact that large numbers of adults were not caught.

FIGURE 2.

CONE TRAP COLLECTION OF *AEDES ALBOPICTUS* MOSQUITOES



D. Mating Behavior in Relation to Competition

Because displacement of *Ae. aegypti* by *Ae. albopictus* has been observed in some areas of New Orleans, laboratory studies were initiated to examine potential sources of competition. Our initial interest was with competition that may exist for mates. Although mating between these two species has been described for strains from Asian countries, no data are available for North American strains. Mating for the purpose of our experiments is defined as the process of copulation and insemination. Three types of mating behavior experiments were conducted: (1) group mating before blood engorgement, (2) group mating after blood feeding, and (3) mating between individual pairs of mosquitoes. For preprandial group mating experiments, 3-day old virgin male and female mosquitoes were placed in 4-liter cages. Fifty individuals of each sex were combined in homospecific and heterospecific crosses. The top of each cage was covered with plastic to prevent extraneous mating with stray males. At the end of one week approximately half of the surviving females were removed and examined for the presence of sperm in their spermatheca. At this time, an equal aliquot of males was also removed to maintain a 1:1 sex ratio. At the end of 3 weeks, the remaining surviving females were examined as described above. The results of two preprandial experiments are shown in Tables 9 and 10. In the case of all experiments involving *Ae. albopictus* males and females or *Ae. aegypti* males and females, sexes in each homospecific group mated readily. However, when reciprocal crosses were examined, *Ae. aegypti* males did not mate as readily with *Ae. albopictus* females as did *Ae. albopictus* males mate with *Ae. aegypti* females.

Table 9. Results of winglength determinations for Aedes albopictus mosquitoes collected from tires in 1987.

Sample week	Male winglengths (mm)					Female winglengths (mm)				
	Mean	SD	N	CL1	CL2	Mean	SD	N	CL1	CL2
2	2.14	0.14	74	2.11	2.17	2.60	0.20	63	2.55	2.65
3	2.04	0.17	19	1.97	2.11	2.53	0.17	22	2.45	2.61
4	2.02	0.21	26	1.94	2.10	2.47	0.22	35	2.40	2.54
5	1.87	0.15	5	1.68	2.06	2.32	0.24	10	2.15	2.49
6	1.92	0.22	75	1.87	1.97	2.34	0.28	53	2.26	2.42
7	1.85	0.16	14	1.76	1.94	2.34	0.24	32	2.25	2.43
8	2.00	0.21	32	1.92	2.08	2.37	0.22	30	2.29	2.45
9	2.11	0.25	15	1.97	2.25	2.28	0.28	22	2.16	2.40
10	1.97	0.13	13	1.89	2.05	2.31	0.26	27	2.21	2.41
11	1.95	0.16	33	1.89	2.01	2.35	0.20	39	2.29	2.41
12	1.92	0.11	2	0.98	2.86	2.34	0.12	13	2.27	2.41
13	1.96	0.24	20	1.85	2.07	2.21	0.29	16	2.06	2.36
14	1.95	0.16	21	1.87	2.03	2.31	0.17	19	2.23	2.39
15	1.86	0.09	9	1.79	1.93	2.46	0.27	5	2.12	2.80
16	2.08	0.10	7	1.99	2.17	2.37	0.27	5	2.04	2.70
17	2.19	0.00	1			2.25	0.00	1		
18	2.19	0.08	2	1.47	2.91	2.64	0.00	1		
19	2.26	0.29	2	- 0.35	4.87	2.35	0.14	7	2.22	2.48
20	2.23	0.11	2	1.29	3.17	2.74	0.16	5	2.54	2.94

Table 10. Results of wing length determinations for Aedes albopictus mosquitoes collected from tree holes in 1987.

	Male wing lengths (mm)					Female wing lengths (mm)				
Samp. week	Mean	SD	N	CL1	CL2	Mean	SD	N	CL1	CL2
5	1.96	0.13	6	6.00	2.10	2.64	0.00	1		
6	2.17	0.00	1			2.52	0.00	2		
7	1.77	0.00	1							
8	2.13	0.00	1							
9	2.02	0.07	4	1.90	2.13	2.70	0.29	3	2.00	3.42
13	1.94	0.07	6	1.90	2.01	2.34	0.09	5	2.22	2.45
14	2.06	0.08	2	1.34	2.77	2.24	0.14	8	2.12	2.36
18	1.90	0.13	8	1.80	2.00	2.12	0.33	2	-0.85	5.10
19	1.90	0.11	21	1.84	1.95	2.27	0.23	19	2.16	2.38

The effect of blood engorgement and blood meal digestion on mating is shown in Table 11. The results presented here indicate that engorgement and digestion do not appear to deter mating in homospecific crosses. Mating was monitored for the first 5 days after engorgement. The proportions of females inseminated in the heterospecific crosses was in a range similar to that observed at the end of 7 day unfed experiment.

Table 11. Group mating behavior of Aedes albopictus and Aedes aegypti mosquitoes following blood engorgement.

Cross		Hours after blood feeding	Insemination	
Male x	Female		No. insem./no. examined	Percent insem.
ALBO	ALBO	12	27/30	90.0
		24	23/30	76.7
		48	28/30	93.3
		72	30/30	100.0
		120	30/30	100.0
ALBO	GYP	12	0/30	0.0
		24	1/30	3.3
		48	1/30	3.3
		72	6/30	20.0
		120	4/30	13.3
GYP	GYP	12	19/30	63.3
		24	30/30	100.0
		48	30/30	100.0
		72	30/30	100.0
		120	60/60	100.0
GYP	ALBO	12	4/30	13.3
		24	9/30	30.0
		48	3/30	10.0
		72	6/30	20.0
		120	4/30	13.3

For single pair mating experiments, 3-day old virgin female mosquitoes were placed in pint-sized cartons 24 hours before a virgin male of the same age was added. After the addition of a male, each pair was observed for 2 minutes and the number of mating attempts recorded. Also noted was the duration of both attempted and successful copulations. At the end of an observation period, pairs were killed by freezing and stored at -20°C until specimens could be examined. Insemination was confirmed by determining the presence of sperm in the spermatheca. Table 12 shows the results of a mating experiment with individual pairs of Ae. albopictus and Ae. aegypti. Tests were conducted with adults between days 3 and 5 after emergence. Mating among Ae. aegypti occurred at a greater frequency (85%) than among Ae. albopictus (15%). Of those pairs of Ae. albopictus that did mate, the males made fewer attempts than their Ae. aegypti counterparts. However, the mean number of attempts was similar for each homospecific pair. With heterospecific crosses, Ae. aegypti males attempted to mate half as often than with their respective homospecific cross. None of the Ae. albopictus males attempted to mate with Ae. aegypti females, even after 40 pairings. Spermatheca examinations showed that one-third of female Ae. albopictus were inseminated, whereas nearly three-fourths of female Ae. aegypti in the homospecific cross and one-fifth in the heterospecific cross were inseminated. The mean duration of copulation for each inseminated female was similar for both homospecific crosses and only slightly less for heterospecific crosses involving Ae. aegypti males. Also, the mean number of mating attempts for each inseminated female was similar (about 3) for all crosses in which mating occurred regardless of which species was involved. The low mating frequency for Ae. albopictus indicates that experimental conditions may not have been optimal in relation to the mating conditions accepted by Ae. aegypti.

Table 12. Results of mating experiment with idividual pairs of Aedes albopictus and Aedes aegypti mosquitoes.

Cross Male	x Female	Age (hrs.)	No. pairs examined	No. pairs attempting to mate	Total no. attempts	Mean no. attempts per pair	Mean duration (sec) of copulation	No. inseminated	Mean duration (sec) per insem. female	Mean no. matng attempts per insem. female
ALBO	ALBO	72	20	3	7	2.3	6.0	1	35.0	4.0
		96	20	3	8	2.7	4.6	1	32.0	3.0
ALBO	GYP	96	20	0	...	...	...	...	...	...
		120	20	0	...	...	...	...	...	...
GYP	GYP	96	20	17	54	12	9.8	12	38.7	3.0
		100	20	17	53	17	11.3	17	34.7	2.8
GYP	ALBO	72	20	12	34	4	12.8	4	26.0	2.8
		120	20	5	12	4	23.6	4	21.2	1.4

E. Tire and Tree Hole Studies

The purpose of this investigation is to examine the relationship between habitat characteristics and the production of *Ae. albopictus* mosquitoes. The habitat analysis procedure employed this year was similar to that used last year (see 1987 NOMCB Annual Report for details), except that tires were examined in sites located near the Audubon Zoo in addition to several sites located in New Orleans East. The same 30 tree holes at the Louisiana Nature and Science Center that were studied last year were also examined this year; in addition, 12 bamboo pots were placed at various locations in the woodlot. Pupae were removed from natural and artificial containers every 2 to 3 days. Soon after adults emerged, the species identity and sex were determined for each specimen. Adult mosquitoes were then frozen and stored at -20°C for later dissection and examination.

The field season for *Ae. albopictus* research activities began during the first week of May and continued until the end of October. To facilitate seasonal comparisons in this long-term study, collection intervals were divided into sampling weeks. Table 13 lists each sampling week and the corresponding beginning date for that week in 1987 and 1988. During the past two years, the first collections of *Ae. albopictus* larvae and adults were in mid-March and early April, respectively. However, population densities in March and April were too low for useful sampling.

Table 13. Sampling weeks and corresponding dates for 1987 and 1988.

Sampling week	Date beginning	
	1987	1988
1	May 3	May 1
2	May 10	May 8
3	May 17	May 15
4	May 24	May 22
5	May 31	May 29
6	Jun 7	Jun 5
7	Jun 14	Jun 12
8	Jun 21	Jun 19
9	Jun 28	Jun 26
10	Jul 25	Jul 3
11	Jul 12	Jul 10
12	Jul 19	Jul 17
13	Jul 26	Jul 24
14	Aug 2	Jul 31
15	Aug 9	Aug 7
16	Aug 16	Aug 14
17	Aug 23	Aug 21
18	Aug 30	Aug 28
19	Sep 6	Sep 4
20	Sep 13	Sep 11
21	Sep 20	Sep 18
22	Sep 27	Sep 25
23	Oct 4	Oct 2
24	Oct 11	Oct 9
25	Oct 18	Oct 16
26	Oct 25	Oct 23

The productivity of tire and tree hole habitats, as measured by the emerging Ae. albopictus adult population, is shown in Table 14. Productivity was described in terms of the mean population density, expressed as the number of adults per wet container per sampling week. The number of tire and tree hole observations were 1,247 and 1,116, respectively, in 1987, and 1,463 and 1,227, respectively, in 1988. Table 14 presents the overall means from these observations. The mean population density of Ae. albopictus adults in 1988 was 160 percent greater than the mean density observed in 1987. In tree holes though, the mean density only increased by 53 percent between the last two years. In 1987 the mean density in tires was 4.6 times greater than in tree holes; however, in 1988, the mean density in tires was 7.9 times greater than in tree holes. The male:female sex ratios of specimens collected from tires in 1987 was 1:1 and 1:1.1, respectively; and 1.3:1 and 1:1.4, respectively, from tree holes. Although the deviations from a 1:1 sex ratio were more pronounced for adults emerging from tree holes, these differences are probably not significant either statistically or biologically.

Table 14. Population density of emerging adult Aedes albopictus mosquitoes collected as pupae from tire and tree hole habitats.

Habitat	Year	Mean population density (Adults/wet container/week)		
		Females	Males	Sexes combined
Tire	1987	0.44	0.44	0.88
	1988	1.20	1.09	2.29
Tree Hole	1987	0.08	0.11	0.19
	1988	0.17	0.12	0.29

The seasonal distribution of Ae. albopictus adults collected as pupae from tires in 1987 and 1988 is shown in Fig. 3. Cyclic oscillations of population density were observed during both seasons, but the lack of rainfall in 1987 greatly reduced the amplitude of the population fluctuations. It appears that between May and October both populations showed 5 abundance peaks. A peak was defined as one or more points during which the population density exceeded the seasonal mean. In 1988, these abundance peaks were spaced about 4 weeks apart, whereas in 1987 the oscillation periods were separated by about 5 weeks. Population analysis parameters are shown in Table 15. Figures 4 and 5 show comparisons of the seasonal distribution for each sex for 1987 and 1988. Plots of population density in each figure show a high degree of concordance in both periodicity and amplitude for each year.

FIGURE 3.

AEDES ALBOPICTUS ADULTS COLLECTED AS PUPAE FROM TIRES IN 1987 AND 1988.

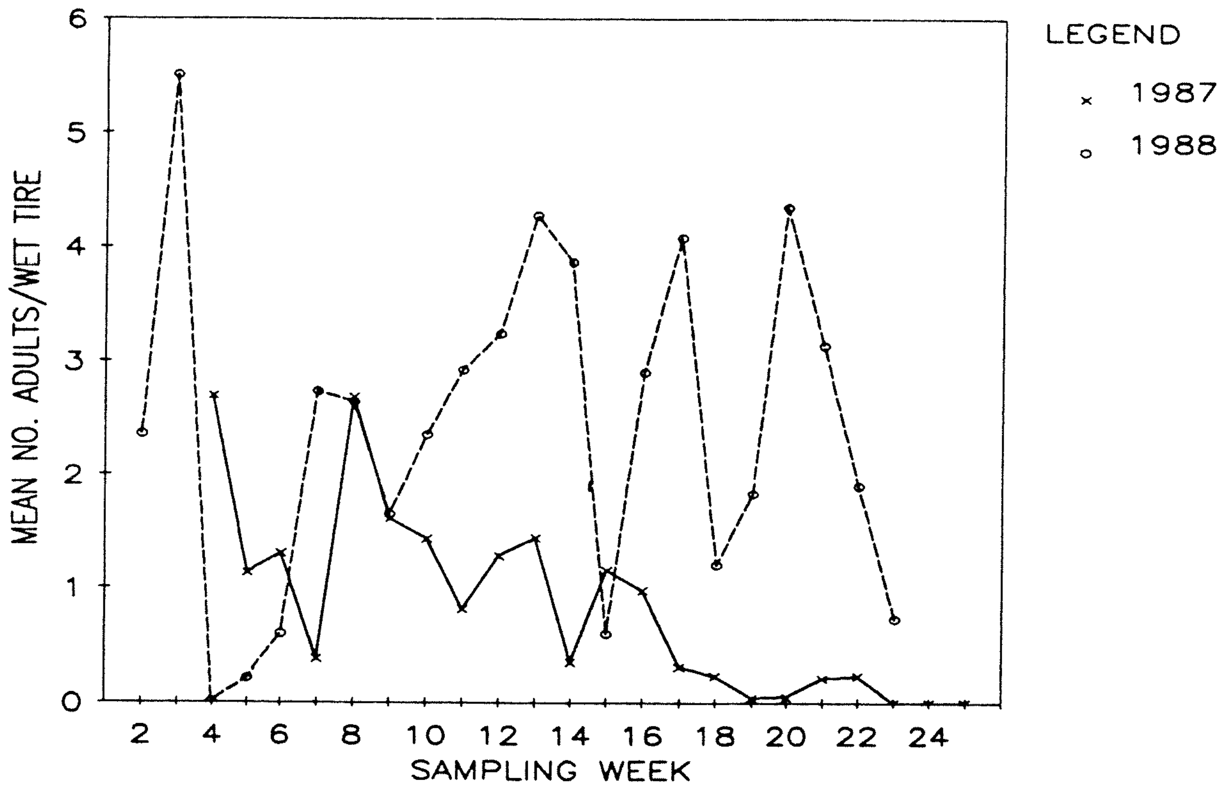


Table 15. Population analysis parameters for Aedes albopictus adults collected as pupae from tires and tree holes.

Habitat	Year	Mean response time (week)	Variation in response time (week)	Mean period of oscillaton (week)	Mean oscillaton amplitude	Carrying capacity
Tire	1987	1.80	3.04	5.4	1.33	0.74
	1988	1.44	1.05	4.4	3.18	2.44
Tree Hole	1987	1.65	8.10	6.0	0.58	0.30
	1988	2.10	5.74	6.0	0.72	0.29

FIGURE 4.

DISTRIBUTION OF *AEDES ALBOPICTUS* ADULTS COLLECTED AS PUPAE FROM TIRES IN 1987.

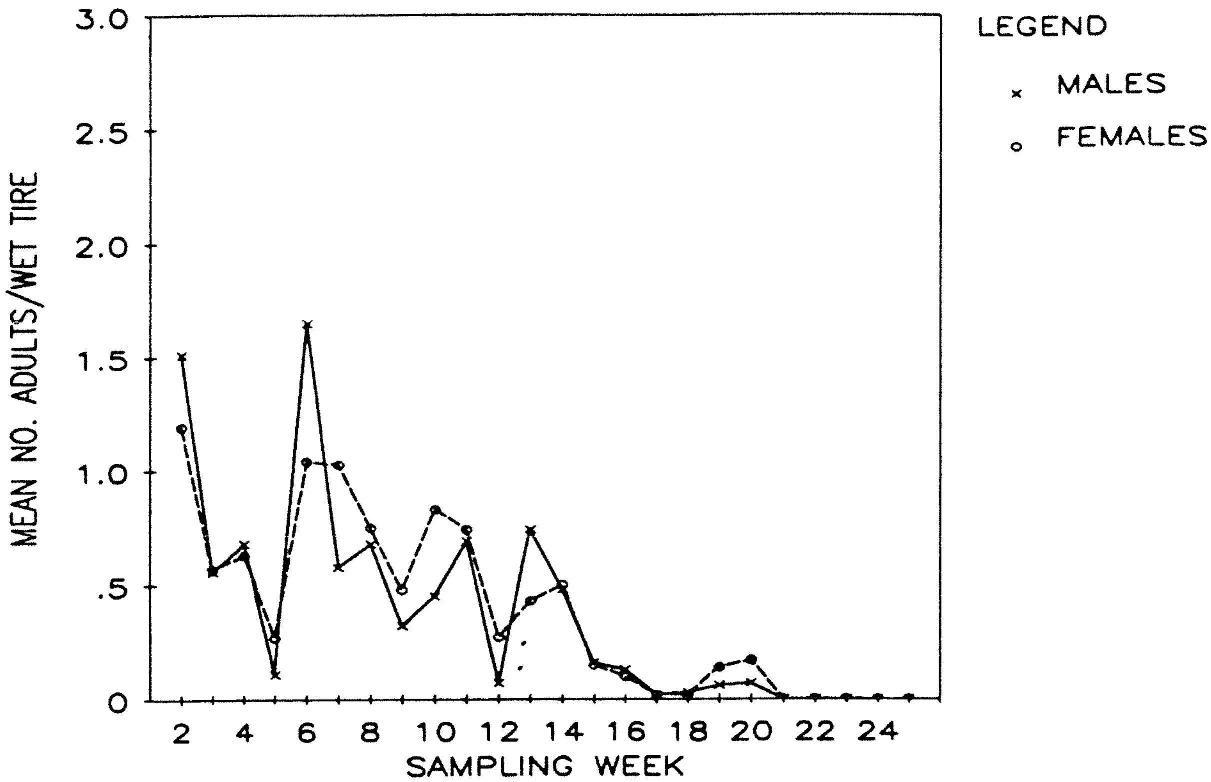
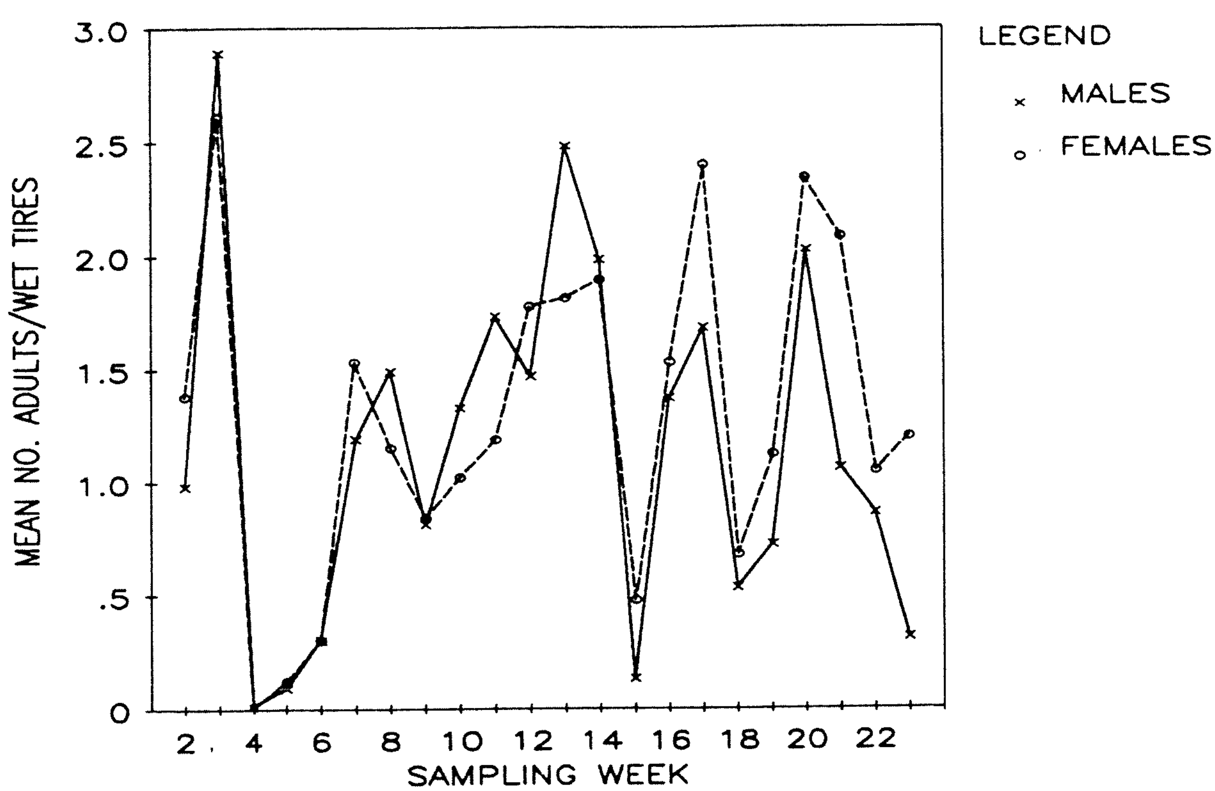


FIGURE 5.

DISTRIBUTION OF *AEDES ALBOPICTUS* ADULTS COLLECTED AS PUPAE FROM TIRES IN 1988.



A similar seasonal distribution for adults collected as pupae from tree holes in 1987 and 1988 is plotted in Fig. 6. Three abundance peaks were observed in 1987 while 4 were noted in 1988. Although the mean period between peaks was calculated to be about 6 weeks (Table 3), population crests with the greatest abundance occurred in August and September. Figures 7 and 8 show the population distributions for males and females in 1987 and 1988. As with the tire observations, population densities for each sex were in close concordance during both years studied.

The foregoing information indicates that there are discrete differences in the seasonal distribution of Ae. albopictus populations and that these differences appear to be related to the type of larval habitat.

FIGURE 6.
AEDES ALBOPICTUS ADULTS COLLECTED AS PUPAE FROM TREE HOLES IN 1987 AND 1988.

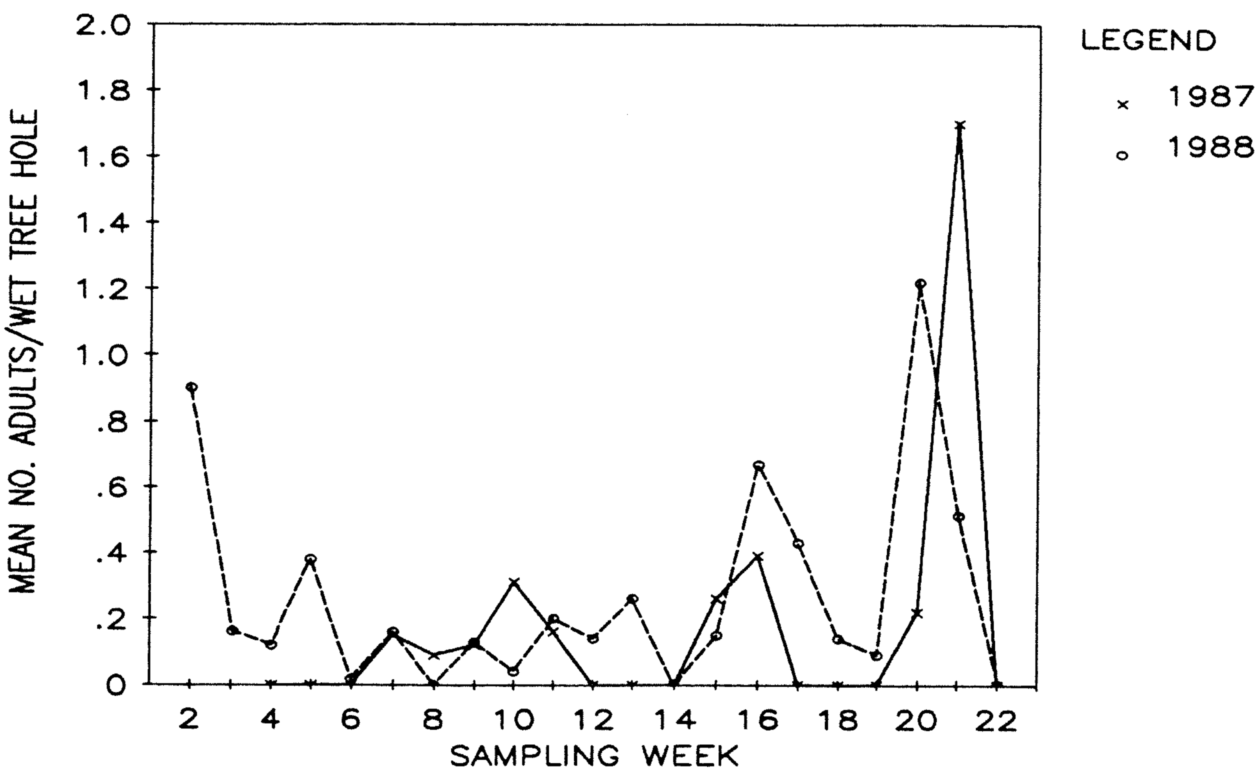


FIGURE 7.

DISTRIBUTION OF *AEDES ALBOPICTUS* ADULTS COLLECTED AS PUPAE FROM TREE HOLES IN 1987.

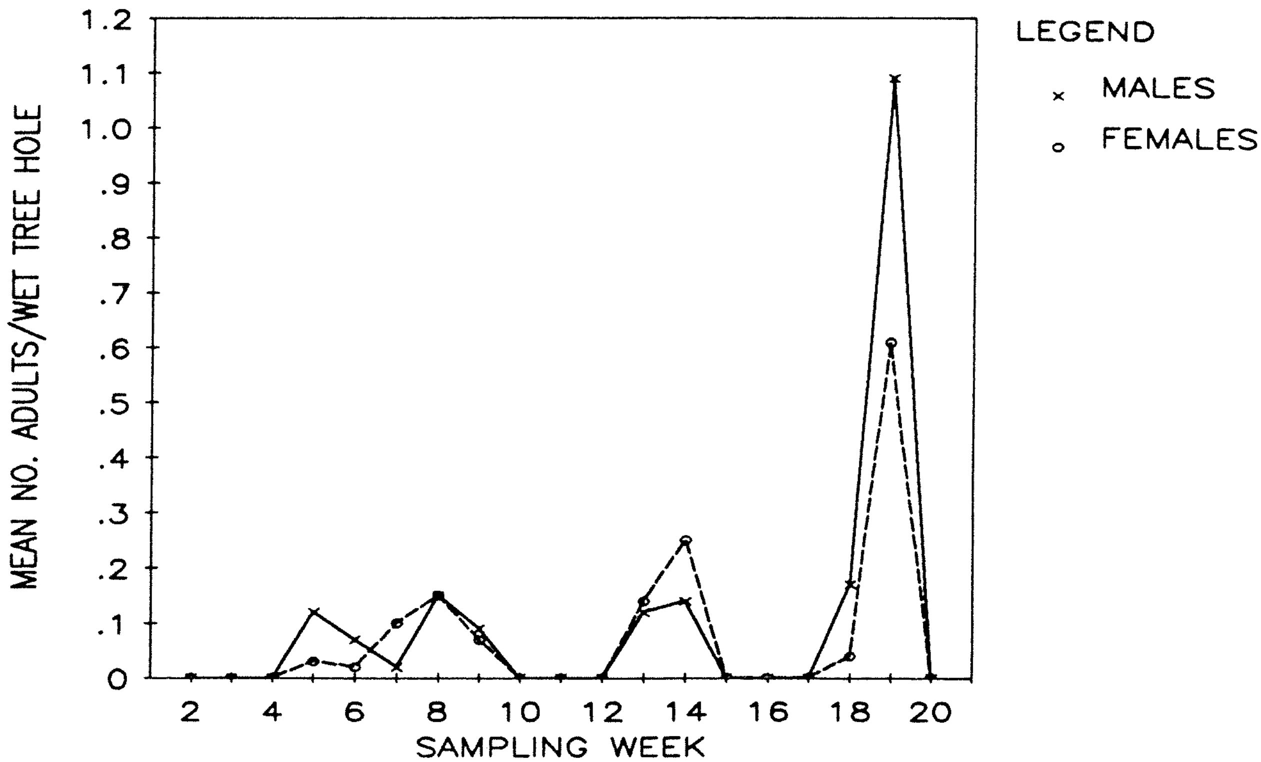
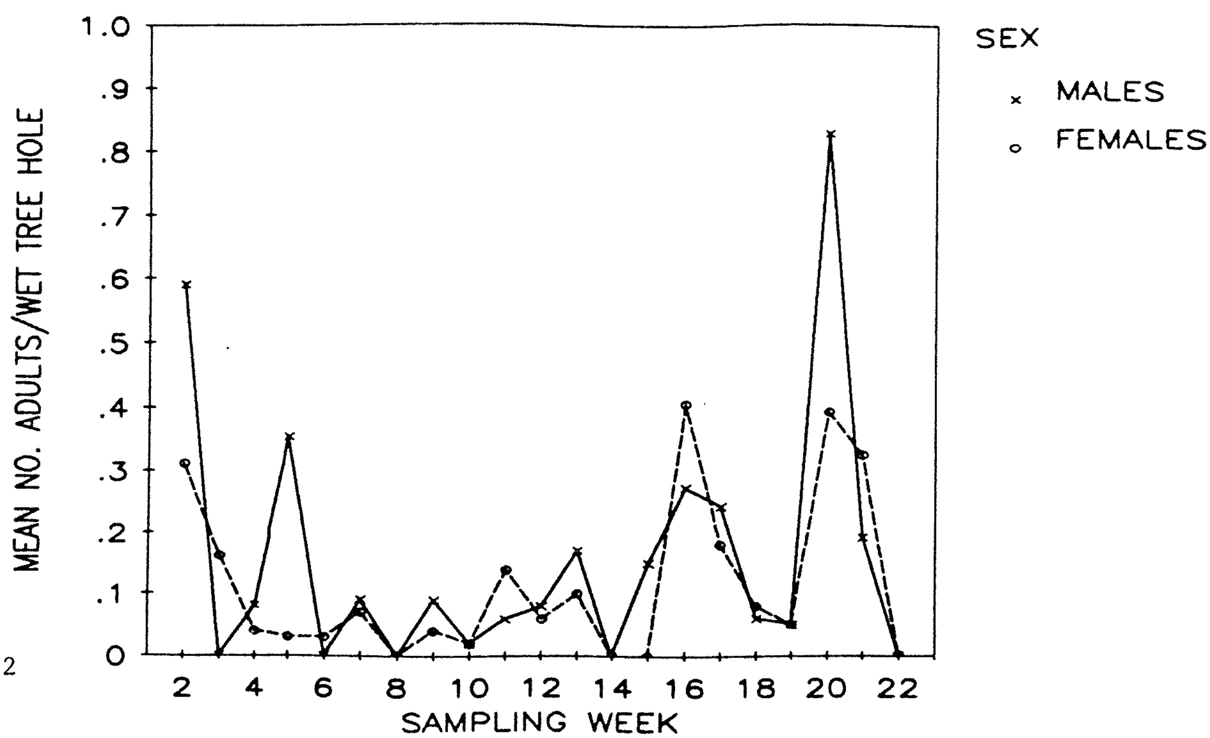


FIGURE 8.

DISTRIBUTION OF *AEDES ALBOPICTUS* ADULTS COLLECTED AS PUPAE FROM TREE HOLES IN 1988.



F. Wing length studies

Wing length measurements were made on Ae. albopictus mosquitoes collected as pupae from selected tires and tree hole habitats. The rationale for this investigation was that studies by other investigators have shown that larger adult mosquitoes survive longer, feed more successfully on blood hosts, develop more eggs, go through a greater number of gonotrophic cycles, and migrate longer distances. Since adult body size has been shown to be correlated with wing length, we used this method to estimate the body size of mosquitoes emerging from tire and tree hole habitats. The procedure for measurements involved the removal of a specimen's left wing, attachment to a microscope slide, and length determination using an Olympus filar micrometer at 20x magnification. Measurements were made from the axillary incision to the wing margin, excluding the wing fringe.

1. Seasonal Variation in Wing Length

Seasonal changes in wing length for Aedes albopictus adults collected as pupae from tires and tree holes are shown in Figures 9 and 10, respectively. The seasonal means for the length of male and female wings is illustrated by a dotted line in both figures. As shown in Figure 9, male and female Ae. albopictus were larger than average during the season's early weeks; however, body size of both sexes decreased to near average levels until September. The increases in body size observed at the season's end may be due to longer developmental times induced by cooler temperatures. In addition, abundant rainfall in September, 1987, combined with new leaf fall may have enhanced the nutrient level available to larvae.

FIGURE 9.

MEAN WING LENGTHS OF *AEDES ALBOPICTUS* MOSQUITOES COLLECTED AS PUPAE FROM TIRES IN 1987.

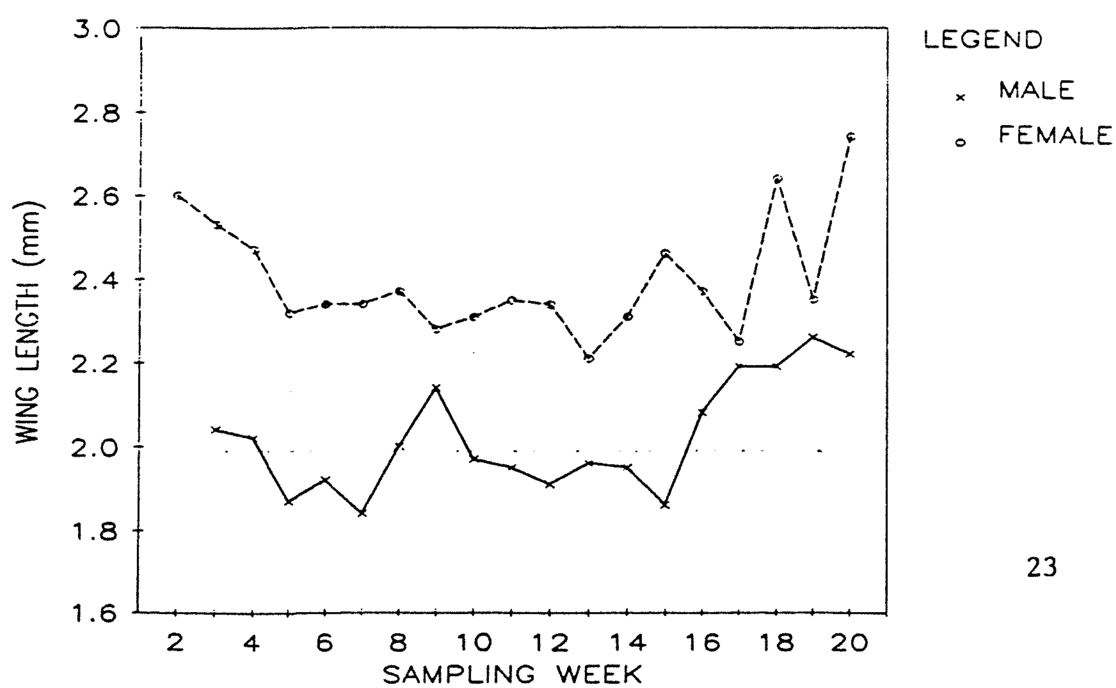
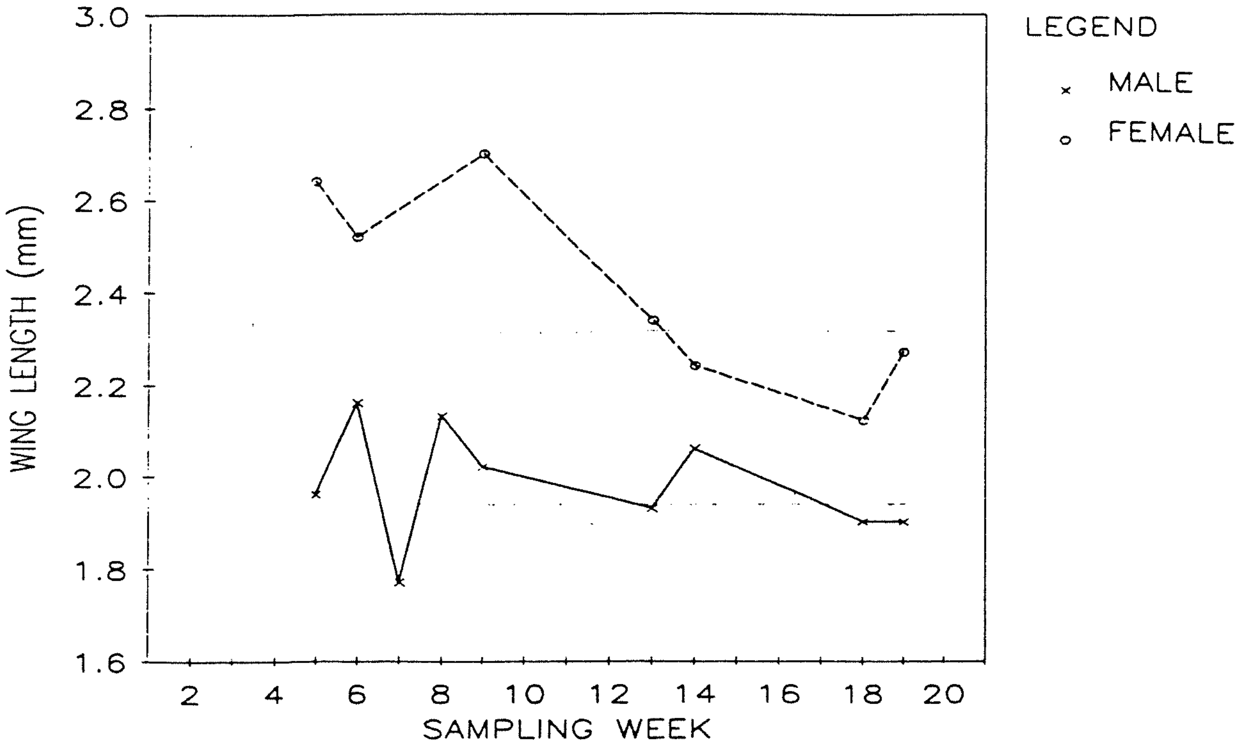


FIGURE 10.

MEAN WING LENGTHS OF *AEDES ALBOPICTUS* MOSQUITOES COLLECTED AS PUPAE FROM TREE HOLES IN 1987.

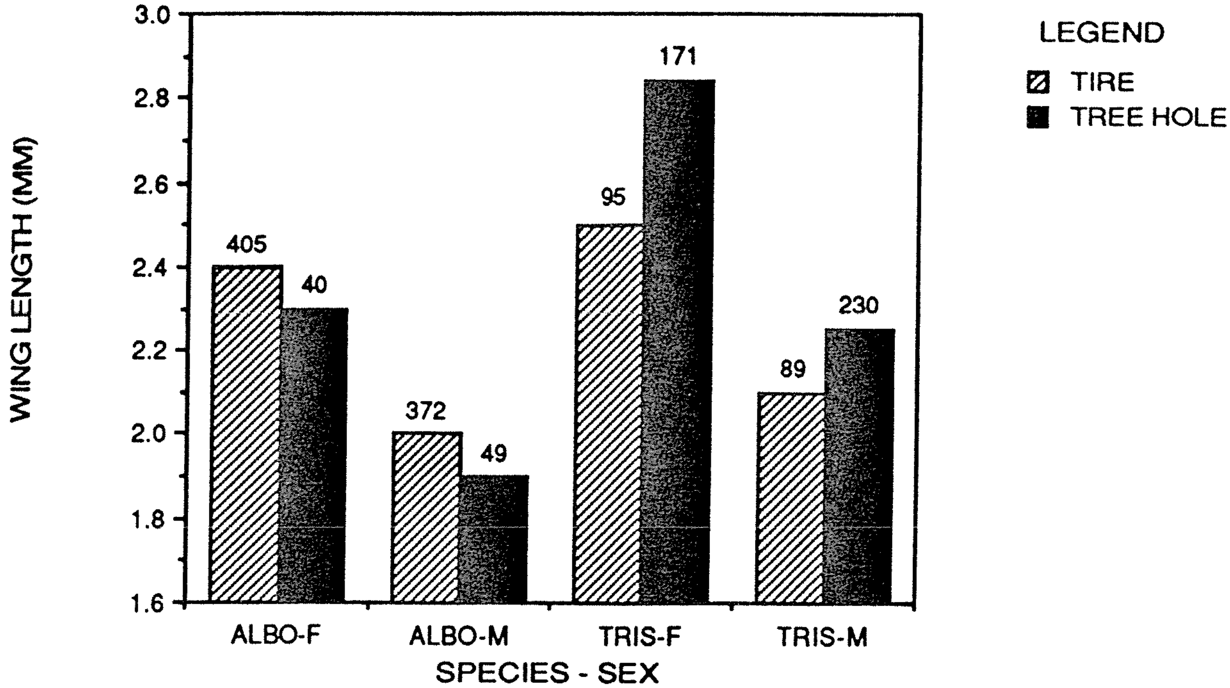


A slightly different seasonal pattern was observed for the body size of Ae. albopictus adults collected as pupae from tree holes. Because few specimens were obtained from this habitat, mean values were based on a smaller number of samples. Early summer body sizes were generally above seasonal averages for both sexes. In contrast, specimens collected at the end of the season were below the seasonal wing length average. This smaller size may be due to depletion of nutrients that were inadequately replenished by rainfall and stem flow in September. Competition with Ae. triseriatus, which was most intense from early to mid-summer, was not reflected in the body size of emerging adults.

2. Comparison of Wing Lengths for Aedes albopictus and Aedes triseriatus

A comparison of mean wing lengths of Ae. albopictus and Ae. triseriatus from tires and tree holes in 1987 is shown in Figure 11. Both sexes of Ae. albopictus from tires were larger than those specimens collected from tree holes. However, male and female Ae. triseriatus from tree holes were larger than those from tires. Results of an analysis of variance and multiple comparisons employing the Student-Newman-Keuls, Bonferroni, and Duncan's multiple range tests showed that wing length mean values for each species and sex significantly different ($p \leq 0.05$). The biological importance of these differences has yet to be determined.

FIGURE 11.
COMPARISON OF MEAN WING LENGTHS OF AEDES ALBOPICTUS AND AEDES TRISERIATUS FROM TIRES AND TREE HOLES IN 1987.



G. Larvicide Studies

1. Permethrin Sand Core Granules

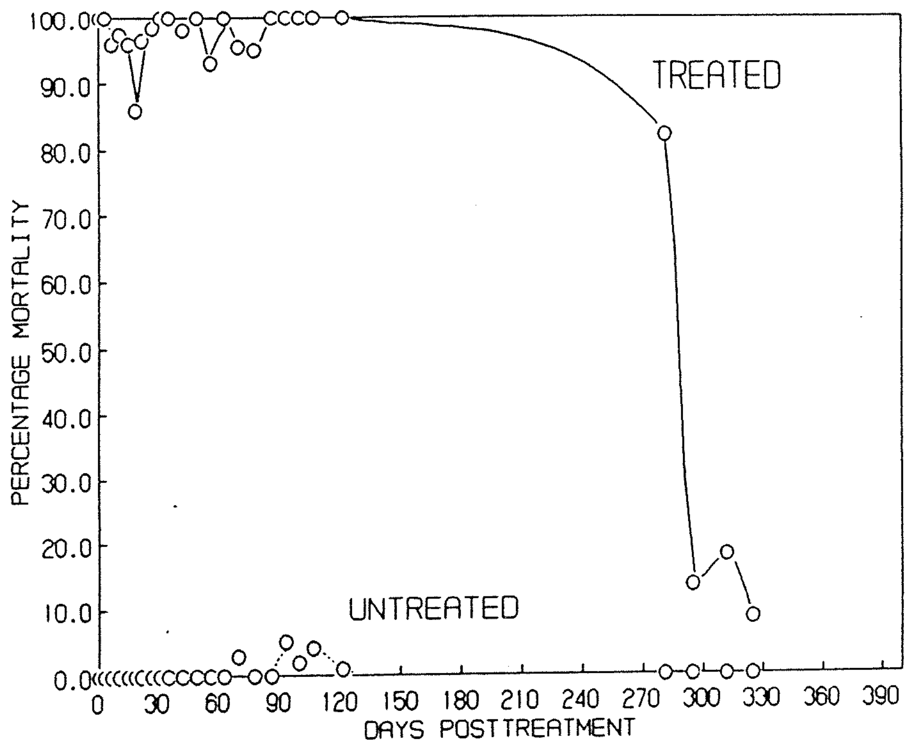
In August, 1987, a field plot test was performed with a sand core granule formulation of permethrin. The granules contained 1.5 percent active ingredient. Specific details regarding procedures for this experiment are described in the August, 1987, monthly report. Persistence of toxicity was monitored in bioassays that employed mature Ae. albopictus larvae. Bioassays were conducted every 3 or 4 days during the first 35 days and only once a week thereafter.

The results of these bioassays are illustrated in Fig. 12. Mortality of bioassay larvae in the treated tires remained at greater than 80 percent for nearly 300 days following the single application. Mortality among test larvae decreased rapidly in May. This loss of effectiveness may have been due to increases in average daily temperature, since previous observations suggested that toxicity was negatively correlated with temperature. It is noteworthy that although the effectiveness of permethrin diminished, no larvae has occurred in any of the tires treated last August.

To determine the minimal amount of permethrin necessary for complete mortality of Ae. albopictus larvae in tires, a measured dose experiment was performed. In this experiment 21 tires were divided into groups of three. Each group of three tires was spaced about 15 feet apart. Every group of tires received one of 6 different amounts of permethrin

permethrin granules. One group of three tires served as an untreated control. Tires were filled to capacity with water before the insecticide dose was added. Immediately prior to each bioassay, water levels were increased to the maximum level. Bioassays consisted of exposing 20 fourth instar larvae to the experimental dose in a test tire for 24 hours. Fiberboard egg strips were attached to the inside of all treated and untreated tires to determine minimal dosages that would act as a deterrent to oviposition.

FIGURE 12.



Persistence of permethrin toxicity in tires as measured by mortality among Aedes albopictus bioassay larvae exposed in treated and untreated tires for 24 hour periods.

The results of this test, shown in Table 16, indicated an erratic response to the measured amounts of insecticide. When a dose was less than 1.0 g, the percentage mortality varied greatly between doses. For example, tires treated with 0.01 g had a higher level of mortality than those treated with 0.50 g. These inconsistent results may be due to an uneven distribution of permethrin concentration in the granules.

A field plot test was conducted using a wettable powder formulation of 25% permethrin and 0.0625% Uvitex. This material was obtained from Fairfield American Corporation. In this experiment, a pile of 50 discarded tire casings was treated with a 1.0% permethrin wettable powder suspension. Another pile of similar size was left untreated. Also, four groups containing 3 tires each were treated with concentrations above and below that applied to the test tire pile. The permethrin concentrations tested in these small groups were 0.1%, 1.0%, 5.0%, and 10.0%. Before the initiation of this experiment, all tires were allowed to become infested naturally with Ae. albopictus mosquitoes present at the field plot test site. Prior to treatment, the number and stages of mosquito larvae and pupae were determined in 10 casings selected randomly from both experimental and control tire piles. In addition, mosquito populations in each of the 12 tires receiving predetermined doses were examined before and after treatment. Following larvicide application, a bioassay cage containing 20 fourth instar Ae. albopictus NEW ORLEANS larvae was added to each of the 32 study tires. The effect of permethrin on oviposition was measured by attaching a fiberboard ovistrip to the inside of each study tire. These strips were exchanged at 7 day intervals and the number of eggs of Ae. albopictus and Ae. triseriatus counted.

Table 16. Bioassay results of fourth instar Aedes albopictus larvae exposed in tires for 24 hours to various amounts of permethrin.

Day posttreatment	Percent mortality							
	Dosage (g)	0.00	0.01	0.05	0.10	0.50	1.00	2.5
1		0.0	41.7	8.3	70.0	30.0	98.3	96.7
7		0.0	11.7	20.0	40.4	1.7	63.3	98.3
15		0.0	45.0	18.3	0.0	0.0	58.3	NA

Table 17 shows that all of the naturally occurring larvae present in tires before treatment were killed by the concentrations of wettable powder that were tested. Except for the 0.1% treated tires, all bioassay larvae, as shown in Table 18, were killed within 24 hours following treatment. Fourteen days after treatment, mortality among bioassay larvae in the treated tires remained greater than 50%; however, in tires receiving variable concentrations of 1.0% or more, mortality was nearly 100%. The discrepancy between the tire pile treated with 1.0% permethrin and the group of 3 individual tires may have been due to placement, since tires in the pile were not equally accessible to the spray.

Table 17. Populations of mosquitoes present naturally in tires immediately prior to treatment with wettable powder formulaton of permethrin.

Group		Culicinae instars					Toxorhynchites instars				
		I	II	III	IV	P	I	II	III	IV	P
Untreated:											
	sum	0	7	31	27	1	1	1	9	15	6
	mean	0.0	0.7	3.1	2.7	0.1	0.1	0.1	0.9	1.5	0.6
	variance	0.0	2.6	23.7	30.0	0.1	0.1	0.1	1.4	1.8	0.5
	std	0.0	1.6	4.9	5.5	0.3	0.3	0.3	1.2	1.4	0.7
Treated:											
(1.0%)	sum	37	25	30	30	3	2	4	9	29	4
	mean	3.7	2.5	3.0	3.0	0.3	0.2	0.4	0.9	2.9	0.4
	variance	114.2	10.1	14.4	22.4	0.2	0.4	0.5	2.5	4.5	0.5
	std	10.7	3.2	3.8	4.7	0.5	0.6	0.7	1.6	2.1	0.7
0.1%	sum	6	5	12	12	0	1	2	1	10	1
	mean	2.0	1.7	4.0	4.0	0.0	0.3	0.7	0.3	3.3	0.3
	variance	12.0	2.3	16.0	12.0	0.0	0.3	1.3	0.3	4.3	0.3
	std	3.5	1.5	4.0	3.5	0.0	0.6	1.2	0.6	2.1	0.6
1.0%	sum	9	8	8	7	0	0	5	0	11	2
	mean	3.0	2.7	2.7	2.3	0.0	0.0	1.7	0.0	3.6	0.7
	variance	27.0	4.3	4.3	2.3	0.0	0.0	4.3	0.0	8.3	1.3
	std										
5.0%	sum	1	4	2	5	0	1	0	0	5	3
	mean	0.3	1.3	0.7	1.7	0.0	0.3	0.0	0.0	1.7	1.0
	variance	0.3	5.3	0.3	4.3	0.0	0.3	0.0	0.0	2.3	3.0
	std	0.6	2.3	0.6	2.1	0.0	0.6	0.0	0.0	1.5	1.7
10.0%	sum	0	3	4	12	1	1	1	2	4	1
	mean	0.0	1.0	1.3	4.0	0.3	0.3	0.3	0.7	1.3	0.3
	variance	0.0	1.0	1.3	37.0	0.3	0.3	0.3	0.3	1.3	0.3
	std	0.0	1.0	1.2	6.1	0.6	0.6	0.6	0.6	1.2	0.6

2. Bacillus sphaericus

The effect of Bacillus sphaericus on Ae. albopictus larvae was evaluated in a laboratory test. The response of fourth instar larvae was assessed using a modification of the World Health Organization's recommended protocol for determining larvicidal action. The technical grade B. sphaericus employed in this trial was obtained from Abbott Laboratories. In addition to Ae. albopictus, two other mosquito species, Ae. aegypti and Culex quinquefasciatus, were tested for comparison. Preliminary tests were conducted to determine the range of toxic units to use in establishing lethal concentration values. The ITU range tested for each species was 312.0 - 1560.0 ITU/l for Ae. albopictus, 520.0 - 8320.0 ITU/l for Ae. aegypti, and 5.2 - 91.0 ITU/l for Cx. quinquefasciatus. After determining the appropriate insecticide range for each species, tests were performed to determine the LC_{50} and LC_{90} values. The results of a probit analysis of the susceptibility data are shown in Table 18. The lowest LC_{50} and LC_{90} values obtained from two tests with Ae. albopictus were 63 and 157 times greater than those observed with Cx. quinquefasciatus. With respect to LC_{50}'s, Ae. aegypti was approximately 6 times more tolerant to B. sphaericus than Ae. albopictus. This data suggests that B. sphaericus in not an effective agent for controlling Ae. albopictus mosquitoes.

Table 18. Susceptibility of Aedes albopictus larvae to Bacillus sphaericus.

Species / strain	Test no.	LC_{50}	(95% F.L.)	LC_{90}	(95% F.L.)
Aedes albopictus NEW ORLEANS	1	937.2*	(862.3 - 1009.4)	1805.1	(1605.3 - 2133.6)
	2	725.9	(629.6 - 862.3)	2151.2	(1590.2 - 3589.3)
Aedes aegypti NEW ORLEANS	1	4578.0	(4177.3 - 5067.5)	11908.8	(10138.2 - 14520.0)
	2	4161.0	(3682.3 - 4926.5)	9574.1	(7418.2 - 14427.1)
Culex quinquefasciatus NEW ORLEANS		11.5	(9.8 - 13.1)	27.0	(23.3 - 32.9)

* ITU/liter

3. Bacillus thuringiensis israelensis

A field plot test was conducted using a liquid formulation of Bti (Bacillus thuringiensis var. israelensis, serotype H-14). The material used was obtained from Abbott Laboratories and is marketed under the trade name Vectobac-12AS. The research designation of the material tested was ABG-6193. This aqueous suspension contains 1200 international toxic units (ITU) per milligram which is equivalent to 1.279 billion ITU per liter.

Several piles of discarded tire casings were created for this experiment at the Bullard Avenue & Chef Menteur Highway test site located in New Orleans East. Two piles of about 50 tires each were established about 75 feet apart. Additionally, 4 groups of 3 tires each were arranged in a vertical position about 50 feet from the larger tire piles. In this experiment, one of the larger tire piles was treated with an insecticide concentration at an approximate "label rate". The rate selected, 0.5 pt/acre, was based on current label recommendations for treatment of mosquito larvae in roadside ditches, standing ponds, woodland pools, and catch basins. The other tire pile served as an untreated control. The Bti concentrations tested in the four smaller groups of tires were 0.05, 0.1, 0.5, 1.0 pt/acre. Before the initiation of this experiment, all tires were allowed to become infested naturally from an abundant population of Aedes albopictus mosquitoes present at the field plot test site. Immediately prior to treatment, the number and stages of mosquito larvae and pupae present naturally were determined in

10 casings selected randomly for study in both the experimental and control tire piles. Also, mosquito populations in each of the 12 tires receiving variable doses were examined before and after treatment. Following larvicide application, a bioassay cage containing 20-4th instar *Ae. albopictus* NEW ORLEANS larvae was added to each of the 32 study tires. The effect of Bti on oviposition was measured by attaching a fiberboard ovistrip to the inside of each study tire. These strips were exchanged at 7 day intervals and the number of eggs of *Ae. albopictus* and *Ae. triseriatus* determined.

The distribution of populations of naturally occurring mosquitoes among the treated and untreated tire groups is shown in Table 19. Population means for the large treated and untreated piles were similar for all Culicinae instars. However, the large treated pile contained about twice as many *Toxorhynchites* mosquitoes. Population means for Culicinae instars in the four tire trios were similar for the 0.05 and 0.10 pt/acre and the 0.5 and 1.0 pt/acre. *Toxorhynchites* population means and instar distributions were similar for all four groups.

The insecticide was applied with a backpack sprayer (SwissMex, Model SP1, 2 gallon polyethene tank). Each aqueous dilution was prepared immediately prior to application. Spray doses were delivered in sequence beginning with the lowest concentration. With the sprayer nozzle set at a medium diameter, spray was applied as a single pass across a tire opening.

Twenty-four hours after treatment each tire was examined and mortality determined for naturally occurring mosquitoes. Each of the Bti application rates tested killed all Culicinae larvae, including those of *Ae. albopictus*, but did not kill most of the *Toxorhynchites* larvae. Table 19 shows the results of 24 hour posttreatment examinations for toxicity to naturally occurring *Toxorhnchites*. Although no mortality was observed among larvae in the treated large pile of tires, several of *Toxorhynchites* larvae moved slowly when disturbed. These apparently moribund larvae were not considered in the mortality rates shown in Table 19. Greatest mortality was observed at the highest Bti concentration tested. Mosquito pupae, regardless of species, did not seem to be affected by the Bti treatments.

Table 19. Populations of mosquitoes present naturally in tires immediately prior to treatment with formulaton of Bti (Vectobac 12AS).

Group		Culicinae instars					Toxorhynchites instars				
		I	II	III	IV	P	I	II	III	IV	P
Untreated:											
	sum	98	134	113	60	1	1	3	3	14	2
	mean	9.8	13.4	11.3	6.0	0.1	0.1	0.3	0.3	1.4	0.2
	variance	513.1	575.4	187.1	124.4	0.1	0.1	0.2	0.2	2.5	0.2
	std	22.7	24.0	13.7	11.2	0.3	0.3	0.5	0.5	1.6	0.4
Treated:											
(0.05)	sum	72	188	80	58	1	0	1	7	27	15
	mean	7.2	18.8	8.0	5.8	0.1	0.0	0.1	0.7	2.9	1.5
	variance	58.2	533.1	112.9	66.6	0.1	0.0	0.1	2.2	6.5	3.6
	std	7.6	23.1	10.6	8.2	0.3	0.0	0.3	1.5	2.5	1.9
0.05	sum	40	12	4	1	2	3	1	2	2	2
	mean	13.3	4.0	1.3	0.3	0.7	1.0	0.3	0.7	0.7	0.7
	variance	217.3	3.0	5.3	0.3	1.3	3.0	0.3	0.3	1.3	0.3
	std	14.7	1.7	2.3	0.6	1.2	1.7	0.6	0.6	1.2	0.6
0.1	sum	18	42	15	26	5	0	0	1	7	3
	mean	6.0	14.0	5.0	8.7	1.7	0.0	0.0	0.3	2.3	1.0
	variance	61.0	397.3	75.0	200.3	8.3	0.0	0.0	0.3	0.3	1.0
	std	7.8	19.9	8.7	14.2	2.9	0.0	0.0	0.6	0.6	1.0
0.5	sum	10	5	1	2	0	1	0	3	3	2
	mean	3.3	1.7	0.3	0.7	0.0	0.3	0.0	1.0	1.0	0.7
	variance	33.3	8.3	0.3	1.3	0.0	0.3	0.0	1.0	1.0	1.3
	std	5.8	2.9	0.6	1.2	0.0	0.6	0.0	1.0	1.0	1.2
1.0	sum	2	4	2	2	0	2	2	0	3	1
	mean	0.7	1.3	0.7	0.7	0.0	0.7	0.7	0.0	1.0	0.3
	variance	1.3	5.3	1.3	0.3	0.0	0.3	0.3	0.0	1.0	0.3
	std	1.2	2.3	1.2	0.6	0.0	0.6	0.6	0.0	1.0	0.6

Results of bioassays at various time intervals following treatment are shown in Table 20. Immediately following treatment, mortality among bioassay larvae was 100 percent for all application rates tested. However, the mortality rates declined steadily during succeeding weeks. Mortality was below 80 percent on the 7th day after treatment, below 50 percent on day 21, and less than 10 percent by day 35. High mortality rates for bioassay larvae persisted longer in the tire trios than in the pile of 30 casings. Since tires in the small groups where stationed in individual vertical positions, insecticide applications could be made with easy access to each tire. This was not the case for tires in the larger pile. Thus, tires in the smaller piles seemed to represent ideal treatment conditions, whereas tires in the larger pile seemed to reflect more realistic arrangements.

Table 20. Results of bioassays for Bti toxicity.

Days post-treatment	Treatment Group (pt/acre)	No. larvae dead/total	Mortality in percent
1	Untreated	0/200	0.0
	Treated (0.5)	200/200	100.0
	0.05	60/60	100.0
	0.1	60/60	100.0
	0.5	60/60	100.0
	1.0	60/60	100.0
7	Untreated	0/200	0.0
	Treated (0.5)	156/200	78.0
	0.05	17/60	28.3
	0.1	58/60	96.7
	0.5	54/60	90.0
	1.0	60/60	100.0
14	Untreated	8/200	4.4
	Treated (0.5)	111/179	62.0
	0.05	41/60	68.3
	0.1	59/60	98.3
	0.5	60/60	100.0
	1.0	59/60	98.3
21	Untreated	0/200	0.0
	Treated (0.5)	93/200	46.5
	0.05	13/60	21.7
	0.1	18/60	21.7
	0.5	26/60	43.3
	1.0	41/60	68.3
28	Untreated	0/200	0.0
	Treated (0.5)	63/200	31.5
	0.05	9/60	15.0
	0.1	20/60	33.3
	0.5	39/60	65.0
	1.0	38/60	63.3
35	Untreated	0/160	0.0
	Treated (0.5)	18/200	9.0
	0.05	2/60	3.3
	0.1	1/60	1.7
	0.5	6/60	10.0
	1.0	27/60	45.0

The effect of Bti on oviposition in tires by _Ae_. _albopictus_ and _Ae_. _triseriatus_ mosquitoes is shown in Table 21. Treated tires received a greater mean number of eggs than untreated ones. In addition, the treated tires arrayed in groups of 3 generally received more eggs than the treated tires of the larger pile. Although the mean numbers of eggs seem to indicate that treated tires may be more attractive as sites for oviposition, there was extensive variation in the numbers of eggs received by each group. A statistical analysis of the data failed to show that the treatment had any effect on oviposition.

Table 21. Effect of Bti on oviposition in tires by _Aedes albopictus_ and _Aedes triseriatus_ mosquitoes.

Egg collection interval (Days posttreatment)	Species	Mean no. eggs/ovistrip					
		Untreated	Treated (0.5 pt/a)	0.05	0.1	0.5	1.0
1 - 8	_Ae. albopictus_	19.8	53.0	93.0	50.3	32.3	38.8
	Ae. triseriatus	2.5	3.7	22.3	64.3	54.3	44.0
14 - 21	_Ae. albopictus_	29.0	30.5	37.3	21.0	18.3	56.7
	Ae. triseriatus	1.3	12.4	65.3	23.7	68.3	33.3
28 - 35	_Ae. albopictus_	5.9	11.7	34.0	31.3	45.3	19.0
	Ae. triseriatus	7.6	7.5	80.0	74.7	121.3	209.0

H. Mosquito Collections for Virus Isolation

Between May 18th and December 20th, mosquitoes for virus isolation were collected from 5 ecologically diverse areas in Orleans Parish. These areas were: Algiers, eastern New Orleans, the port area, Michoud Blvd. site, and a site near the NASA facility. Within each of the first 3 areas, ten sites were established for regular mosquito collections at weekly intervals. At each station, specimens were caught using routine methods for carbon dioxide augmented human-baited landing rate collections. At the Michoud Blvd. and NASA sites, resting collections were performed using backpack aspirators. Table 22 shows the results of mosquito collections for virus isolation. A total of 4,301 specimens representing 14 species were collected. _Aedes albopictus_ adults accounted for 44.7 percent of the total. The source of _Ae. albopictus_ mosquito collections for virus isolation is shown in Table 23. More than 80.0 percent of those caught came from resting collections made at the Michoud Blvd. site. Pools of mosquitoes from these collections were shipped to the CDC laboratory in Fort Collins for virus isolation.

Table 22. Results of mosquito collections for virus isolaton in 1988.

Species	Type of collection	Sex	Number caught	Number pools	Average pool size
Ae. aegypti	CO_2 - LR*	F	99	8	10.9
		M	89	7	10.4
Ae. albopictus	CO_2 - LR	F	292	19	15.4
		M	67	10	6.7
	Resting	F	1160	47	24.7
		M	402	17	23.7
Ae. atlanticus	CO_2 - LR	F	3	2	1.5
Ae. sollicitans	CO_2 - LR	F	469	25	18.8
	Resting	F	25	2	12.5
		M	3	3	1.0
Ae. taeniorhynchus	CO_2 - LR	F	60	6	10.0
Ae. triseriatus	CO_2 - LR	F	4	4	1.0
	Resting	F	243	4	24.3
		M	22	2	11.0
Ae. vexans	CO_2 - LR	F	165	16	10.3
An. cucians	CO_2 - LR	F	662	33	20.1
		M	1	1	1.0
	Resting	F	62	3	20.7
		M	70	5	14.0
Cx. quinquefasciatus	CO_2 - LR	F	104	10	10.4
Cx. restuans	CO_2 - LR	F	1	1	1.0
Cx. salinarius	CO_2 - LR	F	277	20	13.9
	Resting	F	4	1	4.0
Cs. inornata	CO_2 - LR	F	6	4	1.5
Ps. confinnis	CO_2 - LR	F	1	1	1.0
Ps. ferox	CO_2 - LR	F	10	5	2.0

*CO_2 - landing rate collection.

Table 23. Collection of Aedes albopictus mosquitoes for virus isolation in New Orleans during 1988.

Site	Type of collection	Sex	Number caught	Number pools	Average pool size
Algiers	CO_2 - LR	F	65	4	16.3
		M	43	5	8.6
Eastern N.O.	CO_2 - LR	F	146	9	16.2
		M	24	5	4.8
Michoud Blvd.	Resting	F	1135	46	24.7
		M	402	17	23.7
NASA	Resting	F	25	1	25.0
Port Area	CO_2 - LR	F	81	6	13.5

BIOLOGICAL CONTROL (COPEPODS) - GERRY MARTEN

Cyclops are small predatory crustaceans in the order Copepoda. They are only about a millimeter in length, but some of the larger species prey on first-instar mosquito larvae. During summer of 1988 a study was initiated in collaboration with the Centers for Disease Control to determine whether there are cyclops in New Orleans that can be used for biological control of Aedes albopictus.

Field survey

Samples were taken from a variety of water bodies around New Orleans such as freshwater lagoons, ponds, swales, and tires, in order to determine which cyclops species prey upon Ae. albopictus larvae. The following species were found:

*Acanthocyclops vernalis

Apocyclops panamensis

*Diacyclops navus

Ectocyclops rubescens

Eucyclops agilis

Eucyclops speratus

Homocyclops ater

*Macrocyclops albidus

Metacyclops denticulatus

*Mesocyclops edax

*Mesocyclops longisetus

*Mesocyclops sp.(leuckarti group)

Microcyclops varicans

Orthocyclops modestus

Paracyclops fimbriatus

Paracyclops poppei

Thermocyclops inversus

Tropocyclops prasinus

Most of the above species are too small to prey upon mosquito larvae, but the six species marked with an asterisk are large enough to kill Aedes larvae in substantial numbers. (Homocyclops ater is also large but does not prey on mosquito larvae.)

Five of the larvivorous species -- Acanthocyclops vernalis, Diacyclops navus, Macrocyclops albidus, Mesocyclops edax, and Mesocyclops sp., occur throughout much of North America and are therefore of potential significance for mosquito control in many areas in addition to New Orleans. (Mesocyclops sp. appears to be a new species in the Mesocyclops leuckarti species group.) Each of these five species has a unique ecology with regard to its foraging habits, diet, and ability to withstand stresses such as high water temperatures or drying of the habitat. During 1988, each was the object of field and laboratory tests to evaluate its potential for biological control. The five species were cultured in five gallon bottles containing pasteurized pond water, wheat seed, bacteria, protozoa, and rotifers, to produce the thousands of live specimens required for experiments. It was possible to store them live for months in the refrigerator.

Natural cyclops populations in tires

Discarded tires are a habitat of particular interest because Ae. albopictus uses them so frequently for breeding. Cyclops (e.g., Paracyclops poppei and Eucyclops agilis) were sometimes found in tires, especially if the tires had been around for years. Among the larvivorous cyclops, Acanthocyclops vernalis, Diacyclops navus, and Macrocyclops albidus were occasionally found in tires.

Impressive evidence on the effectiveness of cyclops predation came in June from a group of tires at the edge of an Ae. albopictus-infested woodlot near Grant Street (New Orleans East). About half the tires contained natural populations of Macrocyclops albidus and Diacyclops navus that appeared to have been together in the tires for years. Most other tires in the same group contained no cyclops at all. The following numbers of cyclops and mosquito larvae were counted in the tires:

	Diacyclops navus and Macrocyclops albidus	
	Present	Absent
Average number of Diacyclops*	66	--
Average number of Macrocyclops*	76	--
Percent of tires with Ae. albopictus	8 %	60 %
Average number of Ae. albopictus*	5.0	12.6
Percent of tires with Culex larvae	35 %	40 %
Average number of Culex larvae*	3.5	6.8

*Average numbers per tire, based on tires where the indicated animal was present.

Overall, there were twenty times as many Ae. albopictus larvae in tires without cyclops as there were in the tires with Macrocyclops and Diacyclops. When one hundred newly hatched larvae were placed in a series of these tires with and without natural populations of Macrocyclops and Diacyclops, larval survival after 48 hours in the tires without cyclops averaged 55%, while 48-hour survival in the tires containing Macrocyclops and Diacyclops was only 0%-1%. Macrocyclops appeared to be responsible for most of the predation.

Field tests

In August, Acanthocyclops vernalis, Diacyclops navus, Macrocyclops albidus, and Mesocyclops sp. were introduced to a series of 70 tires in an Ae. albopictus-infested woodlot near Hayne and Bullard Blvds. A single species was introduced to each tire with a few tires receiving both Diacyclops and Macrocyclops. Introductions were a single adult female, 10 adults, or 20 nauplii (the first juvenile stage). All introductions of 110 adults were successful, but only about half the single-female and nauplii introductions established a population.

There were Toxorhynchites in some of the tires. Toxorhynchites have been observed to prey on cyclops in the laboratory, but the Toxorhynchites appeared to have no negative effect on cyclops numbers under field conditions.

The following are average numbers of each cyclops species in the tires six weeks after introduction:

	Cyclops/tire
Diacyclops navus	628
Macrocyclops albidus	83
Mesocyclops sp.	382

There was not time to evaluate the impact of cyclops on Ae. albopictus larvae in the tires before Ae. albopictus diapause began in September. However, samples from each tire were brought to the laboratory in pint jars to assess how many larvae the cyclops could kill. Macrocyclops albidus and Mesocyclops sp. were particularly effective predators, usually killing 99%-100% of the larvae even when a thousand larvae were introduced at the same time. Acanthocyclops vernalis appeared nearly as effective, but the results were not conclusive because Acanthocyclops was introduced to only a few tires. Diacyclops killed only about 50% of the larvae.

These same tires will be monitored next year to see how well the cyclops survive and how effectively they eliminate Ae. albopictus larvae. The tires can be expected to dry out from time to time, a serious threat to survival for an aquatic animal, but at least some of the cyclops species can be expected to survive because they are often found in temporary pools. When a pool with Acanthocyclops vernalis and Diacyclops navus dried up and soil was taken to the laboratory and flooded with water, adults and subadults emerged from the soil and assumed normal activities within an hour.

Laboratory tests

The five larvivorous cyclops species were tested in approximately 200 one-liter polypropylene containers. Water and detritus in the containers was collected from discarded tires in a wooded area. Some of the containers were kept under a fluorescent light, where they maintained an abundance of phytoplankton, while other containers were kept under shade conditions, Ten adults of a particular species (or species mix) were introduced to each container, and the subsequent population of cyclops was monitored for several months. One month after introducing the cyclops, 100 newly-hatched Ae. albopictus larvae were introduced to each container and counted three days later to assess their survival. If all (or nearly all) the larvae were killed, the same process was repeated with 500 larvae. Larval survival in control containers (without cyclops) was in the range of 90%-100%.

In plastic containers with an abundant food supply (i.e., phytoplankton or decomposing leaves), Macrocyclops albidus and Mesocyclops sp. established and maintained populations that were large enough to kill all first-instar Ae. albopictus larvae that were introduced, even when 500 were introduced. Acanthocyclops vernalis performed nearly as well. With fluorescent light (i.e., abundant phytoplankton), there were enough Mesocyclops edax to kill 95%-100% of the larvae. The same was usually true under shade conditions, but sometimes there were only a few Mesocyclops edax under shade conditions, and the percentage of larvae they killed was lower. Diacyclops navus established larger populations than the other species, but the intensity of Diacyclops predation was highly variable. Most strains (i.e., separate cultures) of Diacyclops killed 50%-90% of the larvae. The most effective strain killed 85%-100% of the larvae, but one strain did not kill any larvae at all.

Diacyclops navus was the only cyclops species that established large populations when food was scarce in a container. (An example of food scarcity is a container with water and fine detritus left over after animals graze on decomposing leaves. The nutritional value of the fine detritus is very low). Species other than Diacyclops generally maintained only a few individuals in a container under low-food conditions. They killed substantial numbers of Ae. albopictus larvae, but usually less than 100%. It is worth noting, however, that Ae. albopictus larvae which survived cyclops predation under low-food conditions seldom obtained enough nutrition to develop successfully to the adult stage. If a container has enough food for Ae. albopictus larvae to develop successfully, there is also enough food to support populations of Acanthocyclops vernalis, Macrocyclops albidus, or Mesocyclops sp. that are large enough to kill virtually all larvae hatching into the container.

It is fortunate that these species of cyclops can kill such a large percentage of the larvae, because nearly 100% mortality is necessary for a larval predator to be effective for biological control. This was demonstrated by an experiment in which 5, 10, 20, 40, 80, or 160 larvae were introduced to a total of approximately 200 half-liter plastic containers with water and detritus collected from tires. The output of adult mosquitoes from the containers was very different in containers with different quantities of food (e.g., decomposing leaves), but with the same amount of food, the output of adult mosquitoes was the same over a broad range of larval inputs (Figure 1). In other words, the quantity of food resources was limiting the production of adult mosquitoes. A predator that kills 80%-90% of the larvae may simply be thinning an overcrowded larval population with little or no impact on the production of adult mosquitoes.

Experiments begun by Wenyan Che during 1988 provided valuable information on the compatibility of cyclops with larvicides. All cyclops species that were tested functioned normally at Bti and permethrin concentrations hundreds of times higher than would ever be used for practical larviciding. If a larvicide and cyclops are applied together, the larvicide can produce an immediate kill of all larvae in a container, and the cyclops can take over as the larvicide wears off.

Conclusions

There are definitely cyclops species in New Orleans with a high potential for biological control. *Macrocyclops albidus* and *Mesocyclops* sp. are most promising; they usually eliminate all *Ae. albopictus* larvae from a container. *Acanthocyclops vernalis* and *Mesocyclops edax* may also prove useful, particularly when used in combination with *Mesocyclops* sp. or *Macrocyclops*. Because the field trials this year have been limited, more trials will be necessary to ascertain how well each of these cyclops species performs under the variety of ecological conditions that exist in the field.

Program for 1989

The scale of field trials will be expanded considerably next year. The five larvivorous cyclops will be introduced to more than a thousand discarded tires under a variety of ecological conditions with regard to size and depth of the tire pile, exposure to sun, frequency of drying, and natural supply of food. The cyclops will also be introduced to treeholes, swales, and discarded buckets. There will be tests of promising mixtures of cyclops species, which may be more effective than a single species by itself. After the introductions, cyclops and mosquito larvae will be monitored through the summer to document how well each cyclops species survives and how effectively it eliminates *Aedes* larvae.

Development will continue on techniques for mass production, storage, and delivery of cyclops to breeding containers. Production will be extended to 4' x 8', fiberglass pans that have been used for rearing *Toxorhynchites*.

Tests have already shown that cyclops can be squirted without harm from a backpack sprayer with a simple 3-mm hole in the nozzle. Next year there will be tests on spraying the cyclops onto tire piles with various kinds of sprayers. Work will begin on granular encapsulation of the cyclops for storage and distribution.

ENTOMOLOGICAL REPORT

As has been the case for several years, the predominant pest species throughout 1988 was the permanent saltmarsh mosquito Culex salinarius, which totaled 66,099 females, or 63% of the year's catch. This was followed by Anopheles crucians at 14%, Aedes vexans at 11%, Uranotaenia sp. at 4%, Culiseta inornata at 3%, Culex resturans at 2%, Ae. sollicitans at 1% and all others less than 1% each.

The first quarter of 1988 yielded adult densities c. 50% below the expected seasonal average. The second quarter was very active in April and June, with June's activity well above seasonal norm. Again, the prime species was Cx. salinarius. July and August in the third quarter continued to be very active, with Anopheles crucians and Ae. vexans buildups. The last quarter was mostly uneventful, with moderate Cx. salinarius problems in late october and early November.

Aedes albopictus continued to spread parish-wide during the year and presented numerous control challenges. The spring and winter allowed this mosquito to continue adult activity through at least December 10th, when four females were collected in the light traps. During 1988, Aedes albopictus represented 6.2% of the Outside CO_2 collections (0.4% Ae. aegypti), 12.8% of the Algiers CO_2 (1.1% Ae. aeygpti) and 39.3% of the Port CO_2 catch (35.7% Ae. aeygpti).

LARVAL SURVEILLANCE AND CONTROL

Abundant rainfall and cool temperatures produced "permanent" water swales throughout the city , especially in parks and parkways during the first quarter of 1988. This resulted in heavy urban production of Culex resturans and Cx. salinarius. The fluctuating water levels also produced moderate broods of Aedes vexans larvae by late February. The second quarter experienced near drought conditions, with little urban larval activity. These same conditions produced favorable impounded marsh conditions, which enhanced the production of Culex salinarius and Anopheles crucians larvae. The third quarter experienced unusually high rainfall, resulting in widespread flooding, often making larviciding impractical. The last quarter was very dry, with very low larval production.

Considerable Aedes albopictus container inspection was done from April through December, and is reported elsewhere in this report.

ADULT SURVEILLANCE

Adult surveillance is essential in monitoring the density, species and temporal occurance of adult mosquitoes. Several methods are employed to these ends. The basic method uses the standard New Jersey light trap. Other means of collecting this data is through the use of CO_2 enhanced human landing rates, truck mounted funnel traps, CDC miniature light traps, Fay traps with ultraviolet lights, backpack aspirators and information recieved from telephoned complaints. During 1988, routine operational adult mosquito collections totaled 107,576 mosquitoes, identified to sex and species. This information allows us to properly time treatments and confine them only to where the problem areas are.

During the year, the New Jersey light traps collected 22 species of mosquitoes, ranging from one Psorophora ciliata, one Aedes fulvus pallens, one Toxorhynchites rutilus septentrionalis to 71,705 Culex salinarius.

ADULTICIDING

Adulticiding began in March in response to Culex salinarius activity. A spring brood of Aedes vexans in April brought about increased adulticiding. Activity in May decreased slightly, only to considerably increase in June, July and August. An average amount of both ground and aerial activity continued through November, with no adulticiding needed in December.

Insecticides used both in aircraft and ground units were malathion (undiluted Cythion) and resmethrin/PBOT (Scourge diluted with agricultural grade mineral oil). Larval and adult susceptibility test on several species of larvae and adults throughlut the year showed no signs of resistance to these insecticides. There were no insecticide spills, nor were there any insecticide related injuries.

VECTOR MOSQUITO MANAGEMENT - ED FREYTAG

Routine surveillance using UV Fay traps was continued during the winter months as a carry over from last year even, though no adults were detected. Fay traps and ovitraps set in various parts of the city to collect Aedes albopictus and Ae. aegypti adults and eggs were discontinued in June due to the low numbers.

Intensive surveillance of tires and other water-holding containers for the presence of Ae. albopictus and Ae. aegypti larvae was conducted early in the spring. Aedes albopictus adults were collected in April, a week earlier than Ae. aegypti suggesting that Ae. albopictus hatch or develop faster than Ae. aegypti in the spring. Aedes triseriatus eggs were collected in ovitraps in wooded areas of East New Orleans in the first week of April. Egg collections increased if the ovitraps were placed about seven feet up on tree trunk.

Plans were made for collections of Culex salinarius adults and rearing them to do a mark-release-recapture to see if males stay close to breeding areas and to determine distances traveled. Muck buckets were set up in East New Orleans in a marshy area to collect Cx. salinarius egg rafts. Flooding resulting from heavy rainfall made the muck buckets less attractive oviposition sites. Attempts to collect Cx. salinarius eggs in Lower Coast Algiers in muck buckets for laboratory colonization were unsuccessful. Larvae of Cx. salinarius were found in tires along with Ae. albopictus larvae, but not enough were collected to start a laboratory colony. Attempts were made to collect Cx. salinarius adults with CDC light traps but were unsuccessful as the populations crashed due to hot weather or drying up of breeding sites.

A mosquito consulting trip to Puerto Cortes, Honduras, involved the Assistant Director and the Entomologist 4th through the 12th. The purpose of the visit was to determine the extent of potential breeding sites in and around the city, and to formulate control recommendations. An extensive report was prepared in English and Spanish.

A mosquito collection was started for reference and teaching purposes. This collection will be used to train visitors, students, and new personnel, especially those that will work on the CDC aerial spray contract. It will also be used to more easily identify uncommon mosquitoes.

Hot and dry weather in the summer reduced mosquito activity except for Cx. salinarius adults which were being collected in high numbers in the light trap in Lower Coast Algiers. Aedes albopictus and Ae. aegypti adults were responsible for the majority of the complaint calls received in July. Inspectors servicing complaints inspected backyards for wet containers and left information leaflets with the homeowners to educate them on how they can help control mosquito breeding in the backyard.

Complaints from citizens in Eastern New Orleans prompted ground and aerial adulticiding treatments to control Ae. sollicitans broods invading this area. These adulticiding treatments were also assigned to control broods of Ae. vexans, Cx. salinarius, and Anopheles crucians which could affect visitors and guests attending the Republican Convention.

One of the major problems encountered when servicing mosquito complaints is that homeowners are usually not at home during the day. Leaflets and door hangers are left in the premises but the majority choose not to call to make an appointment for an inspection. Many backyards that appear to be potential Ae. aegypti and Ae. albopictus breeding hot spots are left untreated if permission is not acquired from homeowners. A new form for logging mosquito complaints was designed to obtain as much pertinent information as possible to provide better service to the public.

An aerial treatment test with malathion insecticide was conducted in a New Orleans East area located by Crowder Road and Chef Highway. Bioassay larvae and adults of Ae. albopictus and Ae. aegypti were placed in slab housing, elevated housing and in wooded areas. Open and sequestered sites were located for the bioassays. Results indicated that percent kill for Ae. aegypti was 1/3 times higher than for Ae. albopictus. It was also observed that mortality was higher in open areas than in sequestered areas.

By October, most of the urban container breeding mosquitoes had decreased due to cooler temperatures, but Ae. vexans and Cx. salinarius populations increased, causing sporadic mosquito complaints. Culex salinarius, An. crucians, and Cx. inornata became more frequent later in the year. Mosquito complaints in late December were serviced for Cx. quinquefasciatus and Cx. restuans that were found breeding in containers in backyards.

SUSCEPTIBILITY STUDIES - ED FREYTAG

Several attempts were made to colonize Culex salinarius to provide sufficient mosquitoes for mark-release-recapture studies and for susceptibility tests using WHO and Wind Tunnel procedures. A Cx. salinarius colony was started but many problems were encountered. Caged adults failed to mate in the insectary. Females readily blood fed on the hand of the insectary technician, however, the few egg rafts that were deposited did not hatch.

Adults and egg rafts were collected in the marsh to increase the colony in an effort to get more eggs.

Collections of mosquitoes were made in the marsh by Highway 11 using the backpack aspirator in the mornings, but very few Cx. salinarius were collected. Heavy rainfall flooded the breeding site where many egg rafts and larvae were previously collected. Muck buckets were placed in the field in Lower Coast Algiers to collect egg rafts, but very few were collected. The colonization of Cx. salinarius was abandoned due to other pressing projects.

Eggs of Aedes triseriatus were collected using ovitraps in sylvan habitats to start a laboratory colony. When trying to establish an Ae. triseriatus colony from eggs collected in ovitraps in the field, the possibility exists that Ae. albopictus may also be present in the ovistrip. Because of the differences in embryonic requirements and larval development times, the Ae. albopictus can be separated to avoid contamination by several procedures. Ovistrips can be flooded hatching off Ae. albopictus, and since Ae. triseriatus begins pupating in a minimum of seven days compared to 100 hours for Ae. albopictus, any pupae removed before seven days can be assumed to be Ae. albopictus. Any escaping Ae. albopictus adults can be easily removed with an aspirator from the insectary cages.

It has been observed that when handling more than one species of mosquitoes in the insectary, one must be careful with eggs of Ae. aegypti, as they can contaminate other colonies. Because they are reared so easily, Ae. aegypti may contaminate and even replace colonies of other species in the insectary within a short time.

A technique for mass rearing larvae was implemented in the insectary to provide large quantities of larvae and adult Ae. aegypti and Ae. albopictus for susceptibility studies. Ample supplies of eggs are required to provide a desired number of adults, and if only one sex is desired, up to four times the number of eggs should be hatched. A calibrated pipette is used to draw a specific number of first instar larvae in rearing trays or beakers. Mosquitoes are reared at a constant 80^{o}F and 80% RH. The Kurgen Larval-Pupal separator was used to separate male from female pupae, but a 20% pupal mortality was experienced.

The insectary technician experimented with several cage designs for maximizing adult emergence while cutting down on labor. The most efficient cage was built using a three gallon plastic bucket with the lid cutout and replaced with netting. To gain access to the mosquitoes a large hole was cut on the side and a surgical stockinette was staples in place.

A new technique for rearing Ae. aegypti larvae was tried using 400 ml glass beakers instead of enameled metal pans. It was observed that larvae grown in pans tend to ball up in one corner to get away from light, and this results in undernourished, undersized larvae. By placing 200 larvae in each beaker, the food is always available at the bottom of the beaker and more uniform larvae can be obtained. Larvae of uniform size must be used in susceptibility tests to avoid erratic results. Another advantage to rearing larvae in beakers is that productivity is vastly increased using the same amount of counter space that a pan occupies.

A colony of Uranotaenia lowii was maintained in the insectary for a short period by blood feeding adults on frogs. The first instar is prone to food shock and the adults are very susceptible to desiccation. Because this is not a human pest species, the colony was discontinued.

Attempts were made to colonize Psorophora howardii from larvae collected in the field. Since the larvae are predacious after molting to the 2nd instar, they were fed first and second instar Ae. aegypti, but had to be reared in individual beakers. The bite of Ps. howardii is extremely painful, so laboratory animals used for blood feeding this species experienced too much discomfort and were used only a few times. Psorophora howardii will readily feed on a human arm if offered carefully. Two blood meals are necessary to produce a batch of eggs, which they lay on a wet paper towel. Eggs were collected from Ae. tormentor adults reared from field collected larvae. Particle board soaked in water was used as a oviposition substrate.

A new dusting cage was designed for marking mosquitoes with fluorescent dust since mortality rates were excessive. The new cage consists of a three gallon plastic bucket with the lid cutout and replaced with netting. The bottom was also cut out and netting hot glued in place. This allows the dust to settle out of the cage and prevents the mosquitoes from getting overdusted. A glass or plastic lid is in place while the dust is being applied.

Larvae of Ae. aegypti were reared at several densities to determine if crowding affects the results of susceptibility tests using malathion 91% technical. The larvae were reared in densities of 100 to 3200 in pans with the same dimensions and water volume, and fed the same amount of food. A trend was observed indicating that as overcrowding increases, so does susceptibility, apparently because the larvae are undernourished.

To test the effects of different feeding rates on Ae. albopictus in the insectary, lots of 400 larvae were fed 0.0006 to 0.2 mg defatted liver powder per larvae. Susceptibility tests using Scourge indicated that larvae reared with plenty of food are quite tolerant to Scourge, while those reared with very little food were many times more susceptible. When the susceptibility regressions were plotted, it was evident that the slope was basically the same for the different feeding rates, even though the LD_{50} was significantly different. An explanation for this may be due to the physiological response to the insecticide due to the different larval sizes.

Susceptibility tests using larvae have always been done with glass beakers. The disadvantages are that the glassware has to be thoroughly cleaned every time they are used, glass beakers are expensive, and they break easily. Results from susceptibility trials using waxed and plastic coated paper cups indicated that plastic coated paper cups are not significantly different than glass. Susceptibility tests using waxed paper cups appeared to give varied results when compared to glass beakers.

TOXORHYNCHITES – STEVE SACKETT

As noted on the 1988 report cover, a new mosquito control research facility is planned for the near future, with the mass production of Toxorhynchites occupying a major portion of the laboratory. It was hoped that construction would have been initiated sometime this year, but delays in the various phases of planning and design have pushed this date into mid-1989. This laboratory should have a major impact on our ability to deal with the problems of container-breeding mosquitoes such as Aedes aegypti and Aedes albopictus.

Several species of Toxorhynchites were in production throughout the year as new rearing systems and techniques were evaluated. Two of the three technicians involved in the bio-control research were lost to private industry in April and May, reducing our ability to attack the problems as needed. Even with this deficit, several areas critical to the successful mass-production of predators were intensely monitored and changes were made where necessary. Personnel were also deeply involved with operational studies at the main NOMCB facility.

SHIPMENT OF TOXORHYNCHITES

Toxorhynchites amboinensis pupae were successfully delivered to the CDC lab in Fort Collins, Colorado, via overnight air express. Several shipping methods were tested to optimize survival and emergence. The method producing the least trauma was also the simplest, that of placing 100 pupae in 1-pint plastic cups containing 100 ml of water. Several thousand insects were delivered in this manner with minimal mortality. Unsuccessful methods tried recently or in the past include wiping immatures on wet sphagnum moss, on wet sponges, and in plastic bags filled with water and oxygen. In all cases, cups or bags were placed into styrofoam shipping boxes packed with additional foam insulation.

With an effective shipment method for Toxorhynchites now established, delivery to other agencies for use in virology studies or biological control programs is now a reality. With a small charge per insect, funds may be generated to provide additional equipment for the new rearing facility.

AMCA PRESENTATION

A paper entitled "Toxorhynchites amboinensis vs. Aedes albopictus: IS THERE A CHANCE FOR CONTROL?" was presented at the AMCA meeting in Denver, Colorado. This paper discussed the effects of weekly releases of Toxorhynchites adults on the populations of mosquitoes produced from artificial containers and treeholes (see 1987 annual report for results). Of major interest at the meeting was a symposium on Ae. aegypti and dengue control, in which the participants underscored the difficulty in reducing Ae. aegypti populations or disease transmission with the sole use of insecticides. Evaluations of 5 aerially-applied Dibrom treatments in San Juan, Puerto Rico, demonstrated minimal suppression of adults, with lack of mosquito/chemical contact suggested as the primary reason for the poor results.

WEST INDIES

At the request of the Pan American Health Organization (PAHO) and the Caribbean Epidemiology Center (CAREC), I visited Union Island, St. Vincent and the Grenadines, to consult with personnel involved with the Ae. aegypti control program. Of primary interest was the evaluation of Tx. moctezuma as a biological control agent for use in large water storage containers where mosquito breeding was occurring. Tx. moctezuma is native to Trinidad and many of the surrounding islands of the West Indies and was thought by some to be the best species to use in that island's habitat. Although some reductions in mosquito density were observed following introductions of predators into the cisterns, logistical as well as personnel problems hampered the overall success of the program.

QUALITY CONTROL -- INSECTARY OPERATIONS

Development times for Toxorhynchites immatures have been slowly decreasing from ca. 12 days to 10 days (period of time from egg collection to first pupations), even though rearing techniques have remained relatively constant. It may be that a genetic selection for the more rapidly developing larvae is occurring during the mass rearing process, as the smaller/younger individuals fall prey to their larger siblings. Cannibalization has been minimized with optimum predator/prey ratios, but is still occurs at a low rate throughout the larval development period. Over time and through many generations, this cannibalistic feeding could potentially select for the faster growing individuals. Increases in fecundity have also become evident over the past few years. These shifts in development times and fecundity do not pose any major problems in the laboratory, but emphasize the fact that continuous change is occurring in the genetic composition of the colony.

Mosquito rearing trials comparing the use of large trays (4' x 8') to our standard size trays (15" x 18") did not indicate any significantly differences in parameters such as pupal weights, survival, or development times for the immatures of either Toxorhynchites or Ae. aegypti. The average number of predators produced per large tray ranged from 2000-4000, with a notable decrease in labor compared to mosquito production in the smaller trays.

Toxorhynchites were again plagued with poor and erratic egg hatch for much of the year. Egg viability was monitored on a regular basis, with percent hatch ranging from 0% to 94% (average ca. 45% for all strains).

TX. RUTILUS SEPTENTRIONALIS

While assisting Dr. Gerry Marten in his study on the effects of introductions of copepods into tires, it was interesting to observe that a high proportion of the tires contained large numbers of Tx. rutilus septentrionalis. Approximately 85% of the 70 tires examined were positive for this indigenous predator, averaging 9 fourth instars per tire. Many people are under the impression that the cannibalistic behavior of Toxorhynchites will not allow multiple predators to co-exist within the same container, but under favorable conditions, as many as 28 larvae have been noted within a single tire. High input of food tends to support higher populations, but these predators can also "fast" for extended periods of time when food input is low. In the majority of tires, few, if any, Aedes larvae were present.

Several hundred Tx. rutilus septentrionalis larvae were collected and returned to the laboratory in hopes of establishing a colony and evaluating their potential for biological control. The literature reports that force mating (decapitation off the male followed by union with the female) is necessary for successful insemination, but by using a large walk-in cage for the adults, natural mating did occur. Oviposition occurred only after a small tire with water was placed into the cage; no eggs were deposited in the black cups typically used to collect eggs from other Toxorhynchites species.

Although several generations were successfully reared, larval development times were significantly longer than for other predator species and consumption of prey was reduced. Oviposition gradually declined with the colony eventually crashing. It was hoped that with successive generations the ease of rearing would improve and Tx. rutilus seUptentrionalis could be added to our arsenal of biological control agents.

ENCEPHALITIS SURVEILLANCE – C. J. LEONARD

Sampling of bird blood commenced two months later than usual this year. The state lab requested that no samples be sent in until May 15th, therefore sampling was not begun until mid May.

Ten sparrow traps were operated 5 days per week. Only those sites which were the most productive during the previous year were retained. Six netting locations were selected in areas where traps were not practical. Netting operating were carried out at two of these sites each week beginning in mid May.

The sparrow traps are usually operated 7 days per week during August and September since encephalitis activity is most probable during these months. Due to the reduction in manpower with the termination of the summer program and the elimination of overtime, the sparrow traps were operated only 5 days per week, and mist netting was eliminated.

Excessive rainfall also curtailed trapping activities in August and September. Sparrow traps operated only 11 days during September because of hurricanes in the vicinity of New Orleans. Rising water made it impossible to reach some traps, and wind and rain would have killed any birds caught if the traps had been operated.

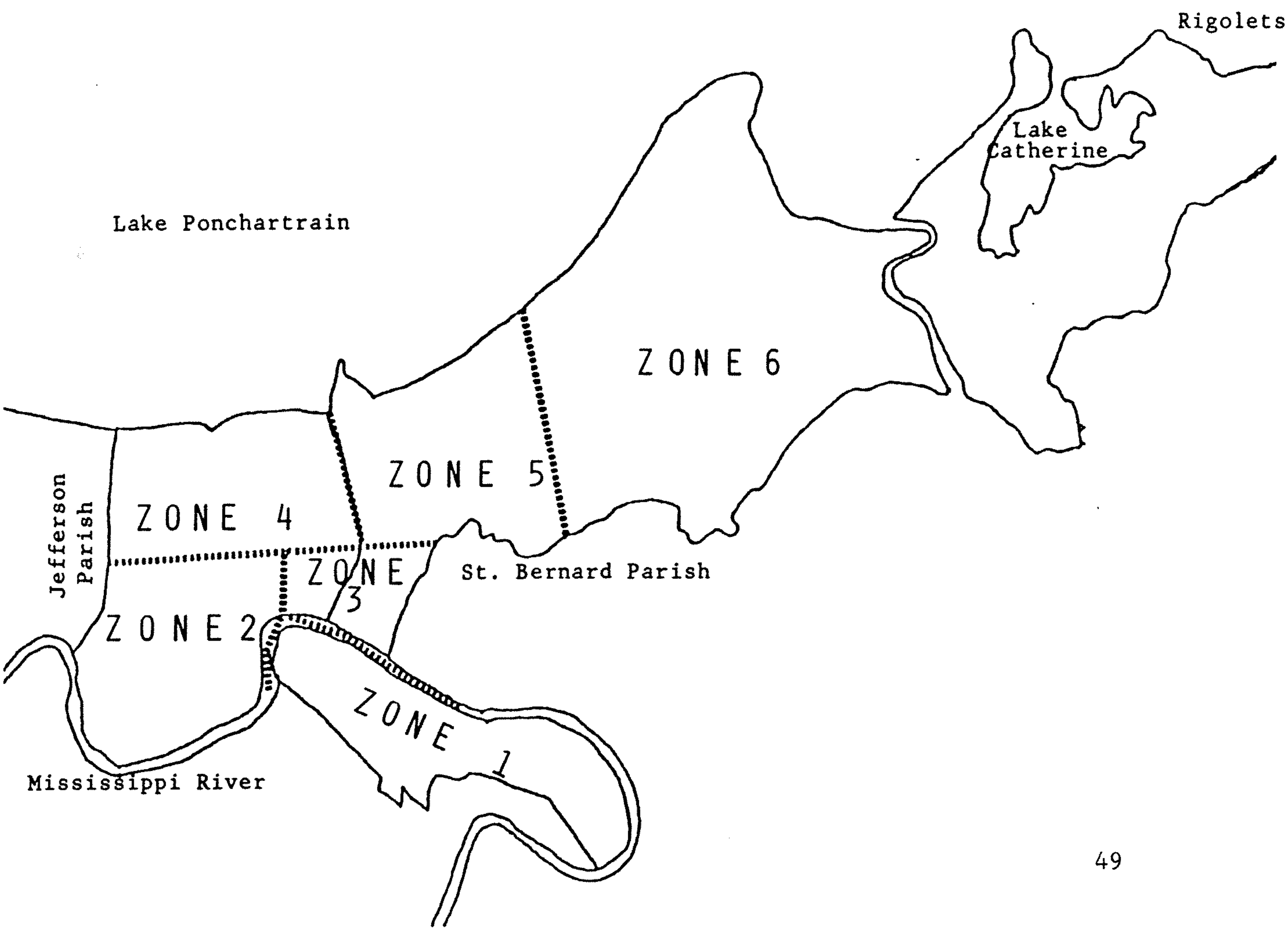
Seven hundred fifty-one birds were caught, bled, banded and released from mid May to mid September 1988. As usual over 80% of the birds captured were common sparrows (Passer domesticus).

No encephalitis activity was detected in the blood samples and the program was terminated in mid September due to environmental conditions and lack of manpower.

	Man hours	Costs	Miles	Costs
Trapping	506	$3827	7363	$1104
Netting	91	966	819	123
Administration	22	233	86	13
TOTAL:	619	$5026	8268	$1240

ENCEPHALITIS SURVEILLANCE - **YEAR TO DATE**

	TOTAL	SPARROWS ADULTS	SPARROWS IMMATURE	OTHERS ADULTS	OTHERS IMMATURE
ZONE - 1	56	10	7	24	15
ZONE - 2	110	37	72	1	
ZONE - 3	156	43	87	21	5
ZONE - 4	104	35	68	1	
ZONE - 5	97	28	59	9	1
ZONE - 6	228	50	142	26	10
TOTAL	751	203	435	782	31
# POS / % POS	0/0%	0/0%	0/0%	0/0%	0/0%



AVIATION OPERATIONS - P.A. ROCHÉ

The FAA Annual Inspections of both the Grumman "Ag-Cat" and the Britten-Norman "Islander" aircraft were performed during the months of January and March. The spray systems on both aircraft were inspected and calibrated shortly after this for the 1988 spray season.

A closed circuit freon air-conditioning system was installed by our aviation shop in the Islander aircraft. Additional maintenance on the Islander included: installation of landing light deflectors on both wings, to keep glare from imparing the pilots night vision during night spraying operations; both propellers were removed and sent in for overhaul and reinstalled; a defective "ELT" antenna was replaced and the two comm./nav. antennas were relocated; bead blasting and interior painting for corrosion control purposes was accomplished prior to delivering the aircraft to Chaparral Aviation in San Antonio, Texas for complete stripping and painting.

A complete renovation of the Ag-Cat spray system hopper installation was made this past year. These modifications encompassed the installation of two chemical tanks (increasing total capacity by a factor of 2 to 30 gallons.) Additionally a flush/primer tank was also installed to preclude a loss of prime when tanks were switched.

Preventative maintenance was performed on our special dual pump/pallet mounted pressurized loading assembly. An additional piece of equipment was added to our ground support inventory. This piece of equipment is in the form of 200 gallon PVC tank, mounted on a specially designed pallet to be lifted by a fork-lift. This enables us to gravity load our aircraft with chemical as an option to pressure loading. This assemble was designed and fabricated in our aviation department.

Av average number of flights were made with the single-engine "Ag-Cat" this past year. Most flights were for adulticiding treatment and the other flights were for pilot proficiency, obstruction survey and maintenance tests.

An average number of flights were made with the twin-engine "Islander" aircraft. Half the flights were for adulticiding treatments, the other half were for pilot proficiency, obstruction survey. Two of these flights were to ferry the aircraft to Baton Rouge to remove it from the path of Hurricane Gilbert.

Rental aircraft were utilized on seven occasions during the year. Six of these were fixed-wing small aircraft used for aerial survey, marsh inspection and aerial photography. A helicopter was used on one occasion for special photographic and inspection work.

Several meetings were held with the architects with regard to the aircraft hangar project. At this time the only thing remaining to be resolved is permission from the Federal Aviation Administration as to the location with respect to the runways and landing facilities.

SOURCE REDUCTION - BROOKS HARTMAN

For most of 1988 the source reduction program was active with inner city projects, new ditch construction in New Orleans East with old ditch maintenance for added adult mosquito reduction for residents of surrounding residential areas.

Area S-21 (Alvar, Almonaster Road, France Road, Florida Avenue) was drained by installation of 6" plastic drain pipe via subsurface drainage at Alvar. This drainage will help reduce mosquito populations in this industrial and residential area. Other areas around the city and New Orleans east (S-21, U-13, U-7, V-6, U-15, V-15 and City Park) received new ditches or routine ditch maintenance by removal of dense obstructive vegetation.

The W-2 wetlands project has been placed on hold again for 1989 pending the institution of the Bayou Sauvage National Wildlife Refuge. Amphibious ditching of the "W" areas east of Paris Road was halted in 1986 until further notice. Ditching of these areas is important to New Orleans because of their location close to humans, schools and shopping areas.

	Backhoe 1 & 2	Crawler	DL-1	Ditcher
Total hrs.	605	193	13	14
Digging hrs.	352			
Linear ft.	5535			
Salary	$13890	$ 3273	$ 253	$ 78
Costs (fuel, oil maint.)	$ 1278	$ 1112		
TOTAL:	$15168	$ 4385		$ 78

Project insp. & evaluation	839
Misc. shop & maint.	846
TOTAL:	1685

Service support Vehicles	Miles Traveled	Cost
S-89	4890	$ 855
S-109	293	52
DT-95	1350	298
S-19	200	44
S-3109	3213	601

PUBLIC EDUCATION - C.J. LEONARD

The public education program at New Orleans Mosquito Control continued to rely on videotape programs to reach our audience in 1988. Several new videos were produced this year.

"Integrated Pest Management" completed early in 1988 emphasizes the scientific and technical aspects of mosquito control, and the need for mosquito research in an operational program.

"A Tour of New Orleans Mosquito Control" produced later in the year shows the facilities, equipment and laboratories. This program shows the nature of the mosquito problem, and how the facility is used to combat these pests.

Videography was done on several occasions for the City Public Information Office. In January videography was done for a joint project of the City and Cox Cable. This piece was submitted to the Arts and Entertainment Network for a competition among cities and was a finalist.

Revision and re-editing of eight of our tapes was also completed this year. Video of tire slicers was added to "Old Tires: A National Health and Sanitation Problem" and aerial video of the Britten-Norman Islander was replaced in seven of our videos. The new footage of the Islander showed the aircraft spraying over the city. The old footage gave the wrong impression by making it appear that the marsh was being treated.

Several Public Service Announcements (PSA's) were produced in various lengths. Two 20 second and one 60 second spot were sent to local broadcast channels 4, 6, 8, 26 and 38 and have been in use since August. The PSA's concentrate on the problem of container breeding mosquitoes and urge the public to clean up water holding trash. Copies of the PSA's and our school programs were also sent to WCCL-Channel 49 which has recently gone on the air.

PSA's were also used as filler to tie several of our programs together for the School Board and Government Access channels. Three tapes were made for each channel that exactly fit their time requirements. The two 30 minute and one 60 minute tapes will be easy for them to insert into their program schedule and will be used more frequently.

The Public Education Program continues to focus on schools as a major part of our effort. The cooperation of the School Board cable channel helped to reach more schools at a lower cost. By scheduling the cablecast of New Orleans Mosquito Control tapes several weeks in advance, we are able to notify all elementary, middle and high schools in Orleans Parish by letter of the time and content of these programs, as well as the availability of teachers guides to each program. This allowed the complete elimination of the hand delivery of tapes to each school which was expensive both in terms of materials and manpower.

Requests for copies of our videotapes were received throughout the year. In 1988 over 100 copies were sold, netting $3,942.30. The price of New Orleans Mosquito Control videos will be raised to $55/each as of January 1, 1989.

Videos were sent at no charge to several publications, institutions and the Louisiana Nature and Science Center.

A new close up video lens adaptor and related techniques and equipment were developed this year in order to obtain video of larvivorous copepods being developed by Dr. Marten. These pictures will be incorporated in future productions.

Still photography of various aspects of the program was carried out during the year, including aerial photography of the study sites for the Centers for Disease Control project.

Presentations were given to a number of schools and universities both at the schools and at the mosquito control facility. Several seminars were also held at mosquito control including a group from Pakistan which spent 10 days learning modern control techniques.

A list of all video footage in our library was put on computer. This listing of the contents of over 100 video cassettes makes it easier to find stock footage needed for new productions.

The inventory of all equipment at New Orleans Mosquito Control was also verified and put on the computer this year. A clumsy paperwork system has been eliminated. The new inventory can provide much more useful information and is much easier to update.

	Man hours	Cost	Miles	Cost
Public education	420	$4464	1172	$ 176
Photography	492	5245	1142	171
Maintenance	23	241	89	13
TOTAL	935	$9950	2403	$ 360

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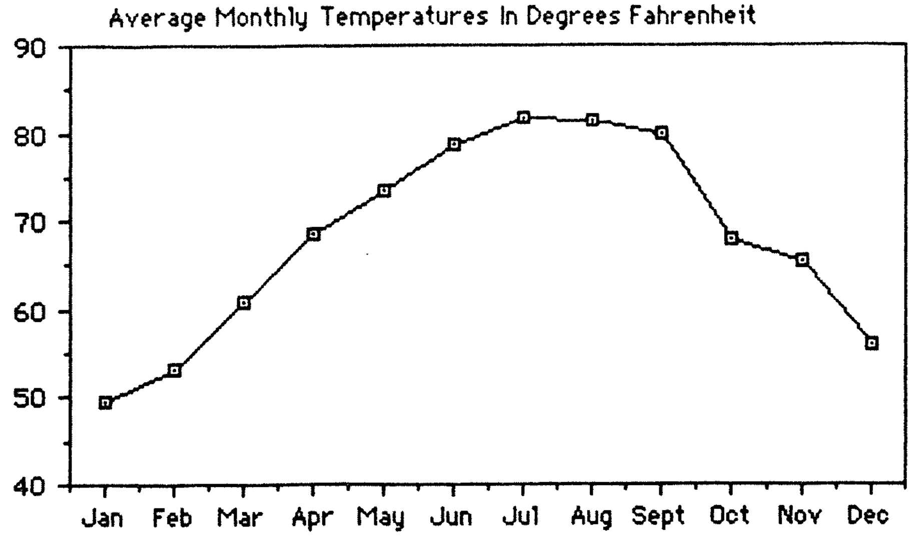
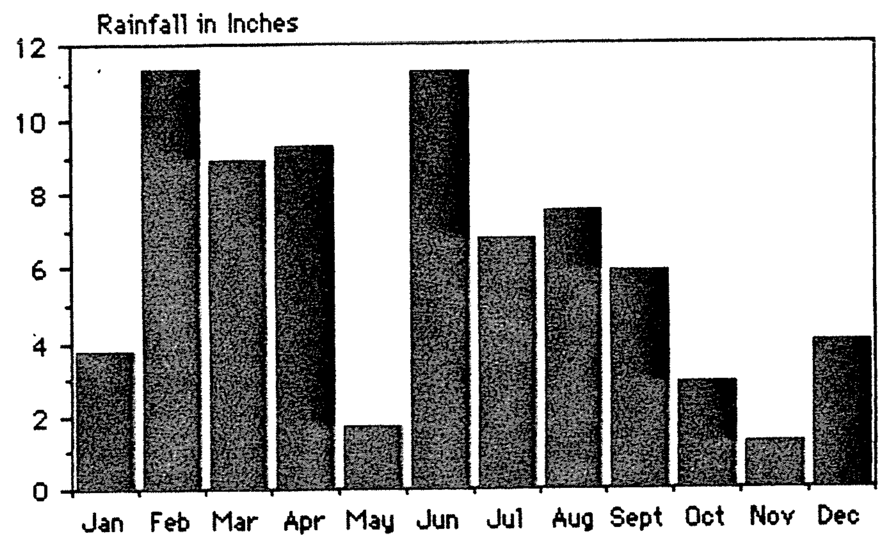
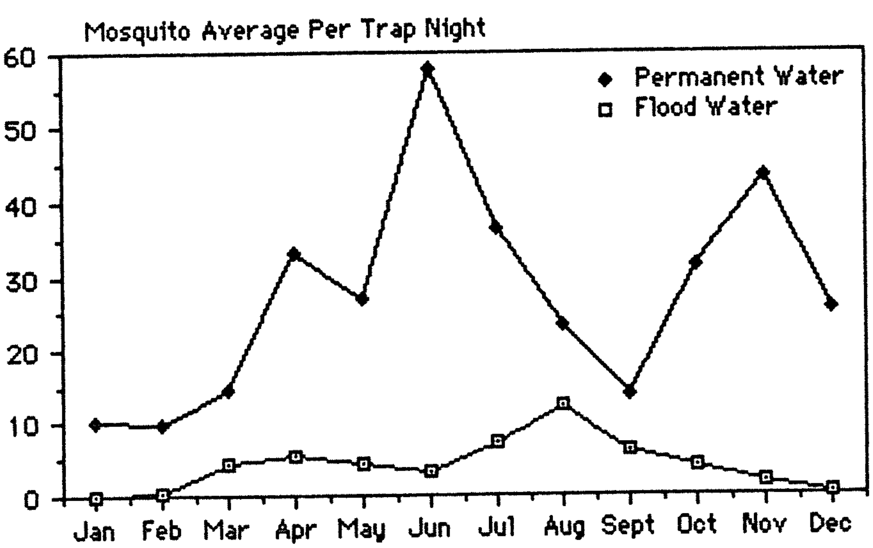


Average Monthly Temperatures In Degrees Fahrenheit
90
80
70
60
50
40
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec

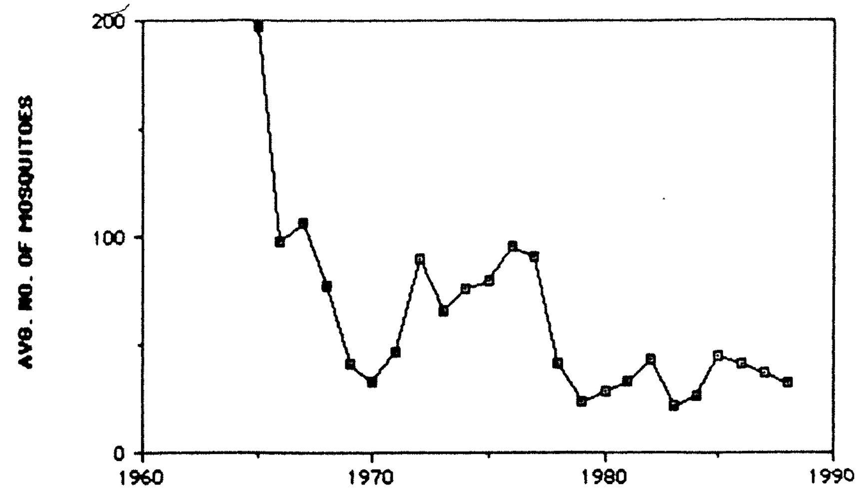


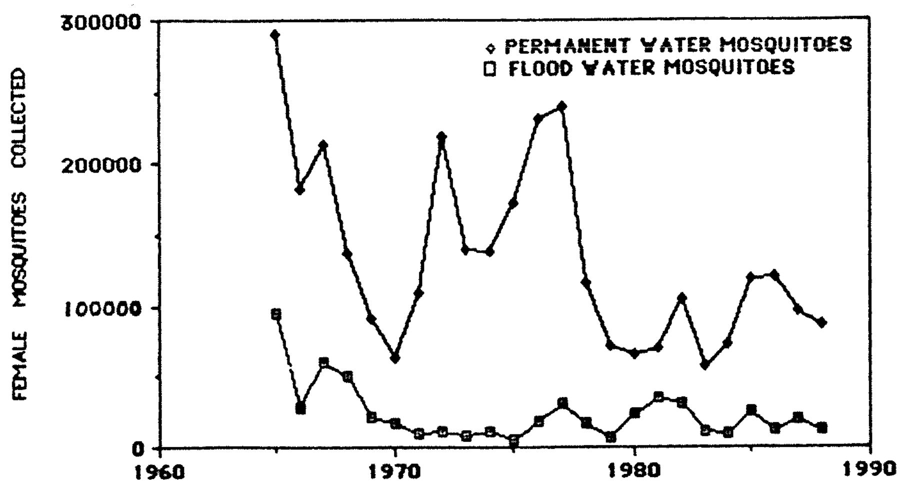
Rainfall in Inches
12
10
8
6
4
2
0
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec



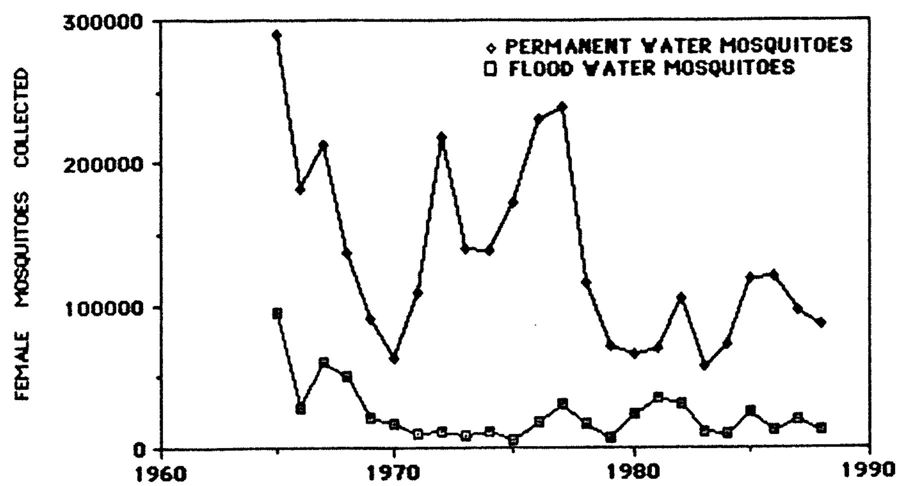
Mosquito Average Per Trap Night
Permanent Water
Flood Water
60
50
40
30
20
10
0
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec

MOSQUITO AVERAGE PER TRAP NIGHT



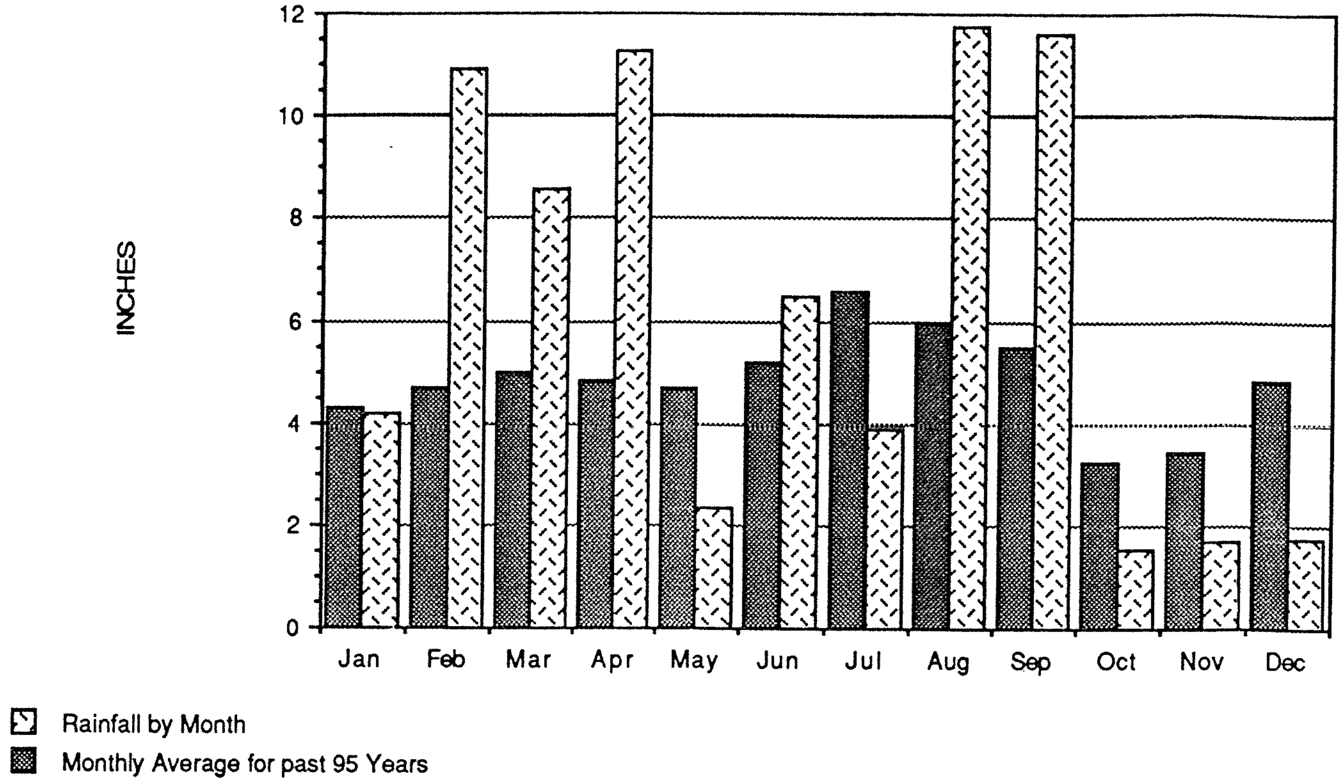


(BI-WEEKLY OPERATION OF NEW JERSEY LIGHT TRAPS)



(BI-WEEKLY OPERATION OF NEW JERSEY LIGHT TRAPS)

1988 Monthly Cumulative Rainfall



1988 Monthly Cumulative Rainfall