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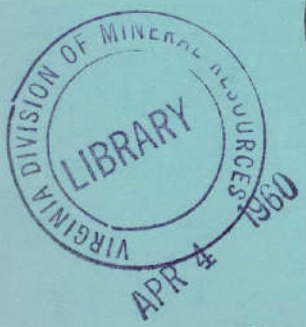

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FIRE ANTS, HEPTACHLOR, AND FISH KILL

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ABSTRACT. Twenty pounds of 10 per cent heptachlor were applied per acre on the northern half of the Fralise Farm near Sour Lake, Texas. Fish kill was heavy and continued for over three weeks. Young fish died first. The few survivors were usually large and, except for shad and gambusia, were thin. Two months after the poisoning, larvae of several species were found, and the population of fishes appeared to be on the way to recovery. During a later treatment of the southern part of the farm, extreme care was taken to avoid contamination of water with heptachlor. Fish kill was avoided.

The imported fire ant, *Solenopsis saevissima richteri* Forel, has become a major pest in the Gulf Coast states. The Agriculture Research Service, Plant Pest Control Division of the Department of Agriculture is planning an eradication program which would cover much of the Austroriparian Biotic Provence with insecticides. The Fralise Farm, a cattle and rice unit partially filling the triangle between State Highway 105 and Farm Road 326 northeast of Sour Lake, Hardin County, was chosen for the first major application of poison in Texas. Granular 10 per cent heptachlor was applied at the rate of 20 ponds per acre. Heptachlor, selected because of its relatively low cost, is effective against fire ants for three to five years.

Numerous fishes lived in a small stream, which bisects the farm into northern and southern halves, and in a network of canals and ditches which irrigates and drains the rice fields. It was expected that the poison would have a severe effect on fishes. We determined the effect by making extensive collections, by means of a twenty-foot common sense seine, before and after the poison was administered, and by frequent inspections for dead and dying fishes. The duration of this study was 15 February to 5 June 1958.

M and M Air Service of Nome, Texas, began treating the area north of the stream with duster aircraft 3 March at 6:30 A.M. and completed poisoning on the fourth. Livestock were moved to the southern half of the farm to protect them from the heptachlor prior to the application of the poison. About two weeks later they were moved back to the north side. Application of insecticide on the south side was delayed until 13 May. When the north side was treated, water standing in rice

fields, minor ditches, and the stream was not protected. Care was taken to keep aerial application away from the major irrigation canal, but some heptachlor drifted in. Crews of laborers treated the banks with hand seeders.

Four major habitats were checked on the north side. The first consists of a three- to fifteen-foot wide irrigation canal about two miles long. It is fed by a deep-well pump and is divided into sections by locks which control the water level. It is used to flood rice fields and to water cattle. The assortment of fishes in this habitat may be influenced by seasonal inflow of clear deep-well water. Only turbid surface run off was in the canal until 23 March at which time the ditch was flushed with well water. The upstream sections are shallow and the downstream sections reach a depth of five feet. The species of fishes found in this canal were:

Gizzard shad, *Dorosoma cepedianum* (LeSueur); redfin pickerel, *Esox americanus* Gmelin; lake chubsucker, *Erimyzon sucetta* (Lacépède); golden shiner, *Notemigonus crysoleucas* (Mitchill); pugnose minnow, *Opsopoeodus emiliae* Hay; black bullhead, *Ictalurus melas* (Rafinesque); golden topminnow, *Fundulus chrysotus* Holbrook; gambusia, *Gambusia affinis* (Baird and Girard); pirateperch, *Aphredoderus sayanus* (Gilliams); largemouth bass, *Micropterus salmoides* (Lacépède); warmouth sunfish, *Chaenobryttus coronarius* (Bartram); bantam sunfish, *Lepomis symmetricus* Forbes; longear sunfish, *Lepomis megalotis* (Rafinesque); bluegill sunfish, *Lepomis macrochirus* Rafinesque; black crappie, *Pomoxis nigromaculatus* LeSueur; white crappie, *Pomoxis annularis* Rafinesque; and slough darter, *Etheostoma gracile* (Girard). Few rough fish were taken. Prior to the poisoning, the canal was heavily populated with fat forage and game fishes. Warmouth, longear sunfish, and bluegill were abundant. Largemouth bass, white and black crappie, and gizzard shad were taken only in the deeper sections. Golden shiners, gambusia, and slough darters were most abundant in the shallow upstream stations. The only sucker (lake chubsucker) collected came from a deep section.

The poisoning of this canal was accidental. Some heptachlor drifted in from the aerial treatment and the men with the hand seeders may have been careless. White granules of insecticide could be seen on the ditch bank; a heavy rain following treatment probably washed many of these granules into the water. Some poison may have floated in with water draining from the rice fields. Observations the afternoon of the first poisoning revealed no effect on the fish, but numerous sick

insects and spiders were noticed. Three days later golden shiners, black bullheads, gambusia, and small centrarchids were seen dead and dying.

Surface commotion drew attention to the affected fishes. They reacted in one of three ways: they either swam to the surface and repeatedly thrust their heads out of the water, swam in tight circles, or swam in a straight line in wild dashes. On occasion, gizzard shad, black bullheads, and sunfishes were seen fighting to get out onto the banks. This appeared to be the ultimate aim of the affected . . . To get out of the water.

By 10 March, fishes, up to five inches in length, were dead along most of the canal bank. Small, particularly young fishes, died first. With the passage of time, progressively larger fishes died. On 14 March, a seven-inch-long shad and sunfishes over five inches long were dead. Seining on 15 March produced few young fishes and the fishes caught were thin. The poor condition of these fishes could either be a direct effect of the poison or caused indirectly by the destruction of crustaceans, insects, and fishes used for food. Fishes dying from the poison were invariably thin. Starting on 23 March, the supervisors of the farm flushed the canal with deep-well water for three days. They were afraid of possible lethal effects resulting from their registered cattle's drinking the water that had proved so deadly to fishes. A heavy kill of birds and small mammals (Lay 1958), reinforced their fear. No dead fishes were observed after this date. As deaths ceased in all habitats within a week, fish kill would probably have ended in the canal without the flushing.

Half a day was spent collecting in the canal on 4 May, two months after the application of heptachlor. This collection yielded the only pickerel and pirateperch caught in the canal. Young fishes, which were abundant prior to the poisoning, were not found. The few survivors were large but not plump, except for the shad and gambusia. Female gambusia were swollen with embryos, but no adult males were found. The slough darter was the only formerly abundant species missing. The poisoning, which occurred during its breeding season, probably would have been as toxic to darter fry as it was to other young fishes. Adult slough darters are difficult to find at the end of the breeding season. In most places, this darter is probably an annual, so lack of adults may not have been a result of the poisoning. Larvae of shad, golden shiners, gambusia, bass, and sunfishes were present on 4 May. The canal appears on its way to recovery and prospects appear excellent that the heptachlor will not have a three- to five-year detri-

mental effect on fishes as is claimed for fire ants, unless the food supply continues to be diminished by the poison.

The second habitat consisted of shallow water standing in depressions in fallow rice fields. Gambusia and bantam sunfish were the abundant species. In the two areas checked, kill was 100 per cent. No effect was noticed on tadpoles.

The third type of habitat consisted of small ditches draining the poisoned areas. Kill was severe, but living fishes were found wherever a seine was used. The last dying and recently dead fishes were seen in the stagnant end of a roadside ditch on 30 March. This lot consisted of a yearling largemouth bass and several gambusia.

The fourth major habitat consists of a small snag-filled, sand-and-silt-bottomed stream ranging from two to ten feet wide and averaging from two inches to about a foot deep. Following rains it is much larger. This stream received poison directly from the airplanes and indirectly from water draining from the rice fields. Polution from an upstream oil field undoubtedly influences the occurrence and abundance of fishes. During floods, oil escapes to the stream from oil pits. The presence of striped mullet, *Mugil cephalus* Linnaeus, may indicate salt pollution. The prepoisoning collections were made during a period of heavy rain and the collections two months after poisoning were made during a dry spell. Species taken in this stream were:
Redfin pickerel, *Esox americanus;* lake chubsucker, *Erimyzon sucetta;* golden shiner, *Notemigonus crysoleucas;* pugnose minnow, *Opsopoeodus emiliae;* ribbon shiner, *Notropis fumeus* Evermann; redhorse shiner, *Notropis lutrensis* (Baird and Girard); spottail shiner, *Notropis venustus* (Girard); weed shiner, *Notropis roseus* (Jordan); silvery minnow, *Hybognathus nuchalis* Agassiz; bullhead minnow, *Pimephales vigilax* (Baird and Girard); channel catfish, *Ictalurus punctatus* (Rafinesque); yellow bullhead, *Ictalurus natalis* (LeSueur); black bullhead, *Ictalurus melas;* tadpole madtom, *Schilbeodes gyrinus* (Mitchill); golden topminnow, *Fundulus chrysotus;* gambusia, *Gambusia affinis*; pirateperch, *Aphredoderus sayanus*; striped mullet, *Mugil cephalus;* largemouth bass, *Micropterus salmoides*; warmouth sunfish, *Chaenobryttus coronarius;* green sunfish, *Lepomis cyanellus* Rafinesque; bantam sunfish, *Lepomis symmetricus*; redbreast sunfish, *Lepomis auritus* (Linnaeus); longear sunfish, *Lepomis megalotis;* bluegill sunfish, *Lepomis macrochirus*; dusky darter, *Percina sciera* (Swain); bluntnose darter, *Etheostoma chlorosomum* (Hay); slough darter, *Etheostoma gracile*; and cypress darter, *Etheostoma proeliare* (Hay). The variables in this stream make assessment of the effect of

heptachlor on the fishes difficult. Two stations were collected. One was downstream from the western border of the farm where the stream flows through an open pasture. Eighteen species were caught in the prepoisoning collection and ten occurred in the collection made on 4 May. Two of the species taken in the second collection were not present in the first collection. The stream was collected in a canopied area upstream from its exit from the poisoned area. Nineteen species were collected prior to the poisoning and sixteen on 4 May. Four of the species found in the later collection were not found in the former.

The poison may have been responsible for the disappearance of species from the stream or the change may be an artifact of collecting. Darters and small sunfishes were rare in 4 May collections. In contrast to the canal, male gambusia survived. Small dead sunfishes were observed in the drift along the stream on 7, 8, 10, and 14 March. These could have been either residents of the stream or washed in from drainage ditches. One dead striped mullet, probably a resident of the stream, was found.

The south side of the farm was treated 13 and 14 May, both aerially and by hand. Extreme care was taken to avoid all water. The airplanes left untreated two swath widths bordering a farm pond, irrigation canals, drainage ditches, watering holes, and the stream. Hand seeders were used on these two swath widths, but no poison was applied close to the water. In contrast to the north side, the poison was applied when the ground was relatively dry. Few, if any, fishes were present in the rice fields which received the poison. Although we did not check the south side until 5 June, we believe fish kill was slight. All sizes of fishes appeared abundant and no sign of dead or sick fishes was found. Dan Lay, State Research Biologist, and Billy Weston, farm foreman, believe there was little, if any fish kill.

From our investigation, it appears that care must be taken to keep heptachlor away from water to prevent severe damage to fish populations. An ill-supervised fire ant control program could result in at least temporary poor fishing and in the local extermination of some species throughout the Gulf Coast states.

We are most grateful to Mr. Ray Edmondson, manager, and Mr. Billy Weston, foreman, of the Fralise Farms, Incorporated, for facilitating our investigation. Mr. C. B. Williams, Beaumont District Leader, Plant Pest Control Division, U.S.D.A., has provided information on the fire ant control program. Mr. Dan Lay, State Research Biologist, Buna, Texas, has given freely of his extensive observations on the effect of heptachlor on the fishes, birds, and mammals. Drs.

George A. Moore and Royal D. Suttkus have aided in the identification of fishes. Dr. George A. Moore has criticized the manuscript.

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