august

ANNUAL REPORT

1994

NOMCB

NEW ORLEANS MOSQUITO CONTROL BOARD

Ed Freytag

Naturally occurring aquatic predators, such as this creeping water bug, are very important to overall mosquito control.

CITY OF NEW ORLEANS

NEW ORLEANS MOSQUITO CONTROL BOARD
ANNUAL REPORT
1994

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ANNUAL REPORT

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DIRECTOR'S REPORT

EDGAR S. BORDES

Is there a resurgence of mosquito and vector-borne disease currenty taking place in the United States? If the State of Louisiana is any indication, there is certainly some evidence that would support the suggestion that there is more activity than we have witnessed in the past 30 years of mosquito control. St. Louis Encephalitis, Eastern Equine Encephalitis, Hantavirus and the anticipation of Lyme Disease moving further south are all good reasons to suspect that we may be in the midst of increased vector-borne disease activity. In addition to the activity in the state of Louisiana, New Jersey, New York and Texas have experienced indigenous cases of Malaria. It has long been the contention of medical entomologists that we have the vectors, the susceptible human population and only the disease organism is missing.

St. Louis Encephalitis (SLE) is an occasional visitor to the populated areas of Louisiana, and this past year was that occasion. St. Louis Encephalitis is a disease of birds that is transmitted from bird to bird and bird to humans by mosquitoes. The most probable vector mosquito in the New Orleans area is _Culex quinquefasciatus_ (the Southern House Mosquito). With twelve confirmed human cases of SLE, the New Orleans Mosquito Control Board directed all of its ground and aerial control efforts to the elimination of adult mosquitoes that could possibly move the disease into susceptible individuals. With that task completed, we next began the control of larval populations to reduce the potential for continued disease transmission by the next generation of adult mosquitoes. One positive bird blood was addressed in the same fashion, as a positive bird indicated the potential for human involvement.

Surveys conducted by NOMCB and the Housing Authority of New Orleans (HANO) indicate that approximately 40% of their housing stock is experiencing leaking plumbing lines that are creating mosquito breeding habitat under the buildings. The NOMCB and HANO are cooperating to solve the problem by locating the structures with leaking sewer lines. New Orleans Sewerage and Water Board is then cooperating with HANO to order the necessary supplies for the HANO plumbers to make the repairs. Meanwhile, the HANO team is working with us to control the mosquitoes that are breeding under the buildings with the leaking sewer lines.

Drs. Bruce Francy and Roger Nasci were sent to New Orleans by the Centers for Disease Control (CDC) to work with us on the SLE outbreak. Because of their efforts, 6,000 mosquitoes were collected and tested for SLE virus. Culex salinarius, Culex quinquefasciatus and Culex nigripalpus were the predominant species collected in the CDC and gravid trap collections. None of the mosquito pools tested positive for the SLE virus. The final human case of SLE was reported to us on October 19th. Even though the address used by this individual could not be confirmed, the entire area was inspected and treated.

Expanded responsibilities of the City of New Orleans Mosquito Control Board now include the control of Formosan termites in City-owned trees and buildings. The joint tree project with NOMCB, Parkway Commission and LSU was concluded during the year. Over 4000 city trees were inspected for active Formosan termite infestations and 70 of these trees were baited with a new and innovative system. A dozen city structures are also in the process of treatment using Integrated Termite Management technology. Water soluble borates, termite baiting, mechanical barriers, subterranean tubing systems and improved construction techniques are all being used to combat the ever expanding Formosan termite infestation in the City of New Orleans.

Public education efforts included letters sent to science teachers in all grammar and high schools in Orleans Parish to inform the teachers of the availability of our Mosquito Control Educational Packets. Video tapes, teachers guides and demonstration kits were provided to all interested educators. Demonstration kits were a new addition to the packet and include mosquito eggs, suitable food and a container to rear mosquito larvae to adults. Education displays were used at garden shows, universities, town hall meetings, civic clubs, high schools and grammar schools. Over 10,000 visitors had the opportunity to view our educational display of mosquito control technologies and see some of our biological control methods at work. Toxorhynchites (cannibal mosquitoes), copepods, turtles and fishes were the primary bio-control species that were displayed.

Biological control efforts included the development of improved mass rearing techniques for Mesocyclops longisetus and Macrocyclops albidus. Juvenile turtles, minnows, Chlorella protothecoides (larvicidal algae) and Lemna (duckweed) were all utilized in selected mosquito breeding habitat. Some effort was invested in the use of genetic engineering to insert BTi toxin into the blue-green algae Agmenellum quadruplicatus (cyanobacteria) in an attempt to extend the larvicidal activity of the toxin.

Biological control efforts were expanded to the Far East with staff members visiting Vietnam, Indonesia and Thailand. The trip was sponsored by outside agencies, and the results were very encouraging. Most of the work was concentrated in Hanoi with the staff of the National Institute of Hygiene and Epidemiology. The purpose of the trip was to provide technical assistance on the use of cyclops to control Aedes aegypti. Thousands of Vietnamese children are killed every year by the transmission of dengue hemorrhagic fever by Ae. aegypti mosquitoes.

Biological control, source reduction, public education and the application of the total Integrated Mosquito Management system are the preferred methodologies of the City of New Orleans Mosquito Control Board. With the implementation of our total environmental management system, the use of mosquito pesticides is replaced with a control program that emphasizes the existing system of natural predation, water management and a cooperative citizenry. Frequent application of pesticides as the major mosquito control measure is now in jeopardy and alternative technology must be developed to continue our responsibility to protect the public from the illness and aggravation of the mosquito.

ENTOMOLOGICAL REPORT -

MICHAEL CARROLL

This year began as usual with a January and February peak of Culiseta inornata, the winter mosquito. By the end of January, staff personnel had inspected c. 1,500 city owned live oak trees for Formosan termites. The area with the highest apparent infestation is the Uptown-Garden District neighborhoods, where 8.4% of the trees showed signs of active termites. We estimated that 5-40% of the city oaks are infested, depending on location. By March we had inspected c. 4,000 oak trees and selected 70 for baiting trials.

March and April produced the expected spring build-up of Culex salinarius. Overall mosquito activity was relatively low and adulticiding was not needed. Large numbers of male Cx. salinarius at the Oak Island Apartments on Michoud Blvd. alerted us that a major permanent breeding site was nearby. We found several acres of trapped rainwater c. one block from the apartments and scheduled the site for draining by Source Reduction personnel.

By May and June, populations of Culex salinarius and Anopheles crucians required aerial and ground ULV treatments. Aedes albopictus populations had also increased and generated a significant number of telephone complaints.

High marsh water levels and high temperatures in July and August suppressed permanent water mosquito production. This was little consolation, as August produced four human cases of St. Louis Encephalitis (SLE). (See Encephalitis and Field Operations reports)

September continued to yield more human cases of SLE, 11 or 12 confirmed since August. We kept the pressure on the "quink" population with aerial, ground and handheld ULV spraying. The major source of breeding appeared to be in the flooded crawl spaces under many of the HANO public buildings.

During September and October, we collected over 6,000 adult mosquitoes from around public housing and sent them to CDC for virus screening. One final human case of SLE was reported in October, from the Village de L'est area. The ULV spraying continued and HANO employees were trained to inspect and spray the nearly 1,000 HANO buildings.

The remainder of the year was quiet. Of note was the near absence during the year of Aedes sollicitans and Ae. taeniorhynchus, mosquitoes that were responsible for the initial existence of our program. Years of accumulated source reduction have made an obvious difference.

FIELD OPERATIONS -

STEPHEN SACKETT

The major thrust of the Field Operations Unit was again directed at larval control, using public education, source reduction, biological control agents, and larviciding oils as the primary weapons. With Aedes albopictus as one of our most pestiferous urban pest species, information brochures were delivered to the public during all residential inspections in an attempt to involve the community in reducing back-yard mosquito breeding. Minnows were furnished to homeowners who requested them for pools or fountains.

On a cost-per-effort basis, backhoes remain one of the best tools we have in reducing mosquito breeding. The source reduction crew worked diligently with inspection teams to identify the major breeding sites that were conducive to drainage, and prioritized them based upon mosquito production rates and proximity to human populations. In many cases, a small ditch connected to the existing underground drainage system was sufficient to keep large tracts of land dry for extended periods of time. It is encouraging to see that such a small amount of effort can have such long-lasting effects. The more ephemeral breeding sites were treated with oil, Bti, cyclops, or minnows. Cyclops are produced in our laboratory and fish are trapped and released as needed.

Ground and aerial adulticiding operations were initiated when adult mosquito populations exceeded treatment thresholds. The primary target species for adulticiding were Culex salinarius, Anopheles crucians, Aedes vexans, and Cx. quinquefasciatus, with the "quink" treatments stimulated by the SLE outbreak during August and September.

On August 5, 1994, we were notified that a patient in Charity Hospital was diagnosed with SLE. His residence was inspected and found to be without electricity or adequate window screening. Mosquitoes were collected for virus isolation, and ground and aerial adulticiding operations were set into action. Over the next two weeks, three additional cases were confirmed, with all patients living within two miles of each other along the line of Claiborne Avenue. One of the patients lived in the Lafitte Housing Development, where large populations of Culex quinquefasciatus were found to be breeding and resting under the elevated buildings. Broken sewer lines and standing water were observed in the majority of the crawl spaces at that site. Permanone (10% EC) was applied under the buildings with a portable hand fogger, and methoprene briquettes were used to larvicide the septic water.

Additional investigations revealed that broken sewer lines were prevalent in housing developments throughout the City, and that the combination of large mosquito and bird populations at these sites put the residents at risk of SLE. The Housing Authority of New Orleans (HANO) was notified of these problems, and with the help of HANO employees, the entire houing development system was treated with Permanone and Altosid. Plumbers were also sent in to begin the major task of repairing the numerous leaks in the sewerage lines.

Communications with the Centers for Disease Control led to visits by Dr. Bruce Francy and Dr. Roger Nasci during mid-October. Nearly 6,000 mosquitoes were collected and tested for SLE, with no positive pools indicated. Culex nigripalpus, Cx. quinquefasciatus, and Cx. salinarius were the predominant species collected in the CDC and Gravid traps.

Although twelve cases of SLE were confirmed for Orleans Parish in 1994, it is very probable that the disease transmission rates could have been higher if mosquito control operations had not been initiated. We hope to reduce the risk of disease transmission in future years by improving our surveillance system around the housing developments, and by involving HANO in mosquito prevention activities.

ENCEPHALITIS SURVEILLANCE - C. J. LEONARD

The bird feeders were replaced with traps at the beginning of May. Sampling began on May 20. Seventeen traps were located throughout the City and the traps were operated five days per week. Birds are bled on site, and released. Although it sometimes takes over a week to get results from the State Lab on paper, the technicians will telephone us immediately if there is a positive sample. Since we have good verbal communications, the delay in arrival of the actual report is of no concern.

In June, positive birds were reported in St. Tammany and Jeff Davis Parishes for Highland J virus. The 235 birds sampled in Orleans Parish were negative.

In July, one sample was positive for St. Louis Encephalitis. The sample was taken on July 19, 1994 in Zone 5. We were notified that it was positive on August 2nd. Surveillance was increased with the collecting of mosquitoes for pools, and trapping increased to seven days per week. The area was sprayed with the trucks beginning on August 4, 1994. Unfortunately, this area was far from where the outbreak was soon to occur.

A human case of SLE was reported in Orleans Parish on August 5, 1994. The person apparently lived in the uptown area, but was discharged from the hospital before anyone obtained his correct address and history.

Throughout this outbreak, getting correct information on human cases was a problem. The state epidemiologist tried to get us accurate information, but by the time a human case was diagnosed in the hospital, the patient could be incoherent, unconscious, or discharged. Also some of the patients were homeless, and the addresses they gave were places where they received their mail; these addresses had no relationship to the area where they were infected.

Suspect areas around human SLE cases were sprayed with trucks on August 5, 1994, and a large area was adulticided by air on August 9th. We were notified of two more cases in the same area on August 10th. Ground spraying was increased, and another aerial treatment was done on August 12th.

There were 279 birds sampled during August. Results from the State Lab on all samples continued to be negative. Mosquito pools were also negative; but virus activity continued. In response to these cases of SLE, the city was adulticided by air on 8/9, 8/12, and 8/23. Also, affected areas were adulticided by ULV trucks seven times in August and once in September.

All of the cases occurred in areas where Culex quinquefasciatus breeding was found. Areas under public housing facilities were found to be breeding amid broken pipes and sewerage. These areas were larvicided and adulticided.

All of the cases occurred in the central area of the City, but none occurred close to a bird trap. Although 17 traps are deployed around the City, it appears that surveillance failed due to the absence of a trap in the infected area. Even though one of the traps was located less than one mile from an area where a death occurred, this trap captured few birds during this time. This is a problem with wild bird surveillance in urban areas. In the late summer when the temperature increases, the number of birds captured in traps usually decreases. This is just the time when an increased number of samples is needed. Also, the virus activity in mosquitoes under the housing projects may not have been indicated even by a larger number of wild birds captured in traps. There were no traps in public housing areas.

Eighty-four birds were sampled during September. Results from the State Lab showed six specimens positive for SLE. These specimens were collected on the 14th, 15th, and 21st of September. The species are shown on the chart, three of the positives were from Zone 5, two from Zone 6, and one from Zone 2. Since positive bird samples were found in several areas of the Parish, aggressive measures were taken to control the mosquito vector.

Birds sampled during the first two weeks of October were useless due to a problem with the diluent. After this problem was corrected, 30 birds were sampled during the last two weeks of the month. One positive bird was found, a Mourning Dove, sampled in Zone 4.

Results were received on mosquitoes collected at the sites of some of the human cases. These mosquitoes were collected by CDC personnel that visited New Orleans in October. All samples were negative.

Surveillance was terminated at the end of October. The Housing Authority treated for mosquitoes under the buildings in the projects, and no additional cases of Encephalitis were reported.

There were twelve confirmed human cases of SLE in Orleans Parish, three of the cases were fatal. A study of the human cases showed that those affected spent much of their time outdoors and in areas where they were exposed to the mosquito vector. Many of the victims also had their health compromised by other pre-existing conditions.

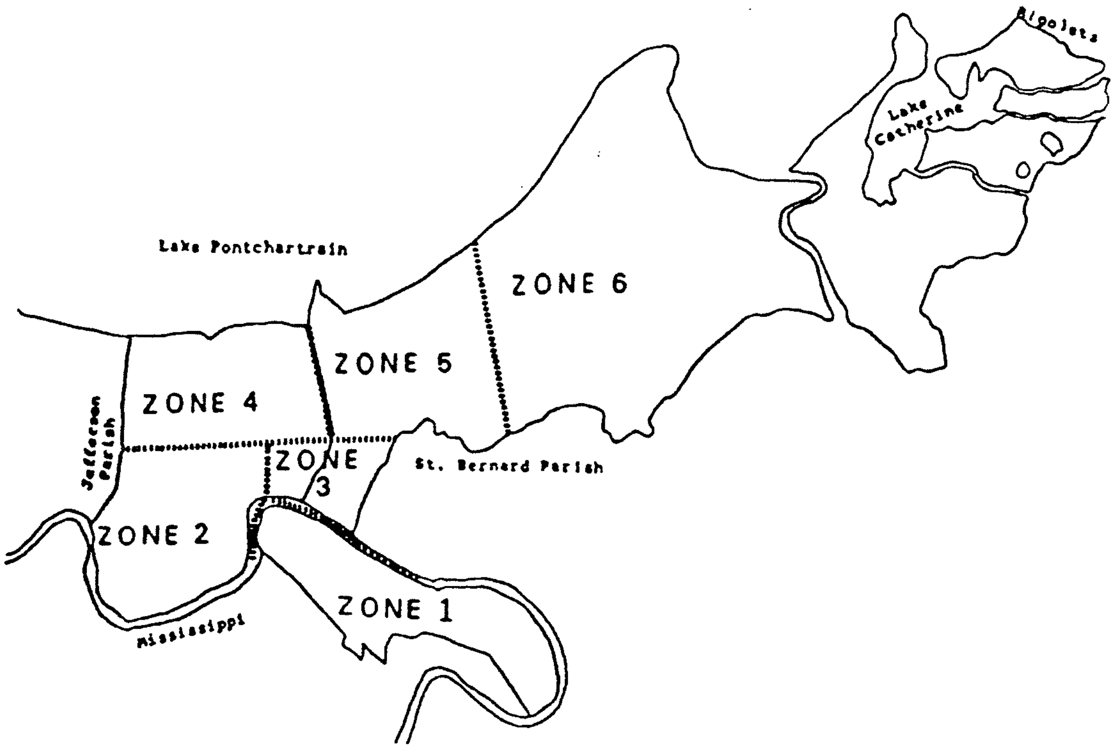
Our surveillance was unsuccessful at trapping birds in the public housing areas. Because of this, our surveillance program, which successfully predicted virus activity in the past, (1980 outbreak) failed to predict virus activity this year.

After consulting with several experts, it was decided to use sentinel chickens along with the wild birds next year. We will try to place sentinels underneath some of the housing projects, as well as in the surrounding areas.

Some of the wild bird traps will be moved so as to concentrate on areas where activity has occurred in the past.

1994 ENCEPHALITIS SURVEILLANCE

SPECIES	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	TOTAL	# POS
BLUE JAY	56	22	4	21	60	13	176	2
BRONZED COWBIRD				1		10	11	0
BROWN HEADED COWBIRD		2			31	70	103	0
CARDINAL	9	1	2		1	1	14	0
MOCKINGBIRD			1				1	0
MOURNING DOVE	22	19	14	3	19	47	124	5
RED WING BLACKBIRD		4		4	18	62	88	1
SPARROW	9	66	26	67	110	124	402	0
OTHER	3					2	5	0
TOTAL	99	114	47	96	239	329	924	8



SOURCE REDUCTION -

BROOKS HARTMAN

The Source Reduction program was active again this year with inner-city projects with the exception of Area R-1 (Michoud Blvd., I-10 Service Road, Lake Forest Blvd., and the Oak Island Apartment complex). This area is about 150 acres in size and has been a mosquito breeding area for many years. It is also near schools, shopping centers, commercial and existing residential and other proposed developments.

Drainage of this area was thought to be near impossible until this year. An intense inspection of the area revealed an increase in depth of existing subsurface drainage along Michoud Blvd., about 1/4 mile from the Oak Island Apartments. The existing ditch was lowered about two feet to accommodate the depth difference of the subsurface system along Michoud Blvd. The R-1 area has fair drainage at this time, but much more work is needed over the next few years to insure that R-1 will no longer be a serious problem in years to come.

The S-1 area, a five acre area that is the site for a proposed City playground, was reditched and is draining via an opening into Farrar Canal. This area is now dry and no longer a breeding site. The S-2 area, another section that is closer to Read Blvd., was reditched and is also dry at this time. Both areas are close to the more populated settlements in New Orleans East.

Monitoring of all sites in Orleans Parish will be done on a regular schedule during the coming year.

AVIATION OPERATIONS -

JOSEPH RIEDL

Aircraft usage was up this season, compared to the past few years. The Britten-Norman (twin-engine) Islander and the Grumman (single-engine) AgCat flew, in addition to spray flights, on inspection, surveillance, test and proficiency missions. During an outbreak of encephalitis, aerial adulticiding was conducted in the New Orleans area. Most of the spraying was done in the Islander over the City's public housing units. Throughout the year, no serious problems were encountered with the machines. The Islander remains rigged for dispensing Malathion and the AgCat set up to use Scourge. Both airplanes continue to be ready to spray should the need arise.

This spray season began with the completion of the required inspections on the airplanes. As usual, newspaper notification of our intentions was given, insurance renewal acquired and calibration and droplet tests performed on the airplanes. All necessary paperwork was brought up to date. Flight physicals were taken and cholinesterase checks were made. Pilot proficiency was maintained. Surveillance flights for obstructions were conducted. Every effort was directed toward a successful operation. This is in line with preparations made every year.

Work in our aircraft maintenance department continued through this period. The required annual inspections were completed on the planes. Scheduled lubrication and oil changes were made. Oil samples were sent in for analysis. The Islander's L.H. brake seals were replaced, a new emergency locator transmitter battery was installed and several airworthiness directives were complied with on the twin.

On the AgCat (biplane), the fuel tank sumps were removed and the tank cleaned. A deteriorated manifold pressure line and a leaking fuel hose was replaced. A number of airworthiness directives were also complied with on this airplane. Routine preventive maintenance was carried out to assure continued reliable operation on both airplanes.

Hangar upkeep was accomplished. Maintenance of tools and ground support equipment was carried out. Spare parts have been kept in order. Having the use of this facility has continued to make our operation more efficient.

Spray systems on the airplanes have been cleaned and maintained. Calibration and droplet tests were routinely carried out. Nozzle tips were replaced at regular intervals. Few operational problems were encountered.

Aircraft records and files were kept up to date. Manual revisions and inspection micro fiche was inserted as received. Plans for the next season are being formulated.

PUBLIC EDUCATION - C. J. LEONARD

This year, we decided to return to the practice of sending tapes to schools that request them. Broadcasting over the School Board's cable channel has been used for several years to save the cost of copying our programs. Sending tapes to teachers will allow them to incorporate them into their lesson plan at a time of their choosing.

The price of video tapes is now so low that it is not economical to ask the teachers to send the tapes back when finished. Accordingly, it was decided to include five programs on each tape sent as follows:

THE MOSQUITO PROBLEM
MOSQUITO CONTROL SCIENCE AT WORK
INTEGRATED PEST MANAGEMENT
COPEPODS-BIOLOGICAL CONTROL THAT WORKS!
FORMOSAN TERMITES: THE UNSEEN DESTROYER

The teachers are given information on each program, and told to keep the tape. This makes distribution and reproduction easier since the same tape is sent to all schools. The tapes cost about $1.50 each. This is what it costs to mail a tape across town. Instead of wasting money on postage, the teacher keeps the tape, which can be used again. School names and addresses were added to a computer database which produces mailing labels. The database will also keep track of requests from schools.

Letters were sent to science teachers at all schools in Orleans Parish. Included were an explanation of the Public Education Program and a list of tapes available for classroom use. Tapes will be sent to all schools that request them by phone or mail. Teachers guides are also available; these guides were developed by a professional science teacher. Mosquito eggs are available on request for classroom demonstrations. Kits have been made up containing eggs, larvae, food, and a suitable container. Mr. Sackett has drawn up a protocol to explain to the teachers how to handle the eggs and larvae.

The Mosquito Control Board had a display booth again this year at the Spring Garden Show at City Park. The booth was manned by M. Nguyen, C. Spain, and C. Spizale. Their presentation won first place awards for "Educational Excellence" and "Government Agency Division". The display also won First Place in "Educational Excellence" last year.

The display includes video and photographs as well as custom made tanks containing live copepods, Toxorhynchites larvae, fish turtles, and other predators. A lot of work goes into these displays; the equipment fills a large pickup truck.

Our aging video equipment spent more time in the shop this year. The Hi8mm camcorder, which is used for most of our video work, was in for repairs several times. Two of our 3/4 inch editing machines were also serviced more than once. It is hoped that some of the new computer based editing systems will replace the old equipment soon. The new computer systems are becoming much more affordable than traditional editing systems.

Video and slides have been done of several projects, especially termites and butterflies. There are also many additional slides to catalog.

There were many visitors to our facilities this year including several groups from Central America, as well as classes from local universities, high schools, and grammer schools.

1994

BIOLOGICAL CONTROL - GERALD MARTEN

Because our research and development with cyclops in previous years has already provided the techniques that we need to use cyclops for operational mosquito control, we did not do much new research and development with cyclops during 1994. We continued to use cyclops for practical mosquito control operations by introducing Mesocyclops longisetus to discarded tires and Macrocyclops albidus to swales.

An important part of our cyclops program during 1994 was technical assistance to mosquito researchers in Southeast Asia, where dengue hemorrhagic fever transmitted by Aedes aegypti is a serious problem. Dr. Marten visited Thailand and Indonesia to assist researchers who are beginning to explore the use of cyclops for Ae. aegypti control in household water storage containers. Dr. Marten and Mieu Nguyen visited Vietnam to work with scientists at the National Institute of Hygiene and Epidemiology in Hanoi. The Vietnamese scientists initiated field trials with Mesocyclops two years ago in a village of four hundred households. The field trials have been highly successful. Ae. aegypti has virtually disappeared from the village, and so has dengue fever.

JUVENILE TURTLES

We monitored the cool-season appetites of turtles for mosquito larvae in an outdoor cage at the New Orleans Mosquito Control Board's Biological Control Facility. The turtles consumed at least 500 larvae/day throughout the winter, except for two weeks in February when daytime temperatures were less than 20° C.

We started field trials in April at a residential roadside ditch that was polluted with septic tank effluent. The ditch had a previous history of producing large numbers of *Culex quinquefasciatus*. Eight-month-old turtles were placed in the ditch at a stocking rate of one turtle per meter of ditch. A six-meter-long fenced enclosure ensured that the turtles stayed at the site. There were large numbers of all *Cx*. *quinquefasciatus* larval instars and pupae inside and outside the enclosure before the turtles were introduced. The enclosure continued to have large numbers of first instar *Cx*. *quinquefasciatus* larvae after the turtle introduction, indicating continuous oviposition by adult *Cx. quinquefasciatus* in the neighborhood. However, III/IV instar larvae and pupae virtually disappeared from the enclosure within three weeks after the turtles were introduced, and the III/IV instar larvae and pupae stayed at a low level after that (Figure 1). During the same period, III/IV instar larvae and pupae were often very numerous in an adjacent control enclosure without turtles.

We can conclude that juvenile turtles can be effective for *Cx*. *quinquefasciatus* control, at least when forced to remain in the ditches. Although only neighborhood-scale field trials can demonstrate conclusively whether unrestrained turtles will remain in polluted parts of ditches in sufficient numbers to be effective for mosquito control, experiments that we conducted in the laboratory have suggested that turtles will not avoid polluted water. We kept ten turtles in an enclosure with two pans, one containing clean charcoal-filtered tap water and the other containing polluted ditch water. We counted the number of turtles in each pan on a daily basis for two months and observed that the turtles spent the same amount of time in both polluted and clean water.

Because turtles can serve as alternate hosts for *Salmonella*, we evaluated whether turtles in use for mosquito control would create a hazard of human infection. We assumed that farm produced turtles could start out *Salmonella* free, and we conducted a series of experiments to see if they could be infected with *Salmonella*, and if so, whether they could contaminate ditch water with *Salmonella*.

The most important result was our observation that ditch water (including polluted ditch water) is not a favorable habitat for *Salmonella*. We analyzed 22 water samples from polluted ditches, and none of them were naturally contaminated with *Salmonella*.

Moreover, Salmonella entertidis was not able to multiply when we introduced it to ditch water in the laboratory. Salmonella entertidis always disappeared from ditch water in the laboratory within a few weeks after we introduced it. When we kept turtles in ditch water that we contaminated with S. entertidis in the laboratory, some of the turtles showed signs of infection (releasing Salmonella in their feces) for a few weeks, but most of the turtles showed no signs at all. Infected turtles released very small quantities of Salmonella (a few hundred Salmonella cells/day), and they stopped releasing Salmonella within a few weeks. The concentration of Salmonella in ditch water with infected turtles never exceeded one viable Salmonella cell/ml. Because a person must ingest thousands of Salmonella at the same time to become infected, we concluded that turtles should not create a risk of human infection when used for mosquito control in ditches.

LARVICIDAL ALGAE (PHYTOPLANKTON)

Most of the discarded tires to which we introduced the microalgae Chlorella protothecoides in 1992 still contained a dense growth of these algae in 1994. The algae were still preventing mosquito production. However because the Chlorella introductions in 1992 did not result in mosquito control in some of the tires, we conducted new field trials in 1994 to clarify the matter.

The results were quite clear. Chlorella protothecoides introductions in 1994 were completely successful in all tires that did not contain a conspicuous growth of some other kind of algae before C. protothecoides was introduced. Chlorella prototecoides populations were still strong in all of these tires at the end of 1994. It appears they will continue to provide effective mosquito control for years.

However, C. protothecoides failed to suppress mosquito production in most tires that already contained a conspicuous growth of some other kind of algae before the C. protothecoides was introduced. The result of introducing C. protothecoides to these tires was usually a mixture of C. protothecoides and the other algae, which was not sufficient to suppress mosquito production. We have found that C. protothecoides must be more than 90% of all the algae in a tire if it is to suppress mosquito production.

We tried to overcome the problem with tires that already have other kinds of algae by treating such tires with chlorine a few weeks before introducing C. protothecoides, the objective being to eliminate the other algae. Unfortunately, the other algae came back after the chlorine wore off, so mosquito production was not suppressed.

In conclusion, C. prototheсoides is highly effective for long-term treatment of tires that do not already have other algae. Because most tires do not have algae during the first year after they are discarded, C. protothecoides should be particularly effective for treating recently discarded tires. Because it should be possible to mass produce C. protothecoides and apply it over a large area with a sprayer, C. protothecoides could be of use for treating large tire piles.

AQUATIC VEGETATION AND PREDATORS OF MOSQUITO LARVAE

Floating plants can play a major role in shaping an aquatic habitat so it is suitable or unsuitable for survival of mosquito larvae. For example, floating plants such as water hyacinth (Eichornia) or water lettuce (Pistia) may help mosquito larvae to hide from predators. Floating plants such as duckweed (Lemna) and mosquito fern (Azolla) may cover the water so completely that they obstruct oviposition by adult mosquitoes or prevent larvae from reaching the surface to breathe.

We began to explore the interaction between floating aquatic vegetation, mosquito larvae, and predators of mosquito larvae with a series of laboratory experiments. Duckweed collected from a canal adjacent to a marsh in eastern New Orleans was placed in three-gallon aquaria. Anopheles quadrimaculatus larvae from a laboratory colony were placed in the aquaria (different larval instars in different aquaria). No larvae survived.

We then conducted a series of experiements in which larval survival was observed under various conditions: a full cover of duckweed in an aquarium, covering only half the surface of the water with duckweed (so larvae could reach the surface), removing all duckweed but leaving the natural fauna that came with the duckweed, and selectively removing the natural fauna from the aquarium. We concluded that the physical obstruction provided by a full cover of duckweed is sufficient to prevent mosquito production. However, we also observed that natural populations of larval predators associated with the duckweed in our experiments--in particular, the copepod Macrocyclops albidus and various species of aquatic insect predators--were also sufficient to prevent larval survival. Because An. quadrimaculatus larvae survived when both duckweed and predators were removed from the water, we concluded that duckweed does not release any chemical into the water that suppresses mosquito production.

Next year we expect to expand the study on aquatic vegetation and predators of mosquito larvae to other floating plants such as water hyacinth and water lettuce and to larval predators such as turtles and fish.

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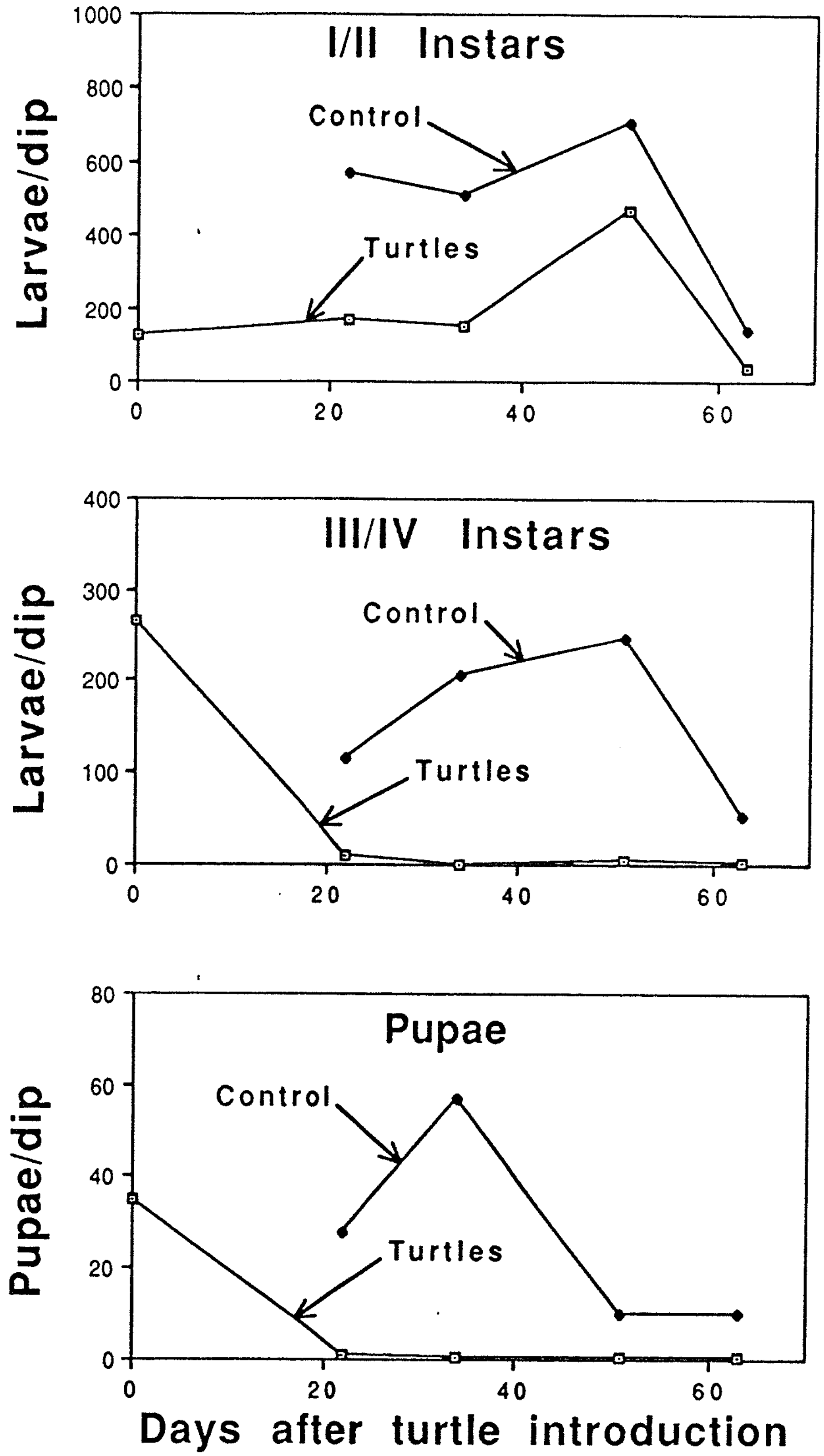
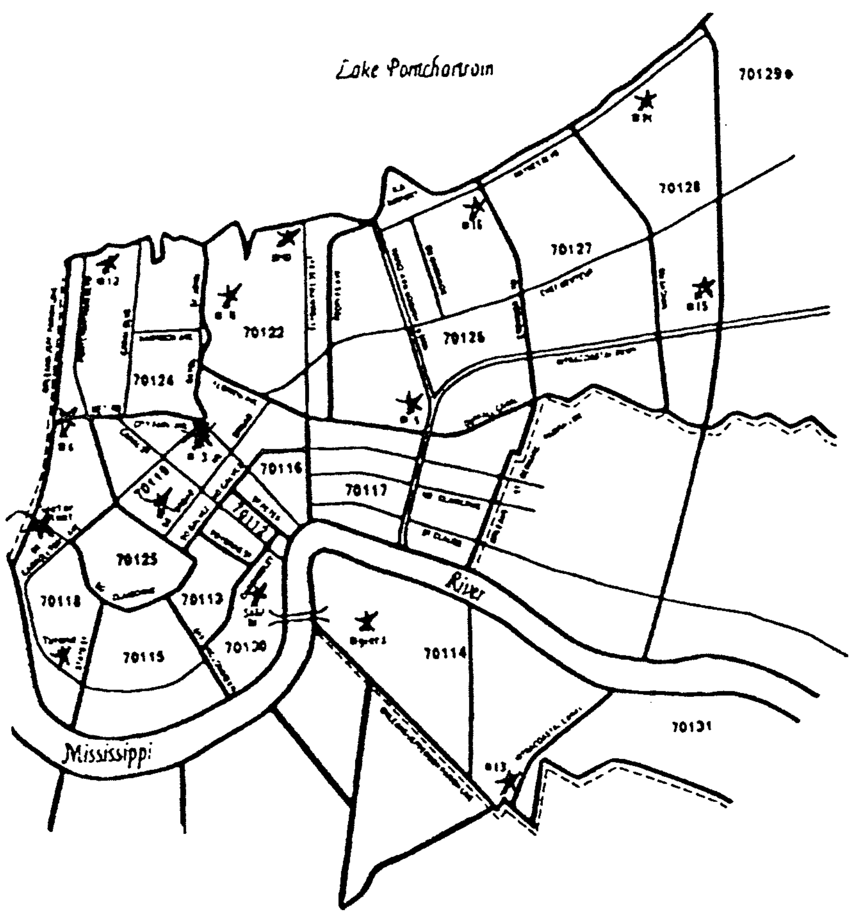
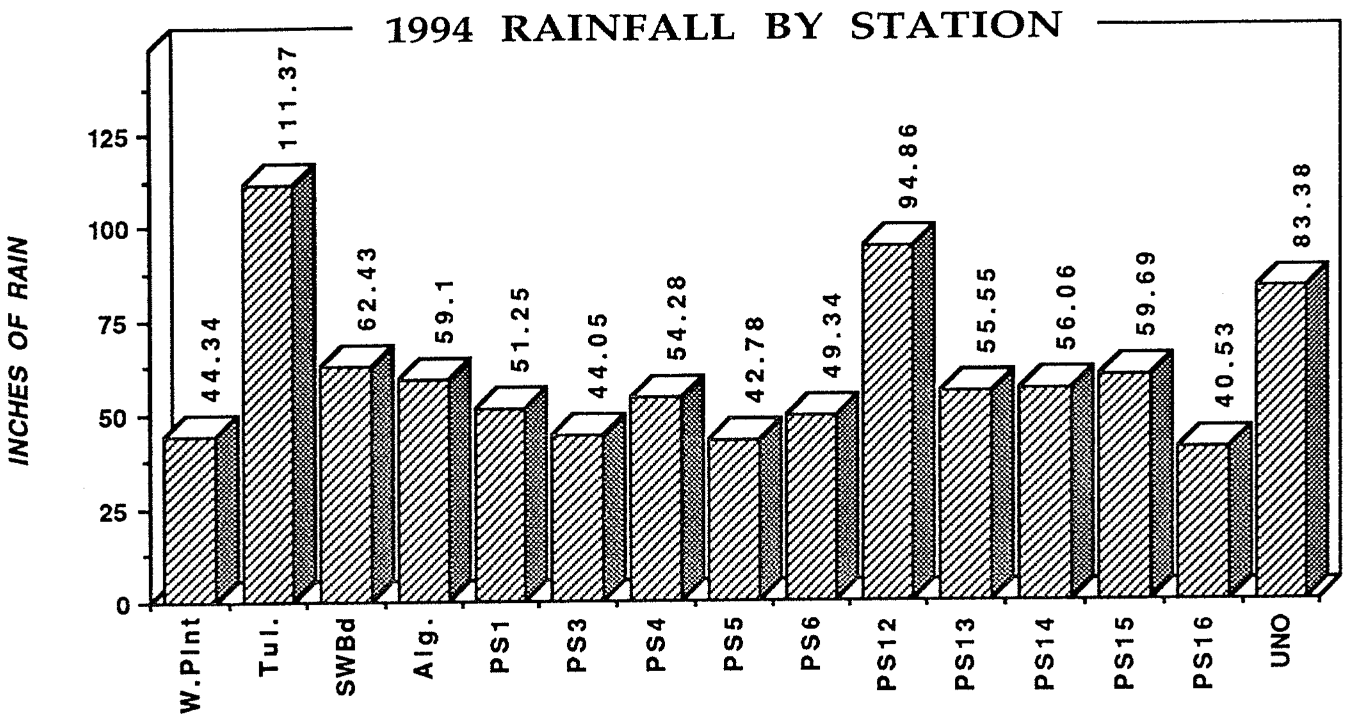


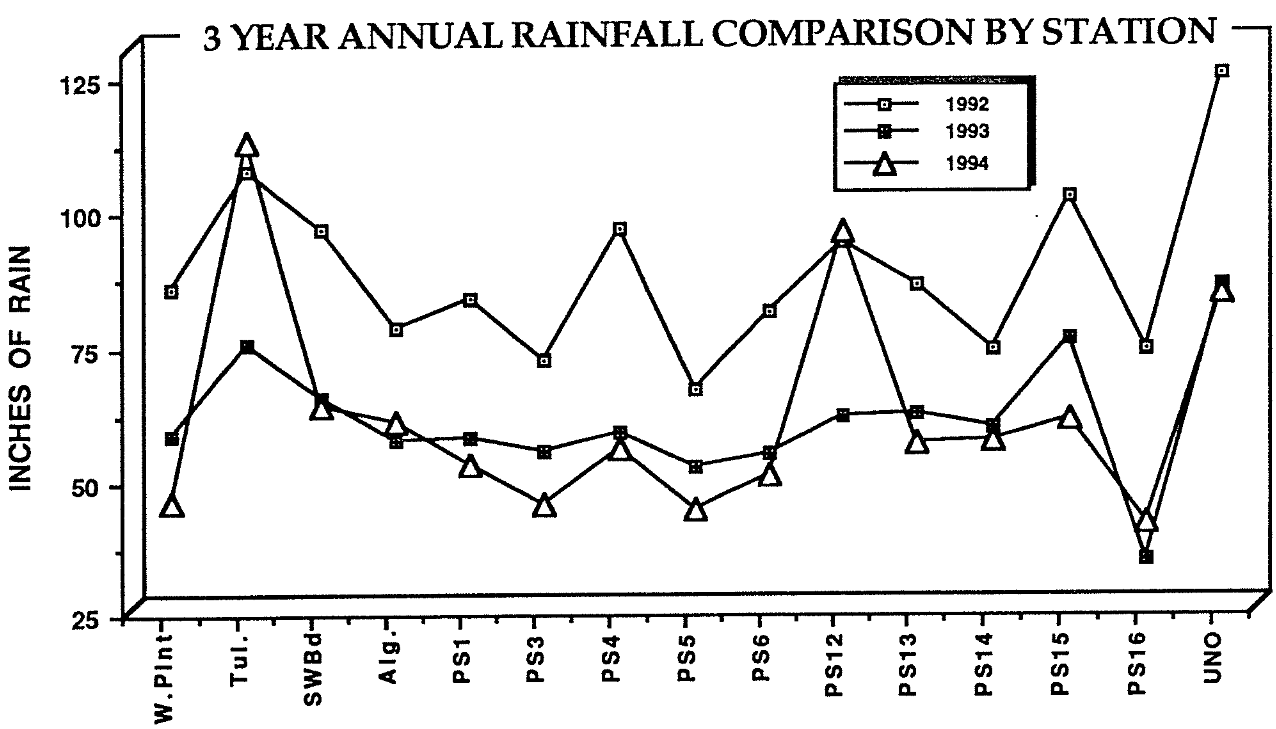
FIGURE 1: Numbers of <u>Cx. quinquefasciatus</u> larvae in the enclosure with turtles compared with the control enclosure (without turtles)

STATIONS	LOCATION
N.O. Water Plant	8801 Spruce St.
Tulane University	8623 St. Charles Ave.
Sewerage & Water Board	625 St. Joseph St.
Algiers Water Plant	1120 Elmira St.
D.P.S. No. 1	2501 So. Broad St.
D.P.S. No. 3	2251 No. Broad Ave.
D.P.S. No. 4	5700 Warrington Dr.
D.P.S. No. 5	4841 Florida Ave.
D.P.S. No. 6	345 Orpheum St.
D.P.S. No. 12	7223 Ponchartrain Blvd.
D.P.S. No. 13	4201 Tall Spruce Dr.
D.P.S. No. 14 (Jahncke)	12200 Hayne Blvd.
D.P.S. No. 15	Gulf Intracoastal Waterway
D.P.S. No. 16 (St.Charles)	7200 Wales St.
U.N.O.	University of New Orleans-LakeFront



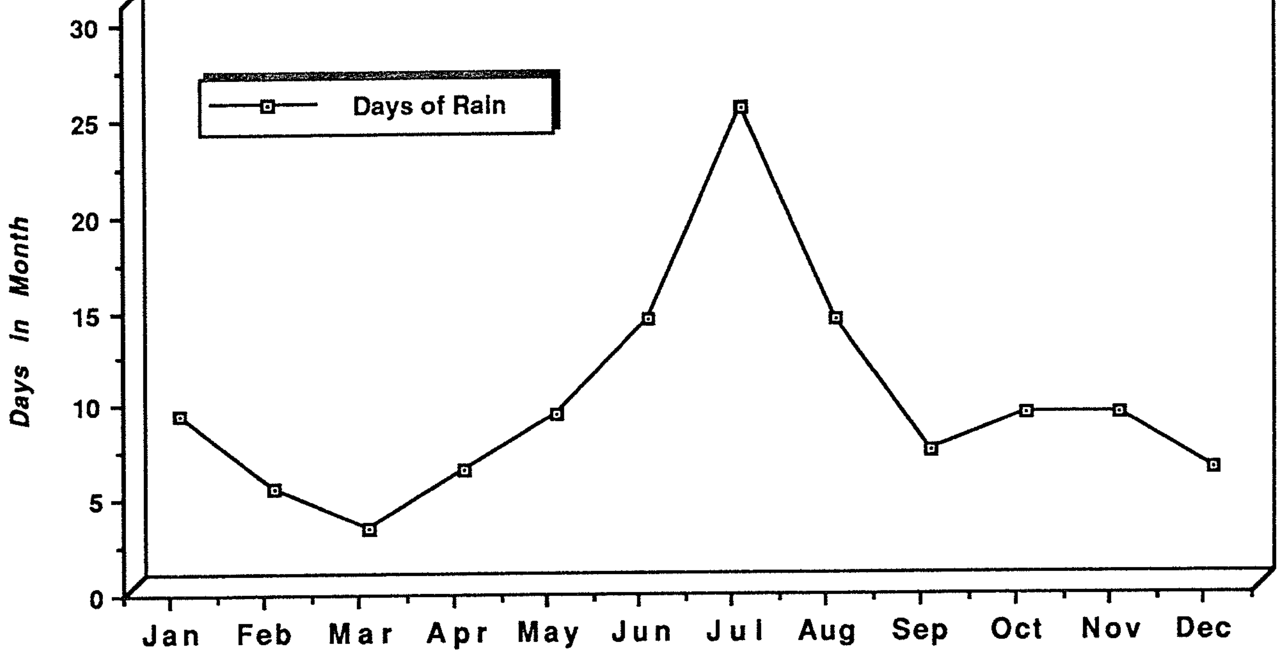


The average precipitation recorded at the 15 stations determines the city's daily rainfall as measured by the Sewerage and Water Board. During 1994, the gauges recorded annual rainfall ranging from 111.37" at the Tulane gauge to 40.53" at D.P.S. No. 16.



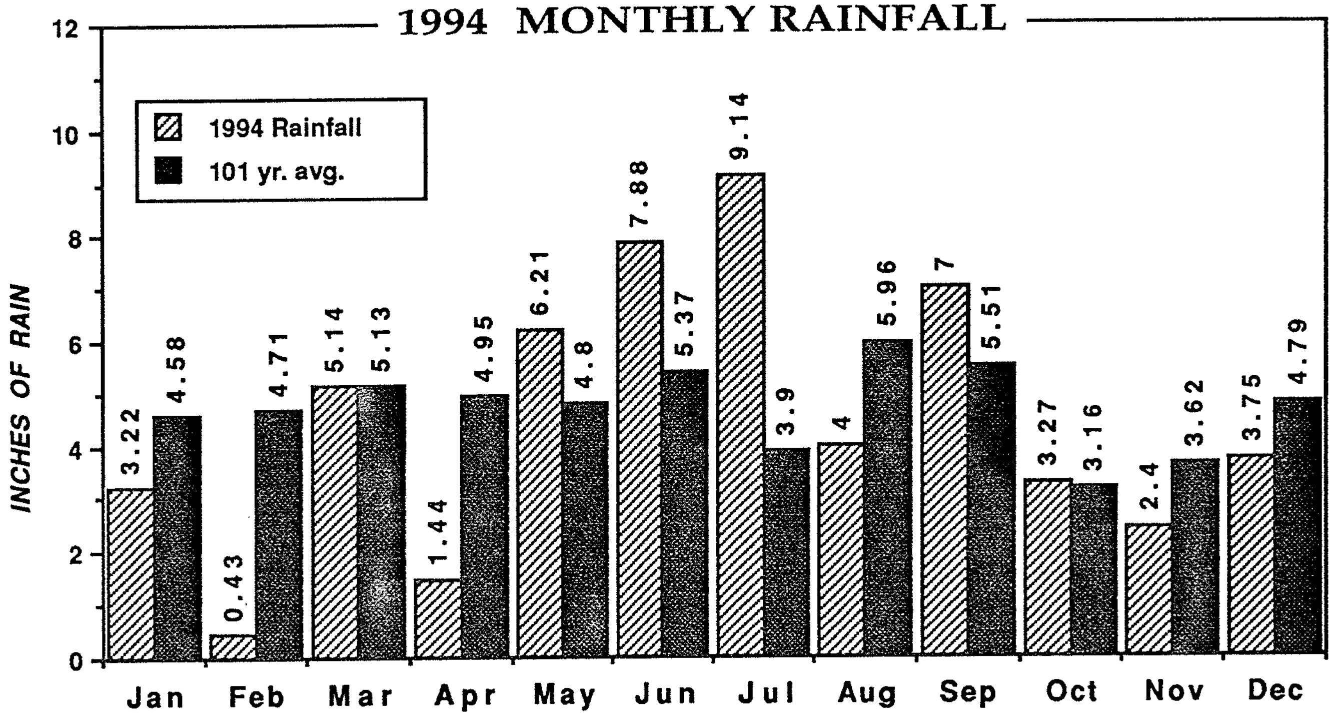
The average annual rainfall in 1994 was 53.88" while 59.55" was recorded in 1993, and in comparison, the 1992 average was 86.87".

1994 RAINY DAYS

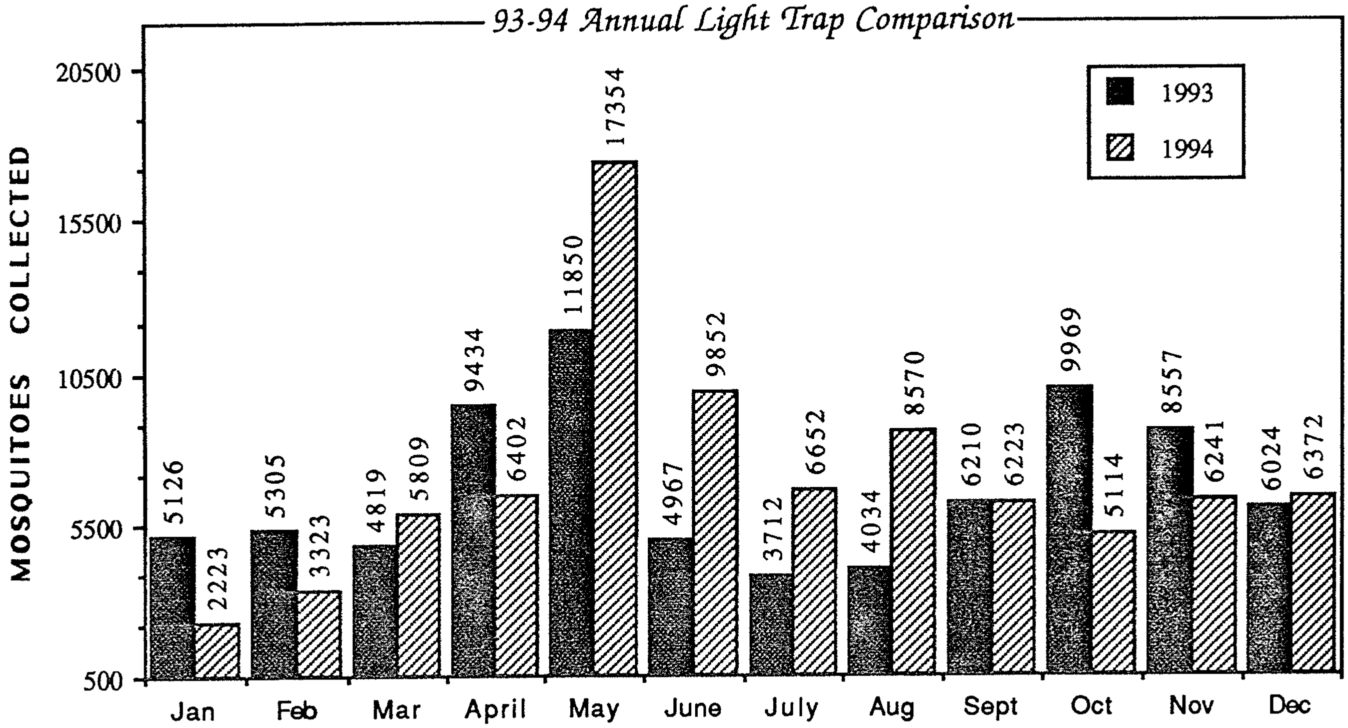


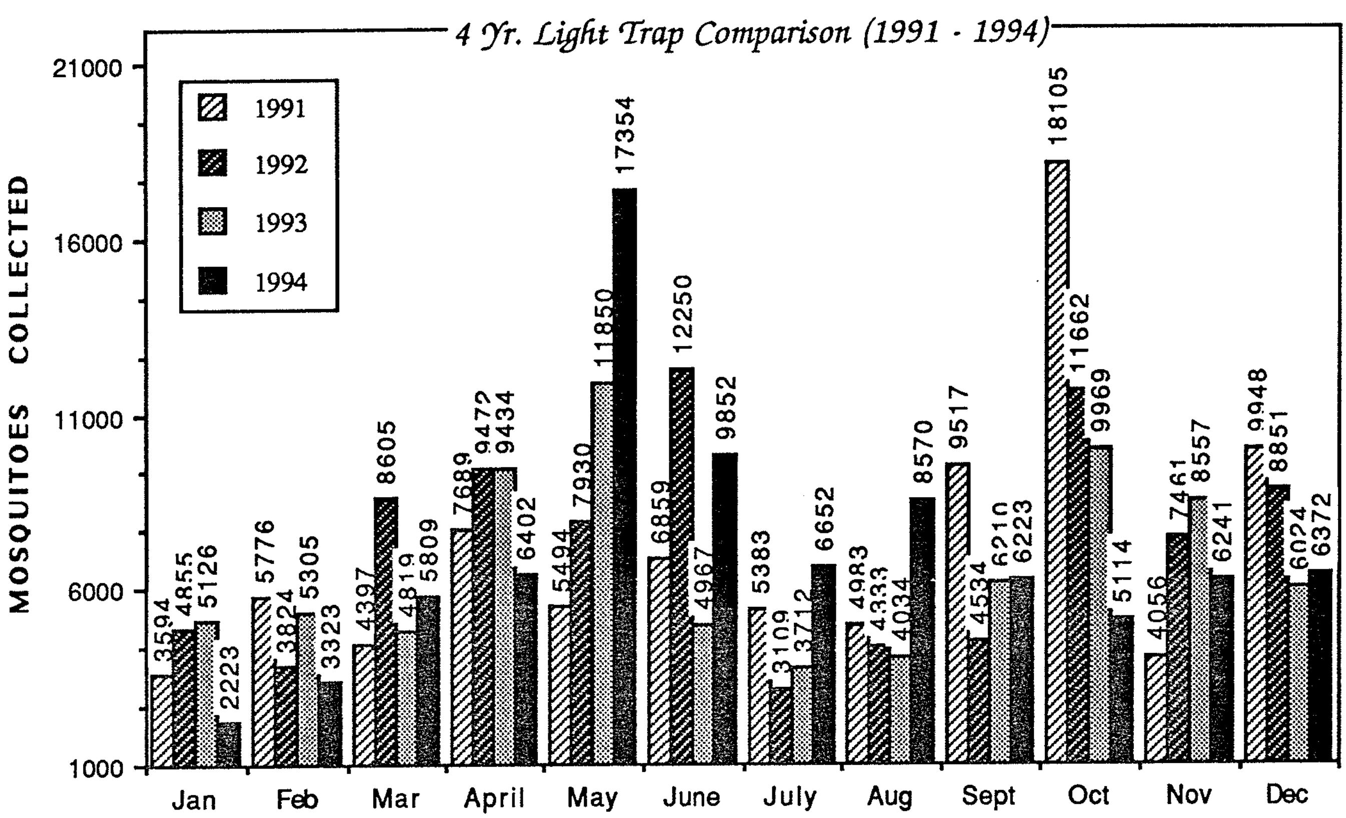
Measurable rain fell on 130 days during 1994. The month of July had 25 days with rain recorded, while March had rain on only 3 days.

1994 MONTHLY RAINFALL



The average rainfall for 1994 was 53.88" compared to the 101 year average of 58.62".


93-94 Annual Light Trap Comparison
1993
1994
MOSQUITOES COLLECTED
20500
15500
10500
5500
500
5126
2223
5305
3323
4819
5809
9434
6402
11850
17354
4967
9852
3712
6652
4034
8570
6210
6223
9969
5114
8557
6241
6024
6372
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec


4 Yr. Light Trap Comparison (1991 - 1994)
1991
1992
1993
1994
MOSQUITOES COLLECTED
21000
16000
11000
6000
1000
3594
4855
5126
2223
5776
3824
5305
3323
4397
8605
4819
5809
7689
9472
9434
6402
5494
7930
11850
17354
6859
12250
4967
9852
5383
3109
3712
6652
4983
4333
4034
8570
9517
4534
6210
6223
18105
11662
9969
5114
4056
7461
8557
6241
9948
8851
6024
6372
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec

1994 Light Trap Collection

	Male	Female	Aes	Aev	ANc	ANq	Cxq	Cxs	Uran	Cxe	Ae	Cxr	Cqp	Cxn	Aet	Csi
1. Willow Drive	241	9048	0\3	15\703	19\230	8\157	0\29	178\6677	10\113	0\152	1\9	3\120	0\4	2\352	1\6	3\468
2. Tall Pines	266	2177	0\1	62\485	2\26	1\14	0\19	185\1244	5\75	1\16	0\2	3\68	0\7	0\46	0\1	6\147
3. Norland Aveni	65	278		9\49	2\6	0\5		37\147	1\26	0\13	0\2	7\7		2\5	0\1	7\15
4. Olivier Street	231	734		22\174	8\34	1\5	1\36	182\365	1\14	0\5	3\5	4\55	0\1	0\6	0\4	9\24
5. Seine Street	89	490		17\115	0\17	1\9	0\20	65\253	0\10	0\3	0\7	4\21	0\1	0\7	0\3	2\14
6. Tennessee St.	195	1063		48\245	6\30	0\11	0\4	129\585	0\81	0\46	3\8	1\13		0\17		8\19
7. Louire Street	19	54		9\17			1\1	6\22	0\2		1\1	0\3		1\1		1\5
8. S.Saratoga St.	17	89		6\20	0\5		0\3	7\44	0\2	0\1		0\1		0\2		4\9
9. LA Avenue	767	1170		58\262	4\15	1\16	8\76	616\632	1\14	0\6	9\5	20\82	0\1	0\8	2\4	48\48
10. Hillary Street	93	398		8\108	0\13	1\6	0\21	65\146	1\2	0\1	2\4	9\73	0\1	0\3	1\1	6\16
11. Audubon Zoo	401	1694		75\394	7\46	3\44	4\55	280\828	3\57	1\21	2\4	3\121	0\5	1\32	2\2	15\69
12. Trafalgar	265	1398		47\502	6\69	0\6	20\21	173\526	1\11	1\5	0\1	3\125	0\1	1\15	0\2	13\103
13. City Park	111	469		22\151	3\11	1\9	0\5	67\174	4\29		5\14	8\22		0\8		0\26
14. S. Genois	22	61		5\27	0\2	0\3	0\3	14\15			2\0	0\8		0\2	0\1	1\0
15. LongueVue Gd	560	2562		233\803	9\71	1\28	0\27	295\1355	2\62	0\16	1\8	8\79	0\1	0\18	1\5	9\80
16. Killdeer Street	206	460		18\98	24\47	0\5	0\17	142\184	4\34	0\3	0\2	2\20		2\7		14\42
17. Louisville	146	598		26\262	5\39	4\3	0\7	94\175	4\21	0\1	1\2	4\42		1\14	1\1	6\31
18. Pont. Park	58	234		18\82	1\3	0\1	0\3	38\101	0\10		1\6	0\7		0\8	0\2	0\8
19. Acacia Street	83	164		32\70	2\6		0\5	36\45	1\26		10\3	0\1		0\3	1\0	1\4
20. Werner Drive	483	1269		142\353	6\13	0\2	0\12	316\665	2\64	0\36	2\2	2\33	0\2	0\38		13\43
21. Lil. A'Corn	256	1125		60\374	4\29	0\4	0\10	180\502	1\20	0\13	0\5	1\29	0\9	1\20	1\3	7\83
22. Vincent	565	3956		99\441	12\87	1\46	0\18	365\2009	52\442	1\31	0\3	2\35	1\595	0\75	0\2	28\141
23. Vil. DeL'Es.	209	1347	0\1 -	58\405	2\20	0\9	0\1	111\601	4\47	0\4	0\8	3\16	0\68	0\53	0\1	22\96
24. Resthaven	159	1759		6\95	14\74	2\23	0\11	125\1194	1\123	0\13	2\10	0\61	0\12	0\49	1\1	7\62
25. Joe Madere's	1046	8112	0\10	19\75	157\863	2\81	0\5	543\4413	278\2455	7\49	0\5	1\29	0\21	34\73	1\2	3\20
26. Lk Barrington	253	275	0\1	67\105	2\3		0\6	176\101	1\38	0\1		0\4	0\1	0\3	1\0	5\11
27. Irish Bayou	483	4829	0\3	6\68	200\1152	15\30	0\2	247\1970	7\1449	0\12	0\3	3\23	0\40	2\26	0\2	3\40
28. Venetian Isles	900	9071	0\36	73\350	62\1353	5\97	7\58	690\6005	7\492	0\103	1\5	13\35	0\20	0\80	6\102	35\318
29. Green Ditch	477	13229	0\69	5\170	111\4061	2\120	0\8	312\5024	9\1153	0\488	2\22	0\6	2\425	0\194	15\45	19\1338
30. Rigolets	1642	5111	0\106	83\249	349\1078	0\22	0\1	1197\3197	0\60	0\134	1\2	0\11	0\24	0\78	0\8	11\38
31. Lake Forest	529	1937	1\8	89\451	10\37	0\5	0\13	352\954	3\97	0\16	0\7	17\80	0\11	1\37	3\1	50\212
32. Oak Island	1130	8974	0\7	218\462	154\1350	5\81	0\42	500\2817	93\876	4\36	2\1	8\87	98\2855	3\53	0\1	43\296
Total	11967	84135	1\257	1655\8165	1181\10790	54\842	41\539	7723\42970	496\7905	15\1225	51\155	129\1317	101\4105	51\1333	37\201	399\3826
%			0.3	9.7	12.8	1	0.6	51.1	9.4	1.5	0.2	1.6	4.9	1.6	0.2	4.5