FIELD TESTS WITH INSECTICIDES AGAINST MOUNTAIN 
Aedes LARVAE IN CALIFORNIA

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INTRODUCTION. The increasing use of mountainous areas for recreation is reflected in reports by many federal and state agencies concerned with the orderly development of recreational facilities. During recent years in California, the use of mountain recreation areas has greatly increased, with accompanying complaints of mosquito annoyance. The demonstration in valley communities that mosquito control can be satisfactorily achieved, has led to an expectancy on the part of the public for similar relief from mosquitoes in mountain recreational areas. An increasing need for mosquito control recommendations in such areas has been made apparent to the Bureau of Vector Control, California State Department of Public Health.

Previous studies in the Sierra Nevada Mountains of California indicated that oil was effective in eliminating mosquito breeding (Herms and Gray 1944). Roth et al. (1947) in Oregon and Rees and Nielsen (1952) in Utah found that DDT gave excellent reductions of Aedes broods, principally as a pre-hatch treatment. Since Hunt and Bischoff (1960) reported the presence of TDE in the fat body of fish and other wildlife in Clear Lake, California, after many years of nonexposure to the material, the use of such persistent compounds in close proximity to fish and other wildlife is looked upon with considerable disfavor by many groups.

Preparatory to investigating control measures in mountainous areas, studies were started several years ago on the distribution and ecology of the California mountain Aedes. The results of some of these studies are being reported by Carpenter (1961a, 1961b, 1962a, 1962b).

Preliminary studies on the relative effectiveness of some larvicides against mountain Aedes in recreational areas were begun in 1962. Organophosphorus and carbamate materials were selected for evaluation since they are less likely to create residue problems and generally present less hazard to fish and wildlife. Prior to field testing, all of the materials were evaluated as to their relative toxicity to rainbow trout fry in the laboratory (Lewallen and Wilder, 1962).

MATERIALS AND METHODS. The following materials were evaluated in the field tests: Bayer 24993 (Baytex)®, 4 lb./gal., emulsion concentrate; Parathion, 2 lb./gal., emulsion concentrate; Malathion, 5 lb./gal., emulsion concentrate; DDVP, 4 lb./gal., emulsion concentrate; Naled (Dibrom)®, 4 lb./gal., emulsion concentrate; Carbothion (Triton®), 4 lb./gal., emulsion concentrate; Hercules AC-5727, 15 percent, emulsion concentrate; Dydex®, 50 percent, soluble powder; Bayer 20403, 5 percent, sand core granule, 30 mesh; Parathion, 5 percent, Attaclay—AA LVM, 24–48 mesh; Malathion, 10 percent, Attaclay—AA LVM, 24–48 mesh; Carbothion, 25 percent, Attapulgite-RYM-A, 30–60 mesh.

The sprays were mixed by measuring the desired quantity of the emulsion concentrate or soluble powder into the spray can and making the final spray by adding ½ gallon of water. These liquids were applied with a 1-gallon portable, pressurized hand can equipped with a 4-orifice teejet nozzle set at the largest opening (#30015). Pressure was maintained at approximately 30 p.s.i. Granular formulations were applied with a horn seeder (Raley 1961). All dosages were replicated

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three times. Most plots measured 1/32 of an acre with a few up to 1/8 acre.

Twenty dips with a white-enamed dipper were taken at random within each plot prior to treatment and at 24 and 48 hours following application of the insecticides. The percent reductions were based on the difference in larval numbers dipped prior to and following treatments. Pretreatment and 48-hour larval samples were collected and identified to species in the laboratory. The following additional information was noted in each plot: depth and temperature of water at time of treatment, presence and survival of potential predators and other aquatic organisms, and stage of larval development. Maximum minimum water temperatures and pH readings were obtained for some plots.

An effort was made to select plots from a variety of habitats that contained different species of mosquitoes. The study areas were located on the eastern slopes of the Sierra Nevada Mountains in Mono County and Yosemite National Park at elevations ranging from about 7,000 to 8,700 feet. A great variety of habitats was used in these tests, ranging from the ideal situation of isolated, open-meadow pools with a minimum of vegetation, to semishaded areas with a moderate amount of seepage passing through the plots, to a contiguous body of deeper water with much emergent vegetation, such as that on a lake margin.

Table 1 shows the distribution of the 78 treatments in the 6 areas, the prevalence of the mosquito species, and the general habitat of each area.

All of the nine species of mountain Aedes reported from California by Carpenter (1961a) were present in one or more of the treated plots, with the exception of Aedes pulicarius (Coquillett). However, substantial numbers of the aquatic stages and several biting adults of the rare (in California) A. pulicarius were collected adjacent to the treated plots in the vicinity of Silver Lake in Mono County. Such a variety of habitats was present in the Silver Lake area, that larvae of all of the mountain Aedes species except A. ventrovarinus Dyar were collected within about a 3-mile radius.

<table>
<thead>
<tr>
<th>Area</th>
<th>No. of plots</th>
<th>Species present in order of prevalence</th>
<th>Habitat and remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mono County</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June Lake</td>
<td>7</td>
<td>incertipus, schizopinax, cataphylla, fitchii (Felt and Young)</td>
<td>Open, isolated, meadow pools</td>
</tr>
<tr>
<td>Silver Lake</td>
<td>4</td>
<td>incertipus, communis</td>
<td>Shaded pools in conifers with seepage through area</td>
</tr>
<tr>
<td>Gull Lake</td>
<td>31</td>
<td>incertipus, schizopinax, cataphylla</td>
<td>Open, marshy margin of lake with contiguous water areas</td>
</tr>
<tr>
<td>Mammoth Lakes</td>
<td>11</td>
<td>incertipus, cinereus (Meigen), schizopinax, hexadontus Dyar communis</td>
<td>Semishaded pools with seepage through many areas</td>
</tr>
<tr>
<td>Yosemite Nat'l Park</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenaya Lake</td>
<td>2</td>
<td>communis, hexadontus cataphylla, versicolor</td>
<td>Coniferous area</td>
</tr>
<tr>
<td>Tuolumne Meadows</td>
<td>23</td>
<td>cataphylla, ventrovarinus hexadontus, fitchii</td>
<td>Open-meadow pools with and without seepage</td>
</tr>
</tbody>
</table>
Aedes incipiens Dyar, A. cataphylla Dyar, and A. schizophrax Dyar were most often encountered in the plots selected for treatment. No clear-cut differences in species tolerance to the materials was noted. Variables such as water depth, vegetation, and water temperature make difficult to obtain such evidence in the field. Some plots contained as many as four species of mosquitoes, with larvae ranging from the first to fourth instar. It as necessary at times to treat plots that contained larvae which were predominately less than fourth instar since larvae of A. cataphylla, A. ventrostriata, and A. immix (DeGeer) were generally an star or more ahead of their companion species.

Data from the maximum-minimum thermometer indicated a low of 30° and high of 92° F. in the plots. The greatest dry temperature fluctuation in any one plot was 60° F. (32°-92° F.). A thin layer of ice was often present on the pools selected for treatment and it was necessary to delay dipping and spraying until the ice melted. The temperature was obtained just prior to treatment showed a great deal of variance which as due in part to the time of treatment (morning versus afternoon). The average temperature of a series of plots at June Lake treated during some cold weather was 41°F., whereas the water temperatures recorded during the treatment of a series of plots at Tuolumne Meadows averaged 74°F. Many of the materials appeared to be more effective when higher water temperatures prevailed, although other interrelated variables such as depth of the water, seepage through the areas, and the amount of emergent vegetation have to be considered. Some pH readings from plots in meadow pools and lake margins ranged from 6.5 to 6.7.

RESULTS AND DISCUSSION. The results of the treatments are shown in Table 2. Since increased reduction of larvae was invariably obtained from the 24- to 48-hour period following treatment, only the 48-hour control figures are given. Bayer 29493 (O,O-dimethyl-O[4-(methylthio)-m-toly!] phosphoro-thioate) was the most toxic compound tested, followed closely by parathion. Hercules AC-5727 (m-isopropylphenyl methylcarbamate), malathion, carboxphenothen (S-[p-chlorophenylthio] methyl)O,O-dimethyl phosphorothioate), and naled (1,2-dibromo-2,4-dichloroethyl dimethylphosphate) gave good control.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Pretreatment count</th>
<th>Percent control in 48 hours at indicated dosage expressed in pounds/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Av. no. larvae/dip</td>
<td>0.01 0.025 0.05 0.075 0.1 0.25 0.5 0.75</td>
</tr>
<tr>
<td>Sprays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bayer 29493</td>
<td>8.9</td>
<td>94    99  100  ...  ...  ...  ...  ...</td>
</tr>
<tr>
<td>Parathion</td>
<td>24.5</td>
<td>... 85  97  100  ...  ...  ...  ...  ...</td>
</tr>
<tr>
<td>Hercules AC-5727</td>
<td>27.7</td>
<td>...  ...  ...  ...  86  99  99  ...  ...</td>
</tr>
<tr>
<td>Carboxphenothen</td>
<td>21.9</td>
<td>...  ...  ...  ...  51  93  99  ...  ...</td>
</tr>
<tr>
<td>Malathion</td>
<td>19.0</td>
<td>...  ...  ...  ...  78  94  99  ...  ...</td>
</tr>
<tr>
<td>Naled</td>
<td>21.4</td>
<td>...  ...  ...  ...  60  95  97  ...  ...</td>
</tr>
<tr>
<td>DDVP</td>
<td>29.2</td>
<td>...  ...  ...  ...  80  80  94  ...  ...</td>
</tr>
<tr>
<td>Dylox @</td>
<td>45.4</td>
<td>...  ...  ...  ...  ...  ...  80  ...  ...</td>
</tr>
<tr>
<td>Granules</td>
<td></td>
<td></td>
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<tr>
<td>Bayer 29493</td>
<td>17.8</td>
<td>... 98  ...  ...  ...  ...  ...  ...</td>
</tr>
<tr>
<td>Parathion</td>
<td>13.9</td>
<td>... 98  ...  ...  ...  ...  ...  ...</td>
</tr>
<tr>
<td>Carboxphenothen</td>
<td>14.4</td>
<td>...  ...  ...  ...  ...  ...  98  ...  ...</td>
</tr>
<tr>
<td>Malathion</td>
<td>18.6</td>
<td>...  ...  ...  ...  ...  ...  65  ...  ...</td>
</tr>
</tbody>
</table>
References Cited

Carpenter, S. J. 1961a. Observations on the distribution and ecology of mountain Aedes mosqui-


———. 1961b. Observations on the distribution and ecology of mountain Aedes mosquitoes in


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(93% or better) at 0.25 pound/acre whereas DDVP was somewhat less toxic

at this dosage. Dylox ® (dimethyl 2,2,2-

trichloro-1-hydroxyethylphosphonate) was

the least toxic of all the materials tested

against the mountain mosquitoes.

Granules appeared to be less effective

than the sprays, although the data obtained

are based on only one dosage of granules.

Incomplete distribution of granular ma-

terials with the horn seeder may have been

a factor. Excellent distribution and covering

of the plots was obtained with the

liquids.

Our observations indicated a good sur-

vival of potential predators such as
dytiscid and hydrophilid adults and larvae,
dragon and damsel fly naiads, caddis fly

larvae, and planaria. Nonpredators, such

as mayfly naiads and chironomid larvae

were apparently not affected by most of

the materials. Fairy shrimp were com-

pletely eliminated by most treatments.

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