The Relationship of the Imported Fire Ant, Solenopsis Saevissima (F. Smith), to Populations of the Lone Star Tick, Amblyomma Americanum (Linnaeus), and the Effects of Mirex on Populations of Arthropods.

Wayne Gerard Harris

Louisiana State University and Agricultural & Mechanical College

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A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Entomology

by

Wayne Gerard Harris
B.S., McNeese State College, 1957
M.S., Louisiana State University, 1959
December, 1971
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ABSTRACT

Survey of the lone star tick, *Amblyomma americanum* (Linnaeus), in northwest Louisiana showed that the adult ticks appeared first in late March or early April. They were most abundant in mid-May and absent by the last of July. Nymphs appeared at the same time as the adults. They were most abundant in mid-May, but had two later population peaks, one in late July and early August and another in September. The nymphs were absent by late October. Larvae first appeared in early June. They were most abundant in July and August and absent by late October or early November.

When eggs, engorged larvae, engorged nymphs, and engorged adult female lone star ticks were placed in an infested area, considerable predation by the imported fire ant, *Solenopsis saevissima* (F. Smith) was observed.

Applications of Mirex bait (0.3%) at the rate of 1.25 pounds per acre reduced populations of Araneae, Gryllidae, and Staphylinidae. These studies also indicated that predaceous beetles in the families Carabidae, Histeridae, and Lampyridae also were affected by Mirex.

The imported fire ant seemed to have little effect on populations of most other arthropods. Ten months after treatment, populations of spiders, beetles, and crickets had returned to approximately the same in Mirex-treated and untreated plots, while there were 30 times more fire ants in the untreated plot.
There probably never has been another insect that has caused as much controversy as the imported fire ant, *Solenopsis saevissima* (F. Smith). Many entomologists consider it only as a nuisance pest. However, livestock farmers claim that it seriously hinders their farm operations, i.e., fire ant mounds clogging and breaking mowers and combines and farm labor being stung when handling baled hay left on the ground for a few hours or overnight. Some sportsmen feel that the imported fire ant is decimating quail and other ground nesting bird populations by feeding on or stinging the chicks as they are hatching.

Many entomologists believe that the ant is beneficial as a predator and helps control harmful arthropods. Other entomologists would like to see the fire ant eliminated but don't believe it to be sufficiently serious as a pest to warrant spending vast sums of money for its eradication. Some scientists believe that there may be more detrimental effects from the widespread use of insecticides for their control than the pestiferous effects of fire ants themselves. Environmentalists are gravely concerned about the contamination of the environment and the effect that large-scale use of insecticides (Mirex) might have on non-target organisms.

The controversy over whether the fire ant is beneficial or detrimental, whether it should be eradicated or controlled has stimulated increased research directed toward a better understanding of the situation. This study was attempted to obtain some facts which may be added to the pool of knowledge regarding the status of the fire ant.
Major emphasis was placed on the relationship of the imported fire ant, *Solenopsis saevissima* (F. Smith), to populations of the lone star tick, *Amblyomma americanum* (Linnaeus). This was predicated on the knowledge that the lone star tick and the gulf coast tick, *Amblyomma maculatum* Koch, were quite abundant in the Florida parishes of southeast Louisiana twenty to twenty-five years ago and were pests of people, livestock, and wildlife. However, in recent years the tick populations reportedly have decreased. Since the dwindling tick populations seemed to coincide with the establishment of the imported fire ant, some entomologists considered the imported fire ant responsible for the decrease in populations.

In addition to the study on the relationship of imported fire ants to tick populations, studies were made to obtain data on the seasonal distribution of the lone star tick, to obtain some indication of the effects fire ants have on other arthropods, and to obtain some indication of the effects Mirex has on arthropod populations other than fire ants.
The Imported Fire Ant

Apparently, the imported fire ant arrived in the United States at the port of Mobile, Alabama, by boat from South America just prior to 1920; but the exact time and manner of arrival and source of the infestation are unknown. Creighton (1930) stated in a paper entitled "The New World Species of the Genus Solenopsis" that he was told by H. P. Loding, a naturalist from Mobile, Alabama, that the ant appeared on the Mobile Bay front in 1918.

After a slow beginning, the ant spread rapidly and presently infests approximately 120 million acres in southeastern United States.

The biology, ecology, life history, and control are reported by Green (1967), and the seasonal life cycle and mound components relative to the life stages of the ant are given by Markin and Dillier (1970).

Green (1967 and 1962) has observed low numbers of imported fire ant mounds in hardwood forests and also that tall grass or other heavy vegetation restricted the establishment of new colonies. He believes this is caused by the removal of surface moisture by plants in the summer, at the time moisture is needed by the queens to rear their first brood in their shallow burrows. He also noted that if a colony becomes established in such a wooded area, the ants seem to fare quite well. A large number of colonies frequently are found in stands of young pine timber along the Gulf Coast of Mississippi. Green believes the frequent rains in this area might aid in helping colonies establish in this type of habitat.
Hays (1958), while working in Argentina, found that insects seemed to make up the larger part of the diet of the imported fire ant. He reported that specialists in that country considered the fire ant to be beneficial because of its insectivorous habits. In a study of the food habits of the imported fire ant, Hays and Hays (1959) found that the principal dietary item in the field was other insects—both living and dead—and that the ants showed no preference for either. Larval forms were preferred over adults, especially the ones small enough to be transported. They observed worker ants to bring aphids, small spiders, and larvae of other insects to the openings of foraging tunnels, which radiate from the mound, and devour them. They found parts of eviscerated insects at the openings of these tunnels. In an area where cow dung was plentiful, fly larvae seemed to be their favorite food; the ants visited each pile of dung, collected the larvae, and took them into the tunnels. Ants were encountered attacking immature and mature stages of millipedes, centipedes, and insects. They were observed to pick up and utilize fragments of insects lying upon the ground. Fire ants were also observed tending aphids and scale insects on several species of plants. In corn fields, they were observed to build mounds up and around bent over ears of corn and consume them, but they were not seen to climb the stalks to feed on the ears. Hayes placed seventeen varieties of seeds and planted eighteen species of plants on fire ant mounds. Only peanuts of the seeds were eaten and only okra of the seedlings were damaged and/or destroyed.

Wilson (1969) concluded from his studies in southeast Louisiana that the imported fire ant is a very active, aggressive general predator. He found that the ant does not seek specific prey but
captures more or less what is available in the general area. He also reported that the fire ant will forage as far as 100 feet.

Reports by Eden and Arant (1949) and Lyle and Fortune (1948) indicated that the imported fire ant damaged germinating and seedling corn.

In Georgia, Travis (1938) reported that fire ants, especially S. geminata (F.), attack quail eggs during hatching and kill and devour the chicks. However, the imported fire ant was not mentioned in this report.

There have been a number of studies relative to the effect of the treatment for the control of the imported fire ant on populations of other arthropods. These studies generally show that the treatment suppresses the predator complex, of which the fire ant is included, and causes an increase in obnoxious insects. Long et al. (1958), comparing sugarcane fields treated with heptachlor for imported fire ant control to untreated fields, found 20 percent more joints bored by the sugarcane borer, Diatraea saccharalis (F.) in the heptachlor-treated fields than in the untreated fields. Hensley et al. (1961), reported that an increase in populations of the sugarcane borer followed early spring and summer applications of heptachlor for fire ant control, apparently caused by suppression of its predators. They stated that wherever the insecticide had been applied for fire ant control and had not been followed by adequate applications of endrin, abnormally high borer populations have occurred and persisted for at least one year. Negm and Hensley (1967) stated that the increase in borer damage in heptachlor-treated plots was mainly due to the suppression of predator populations, especially ants. Correlation studies
showed that ant populations were more important than spiders in determining the degree of borer infestation of sugarcane stalks. The ants were observed to be active and aggressive predators feeding on eggs, larvae, and pupae of the sugarcane borer. Negm and Hensley (1969) studied the sugarcane borer mortality and survival in plots treated with heptachlor and in untreated plots. Artificial infestations of borer egg masses and larvae were used. They found that predation was higher in the untreated plots and that sucking predators destroyed more eggs than chewing predators. The role of the imported fire ant in the predator complex was not evaluated.

Newsom et al. (1959) surveyed rice fields treated with two pounds of technical heptachlor per acre for imported fire ant control and found four times as many rice stink bugs and leaf hoppers as were found in untreated fields.

Gross (1969) found significantly higher numbers of earwigs in lawns treated with heptachlor for fire ant control than in untreated lawns. He also observed that unattended earwig eggs left out overnight were preyed upon by the imported fire ant and by the thief ant, S. molesta (Say). The imported fire ant was observed to devour the eggs on site rather than to bring them back to the tunnel.

Wilson (1969) reported that imported fire ants were not important predators of the Nantucket pine tip moth, Rhyacionia frustrana (Comstock). However, in plots where the ant was eliminated with a treatment of heptachlor, populations of leaf hoppers were significantly higher than in the untreated plots.

Rhoades (1962 and 1963) has done one of the most comprehensive studies on the effect of the fire ant eradication on the environment.
He selected three large study areas—about 1280 acres each—in northwest Florida. Two areas were heavily infested with the imported fire ant, and one area had no fire ants. One of the infested areas was treated with granular heptachlor at the rate of \( \frac{1}{4} \) pounds actual per acre. He found that the treatment eliminated the imported fire ant and greatly reduced populations of other arthropods. Spider populations were reduced to about 10 percent of normal five weeks after treatment. They returned to normal levels about eight months after treatment. Other arthropods were back to normal in 12 months. After a two-year monitoring program comparing the three areas, Rhoades found that populations of arthropods were comparable and concluded that the fire ant had little effect on other forms of wildlife including other insects.

The Lone Star Tick

According to Daimant and Strickland (1965) *Amblyomma americanum* (L.) is one of seven species of the genus *Amblyomma* in the United States. It is called the lone star tick because of a conspicuous light spot on the posterior of the scutum of the female. This tick is one of the more economically important species in the United States, and its great abundance make it especially annoying to livestock. The lone star tick is also important from the public-health standpoint because it is capable of transmitting tularemia, Rocky Mountain spotted fever, and American Q fever, and because it causes tick paralysis in man and dog. The lone star tick is more widely distributed in the United States than are other *Amblyomma* species. It is commonly found from southwest Texas north to Missouri and eastward to the Atlantic coast. It is a three-host tick and may be active from early spring to late fall. All stages attack man and livestock.
There are a number of papers written on the biology, distribution, hosts, behavior, disease transmittal, weather factors, and control of the lone star tick that have been excellently reviewed by Hair and Howell (1970).

Host surveys conducted in Oklahoma by Clymer et al. (1970) revealed that lone star tick larvae may be found on hosts as small as the white-footed mouse, *Peromyscus maniculatus* (W.), and as large as domestic livestock. Nymphs usually were found on animals as large as, or larger than, the cotton-tail rabbit, *Sylvilagus floridanus* (Allen), but occasionally were found on smaller animals such as the cotton rat, *Sigmodon hispidus* (S. & O.). Upon examination of 1,000 host animals, the adult ticks were almost always found on hosts as large as, or larger than, the raccoon, *Procyon lotor* (L.). They reported that the immature stages of the lone star tick parasitized all sizes of mammals and birds, while the adults were found on medium to larger animals.

Hair and Howell (1970) reported that one or more stages of the lone star tick can be found throughout the year in Oklahoma, but that they usually were very scarce from November through January. They reported that adults and nymphs appeared in significant numbers on vegetation in April and that the exact time of this activity depends, to a great extent, on mean and maximum daily temperatures. They stated that photoperiod may be influential in affecting this activity, but it apparently isn't as important as temperature because adult ticks were found on hosts in December and January, and they reported that it seemed likely that increases in temperature stimulated activity regardless of photoperiod. They stated that large numbers of ticks were observed crawling over leaf litter in late March and early April,
but few ticks were found on the vegetation at this time; consequently, drags often failed to give accurate indication of the active ticks in the area sampled. They found that as temperatures increased in April, large percentages of the active populations were found on vegetation. They noted that adult activity in Oklahoma generally subsided by late July, and nymphal activity decreased rapidly in late August.

Hair and Howell (1970) stated that the lone star tick overwintered in various stages, i.e., replete larvae, replete nymphs, and as unfed nymphs and adults. The replete larvae and nymphs usually molted to the next stage by early spring. The length of time required for the molt was dependent upon the temperature during the winter and early spring.

They reported that aggregations of lone star ticks were found along margins of meadows, within forest openings, and in certain plant habitat types; their abundance was dependent upon host utilization of these habitats. Open meadows or prairies supported fewer ticks than other habitats, with the exception of climax forests. In general, brush and low trees supported at least three times as many adults and fifteen times as many nymphs as the surrounding areas. There seemed to be a graduated decrease in tick numbers away from the brush or low tree zones in either direction toward open grassland and toward the climax forest. Persimmon and sassafras woods were found to harbor tremendous numbers of nymphs. They believed this to be the result of tick larvae hosts--especially deer--frequenting these woods the previous year. The deer feed on ripe persimmons that drop to the ground. Sassafras is a preferred browse for deer. Lancaster (1957) reported that 69.6 percent of lone star ticks were found in a brush-type habitat in Arkansas.
Tugwell and Lancaster (1963) reported peak activities of the lone star tick adults and nymphs to be in May. This corresponds with peak activities in Oklahoma. Drummond (1967) found peak activities of adults and nymphs in south-central Texas to correspond with those in Oklahoma, except in 1961 when peak activities occurred in April.

Hixon (1940) reported that the replete female, *A. maculatum*, is active from the time it drops from the host until it conceals itself on the soil surface under vegetation, bark, or other objects. As soon as the place for oviposition is established, it remains inactive during the remainder of the pre-oviposition period or about 4-6 days. The gravid female deposits eggs on the surface of the soil, but on occasion prepares a shallow excavation.

**Mirex**

Mirex replaced heptachlor for control of the imported fire ant in the early 1960's. Lofgren *et al.* (1963), screening for effective fire ant baits, found that corncob grits impregnated with soybean oil containing Mirex was effective when formulated at the ratio of 85% corncob grit, 14.925% soybean oil, and 0.075% Mirex, and applied at 5 lbs/A. At the present time, the United States Department of Agriculture is recommending three applications of 0.3% Mirex bait at the rate of 1.25 lbs/A for fire ant control. This is equivalent to 1.7 grams technical Mirex per acre per application, or a total of 5.1 grams per acre in three applications.

Early toxicity studies by Baker (1963), DeWitt *et al.* (1963a and b), and Muncy and Oliver (1963) showed that Mirex was not highly toxic to quail, mallard ducks, ringneck pheasants, and crayfish. Apparently,
these studies were limited in scope and devoted primarily to the acute effects of the chemical. Later studies have shown that Mirex is not easily degraded and is considered teratogenic and carcinogenic by the "Mrak" report (1969). Van Valen et al. (1968) reported that goldfish, *Carassius auratus* L., suffered kidney and gill injury when held in ponds treated with 0.1 and 1.0 ppm Mirex. His studies also showed that Mirex was very stable and persistent in water and that it was effectively concentrated in the tissue of goldfish. Gaines and Kimbrough (1970) reported that female mice fed 25 ppm had fewer offspring born alive, significantly fewer offspring survived to weaning, and many of the young developed cataracts. Females fed 5 ppm produced normal litters. Offspring born to mothers fed 25 ppm and nursed by untreated foster mothers had a low incidence of cataracts and a normal survival rate to weaning. Analysis of milk and fetuses showed excretion of Mirex in milk and passage through the placental barrier.

Ludke and Finley (1971) found that crayfish were extremely sensitive to Mirex through direct and indirect exposure. They found that mortality increased with time and Mirex concentration and appeared to be correlated inversely with animal size. They found that substantial amounts of Mirex leached from granular bait in water. When crayfish were placed into water in which Mirex bait was present but inaccessible, the animals accumulated a residue 16,860-fold greater than that in the water into which the Mirex had leached. In feeding tests they found that juvenile and adult crayfish suffered high mortality after consuming extremely small amounts of granular Mirex bait. Delayed mortality was exhibited by all sizes of crayfish. They found that analysis of bodies of exposed crayfish revealed an increase in residue with length
of exposure. Analysis of the water in which the crayfish were held showed an initial rise in residue followed by a decrease. They believe this to be caused by the leaching of Mirex into the water followed by uptake of Mirex from the water by the crayfish. Mirex residues in crayfish bodies were from 940-fold to 27,210-fold greater than the concentration in the water in which the crayfish were held.
Seasonal Distribution of the Lone Star Tick

Seasonal distribution and abundance studies were carried out in three areas of northwest Louisiana. The Flores farm, known for heavy tick infestations, six miles south of Mansfield, Louisiana, on Highway 71, was studied from June 13, 1968, until May 28, 1970. Another area located in Caddo Parish at the Berry Ranch in Preston, Louisiana, was sampled from January 27, 1969, until January 5, 1970. The Newsom farm, located in Webster Parish about two miles east of Shongaloo, Louisiana, was sampled from May 15, 1969, until September 19, 1969. All areas are hill lands with the predominant trees being pine, oak, and sweet gum.

Each of the above areas was sampled every two weeks by the drag method. The drag consisted of a yard square of white felt cloth which was attached on one edge by staples to a board 1/4 inch thick by 2 inches wide and just over 3 feet long. A heavy nylon string was attached to both ends of the board, and another string was attached to the middle of this string, to be used to pull the cloth along the ground. After each drag, the ticks were counted, and the number of larvae, nymphs, males, and females was recorded.

There were 9 drag stations, each about 100 yards long, at Mansfield--7 along cattle trails in woods habitat and 2 in open pasture. There were 11 drag stations at Preston with 3 in open pasture and the others in woods. In Shongaloo there were 5 stations, 2 of which were in open pasture. The length of each drag station was about 100 yards, and the number of ticks counted were totaled for each study area.
Laboratory Rearing of Ticks

Engorged adult female ticks were collected from Hereford cattle at the Flores farm six miles south of Mansfield, Louisiana. They were returned in paper pint ice cream cartons to the laboratory at Louisiana State University where they were placed in plastic jelly cups, which subsequently were placed in dessicator jars. The jars were charged with a saturated solution of ammonium sulfate that produced a relative humidity of 80% when kept at a temperature of 80° F. They were held in this manner until the eggs were laid and the larvae had emerged.

White leghorn chickens were used as hosts for the larval and nymphal stages. The hens were confined in a set of twelve wire laying cages suspended from the ceiling of the laboratory. The larvae were brushed from their containers onto the underside of the hens' wings. The hens were put back into their respective cages and pans were placed underneath the cages to catch the ticks as they dropped. This method yielded the number of ticks necessary for these studies, but was rather crude, since it allowed ticks to crawl out of the pans to the floor. Consequently, many of the ticks used for testing purposes were swept from the floor. After feeding, the ticks were returned to the dessicator jars until they molted to the next stage. Nymphs were treated in the same manner as the larvae.

Cattle were used as the hosts for adult ticks. Adults were brushed from jelly cups onto the shoulders of confined cattle. They moved from the shoulders to various parts of the animals' bodies for attachment and engorgement. The cattle were confined in raised pens with slatted bottoms. After feeding to repletion, the ticks dropped to a tray beneath the pen and were picked up by hand and placed in
Predation of the Imported Fire Ant on Stages of the Lone Star Tick

Baton Rouge Studies

Six miles south of Louisiana State University on the River Road at the Dunbar property is an area of open pasture interrupted by strips of woodland (Fig. 1). About 3 acres, which included open pasture and woodland and was heavily infested with imported fire ants, was treated in April, 1969, with Mirex; a second treatment was made in May, and individual mounds were treated again in May. The exact quantity of Mirex used is not known, but it greatly exceeded the recommended rates; the purpose in mind was to eliminate the ants.

Ten stations, at which stages of the lone star tick were to be placed at a later date, were selected in the Mirex-treated area, and ten stations were selected in an adjacent area with a similar open pasture-woodland habitat that was heavily infested with imported fire ants. Five stations in each plot were located in the grass pasture, and 5 stations in each plot were located in the forest edge. The farthest of the 5 stations into the woodland was 26 feet in the fire ant infested area and 30 feet in the treated area. The average distance into the woodland was 19.6 feet and 23.2 feet, respectively.

Tick Eggs. Three hundred lone star tick eggs were placed at each station of the two plots (6-10-69). The eggs were placed on damp cellucotton in pint ice cream carton lids, and one lid was set on the ground under grass and weeds at each station. The lids were picked up
Figure 1. An area of open pasture interrupted by strips of woodland where fire ant predation on ticks was studied 6 miles south of Baton Rouge, Louisiana.
Fig. 1
after 24 hours exposure, and the eggs remaining were counted in the laboratory.

Another test was put out (6-16-69) similar to the one described above, except that 200 eggs per station were used. The eggs remaining after 24 hours exposure were collected and counted in the laboratory.

A 72-hour study was begun (6-18-69) using ten stations per plot with three ice cream carton lids containing 200 eggs each (Fig. 2). The lids were marked A, B, and C prior to placing them at the stations and were collected at 24, 48, and 72 hours, respectively. Eggs remaining in the lids were counted at the laboratory.

Engorged Larvae. Engorged lone star tick larvae were placed on dampened cellucotton in the lids of pint ice cream cartons (8-25-69). Three lids containing 10 larvae each, lettered A, B, and C, were placed at each of the ten stations in the treated and untreated plots. A handful of ground litter was placed over the larvae to offer some protection and help prevent them from crawling away. A, B, and C lids were picked up at 24, 48, and 72 hours, respectively, and brought to the laboratory, where the larvae were counted.

Engorged Females. At the same time as the egg predation study (6-18-69), twenty field-collected engorged lone star female ticks were confined, one tick per station, and observed for 72 hours. They were confined in 2 x 2 x 2 inch, open bottom, quarter-inch mesh hardware cloth cages. The tick was placed on the ground and the cage placed over it and pressed down firmly so that the cut ends of the wire on the bottom of the cage were anchored into the ground. The cages were adequate for confining the ticks, but allowed free access for the ants.
Figure 2. Ice cream carton lids in which lone star tick eggs were placed and the small hardware cloth cage that engorged female ticks were confined in.
Analysis of variance was computed for the above tests.

Pine Grove Studies

An area was selected at Pine Grove, Louisiana, that seemed to offer adequate cover for ticks and was open enough for a fairly heavy imported fire ant infestation. This area consisted of heavily cut-over pine woodland with about a three- or four-year regrowth of pine, wax myrtle, persimmon, and scrub oak (Fig. 3).

Two adjacent five-acre square plots with similar ecology were marked off for study. Mirex corn cob grit bait (0.3%) was applied by a Cyclone hand seed sower at the rate of 1.25 lbs/A (7-29-70). A second application was applied at the same rate (8-14-70).

The two plots were located adjacent to a gravel road. Starting from the road ditch bank, a transect was walked through the center of each plot. Stations were located along the transect of each plot at 25, 50, 75, and 100 paces from the ditch bank.

Engorged Nymphs. A known number of engorged lone star tick nymphs, reared in the laboratory, were released (8-14-70 and 9-16-70) from jelly cups under grass growing beneath shrubs about each station in each plot. They were released within a ten-foot radius of the center of the station.

Attempts were made to recover the ticks (3-5-71, 3-12-71, and 3-24-71) approximately six months after release. The attraction of ticks to CO₂ was utilized in the recovery. A yard square of white felt cloth was placed on the ground at the windward side of each station. A quarter-inch mesh hardware cloth platform, 6" wide x 12" long x 2" high, was set in the center of the cloth, and a block of dry ice (about
Figure 3. Cut-over pine woodland at Pine Grove, Louisiana, where fire ant predation on ticks was studied.
6-1/4 pounds) was placed on the platform, as shown in Fig. 4. The small blocks of dry ice were obtained by cutting a fifty-pound block into eight equal pieces. This was done by sawing a deep groove around the blocks and then placing a hatchet into the groove and giving it a gentle tap with a hammer.

The ticks, which had molted to the adult stage since their release, (Fig. 5), were retrieved from the cloth and counted when they were attracted there by the release of CO₂ from the dry ice.

**Engorged Females.** Forty laboratory-reared engorged lone star tick females were confined individually in each plot, i.e., four rows with ten females per row (3-16-71). The previously marked stations served as the center of each row with five caged females on either side of the marker at varying distances apart. Periodic observations were made to determine the survival condition of the females and later to determine survival of eggs if any had been produced. Data from this test were plotted graphically.

**Engorged Larvae.** Known numbers of laboratory-reared engorged lone star tick larvae were mixed with a carrier (forty-ounce box of Quaker hominy grits) and were broadcast by hand down the center transect of the treated and the untreated plots (4-26-71).

Attempts were made to recover the ticks (6-10-71) by the drag and the dry-ice methods, both previously described. Beginning at the ditch bank, seven dry-ice stations were spaced at 45-foot intervals along the center transect of each plot. Two drags were made from the ditch bank to the first station, and two drags were made between each station, or
Figure 4. Dry-ice station used for sampling tick populations.
Figure 5. Dry-ice station, showing adult lone star ticks that were attracted to it by released CO₂.
a total of eight drags per plot. All ticks collected had molted to the nymphal stage.

The Effects of Mirex on Populations of Arthropods

Two areas were selected for studying the effect of the imported fire ant and the effect of Mirex on arthropod populations. One area at Pine Grove, Louisiana, was infested with imported fire ants, while the area at Mansfield had no imported fire ants and had never been treated for ants.

Arthropods were collected in all areas through the use of pit-fall traps. The pit-fall traps were made from tapered, wide-mouth pint fruit jars. The jars were placed in the ground so that about 3/4 inch projected above ground level. Dirt was packed around the jar and sloped downward away from the lip. Rain covers were made from 8-inch squares of sheet metal. Twenty penny nails driven through each corner served to support the cover. A space of 1-1/2 to 2 inches was left between the top of the jar and the cover to allow free access of arthropod species. Approximately 1-1/2 inches of alcohol covered with 1/2 inch kerosene was placed in the jars. Pit-fall traps were operated for six days for each sampling period in all studies.

After each collection, lids were put on the empty jars; the jars were replaced in their holes, and the rain covers were shoved down over them. The nails served to hold the covers to the ground.

The samples were poured in baby food jars and brought to the laboratory for sorting and counting. In the laboratory, collections were sieved through 13-, 30-, and 50-mesh plastic screens attached by glue to the inside of wide-mouth fruit jar rings. The make-shift
sieves then were placed inside a petri dish that had a gridded paper on the inside bottom, which facilitated counting, especially of the smaller organisms, under the microscope.

**Pine Grove Studies**

The Pine Grove study area was the same area used for the tick studies and was described in the section pertaining to the tick studies.

Pit-fall traps were used in pre-treatment sampling of the two five-acre plots (7-23-70). One plot was treated (7-29-70) with 0.3% Mirex bait at the rate of 1.25 lbs/A and again (8-14-70) with Mirex bait at the same rate. Post-treatment samples were taken at 7 and 30 days after the first treatment date (7-29-70).

Ten pit-fall traps were operated 6 days for each sampling period. These traps were set in three rows as shown in Fig. 6; the center row of traps was placed 25, 50, 75, and 100 paces from the road ditch bank. The other two rows were set 25 paces on either side of the center row and the traps were placed 25, 50, and 75 paces from the ditch bank.

The collections were brought to the laboratory for counting and identification. Analysis of variance was computed for Araneae, Gryllidae, and Staphylinidae in the 2 plots.

**Mansfield Studies, 1970**

Two square, 1-1/2-acre plots located in open pasture were sampled prior to treatment with 10 pit-fall traps per plot, as shown in Fig. 7 (8-11-70). The traps were operated 6 days for each sampling period. One plot was treated with one application of 0.3% Mirex at the rate of 1.25 lbs/A. Post-treatment samples were taken at 7 and 30 days.
Figure 6. Plot design showing pit-fall trap locations at Pine Grove, Louisiana, 1970.
### Fig. 6

<table>
<thead>
<tr>
<th>Gravel Road</th>
<th>Untreated</th>
<th>Mirex treated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 2 1</td>
<td>3 2 1</td>
</tr>
<tr>
<td></td>
<td>4 5 6</td>
<td>4 5 6</td>
</tr>
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<td>7 8 9</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Scale: 1 centimeter = 100'
Figure 7. Plot design showing pit-fall trap locations at Mansfield, Louisiana, 1970.

Figure 8. Plot design showing pit-fall trap locations at Mansfield, Louisiana, 1971.
Fig. 7

<table>
<thead>
<tr>
<th>Mirex Treated</th>
<th>Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>7 6 5 4</td>
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Fig. 8

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<td>1 2 3 4 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Treated</th>
<th>C Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Scale: 1 centimeter = 50'
The collections were handled in the same manner as were those for the Pine Grove collections. Analysis of variance was computed for Araneae, *Gryllus* species adults and nymphs, and Staphylinidae in the 2 plots.

Mansfield Studies, 1971

Another study was designed to determine the effects of Mirex bait on arthropod populations at Mansfield, Louisiana (5-11-71). Six one-acre square plots were staked out and pit-fall traps were set for pre-treatment sampling. Mirex bait (0.3%) at the rate of 1.25 lbs/A was applied to three of these plots with a Cyclone hand seeder (5-17-71). These plots were sampled at 7 days post-treatment.

Five pit-fall traps were operated for six days for each sampling period. Four traps were set in a square 70 feet apart and 70 feet from the borders of each plot. Trap 5 was set directly in the center of each plot, or 105 feet from the borders. The design is illustrated in Fig. 8.

The collections were brought to the laboratory for sorting and counting.

Analysis of variance was computed for Araneae, Carabidae, Histeridae, and Staphylinidae.

The Effect of the Imported Fire Ant on Populations of Other Arthropods

Pine Grove Studies

A study to determine the effects of the imported fire ant on other arthropods was conducted in conjunction with the Mirex studies. In
addition to 7 and 30 day post-treatment sampling, pit-fall traps were operated 10 months after the Mirex treatment.
RESULTS AND DISCUSSION

Seasonal Distribution of the Lone Star Tick

Adult lone star ticks were first collected by the dragging method in small numbers in late March or early April. Fig. 9 shows that adults were more abundant during May and early June, with peak numbers occurring in mid-May. After the peak was reached, numbers of adults dwindled through June and were absent by the last week in July.

Nymphs first were collected at about the same time as the adults. However, as shown in Fig. 10, three population peaks occurred. The first peak occurred in May at about the same time as the adult peak. The second peak occurred in late July to early August, and a third small peak was noted in September. Activity ceased completely by late October or early November.

The first larvae were collected in mid-June. Fig. 11 shows that larvae were quite abundant throughout the rest of the summer, but peak numbers occurred from late July until early August. They were no longer picked up by the dragging method by the end of October, 1969, or the first of November, 1969.

Information from the short-duration studies at Preston and Shongaloo, Louisiana (Table 1), agreed with the Mansfield study in that the ticks appeared and the numbers peaked at about the same time.

These findings closely correspond to the seasonal distribution work done in Texas, Oklahoma, and Arkansas. There is little difference in the seasonal distribution within the three states. Drummond (1967) did report that peak numbers of lone star tick nymphs and adults
Figure 9. Seasonal abundance of lone star tick adults at Mansfield, Louisiana.
Fig. 9

No. Adults Per Nine Drags

1968
June 13 26 11 25 7 21 5 18
July 26 11 25 7 21 5 18
Aug. 13 26 11 25 7 21 5 18
Sept. 26 11 25 7 21 5 18

1969
Mar. 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
Apr. 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
May 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
Jun. 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
July 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
Aug. 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19
Sept. 6 20 3 17 1 15 28 11 25 9 23 8 21 4 19

1970
Mar. 6 20 3 17 29 15 26
April 6 20 3 17 29 15 26
May 6 20 3 17 29 15 26
Figure 10. Seasonal abundance of lone star tick nymphs at Mansfield, Louisiana.
Figure 11. Seasonal abundance of lone star tick larvae at Mansfield, Louisiana.
Fig. 11

No Larvae Per Nine Drags

June 13, 16, 25; July 11, 21, 5, 18; Aug. 2, 17, 1, 14; Sept. 11, 25, 9, 23; Oct. 8, 21, 4, 19; Nov. 3, 17, 31, 14, 28

1968 1969
Table 1. Seasonal abundance of the lone star tick in two areas of northwest Louisiana.

<table>
<thead>
<tr>
<th></th>
<th>Caddo Parish</th>
<th>Webster Parish</th>
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<tbody>
<tr>
<td></td>
<td>Totals From 11 Drag Stations</td>
<td>Totals From 5 Drag Stations</td>
</tr>
<tr>
<td></td>
<td>Larvae</td>
<td>Nymph</td>
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<tr>
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<td>Feb. 7</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Mar. 6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>0</td>
</tr>
<tr>
<td>Apr. 3</td>
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</tr>
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<td></td>
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</tr>
<tr>
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<td></td>
<td>15</td>
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</tr>
<tr>
<td>June 11</td>
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<td></td>
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<td>July 9</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>780</td>
</tr>
<tr>
<td>Aug. 8</td>
<td>821</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>228</td>
</tr>
<tr>
<td>Sept. 4</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Oct. 3</td>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a/</sup> Represents total number of ticks for 11 drags.

<sup>b/</sup> Represents total number of ticks for 5 drags.
occurred in south-central Texas in April, 1961; but observations in
other years showed them to correspond with Oklahoma, Arkansas, and the
findings in Louisiana.

Ticks were found to be more abundant along woodland cattle trails
and in shady loafing areas. They were seldom found in open pastures,
but some of all stages were occasionally picked up in this type
habitat.

*Predation by the Imported Fire Ant on Stages of the Lone Star Tick*

Baton Rouge Studies

**Tick Eggs.** The data from the lone star tick egg studies (6-10-69
and 6-16-69) were statistically analyzed as two replicates. Table 2
shows a significantly ($p < .05$) greater reduction of eggs in the
untreated plot and significantly ($p < .05$) more eggs were taken from the
pasture than from the woodland sites of the treated and untreated
plots.

The eggs exposed (6-18-69) for 24, 48, and 72 hours had signifi-
cantly ($p < .01$) greater numbers of eggs taken in proportion to the time
of exposure. Table 3 shows that significantly ($p < .01$) fewer eggs
remained in the untreated plot than in the treated plot. Significantly
($p < .01$) more eggs were taken in the pasture than in the woodland
sites.

**Engorged Larvae.** Significantly ($p < .01$) more engorged larvae,
exposed for 24, 48, and 72 hours, were taken in the untreated plot than
in the treated plot. Table 4 shows that most of the larvae in the
Table 2. Mean percent survival of lone star tick eggs exposed to fire ant predation for 24 hours at Baton Rouge, Louisiana, 1969.a/

<table>
<thead>
<tr>
<th></th>
<th>Mean Percent Survival b/ Pasture</th>
<th>Woodland</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>89.05</td>
<td>100.00</td>
<td>94.53</td>
</tr>
<tr>
<td>Untreated</td>
<td>56.46</td>
<td>89.25</td>
<td>72.75*</td>
</tr>
<tr>
<td>Average</td>
<td>72.75</td>
<td>94.63</td>
<td>83.69</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 1; basic data, table 21.

b/ Studies of 6-10-69 and 6-16-69 combined as two replicates. The 6-10-69 study had 300 eggs per station with 5 in the pasture and 5 in the woodland of each plot. The 6-16-69 study had 200 eggs per station.
Table 3. Mean number of lone star tick eggs surviving 24, 48, and 72 hours exposure to fire ant predation at Baton Rouge, Louisiana, 1969.  

Mean Number of Survivors

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hours</th>
<th>Pasture</th>
<th>Woodland</th>
<th>Pasture</th>
<th>Woodland</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>24</td>
<td>129.20</td>
<td>181.20</td>
<td>200.00</td>
<td>200.00</td>
<td>177.60</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>99.00</td>
<td>151.60</td>
<td>186.80</td>
<td>189.40</td>
<td>156.70</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>38.00</td>
<td>92.60</td>
<td>171.20</td>
<td>197.80</td>
<td>125.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89.00</td>
<td>141.80</td>
<td>186.00</td>
<td>195.73</td>
<td>153.13</td>
</tr>
<tr>
<td>Treated</td>
<td>24</td>
<td>177.60</td>
<td>156.70</td>
<td>125.10</td>
<td>115.40</td>
<td>190.86</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>156.70</td>
<td>125.10</td>
<td>153.13</td>
<td>190.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>125.10</td>
<td>190.86</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Location means: Pasture 137.50  
Woodland 168.76

\textit{a/} Analysis of variance in appendix, table 2; basic data, table 19.

\textit{b/} The initial number of eggs was 200 per station with 5 stations in the pasture and 5 in the woodland of each plot.
Table 4. Mean number of engorged lone star tick larvae exposed to fire ant predation for 24, 48, and 72 hours at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Hours</th>
<th>24</th>
<th>48</th>
<th>72</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>8.00</td>
<td>5.40</td>
<td>6.22</td>
<td>6.55</td>
</tr>
<tr>
<td>Untreated</td>
<td>1.50</td>
<td>0.11</td>
<td>0.33</td>
<td>0.68</td>
</tr>
<tr>
<td>Average</td>
<td>4.75</td>
<td>2.89</td>
<td>3.28</td>
<td>3.62</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 3; basic data, table 20.
b/ There were 10 stations/plot with 10 larvae per station.
pasture and woodland of the untreated plots were taken during the first 24 hours. From the initial 50 larvae only 1 and 2 remained in the pasture and woodland, respectively, in the untreated plot after 24 hours, while the treated plot had 30 and 26 larvae remaining in the pasture and woodland, respectively.

**Engorged Females.** Observations of the caged, engorged female ticks showed that fire ants were present and attacking the ticks in the open pasture of the fire ant-infested area 3-1/2 hours after exposure. Table 5 shows that at the end of 48 hours, all ticks were missing from the pasture, and at the end of 72 hours, all except one tick were missing from the woodland site in the fire ant-infested plot. The remaining female tick was covered with fire ants at the time of the observation. None of the ticks in the treated area were taken.

Large numbers of fire ants were observed to attack the engorged female ticks. Apparently, they cut through the abdominal wall and fed upon the ingested blood of the tick. On several occasions, the remains of the ticks were found buried under a very small mound, evidently constructed by the fire ants. Fire ants were also observed in the ice cream carton lids containing tick eggs and larvae. However, it was difficult to determine whether they were taking the eggs or the larvae.

Results of these studies indicate that the imported fire ant is an effective predator of several stages of the lone star tick under conditions in which it was evaluated. In the forest edge type habitat, the most favorable environment for the tick and less preferred by the ant, predation was lower than in the open areas.
Table 5. Observations on adult engorged female ticks during 72 hours of exposure to fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th></th>
<th></th>
<th>Woods</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pasture Hours</td>
<td></td>
<td>Woods Hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>24 48 72</td>
<td></td>
<td>24 48 72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated</td>
<td>++</td>
<td>+ + +</td>
<td></td>
<td>+ +</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>++</td>
<td>+ + +</td>
<td></td>
<td>+ +</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>++</td>
<td>+ + +</td>
<td></td>
<td>+ +</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>++</td>
<td>+ + +</td>
<td></td>
<td>+ +</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>++</td>
<td>+ + +</td>
<td></td>
<td>* *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>- -</td>
<td>- - ++</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- -</td>
<td>- - +</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>++</td>
<td>- - ++</td>
<td>+</td>
<td>++</td>
<td>+ **</td>
<td></td>
</tr>
<tr>
<td></td>
<td>++</td>
<td>- - -</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>- - ++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

+ = Tick present, no ants present.
++ = Tick present, fire ants present.
- = Tick gone or only remains present.
* = Cage turned over, knocked out of location, and tick missing.
** = Tick present and alive, but fire ants present and attacking.
Engorged Nymphs. The attempts, in March, 1971, to recover ticks released in August and September, 1970, proved highly successful. Recovery attempts were made on March 5, 12, and 24, and 1665, 632, and 161 ticks, respectively, were recovered in the Mirex-treated plot. Data in Table 6 show that of the 3360 nymphs released, 2515 were recovered as adults, but no ticks were recovered in the fire ant-infested plot, where 3557 nymphs were released.

Engorged Females. The engorged adult female ticks caged in the Mirex-treated and in the fire ant-infested plots (3-12-71) were observed periodically for 90 days. For approximately a month there was little difference in the number of females remaining in each plot. During this period, temperatures were low and little ant activity was noted. However, as shown in Fig. 12, there was a sharp drop in the number of females remaining in the fire ant-infested plot between the observation dates of April 8, 1971, and April 20, 1971, with a subsequent decline to 3 ticks by the end of 90 days. There were 24 females remaining of the 40 ticks originally released in the Mirex-treated plot. Naturally, all of the females remaining in the cages were dead at the end of this study. They were counted as surviving if egg masses and larvae were present and if they had died of causes other than predation prior to laying eggs. At the end of the study there were three survivors in the untreated plot and 24 in the treated plot. A few eggs remained in one cage, and large egg masses were present in two cages in the untreated plot. In the treated plot, 13 cages contained large egg masses, a few eggs were present in one, emerged larvae were present in
Table 6. The number of ticks recovered following releases in fire ant treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th>No. Nymphs Released</th>
<th>No. Adults Recovered</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Treated Plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>847</td>
<td>266</td>
</tr>
<tr>
<td>2</td>
<td>832</td>
<td>255</td>
</tr>
<tr>
<td>3</td>
<td>828</td>
<td>264</td>
</tr>
<tr>
<td>4</td>
<td>853</td>
<td>250</td>
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<tr>
<td>Untreated Plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>727</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>787</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>890</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1153</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>3557</td>
<td></td>
</tr>
</tbody>
</table>

a 74.85% of total released.

b No ticks were recovered from the untreated plot.
Figure 12. Differences in survival rate of engorged lone star female ticks when exposed to fire ant predation for 3 months at Pine Grove, Louisiana, 1971.
Fig. 12

Mirex Treated

UNTREATED

No. Engorged Female Ticks

March April May June 1971
four, female remains were present in four with no eggs present, and two cages contained females that died prior to laying eggs.

Fire ants were observed to attack and feed on the ingested blood of the ticks, and remains of ticks were occasionally found under very small mounds.

On one occasion, a fire ant was observed taking eggs from an egg mass in the untreated plot.

**Engorged Larvae.** The engorged larvae that were released (4-26-71) were recovered as unengorged nymphs (6-10-71). The recovery was not as successful as the recovery of adults released as engorged nymphs. However, as shown in Table 7, out of 5351 larvae released, a total of 160 nymphs were recovered from the seven dry-ice stations, and 28 were recovered with the 8 drags in the Mirex-treated plot. No nymphs were found in the fire ant-infested plots.

The results of the studies at Pine Grove showed that ticks released as engorged nymphs in August and September, 1970, had a very high survival rate in the Mirex-treated plot. The ticks survived for longer than six months and molted to the adult stage during this period. However, no ticks were found to survive in the untreated plot. The reduction of other predators by the Mirex treatment might have been partially responsible for this excellent survival of ticks in the treated plot. However, engorged female ticks confined in cages (3-12-71) and engorged larvae released (4-26-71) or seven or eight months, respectively, after the treatment, had a much greater survival rate in the treated plot, while pit-fall trap samples taken in May,
Table 7. The number of lone star tick nymphs recovered following releases of engorged larvae in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1971.

<table>
<thead>
<tr>
<th>No. Larvae Released</th>
<th>No. Nymphs Recovered CO₂</th>
<th>Drag²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treated Plot</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5351</td>
<td>160</td>
<td>28</td>
</tr>
<tr>
<td><strong>Untreated Plot</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5365</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

¹There were seven dry ice stations in each plot.
²Eight drags were made in each plot.
1971, showed that populations of other arthropods were about the same for both plots.

Many people have reported that tick populations are not nearly as abundant in recent years as they were before the establishment of the imported fire ant. Dr. L. D. Newsom, Head, Department of Entomology, Louisiana State University, has hunted in the vicinity of the Pine Grove study area for a number of years. He has seen few ticks in recent years in this area, but he remarked that ticks were quite abundant there fifteen to twenty years ago. Also, negative results were obtained (3-12-71) by the author in an attempt to attract ticks to dry-ice baited stations along woodland cattle trails near the study area at Pine Grove.

Hair and Howell (1970) and Lancaster (1957) have pointed out that more ticks are found in the brush zones, forest edges, and forest openings than in either the open grasslands or climax forest. Fire ants generally inhabit open areas up to the forest edge but are frequently found inhabiting open woodland. The Pine Grove study area is a brush habitat. It is inhabited by cattle, deer, and other forms of wildlife and should be an excellent tick habitat. However, no ticks survived in the fire ant-infested area nor were they found in areas that usually have ticks outside the study area.

Fire ants range up to and into the areas where the most ticks are found. It would seem highly probable that fire ants have suppressed tick populations in the area.

The Effect of Mirex on Populations of Arthropods

Only those arthropod taxons that occurred in large enough numbers for statistical analysis will be discussed in this section. Therefore,
a general list of families and genera for each study area is presented in the appendix (Table 33). Species in the genera *Lycosa* and *Pardosa* in the family Lycosidae were the most abundant spiders trapped in each study area. According to Dr. L. R. Roddy (personal communication), the lycosid spiders are primarily ground dwellers. He said that these spiders hunt for prey rather than use web traps. He also said that spiders feed only on live organisms.

**Pine Grove Studies**

*Araneae*. Table 8 shows a decrease in the number of spiders in the treated plot following Mirex treatment, and their numbers remained low at the 30 day sampling period. However, at the 10 month sampling period, the number of spiders was about the same in both plots. Statistical analysis revealed that there was a significant (p < .05) treatment effect and a significant (p < .05) time effect. However, it revealed no treatment-time interaction, but analysis computed in 1970 through the 30 day sampling period showed a highly significant (p < .01) treatment effect, a significant (p < .05) time effect, and a significant (p < .05) treatment-time interaction. Evidently, the 10 month sampling data influenced the treatment-time effect when analyzed in 1971.

*Gryllidae*. Cricket adults and nymphs were combined for statistical analysis. *Nemobius* species adults were the most abundant crickets trapped. However, there was quite a variety of species, and the nymphal stages outnumbered the adults. Table 9 shows a sharp drop in the number of crickets in the treated plot following Mirex treatment. Their numbers remained low at the 30 day sampling period in the
Table 8. Mean number of Araneae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.\footnote{Analysis of variance in appendix, table 5; basic data, table 22.}

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>6.66</td>
<td>6.20</td>
<td>6.43</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>2.10</td>
<td>5.40</td>
<td>3.75</td>
</tr>
<tr>
<td>30 Day Post-T</td>
<td>2.71</td>
<td>6.70</td>
<td>4.70</td>
</tr>
<tr>
<td>10 Month Post-T</td>
<td>3.10</td>
<td>3.60</td>
<td>3.35</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3.64</strong></td>
<td><strong>5.47</strong></td>
<td><strong>4.55</strong></td>
</tr>
</tbody>
</table>

Mean Number per Trap
Table 9. Mean number of Gryllidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.a/

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>3.22</td>
<td>3.90</td>
<td>3.56</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>0.90</td>
<td>4.70</td>
<td>2.80</td>
</tr>
<tr>
<td>30 Days Post-T</td>
<td>0.28</td>
<td>4.40</td>
<td>2.34</td>
</tr>
<tr>
<td>10 Months Post-T</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Average</td>
<td>1.30</td>
<td>3.45</td>
<td>2.37</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 6; basic data, table 23.
treated plot. There were few crickets at the 10 month sampling period, but there were the same number in each plot. This was probably seasonally influenced. However, statistical analysis revealed that there was a highly significant \((p < .01)\) treatment effect, a significant \((p < .01)\) time effect, and significant \((p < .01)\) treatment-time interaction effects.

**Formicidae.** Table 10 shows that the number of ants trapped in the treated plot at Pine Grove (1970) was higher than the untreated plot when sampled before treatment. There was a reduction in ants in both plots following treatment, but in the treated plot at the 7 day post-treatment sampling period, of the 257 ants caught, 207 were caught in one trap which was located beside an active fire ant mound. The reduction in the untreated plot evidently was influenced by environmental factors. Statistical analysis of the data showed no significant differences between the plots. Apparently, this was because of the great reduction of ants in the untreated plot and because of the high numbers trapped in one trap in the treated plot. *S. saevissima* (F. Smith) was by far the most abundant species. A few *S. molesta* (Say) were noted, but other species were negligible.

**Staphylinidae.** Table 11 shows a sharp drop in numbers of Staphylinidae in the treated plot following Mirex treatment. However, at the 30 day sampling period, their numbers seemed to be rising in both plots. At the 10 month sampling period, they were about the same in both plots. Statistical analysis showed that there was a highly significant \((p < .01)\) treatment effect, a highly significant \((p < .01)\) time effect, but no significant treatment-time interaction. However,
Table 10. Mean number of Formicidae trapped in treated and untreated plots at Pine Grove, Louisiana, 1970.a/

<table>
<thead>
<tr>
<th>Time</th>
<th>Untreated</th>
<th>Treated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>115.10</td>
<td>227.44</td>
<td>171.27</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>33.70</td>
<td>25.70</td>
<td>29.70</td>
</tr>
<tr>
<td>30 Day Post-T</td>
<td>19.40</td>
<td>4.00</td>
<td>11.70</td>
</tr>
<tr>
<td>Average</td>
<td>56.06</td>
<td>85.71</td>
<td>70.89</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 18; basic data, table 34.
Table II. Mean number of Staphylinidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970-71.

<table>
<thead>
<tr>
<th>Mean Number per Trap</th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>9.88</td>
<td>14.70</td>
<td>12.42</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>1.80</td>
<td>12.30</td>
<td>7.05</td>
</tr>
<tr>
<td>30 Days Post-T</td>
<td>7.57</td>
<td>17.40</td>
<td>13.35</td>
</tr>
<tr>
<td>10 Months Post-T</td>
<td>3.90</td>
<td>4.20</td>
<td>4.05</td>
</tr>
<tr>
<td>Average</td>
<td>12.15</td>
<td>5.52</td>
<td>8.83</td>
</tr>
</tbody>
</table>

\(a/\) Analysis of variance in appendix, table 7; basic data, table 24.
if the analysis had included only the data through the 30 day sampling period, as in the case of the spiders, there probably would have been a significant treatment-time interaction.

Mansfield Studies, 1970

Statistical analyses were computed for Araneae, Gryllidae, and Coleoptera through the 30 day sampling period in 1970. However, upon further taxonomic break down, further analyses were computed for Staphylinidae and Gryllus species. Analysis was computed only through the 7 day post-treatment sampling period because this study was on small plots and because of the mobility of the insects concerned. The original analysis will be used in discussing the population of spiders.

Araneae. Table 12 shows that there was a decrease in the number of spiders in the treated plot following the Mirex treatment and that an increase was noted in the untreated plot. Analysis of the data showed a significant (p<.05) treatment effect and a significant (p<.05) treatment-time interaction. However, there was no significant time effect.

Gryllus Species. Gryllus species were virtually the only crickets trapped in this study. The adults and nymphs were separated for statistical analysis. Table 13 shows that the population of adult crickets was nearly eliminated in the treated plot at the 7 day post-treatment sampling period, while there was an increase in the untreated plot. Statistical analysis showed a highly significant (p <.01) treatment effect and a highly significant (p <.01) treatment-time interaction. Table 14 shows that there was a greater number of cricket nymphs
Table 12. Mean number of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>5.2</td>
<td>4.0</td>
<td>4.6</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>3.9</td>
<td>11.2</td>
<td>7.6</td>
</tr>
<tr>
<td>30 Days Post-T</td>
<td>3.6</td>
<td>5.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Average</td>
<td>4.2</td>
<td>7.0</td>
<td>5.6</td>
</tr>
</tbody>
</table>

\* Analysis of variance in appendix, table 8; basic data, table 25.
Table 13. Mean number of *Gryllus* species adults trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.a/

<table>
<thead>
<tr>
<th>Mean Number per Trap</th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>4.56</td>
<td>4.78</td>
<td>4.66</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>0.67</td>
<td>7.00</td>
<td>3.83</td>
</tr>
<tr>
<td>Average</td>
<td>2.61</td>
<td>5.89</td>
<td>4.25</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 9; basic data, table 26.
Table 14. Mean number of *Gryllus* species nymphs trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.\(^{a}\)

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>13.22</td>
<td>39.88</td>
<td>26.56</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>6.22</td>
<td>34.89</td>
<td>20.56</td>
</tr>
<tr>
<td>Average</td>
<td>9.72</td>
<td>37.39</td>
<td>23.56</td>
</tr>
</tbody>
</table>

\(^{a}\) Analysis of variance in appendix, table 10; basic data, table 26.
in the untreated plot at the pre-treatment sampling period and that there was a reduction of nymphs in both plots at the 7 day post-treatment sampling period. As would be expected, analysis of the nymph data showed only a significant (p < .01) treatment effect and no significant treatment-time interaction.

**Formicidae.** Table 15 shows a reduction of ants in both the treated and untreated plots following treatment at Mansfield (1970). However, at the 30 day sampling period, the ants were virtually eliminated from the treated plot. Statistical analysis showed only a significant (p < .01) time effect with no differences shown between the plots. This probably resulted from more ants in the treated plot at the pre-treatment sampling period and because of the decrease in ants in the untreated plot. There was quite a wide variety of species trapped during this study, especially at the pre-treatment sampling period. The number of species trapped at the 7 and 30 day post-treatment periods were fewer. The most predominant species were *S. molesta* (Say), *Monomorium* species, *Ponera* species, and *Tetramorium* species.

**Staphylinidae.** The number of staphylinid beetles was low during this study. Table 16 shows that the treated plot had about one-half as many as the untreated plot at the pre-treatment sampling period and that there was a reduction in both plots at the 7 day post-treatment period. Statistical analysis of the data showed a significant (p < .05) treatment effect and a significant (p < .05) time effect, but there was no significant treatment-time interaction.
Table 15. Mean number of Formicidae trapped in treated and untreated plots at Mansfield, Louisiana, 1970.a/

<table>
<thead>
<tr>
<th>Time</th>
<th>Untreated</th>
<th>Treated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>20.00</td>
<td>44.20</td>
<td>32.10</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>12.90</td>
<td>5.50</td>
<td>9.20</td>
</tr>
<tr>
<td>30 Day Post-T</td>
<td>8.33</td>
<td>0.20</td>
<td>4.26</td>
</tr>
<tr>
<td>Average</td>
<td>13.74</td>
<td>16.63</td>
<td>15.18</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 17; basic data, table 35.
Table 16. Mean number of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.a/

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>2.66</td>
<td>5.66</td>
<td>4.16</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>1.33</td>
<td>3.55</td>
<td>2.44</td>
</tr>
<tr>
<td>Average</td>
<td>2.00</td>
<td>4.61</td>
<td>3.30</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 11; basic data, table 27.
It was noted that numbers of a lampyrid larva, *Photinus* species, and a carabid adult, *Evarthus* species, appeared in the untreated plot in more abundance than in the treated plot. However, insufficient numbers of these species were trapped to statistically analyze. At the pre-treatment sampling period, 2 *Photinus* species were caught in 10 traps in the treated plot and none in the untreated plot, but at the 7 and 30 day post-treatment sampling periods, there were 8 and 27, respectively, trapped in the untreated plot and none were trapped in the treated plot. *Evarthus* species were not trapped in either plot until the 30 day post-treatment sampling period, but at that time, 27 were caught in the 10 traps of the untreated plot, while only 3 were caught in the 10 traps of the treated plot. According to Arnett (1960) *Photinus* larvae are predatory in habit and feed on land mollusks, earthworms, some caterpillars, and other insect larvae.

*Mansfield Studies, 1971*

Only Araneae, Carabidae, Formicidae, Histeridae, and Staphylinidae are discussed in this section. The numbers of Gryllidae were insufficient for statistical analysis.

**Araneae.** Table 17 shows that the number of spiders decreased in the treated and untreated plots at the 7 day post-treatment sampling period. Statistical analysis showed no significant effects of the Mirex treatment.

**Carabidae.** *Anisodactylus* species were the most abundant carabids trapped during this study. Table 18 shows a reduction of carabids following treatment in both plots, but there was a greater reduction in
Table 17. Mean number of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>4.00</td>
<td>5.80</td>
<td>4.90</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>3.60</td>
<td>4.00</td>
<td>3.80</td>
</tr>
<tr>
<td>Average</td>
<td>3.80</td>
<td>4.90</td>
<td>4.35</td>
</tr>
</tbody>
</table>

\* Analysis of variance in appendix, table 12; basic data, table 28.
Table 18. Mean number of Carabidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.a/

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>5.07</td>
<td>3.93</td>
<td>4.50</td>
</tr>
<tr>
<td>7 Days Post-T</td>
<td>0.47</td>
<td>1.93</td>
<td>1.20</td>
</tr>
<tr>
<td>Average</td>
<td>2.77</td>
<td>2.93</td>
<td>2.85</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 13; basic data, table 29.
the treated plot at the 7 day post-treatment sampling period. However, statistical analysis revealed only a significant ($p < 0.01$) time effect, but the treatment-time interaction approached significance at $p = 0.0525$.

Formicidae. Table 19 shows a low number of ants in both plots before treatment and a reduction of ants in both plots after treatment at Mansfield (1971). Statistical analysis showed a significant ($p < 0.01$) time effect and no significant treatment effect. The ants from this study were not taxonomically identified.

Histeridae. According to Arnett (1960), the adults and larvae of Histeridae are carnivorous and prey on other insects. The data in Table 20 show that the number of histerids decreased in both the treated and untreated plots at the 7 day post-treatment sampling period. However, there was a much greater decrease in the treated plot, but statistical analysis of the data revealed only a significant time effect with no significant treatment effect. The treatment-time interaction was at the 0.099 level of probability.

Staphylinidae. Table 21 shows that there was an increase of staphylinids 7 days after Mirex treatment in both plots. Statistical analysis revealed no significant effects as a result of the treatment.

The results of the data from the Pine Grove and Mansfield studies in 1970 show that the numbers of spiders, crickets, and staphylinid beetles were reduced by the Mirex treatment. However, the studies at Mansfield in 1971 show that Mirex had little or no effect on spiders, carabids, histerids, and staphylinids.
Table 19. Mean number of Formicidae trapped in treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean Number Ants</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Untreated</td>
<td>Treated</td>
<td>Average</td>
</tr>
<tr>
<td>Pre-Treat</td>
<td>11.73</td>
<td>14.06</td>
<td>12.90</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>9.46</td>
<td>6.00</td>
<td>7.79</td>
</tr>
<tr>
<td>Average</td>
<td>10.60</td>
<td>10.17</td>
<td>10.38</td>
</tr>
</tbody>
</table>

---

a/ Analysis of variance in appendix, table 16; basic data, table 30.
Table 20. Mean number of Histeridae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.a/

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>12.93</td>
<td>7.53</td>
<td>10.23</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>0.40</td>
<td>4.93</td>
<td>2.67</td>
</tr>
<tr>
<td>Average</td>
<td>6.67</td>
<td>6.23</td>
<td>6.45</td>
</tr>
</tbody>
</table>

a/ Analysis of variance in appendix, table 14; basic data, table 31.
Table 21. Mean number of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Mean Number per Trap</th>
<th>Treated</th>
<th>Untreated</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treat</td>
<td>3.47</td>
<td>1.60</td>
<td>2.53</td>
</tr>
<tr>
<td>7 Day Post-T</td>
<td>6.67</td>
<td>3.20</td>
<td>4.93</td>
</tr>
<tr>
<td>Average</td>
<td>5.07</td>
<td>2.40</td>
<td>3.73</td>
</tr>
</tbody>
</table>

\[a/\] Analysis of variance in appendix, table 15; basic data, table 32.
The conflicting results might be explained by the following reasons. The Mirex used in 1971 had been stored at least 9 months before it was used. Though the Mirex bag had not been opened and the plastic liner was intact, the bait might have lost its attractiveness. Evidently, a number of species of ants feed on the Mirex bait, and because of their omnivorous feeding habits, crickets probably will also feed on the bait. During the 1970 studies, crickets and ants were much more abundant than they were in 1971, and both groups were statistically shown to be reduced by the Mirex treatment. Apparently, the predaceous arthropods take in Mirex by feeding on prey that have consumed Mirex. When there is a low abundance of insects that feed on Mirex, the probabilities of predators being affected is lessened.

The Effect of the Imported Fire Ant on Populations of Other Arthropods

Pine Grove Studies

Table 22 shows that Mirex caused a reduction in populations of spiders, beetles, and crickets at Pine Grove through the 30 day post-treatment sampling period. The 10 month sampling period (5-26 to 6-1-71) showed populations of these groups to be about the same, while there were 30 times more imported fire ants in the untreated.

The study at Pine Grove showed that the imported fire ant had little effect on arthropods sampled with pit-fall traps. However, the tick studies at Pine Grove and Baton Rouge show that imported fire ants are effective predators of ticks. The complete interactions between fire ants and other species of the predator complex are not known. There may be certain factors, such as behavior and nutritive quality,
Table 22. The effects of the imported fire ant on spiders, beetles, and crickets at Pine Grove, Louisiana, 1970-71.

<table>
<thead>
<tr>
<th>Sampling Period</th>
<th>Mean Number per Trap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spiders</td>
</tr>
<tr>
<td></td>
<td>Check</td>
</tr>
<tr>
<td>7-23 to 7-29-70</td>
<td>6.2b</td>
</tr>
<tr>
<td>8-5 to 8-11-70</td>
<td>5.4</td>
</tr>
<tr>
<td>9-2 to 9-8-70</td>
<td>6.7</td>
</tr>
<tr>
<td>5-26 to 6-1-71</td>
<td>3.6</td>
</tr>
</tbody>
</table>

a Pre-treatment sampling date.
b All numbers represent an average of ten traps.
c Sampled ten months after initial treatment.
that make the tick more accessible or more attractive to the fire ant. Although the fire ant is a general predator, it may be more effective in capturing certain species such as slow moving engorged ticks. A blood-filled tick would be highly nutritious and may be very attractive to the fire ant.
CONCLUSIONS

1. In this study the imported fire ant was found to be an effective predator of the lone star tick. It probably has contributed to reduction of ticks in the Florida Parishes of Louisiana since it became established.

2. The imported fire ant had little effect on populations of most arthropods sampled with pit-fall traps.

3. Treatment with Mirex bait reduced populations of spiders, crickets, and staphylinids. Populations of some predatory species of arthropods were reduced in numbers when there was an abundance of Mirex-consuming prey.

4. In northwest Louisiana adult lone star ticks appear about the first of April, peak in abundance in mid-May, and are absent by the last of July. Nymphs appear at the same time as the adults. They are most abundant in mid-May but have two later population peaks, one in late July or early August and another in September. Larvae first appear in early June and are most abundant in July and August. Nymphs and larvae are absent by late October or early November.
LITERATURE CITED


Travis, B. V. 1938. The fire ant (Solenopsis spp.) as a pest of quail. J. Econ. Entomol. 31(6): 649-52.


Table I. Mean squares analysis of variance of the percent of lone star tick eggs surviving 24 hours exposure to imported fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Replication</td>
<td>1</td>
<td>458.33</td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>4695.89*</td>
</tr>
<tr>
<td>Location</td>
<td>1</td>
<td>4782.97*</td>
</tr>
<tr>
<td>Trt. x Loc.</td>
<td>1</td>
<td>1192.46 ns</td>
</tr>
<tr>
<td>Experimental Error</td>
<td>3</td>
<td>320.83</td>
</tr>
<tr>
<td>Sampling Error</td>
<td>32</td>
<td>1048.00</td>
</tr>
</tbody>
</table>
Table 2. Mean squares analysis of variance of lone star tick eggs exposed for 24, 48, and 72 hours to imported fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>1</td>
<td>1466.06**</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
<td>13972.06**</td>
</tr>
<tr>
<td>Loc. x Time</td>
<td>2</td>
<td>302.46 ns</td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>85428.26**</td>
</tr>
<tr>
<td>Loc. x Trt.</td>
<td>1</td>
<td>6955.26 ns</td>
</tr>
<tr>
<td>Time x Trt.</td>
<td>2</td>
<td>7446.66*</td>
</tr>
<tr>
<td>Loc. x Time x Trt.</td>
<td>2</td>
<td>237.26 ns</td>
</tr>
<tr>
<td>Error</td>
<td>48</td>
<td>1836.92</td>
</tr>
</tbody>
</table>
Table 3. Mean squares analysis of variance of lone star tick larvae exposed to imported fire ant predation for 24, 48, and 72 hours at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>1</td>
<td>27.57*</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
<td>21.37*</td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>496.88**</td>
</tr>
<tr>
<td>Loc. x Time</td>
<td>2</td>
<td>4.10 ns</td>
</tr>
<tr>
<td>Loc. x Trt.</td>
<td>1</td>
<td>2.01 ns</td>
</tr>
<tr>
<td>Time x Trt.</td>
<td>2</td>
<td>1.56 ns</td>
</tr>
<tr>
<td>Error</td>
<td>47</td>
<td>6.76</td>
</tr>
</tbody>
</table>
Table 4. Survival, egg or larval production of engorged female ticks following exposure in imported fire ant treated and in untreated plots at Pine Grove, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Row 3-12</th>
<th>15</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>4-8</th>
<th>20</th>
<th>27</th>
<th>5-6</th>
<th>15</th>
<th>26</th>
<th>6-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>0</td>
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<td>10</td>
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<td>9</td>
<td>9</td>
<td>8</td>
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<td>2</td>
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<td>1</td>
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<td>3</td>
<td>10</td>
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<td>10</td>
<td>10</td>
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<td>1</td>
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<td>4</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>37</td>
<td>36</td>
<td>35</td>
<td>33</td>
<td>26</td>
<td>14</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Row 3-12*</th>
<th>15</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>4-8</th>
<th>20</th>
<th>27</th>
<th>5-6</th>
<th>15</th>
<th>26</th>
<th>6-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>10</td>
<td>10</td>
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<td>10</td>
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</tr>
<tr>
<td>2</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
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<tr>
<td>3</td>
<td>10</td>
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<td>8</td>
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<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
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<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>38</td>
<td>37</td>
<td>37</td>
<td>35</td>
<td>33</td>
<td>31</td>
<td>31</td>
<td>30</td>
<td>26</td>
<td>25</td>
</tr>
</tbody>
</table>

\(^a\) 3-13-71. Date test started with ten females per row.
Table 5. Mean squares analysis of variance of Araneae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>55.47*</td>
</tr>
<tr>
<td>Trap (Trt.)</td>
<td>18</td>
<td>5.69</td>
</tr>
<tr>
<td>Time</td>
<td>3</td>
<td>38.01**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>3</td>
<td>20.24 ns</td>
</tr>
<tr>
<td>Error</td>
<td>50</td>
<td>8.06</td>
</tr>
</tbody>
</table>
Table 6. Mean squares analysis of variance of Gryllidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>87.22**</td>
</tr>
<tr>
<td>Trap (Trt.)</td>
<td>18</td>
<td>4.79</td>
</tr>
<tr>
<td>Time</td>
<td>3</td>
<td>27.13**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>3</td>
<td>21.88**</td>
</tr>
<tr>
<td>Error</td>
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<td>3.52</td>
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</table>
Table 7. Mean squares analysis of variance of Staphylinidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970-71.

<table>
<thead>
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<th>Mean Squares</th>
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<tr>
<td>Total</td>
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<td></td>
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<tr>
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<td>672.26**</td>
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<tr>
<td>Trap (Trt.)</td>
<td>18</td>
<td>131.69</td>
</tr>
<tr>
<td>Time</td>
<td>3</td>
<td>345.02**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>3</td>
<td>97.01 ns</td>
</tr>
<tr>
<td>Error</td>
<td>50</td>
<td>181.60</td>
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</tbody>
</table>
Table 8. Mean squares analysis of variance of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>112.12*</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
<td>55.86 ns</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>2</td>
<td>91.53*</td>
</tr>
<tr>
<td>Error</td>
<td>53</td>
<td>19.62</td>
</tr>
</tbody>
</table>
Table 9. Mean squares analysis of variance of *Gryllus* species adults trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
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<td>Total</td>
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<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>96.69**</td>
</tr>
<tr>
<td>Trap (Trt.)</td>
<td>16</td>
<td>8.90</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>6.25 ns</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>84.02**</td>
</tr>
<tr>
<td>Error</td>
<td>16</td>
<td>6.70</td>
</tr>
</tbody>
</table>
Table 10. Mean squares analysis of variance of *Gryllus* species nymphs trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>6889.00**</td>
</tr>
<tr>
<td>Trap (Trt.)</td>
<td>16</td>
<td>409.43</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>324.00 ns</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>9.00 ns</td>
</tr>
<tr>
<td>Error</td>
<td>16</td>
<td>76.50 ns</td>
</tr>
</tbody>
</table>
Table 11. Mean squares analysis of variance of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>61.31*</td>
</tr>
<tr>
<td>Trap (Trt.)</td>
<td>16</td>
<td>11.61</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>26.69*</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>1.36 ns</td>
</tr>
<tr>
<td>Error</td>
<td>16</td>
<td>4.15</td>
</tr>
</tbody>
</table>
Table 12. Mean squares analysis of variance of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>18.15 ns</td>
</tr>
<tr>
<td>Rep. (Trt.)</td>
<td>4</td>
<td>8.45</td>
</tr>
<tr>
<td>Trap (Trt. Rep.)</td>
<td>24</td>
<td>9.42</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>18.15 n</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>7.35 ns</td>
</tr>
<tr>
<td>Rep. x Time (Trt.)</td>
<td>4</td>
<td>2.15 ns</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>5.22</td>
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</table>
Table 13. Mean squares analysis of variance of Carabidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
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<th>Degrees of Freedom</th>
<th>Mean Squares</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
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</tr>
<tr>
<td>Treatment</td>
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<td>0.41 ns</td>
</tr>
<tr>
<td>Rep. (Trt.)</td>
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<td>6.73 ns</td>
</tr>
<tr>
<td>Trap (Trt. Rep.)</td>
<td>24</td>
<td>5.40</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>163.35**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>25.35 ns</td>
</tr>
<tr>
<td>Rep. x Time (Trt.)</td>
<td>4</td>
<td>3.40</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>4.50</td>
</tr>
</tbody>
</table>
Table 14. Mean squares analysis of variance of Histeridae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
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<td>Total</td>
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</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>2.81 ns</td>
</tr>
<tr>
<td>Rep. (Trt.)</td>
<td>4</td>
<td>99.13 ns</td>
</tr>
<tr>
<td>Trap (Trt. Rep.)</td>
<td>24</td>
<td>88.20</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>858.81*</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>370.01 ns</td>
</tr>
<tr>
<td>Rep. x Time (Trt.)</td>
<td>4</td>
<td>81.66</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>77.79</td>
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</tbody>
</table>
Table 15. Mean squares analysis of variance of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>106.66 ns</td>
</tr>
<tr>
<td>Rep. (Trt.)</td>
<td>4</td>
<td>38.76*</td>
</tr>
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<td>Trap (Trt. Rep.)</td>
<td>24</td>
<td>9.87</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>86.40 ns</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>9.60 ns</td>
</tr>
<tr>
<td>Rep. x Time (Trt.)</td>
<td>4</td>
<td>13.00</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>16.43</td>
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</table>
Table 16. Mean squares analysis of variance of Formicidae trapped in treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>2.69 ns</td>
</tr>
<tr>
<td>Rep. (Ttrt.)</td>
<td>4</td>
<td>279.12</td>
</tr>
<tr>
<td>Trap (Ttrt. Rep.)</td>
<td>24</td>
<td>133.86</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>384.57 ns</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>1</td>
<td>125.16 ns</td>
</tr>
<tr>
<td>Rep. x Time (Ttrt.)</td>
<td>4</td>
<td>175.78 ns</td>
</tr>
<tr>
<td>Error</td>
<td>23</td>
<td>97.09</td>
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</tbody>
</table>
Table 17. Mean squares analysis of variance of Formicidae trapped in treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>122.90 ns</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
<td>4347.56**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>2</td>
<td>1687.51 ns</td>
</tr>
<tr>
<td>Error</td>
<td>53</td>
<td>914.61</td>
</tr>
</tbody>
</table>
Table 18. Mean squares analysis of variance of Formicidae trapped in treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>12097.09 ns</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
<td>141184.34**</td>
</tr>
<tr>
<td>Trt. x Time</td>
<td>2</td>
<td>23906.69 ns</td>
</tr>
<tr>
<td>Error</td>
<td>50</td>
<td>15139.51</td>
</tr>
</tbody>
</table>
Table 19. The survival of lone star tick eggs exposed 24, 48, and 72 hours to imported fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th></th>
<th>Pasture</th>
<th>Woods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Treated</td>
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<td></td>
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<td>200</td>
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<td>200</td>
<td>190</td>
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<td>200</td>
<td>200</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
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<td>934</td>
</tr>
<tr>
<td>Average</td>
<td>200</td>
<td>186.8</td>
</tr>
<tr>
<td>Treated</td>
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<td></td>
</tr>
<tr>
<td>64</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>87</td>
<td>49</td>
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<td>186</td>
<td>157</td>
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<tr>
<td>171</td>
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<td>105</td>
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<td>Total</td>
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<td>495</td>
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<td>Average</td>
<td>129.2</td>
<td>99.0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 20. The survival of engorged lone star tick larvae exposed 24, 48, and 72 hours to imported fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Time</th>
<th>Loc. 1 Pasteur</th>
<th>Loc. 2 Woods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Treated</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
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<td></td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>18</td>
</tr>
<tr>
<td>Average</td>
<td>7.4</td>
<td>3.6</td>
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<tr>
<td>Untreated</td>
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<td>**</td>
</tr>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Average</td>
<td>0</td>
<td>0.25</td>
</tr>
</tbody>
</table>

* = Lid turned over and ticks were lost.

** = Cut up by a mowing machine.
Table 21. The survival of lone star tick eggs exposed 24 hours to imported fire ant predation at Baton Rouge, Louisiana, 1969.

<table>
<thead>
<tr>
<th>Treated Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Untreated Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>14</td>
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<tr>
<td>260</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>1500</th>
<th>1500</th>
<th>888</th>
<th>1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>300.0</td>
<td>300.0</td>
<td>177.6</td>
<td>300.0</td>
</tr>
</tbody>
</table>
Table 22. The number of Araneae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th></th>
<th>7-29-70</th>
<th>8-11-70</th>
<th>9-8-70</th>
<th>6-10-71</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Untreated</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>7</td>
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<td>7</td>
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<tr>
<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>7</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
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<td>8</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
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Table 23. The number of Gryllidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

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Table 24. The number of Staphylinidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

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Table 25. The number of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

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|        |         |         |         |
| **Untreated** |       |         |         |
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| 2      | 9       | 10      | 5       |
| 3      | 2       | 6       | 5       |
| 4      | 2       | 13      | -       |
| 5      | 4       | 6       | 13      |
| 6      | 8       | 8       | 3       |
| 7      | 2       | 6       | 5       |
| 8      | 4       | 5       | 11      |
| 9      | 2       | 12      | 4       |
| 10     | 4       | 36      | 3       |
| **Total** | 40      | 112     | 52      |
| **Average** | 4.0     | 11.2    | 5.2     |
Table 26. The number of adults and nymphs of *Gryllus* species trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

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/a/ Adults

/b/ Nymphs
Table 27. The number of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

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Table 28. The number of Araneae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

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Table 29. The number of Carabidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

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<tr>
<td>Average</td>
<td>6.6</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Table 30. The number of Formicidae trapped in Mirex treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Traps</th>
<th>Pre-Treat 5-11-71</th>
<th>Post-Treat 5-30-71</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>UT</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td>62</td>
</tr>
<tr>
<td>Average</td>
<td>26.4</td>
<td>12.4</td>
</tr>
</tbody>
</table>
Table 31. The number of Histeridae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Traps</th>
<th>Pre-Treat 5-11-71</th>
<th>Post-Treat 5-30-71</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>UT</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>Average</td>
<td>4.8</td>
<td>8.0</td>
</tr>
</tbody>
</table>
Table 32. The number of Staphylinidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1971.

<table>
<thead>
<tr>
<th>Traps</th>
<th>Pre-Treat 5-11-71</th>
<th>Post-Treat 5-30-71</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>UT</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Average</td>
<td>2.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>


Table 33. List of arthropods caught in pit-fall traps, 1970-71.

Pine Grove, Louisiana

<table>
<thead>
<tr>
<th>Araneae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agelenidae</strong></td>
</tr>
<tr>
<td>Wadotes sp.</td>
</tr>
<tr>
<td><strong>Anyphaenidae</strong></td>
</tr>
<tr>
<td>Anyphaena sp.</td>
</tr>
<tr>
<td><strong>Gnaphosidae</strong></td>
</tr>
<tr>
<td>Gnaphosa sp.</td>
</tr>
<tr>
<td><strong>Linyphiidae</strong></td>
</tr>
<tr>
<td>Linyphia Tennesseellum sp.</td>
</tr>
<tr>
<td><strong>Lycosidae</strong></td>
</tr>
<tr>
<td>Lycosa sp.</td>
</tr>
<tr>
<td>Pardosa sp.</td>
</tr>
<tr>
<td>Schizocosa sp.</td>
</tr>
<tr>
<td>Tarentula sp.</td>
</tr>
<tr>
<td><strong>Salticidae</strong></td>
</tr>
<tr>
<td>Phidippus sp.</td>
</tr>
<tr>
<td>Salticus sp.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coleoptera</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carabidae</strong></td>
</tr>
<tr>
<td>Harpalus sp.</td>
</tr>
<tr>
<td><strong>Staphylinidae</strong></td>
</tr>
<tr>
<td>(Genera not recognized)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hymenoptera</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formicidae</strong></td>
</tr>
<tr>
<td>Solenopsis molesta (Say)</td>
</tr>
<tr>
<td>S. saevissima (F. Smith)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orthoptera</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gryllacrididae</strong></td>
</tr>
<tr>
<td>Ceuthophilus sp.</td>
</tr>
<tr>
<td><strong>Gryllidae</strong></td>
</tr>
<tr>
<td>Anurogryllus sp.</td>
</tr>
<tr>
<td>Gryllus sp.</td>
</tr>
<tr>
<td>Miogryllus sp.</td>
</tr>
<tr>
<td>Nemobius sp.</td>
</tr>
</tbody>
</table>
Table 33 (continued)
Mansfield, Louisiana

Araneae

Clubionidae
  Castianeira sp.
  Phrurotimpus sp.

Gnaphosidae
  Gnaphosa sp.

Linyphiidae
  Meioneta sp.
  Tennesseeellum sp.

Lycosidae
  Lycosa sp.
  Pardosa sp.
  Schizocosa sp.
  Tarentula sp.
  Trachelas sp.

Salticidae
  Habronattus sp.
  Icius sp.
  Paraphidippus sp.
  Phidippus sp.

Theridiidae
  Dipoena sp.
  Latrodectus sp.
  Steatoda sp.
  Teutana sp.

Thomisidae
  Misumenops

Coleoptera

Carabidae
  Aristomis sp.
  Anisodactylus sp.
  Bradycellus sp.
  Chaenius sp.
  Evarthurus sp.
  Harpalus sp.
  Pterostichus sp.
  Scarites sp.

Cincindellidae
  Megacephalus sp.

Elateridae
  (Genera not recognized)
Table 33 (continued)

Histeridae
   Saprinus sp.

Lampyridae
   Photinus sp.

Orthoptera

Gryllidae
   Anurogryllus sp.
   Gryllus sp.
   Nemobius sp.

Hymenoptera

Formicidae
   Crematogaster sp.
   Iridomyrmex sp.
   Monomorium sp.
   Paratrachina sp.
   Ponera sp.
   Solenopsis molesta (Say)
   S. texana Emery
   S. xyloni
   Tetrarmorium sp.
Table 34. The number of Formicidae trapped in Mirex-treated and untreated plots at Pine Grove, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Trap</th>
<th>7-23-70</th>
<th>8-5-70</th>
<th>9-8-70</th>
<th>6-1-71</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>119</td>
<td>64</td>
<td>39</td>
<td>73</td>
</tr>
<tr>
<td>2</td>
<td>89</td>
<td>21</td>
<td>19</td>
<td>94</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>12</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>108</td>
<td>33</td>
<td>17</td>
<td>51</td>
</tr>
<tr>
<td>5</td>
<td>285</td>
<td>43</td>
<td>20</td>
<td>181</td>
</tr>
<tr>
<td>6</td>
<td>89</td>
<td>19</td>
<td>7</td>
<td>173</td>
</tr>
<tr>
<td>7</td>
<td>105</td>
<td>50</td>
<td>5</td>
<td>42</td>
</tr>
<tr>
<td>8</td>
<td>170</td>
<td>22</td>
<td>14</td>
<td>73</td>
</tr>
<tr>
<td>9</td>
<td>86</td>
<td>32</td>
<td>22</td>
<td>136</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
<td>41</td>
<td>41</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>1151</td>
<td>337</td>
<td>194</td>
<td>912</td>
</tr>
<tr>
<td>Average</td>
<td>115.1</td>
<td>33.7</td>
<td>19.4</td>
<td>91.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trap</th>
<th>Untreated</th>
<th>Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>87</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>979</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>178</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>76</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>197</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>63</td>
<td>26</td>
</tr>
<tr>
<td>8</td>
<td>237</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>182</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>48</td>
<td>207</td>
</tr>
<tr>
<td>Total</td>
<td>2804</td>
<td>257</td>
</tr>
<tr>
<td>Average</td>
<td>280.4</td>
<td>25.7</td>
</tr>
</tbody>
</table>
Table 35. The number of Formicidae trapped in Mirex-treated and untreated plots at Mansfield, Louisiana, 1970.

<table>
<thead>
<tr>
<th>Trap</th>
<th>Treated</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8-11-70</td>
<td>8-25-70</td>
<td>9-18-70</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>237</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>29</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>442</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>44.2</td>
<td>5.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trap</th>
<th>Untreated</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8-11-70</td>
<td>8-25-70</td>
<td>9-18-70</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>43</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>15</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>47</td>
<td>29</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>129</td>
<td>75</td>
</tr>
<tr>
<td>Average</td>
<td>20.0</td>
<td>12.9</td>
<td>8.3</td>
</tr>
</tbody>
</table>
Wayne Gerard Harris was born in Pearl River County, Mississippi, December 29, 1929. He graduated from McNeill High School in 1949. He attended Pearl River Junior College at Poplarville, Mississippi, from 1949 to 1951. He served in the United States Air Force from September, 1951, to September, 1955.

Harris attended McNeese State College at Lake Charles, Louisiana, from 1955 to 1957, from which he received a B.S. degree in Animal Science. He entered Louisiana State University as a graduate assistant in the Department of Entomology in September, 1957. He received the Master of Science degree in Entomology in May, 1959.

Harris was self-employed for two years as a pest control operator from 1959 to 1961. He held the position as biologist for three years with the Louisiana Mosquito Control Association and was Assistant Director of the Mississippi Gulf Coast Mosquito Control Commission for two years. He was an Agriculturist for American Cyanimid Chemical Company from May, 1966, to August, 1968.

Harris entered Louisiana State University as an Associate in the Department of Entomology in August, 1968. He is presently a candidate for the degree of Doctor of Philosophy.
Candidate: Wayne Gerard Harris

Major Field: Entomology

Title of Thesis: The relationship of the imported fire ant, *Solenopsis saevissima* (F. Smith), to populations of the lone star tick, *Amblyomma americanum* (Linnaeus), and the effects of Mirex on populations of arthropods.

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

August 2, 1971