Little information is available on the uptake of insecticides by benthic organisms. DERR and ZABIK (1972) determined that the absorption of DDE by the midge was related to levels of the insecticide in a contaminated environment. No attempt was made to differentiate between uptake from the sediment and from the water. NIMMO et al. (1971) described the absorption of polychlorinated biphenyls (PCB's) from sediment by crabs and shrimp. Because of probable feeding on the sediments by the organisms, no distinction could be made between absorption and ingestion of the PCB's.

Use of the proper test organism is necessary to determine the mode of uptake of an insecticide by an aquatic organism. Since many benthic dwellers are detritus feeders, it is often hard to distinguish between absorption and consumption of toxic materials. The hogchoker (Trinectes maculatus), however, is carnivorous (CASTAGNA, 1955) and ingestion of sediment is unlikely. Thus absorption of an insecticide from a contaminated substrate can be differentiated from consumption of insecticide-laden foods.

The purpose of this study included: (1) determination of the movement of mirex in a soil-water system, (2) measurement of the rate of absorption of mirex by a flatfish in this system, and (3) differentiation between uptake of mirex from the substrate and from the water.

Materials and Methods

Experimental Procedure

The experiment consisted of two 4 week tests, one utilizing static water conditions (static test), the other using constantly flowing water (flow-through test) of 30 ml/min. Nineteen liter aquaria were filled with 3.5 kg of coarse silica sand to simulate a sediment approximately 4 cm deep. Technical grade mirex (97%, Allied Chemical Company) was dissolved in hexane and mixed with sand to obtain test concentrations of about 5000, 1650 and 500 ppb (parts per billion) in 3.5 kg of sand. Control aquaria consisted of hexane without mirex mixed in the sand. Sediment in each tank was covered with 14 l. of water. Characteristics of the test water included: total hardness, 126 ppm (parts per million); pH, 7.8; dissolved oxygen, 7.0 ppm; and temperature, 24.9°C.

Juvenile hogchokers were collected from the Apalachicola River at Chattahoochee, Florida. No mirex was found in any of the...
test fish although muscle averaged 215 ppb DDE and liver averaged 556 ppb DDE. Fish were fed chopped earthworm (Eisenia fetida) every other day at the rate of 2% of the body weight. Trace amounts (less than 10 ppb) of DDT and DDE were present in the earthworms.

**Pesticide Analysis**

Sediment, water and tissue samples were taken on a weekly basis over a period of one month. Sediment samples of about 100 gm were air dried on aluminum foil for 48 hrs and frozen. Water samples were stored in 1 liter glass jars and refrigerated at 6°C. Single muscle samples were obtained from each of two fish at each test concentration. Due to the small size of organs in the hogchoker, livers from two fish were pooled to make one sample.

Muscle, liver and earthworm samples were analyzed according to the micromethod of ENOS (1970). Samples were extracted with acetonitrile in a tissue grinder and the pesticide transferred to hexane. The extract was rinsed through a chromoflex column filled with activated florisil and topped with sodium sulfate. The column was eluted with 20 ml of 5% ethyl ether in hexane. Each elution was concentrated over a steam bath to 1-2 ml for injection. Sediment samples were extracted for 6 hours with 150 ml of 10% acetone in petroleum ether in a Soxhlet apparatus (MILLS et al. 1963). The extract was concentrated to 10 ml for injection. Water samples were extracted by shaking twice with 100 ml of hexane in a separatory funnel. Extracts were dried by rinsing over sodium sulfate and concentrated to about 1 ml.

Samples were analyzed on a Varian Aerograph series 2100 gas chromatograph with Ni^63 and H^3 detectors. The Ni^63 detector employed a 183 cm by 2 mm glass column packed with 6.4% OV 210 and 1.6% OV 17. Operating temperatures were: detector 270°C, oven 180°C, column 210°C and injector 225°C. The nitrogen gas flow rate was 27 ml/min. The tritium detector used a 183 cm by 2 mm glass column packed with 3% OV 101. Detector temperature was 275°C, oven 180°C, column 210°C and injector 225°C. The nitrogen gas flow rate was 70 ml/min. Standards were injected after every fourth sample. Every tenth sample was injected in both columns to verify identification and quantification of the insecticides. Recovery rates were established on tissue, water and sediment by spiking triplicate samples with known quantities of mirex. Recovery ranged from 87 to 100% for tissue, 79 to 80% for water and 91% for sediment.

**Results and Discussion**

Uptake of mirex by the liver and muscle of fish showed a dose dependent (dose=initial sediment concentration) relationship. Regression lines for mirex in the tissues are listed in Table 1.