lines an estimated 555,500 feet of dikes averaging 4′ high by 18′ wide, and impounding water over 13,850 acres to an average depth of one foot. In addition, some 412 acres will be ditched with a dragline requiring some 141,700 lineal feet of ditches averaging 4′ deep by 10′ wide. Some of the islands proposed for improvements will possibly have to be worked with a barge-mounted dragline with clamshell. The District can furnish such a barge and machine. If the District continues to receive aid from PAFB, at least four of the District draglines will be working in the NMILA until the work is completed. As previously stated, this will require at least 4½ years with present equipment.

In order to complete the proposed permanent control program in 3 years, it is requested that NASA furnish the District two ¾ yard draglines and one D-6 bulldozer to aid in this work. Since the work in the marshes requires a different type of dragline from one used on high and dry land, it is recommended that the draglines and tractor be purchased in accordance with the District's specifications. In order to avoid the cost of management, engineering, and the high cost of contracting work of this nature, it is suggested that this equipment be leased to the District for $1.00 per year.

Conclusion. Due to the lack of time, and the obvious advantage of a cooperative program compared to any other way of accomplishing mosquito control on the NMILA, the District has not prepared a detailed breakdown showing the benefits that would be received by NASA in relation to cost. This information can be supplied at a later date, if required.

Detailed studies of the above proposal were made by NASA and the Air Force, and the proposal has been accepted almost in its entirey. The initiation of this cooperative mosquito control plan has been hailed as an outstanding example of cooperation between federal, state, and local agencies.

SPECTRUM OF CROSS-RESISTANCE TO INSECTICIDES IN THE MOSQUITO FISH, *GAMBUSIA AFFINIS* [1]

CLAUDE E. BOYD and DENZEL E. FERGUSON

The first reported case of insecticide resistance in a fish involved DDT-resistance in mosquito fish from Mississippi cotton-growing areas (Vinson, Boyd, and Ferguson, 1963). Subsequently, the same population of fish was shown to be resistant or highly tolerant to endrin, aldrin, dieldrin, toxaphene, heptachlor, BHC (lindane), and DDD (Boyd and Ferguson, 1963). In an effort to further document this broad spectrum resistance to chlorinated hydrocarbon compounds, many of which have not been used extensively in cotton insect control, the following insecticides were tested: Thanite (a thiocyanate compound), Dilan, methoxychlor, Kelthane, Perthane, chlordane, and Strobane.

Resistant fish were collected April 1, 1963 near Sidon, Leflore County, Mississippi, brought to State College, and released in a pond known to be free of insecticide contamination. Fish derived from this stock were tested during late July through early September, 1963, as were non-resistant mosquito fish collected near State College, Oktibbeha County, Mississippi.

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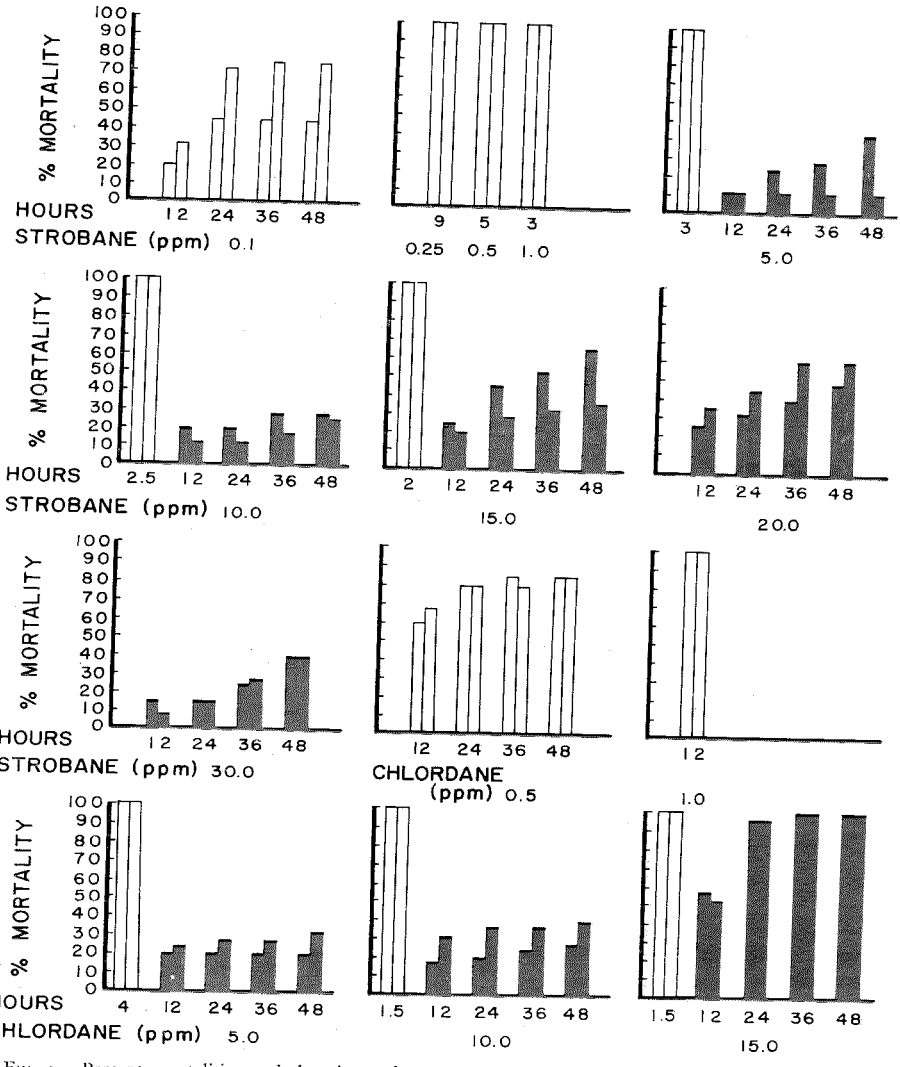

FIG. 1.—Percent mortalities and durations of exposure for non-resistant (white bars) and resistant (black bars) mosquito fish exposed to 9 concentrations of Strobane and 5 concentrations of chlordane. Tests were duplicated by area using 25 fish per test. After 100 percent mortality was recorded, higher concentrations of toxicant were employed to determine effects upon length of required exposure to obtain 100 percent mortality.

Purified samples of test insecticides were obtained from manufacturers and prepared as stock solutions using acetone as a solvent. Further dilutions with tap water gave the desired test concentrations. At each concentration, two replications of 25 fish each were tested from each of the fish populations. This was done by placing 5 medium-sized specimens in a quart fruit jar containing a 500-ml portion of test solution. Mortality was recorded and dead fish removed periodically over a 48-hour period. Temperatures ranged from 70°–80° F during testing. Identical procedures were followed for control fish using acetone blanks. A total of 125 Sidon fish was used as controls, 4 of which died. None of the 100 non-resistant controls died.

The approximate LC_{50} values in Table 1 indicate that the two fish populations do not differ in susceptibility to Thanite, Dilan, methoxychlor, Kelthane, and Perthane. However, the Sidon population exhibited marked resistance to both Strobane and chlordane (Fig. 1). Although chlordane is not a commonly used cotton insecticide, chlordane resistance is not surprising since the chemical is closely related structurally to other cyclodiene derivatives, some of which have been used on cotton. Strobane, which differs only slightly from toxaphene and is much less toxic to birds (Dahlen and Haugen, 1954), was first introduced in Mississippi as a cotton insecticide during the 1963 crop season. The Strobane resistance is most likely a consequence of past selection by toxaphene or possibly other cyclodiene derivatives. This being the case, it is interesting that the level of Strobane resistance (over 300 fold) should exceed that reported for toxaphene (40 fold) by Boyd and Ferguson (1963).

TABLE 1.—A comparison of 24-hour LC_{50} values (p.p.m.) for resistant (Sidon) and non-resistant mosquito fish populations tested against 5 insecticides.

Insecticide	LC_{50} Values (p.p.m.)	
	Sidon	State College
Dilan	0.5	0.4
methoxychlor	0.6	0.9
Thanite	0.8	0.9
Kelthane	2.1	1.9
Perthane	10.4+	10.0+

The wide spectrum cross-resistances reported here for the cyclodiene derivatives are similar to those observed in insects. However, fish resistance to DDT-related compounds, unlike that of insects, shows a pattern of inconsistency which excludes certain closely related compounds.

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