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## TOXICITY OF THE REPELLENT DEET (N,N-DIETHYL-META-TOLUAMIDE) TO *GAMBUSIA AFFINIS* (BAIRD AND GIRARD)<sup>1</sup>

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**ABSTRACT.** The experimental use of DEET (N,N-diethyl-meta-toluamide) as an area space repellent led to an evaluation of its toxicity to the

mosquito fish, *Gambusia affinis*. The LC<sub>50</sub> determination indicates a very low toxicity for the compound.

**INTRODUCTION.** The Naval Medical Field Research Laboratory, Camp Lejeune, North Carolina, has become interested in determining if DEET (N,N-diethyl-meta-toluamide) is effective as an area repellent when applied on talc or other inert carrier. Since ground application is indicated, the question of run-off and the resulting toxicity to aquatic organisms has been raised. In response to this question, a study was developed to determine the effects of DEET on fish. The mosquito fish, *Gambusia affinis*, was chosen as the test animal due to its availability and use

in mosquito control on military bases (Sholdt, *et al.*, 1972).

**METHODS AND MATERIALS.** Experimental fish were drawn from two 30-gallon aquaria maintained in the laboratory. Two females, 3.5 to 5.0 cm in length, were added to 3-liter glass jars containing 2 liters of water drawn from the aquaria. Aeration was provided (Lagler, 1969) and all tests were conducted at room temperature (70° F). Covers were placed over the glass jars to keep the fish from jumping out and to reduce evaporation of the test solutions. Feeding was curtailed 24 hours before testing and was not resumed during the experimental period. Test concentrations of DEET were produced by pipetting the desired amount of technical material (95% N,N-diethyl-meta-toluamide and 5% other isomers) into 500 ml of water from each test container. The material

<sup>1</sup>The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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was thoroughly mixed for 15 seconds and reintroduced into the respective jars. Hence, the fish were introduced to the test container prior to the addition of DEET, which we believe causes less stress than direct introduction to a test condition as suggested by Doudoroff, *et al.* (1951). Thirty-four fish were tested at each DEET concentration and mortality was recorded at 24 and 48 hours. Upon death, fish were removed from the container regardless of time. Jars were washed thoroughly and rinsed with acetone immediately after each run was completed.

**RESULTS AND DISCUSSION.** After preliminary testing, odd log spaced dosages of 125, 200, 315 and 500 ppm were selected for test concentrations. Seventeen test series (2 fish at each concentration, not including controls) were conducted and mortality data recorded (Table 1). A

upside down and frequently collided with the container walls, other fish and aerators.

Disorientation was previously noted in a 3-year old girl (Gryboski, *et al.*, 1961), and in rats and rabbits (Ambrose, 1959) exposed to toxic concentrations of DEET. In our study, however, surviving fish transferred to fresh water showed complete and rapid return of equilibrium with no visible side effects. Observations were continued for 2 months. Similar symptoms followed by recovery were observed in fish exposed to detergents by Hazeltine (personal communication).

It does appear that the toxicity of DEET to *Gambusia affinis* is very low in comparison to organochloride and organophosphate insecticides. The LD<sub>50</sub> (36 hours) for DDD in mosquito fish was as high as 2.4 ppm (Boyd and Ferguson, 1964). Lewallen (1959) reported 40 percent mor-

TABLE 1.—Mortality at 24 and 48 hour exposures.

Concentration (ppm)	Number of fish tested	24 hr. mortality		48 hr. mortality	
		No.	%	No.	%
(Control)	34	0	0	0	0
125	34	0	0	1	2.9
200	34	7	20.6	8	23.5
315	34	34	100.0	34	100.0
500	34	34	100.0	34	100.0

straight-line graphic interpolation (Doudoroff, 1951; Lagler, 1969) indicates LC<sub>50</sub> values of approximately 235 ppm for both 24 and 48 hour exposure and therefore only the 48 hour graph is represented (Figure 1).

The actual physiological effects and mode of action of DEET on *Gambusia* are unknown. However, certain behavioral observations were made throughout the experiment. All fish appeared to become tranquilized in 1 to 3 minutes after the introduction of DEET. They exhibited no response to hand movements near the containers as did the control fish. Also, as the experiment progressed, pronounced equilibrium imbalance was noted at all concentrations. The fish rolled over, swam

tality for 0.05 ppm of malathion and 33 percent mortality for 0.004 ppm of parathion after 24 hours of exposure.

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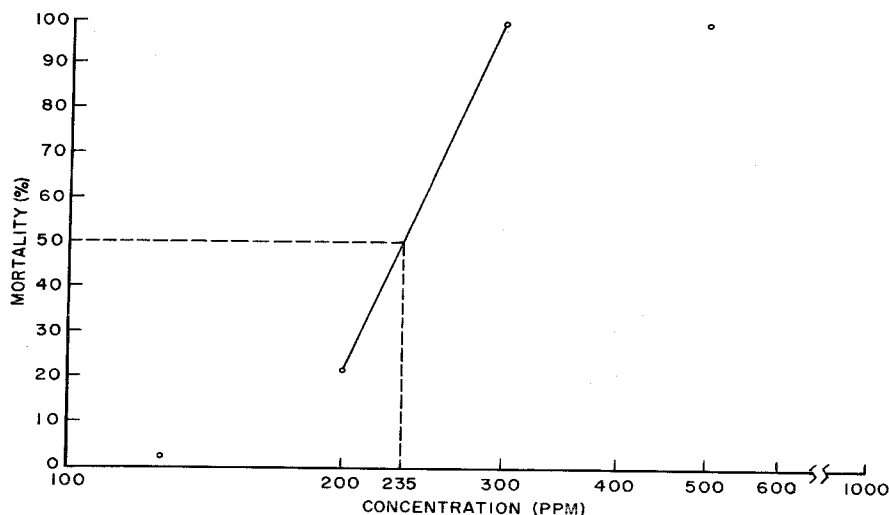


FIG. 1.—Straight-line graphical interpolation of the 48 hour LC<sub>50</sub> value for *Gambusia affinis* exposed to various concentrations of DEET.

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## ERRATUM

The article by Robert G. Means entitled "Preliminary Evaluation of the Effectiveness of Mosquito Beater,<sup>®</sup> a Granular Repellent, against Mosquitoes and Blackflies," which appeared in the December 1973 number (Vol. 33 No. 4, pp. 542-544) should have included the graphs shown on page 35.