FABRICATION OF ARTIFICIAL TREEHOLES AND THEIR PERFORMANCE IN FIELD TESTS WITH *AEDES SIERRENSIS AND ORTHOPODOMYIA SIGNIFERA*[1]

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ABSTRACT. In 1975, the western treehole mosquito, *Aedes sierrensis* (Ludlow), infested all 6 fabricated treeholes in an egg-laying test; and another treehole mosquito, *Orthopodomyia signifera* (Coquillett), also infested the 5 holes that had continuous standing water in them. In 1976, both *Ae. sierrensis* and *Or. signifera* infested all of the 8 holes in an egg-laying test. Oviposition in the holes by *Ae. sierrensis* began in late April 1976, peaked in May, and continued through September 27; oviposition by *Or. signifera* began in late May, peaked in August, and continued through September 27.

In studies involving the biology or control of mosquitoes that breed in treeholes, the investigator usually encounters difficulties in locating adequate numbers of similar sized, easily accessible, naturally occurring treeholes in the same species of tree. Also, the investigator is confronted with differing incidences of many potentially significant variables such as direct sunlight, water quality, and established disease-producing organisms. This situation notwithstanding, few or no practical alternatives have been worked out to minimize or alleviate such variables. However, on consideration, the problem appeared amenable to attack with the resources available and also was of sufficient importance for distributional, biological, and control studies to warrant investigation.

We decided to start with modifications of the fabricated wooden containers used by Lewis and Christenson (1975). These containers were at first put together with wood screws and marine glue, and though the glued joints were satisfactory, the boards themselves tended to crack deeply or split completely along their full lengths. As a result, cracks had to be closed with steel bands that then prevented troublesome new cracks. We concluded that containers would be less difficult to construct if bands alone held them together and gaskets were inserted between the abutting surfaces to make them watertight.

Fabrication procedures and some of the data from limited field tests with the resultant artificial treeholes are reported here.

Materials and Methods. All boards except tops and bottoms were 5.08-cm(2-in)-thick Douglas fir.[3] Both edges of each 5.08-cm-thick board were double beveled with a table saw at angles of 45°(Fig. 1, A). The beveled surfaces were not planed or otherwise smoothed.

Bottoms and tops of containers were made of 1.27-(½ in.) or 1.90-cm(¾-in.)-thick Douglas fir outdoor plywood cut to fit the outlines of the assembled sides, Fig. 1, B and C. The bottoms were fastened on with wood screws or lag screws. Each top had a 5.08-cm-diameter hole in it and was hinged to the container with a short length of webbed strapping. Except when a hole was being delved into, its top was kept closed.

The bands used were made with

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[3] Most dimensions of construction lumber and materials given herein came verbatim from merchants' specifications in inches. We converted inches to the metric system which often resulted in awkward fractions.

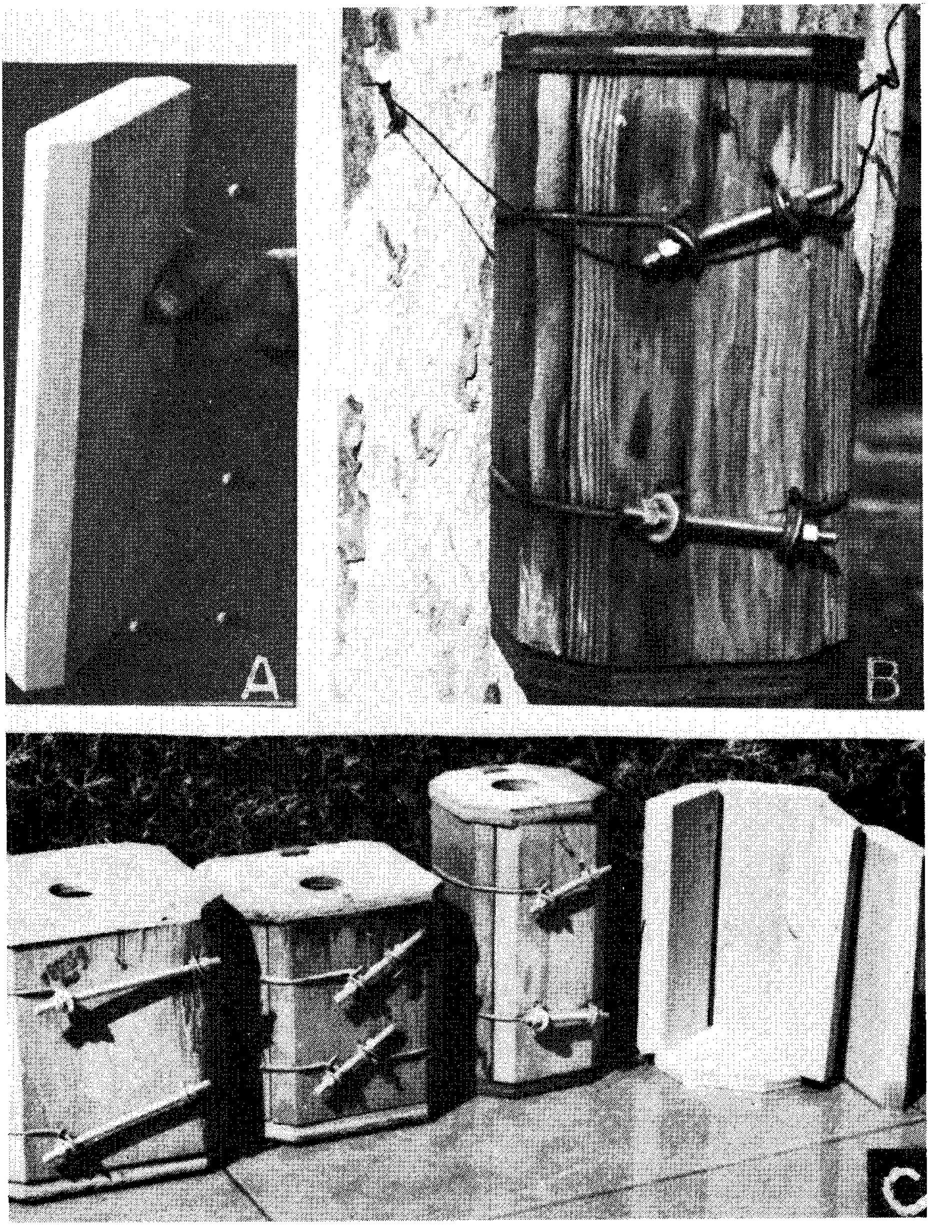

Fig. 1. Examples of artificial treeholes used in this study with details of their assembly.

6-gauge (4.76-mm-diameter) galvanized steel wire with loops in each end that were fashioned with a light sledge and a heavy shop vise. Tension on the bands was obtained by tightening the nuts on bolts (14.29 mm in diameter) inserted through the loops (Fig. 1, B and C). Two bands were used for each container.

In 1975, the containers were assembled with gaskets of either sheet rubber or silicone seal between the abutting surfaces. Three thicknesses of rubber sheeting (ca. 0.794 mm, 1.588 mm, and 3.175 mm) and both clear and white silicone seal (also sold as "silicone glue and seal," and as "silicone calk and seal") were used. In 1976 only silicone seal was used (in a calking gun) for gaskets.

In addition, in 1975, a diverse series of floating devices (referred to hereafter as ovisites) were employed as aids in detecting oviposition. Most were formed with cork sheeting or plastic tubing wrapped in cloth and plastic insect screen. In 1976, the ovisites (ca. 5 cm by 7.6 cm) were made of wood abutted with strips of cork sheeting over which thin, grooved layers of balsa wood were stapled. The degree of buoyancy of each device was adjusted with the cork sheeting so it floated at a level that kept the balsa wood moist but not covered with standing water.

Weekly in both years, the ovisites in the holes were exchanged for fresh ones, and those that had been exposed were brought into the laboratory and examined for eggs with a dissecting microscope. Water and alfalfa pellets were added to the holes as needed.

Several sizes of artificial tree holes were tested in 1975 and 1976. These included square containers made with board widths of 15.25 cm (6 in.), 20.32 cm (8 in.) or 25.40 cm (10 in.), Fig. 1, C. Others were rectangular with end boards 15.25 cm wide and side boards either 20.32 cm or 25.40 cm wide. The 20.32 cm sq and 25.40 cm sq containers were 25.40 cm deep, all others referred to were 30.48 cm deep.

In 1975, we began field observations on March 31 with 6 square (boards 15.25 cm wide) artificial holes attached to tree trunks, Fig. 1, B, in the vicinity of the Kings River from near Piedra, Fresno County, California, to about 4.83 km (3 mi.) upstream. The test area contained populations of both *Ae. sierrensis* (Ludlow) and *Or. signifera* (Coquillett). Additionally, the water retention properties of all the different sized containers and gaskets of the different materials and thicknesses were studied on our laboratory grounds. Ten containers were used in that portion of the study.

In 1976, field observations began on March 15 when 8 rectangular containers were attached to tree trunks in the upper portion of the 1975 Kings River study area. All containers had ends 15.25 cm wide, 7 had sides 20.32 cm wide, and one had sides 25.40 cm wide. Bottoms were fastened on with lag screws. Alfalfa pellets again were used as larval food.

Containers in 1975 were attached at various heights to the trunks of oak, sycamore, and California buckeye trees; in 1976, to avoid molestation by livestock, containers were attached about 2.13 m (7 ft) above ground level to the trunks of oak, sycamore, and cottonwood trees.

RESULTS AND DISCUSSION. In 1975 the first eggs were observed on ovisites on May 20. Thereafter, eggs on ovisites were observed at each weekly examination through August 6.

Throughout 1975, the ovisites, wrapped in plastic insect screen, attracted *Ae. sierrensis*, but no design lent itself to the quantification of oviposition. Eggs of *Or. signifera* were not seen even though larvae and pupae of that species were observed in the holes. *Ae. sierrensis* was adept at concealing eggs within the screen covering on the ovisites, and *Or. signifera* apparently preferred a different type of surface for egg deposition.

Weekly examinations ended on August 20 when oviposition had apparently reached a negligible level. One fabricated hole was dry when collected on November 13; the other 5 contained 2nd - through 4th-instar larvae of *Or. signifera* but none of *Ae. sierrensis*. However, the addition of water to all holes caused hatch of *Ae. sier-*

rensis in 3 of the 6, including the one that had been dry. Subsequently the 3 holes without *Ae. sierrensis* larvae were drained, dried, and then reflooded, which triggered the hatch of *Ae. sierrensis* in them also. Thus, in one season, all holes became infested with viable eggs of *Ae. sierrensis*. Also, all holes with constantly standing water became infested with larvae of *Or. signifera*.

In addition to mosquitoes, various holes harbored the following: Larval populations of *Culicoides* (Diptera: Ceratopogonidae); moth flies (Diptera: Psychodidae); some calypterate Diptera; fungus gnats (Diptera: Mycetophilidae) and rat-tailed maggots (Diptera: Syrphidae); all stages of rove beetles (Coleoptera: Staphylinidae), and springtails (Collembola); and adults of foraging ants (Hymenoptera: Formicidae) and tree frogs (Anura: Hylidae).

On the laboratory grounds, observation on different sized holes in various types of environments revealed that water loss per day was influenced primarily by the size of openings in the covers and by the hours of exposure to direct sunlight rather than by container size. No differences were observed in the waterproofing qualities of the various thicknesses of rubber sheeting and silicone seals.

In 1976, containers were put out on March 15. Eggs of *Ae. sierrensis* were first noted on April 29 and at each subsequent weekly examination through September 27. During the ovipositional season, eggs were observed on 146 of the 168 ovisites examined. Altogether 10,694 *Ae. sierrensis* eggs were observed, and weekly totals from the 8 containers ranged from 3,230 on May 21 to 13 on September 27. Monthly totals, April through September, were, respectively, 173 (1.6%), 6,726 (62.9%), 2,022 (18.9%), 906 (8.5%), 511 (4.8%), and 356 (3.3%). Cumulative counts of *Ae. sierrensis* eggs on ovisites from individual containers were 2,441, 2,271, 1,987, 1,334, 1,079, 683, 511, and 388. We could not account for the rather large variation in numbers.

A total of 2,281 unhatched eggs of *Or. signifera* were observed on the ovisites, the first on May 28, the last on the final day of field observations, September 27. Monthly totals, May through September, were, respectively, 9, 172, 413, 1,246, and 441. Unhatched eggs were noted from 7 of the 8 containers, but eggs that had previously hatched were observed on ovisites from all holes. No attempt was made to count the eggs that were hatched when the ovisites were collected. The incidence of oviposition by each species appeared to be independent of oviposition by the other. The hole with the largest number of *Or. signifera* eggs had the smallest number of *Ae. sierrensis* eggs, but the hole with the largest number of *Ae. sierrensis* eggs had the second largest number of *Or. signifera* eggs.

When the containers were collected on September 27, larvae and pupae of *Or. signifera* were present in 7 of the 8; but unhatched eggs on ovisites from the 8th hole had been observed on more than one occasion. No larvae or pupae of *Ae. sierrensis* were observed on September 27, but the addition of water to the holes resulted in hatch of *Ae. sierrensis* in one container. Later, all containers were drained, dried, and refilled with tap water, which resulted in the hatch of larvae of *Ae. sierrensis* in all holes. Thus in 1976, viable eggs of both *Or. signifera* and *Ae. sierrensis* were deposited in all 8 holes.

In this investigation, then, the local species of treehole mosquitoes readily oviposited in fabricated containers throughout significant portions of 2 seasons. Wherever, and with whatever species this pattern can be replicated, artificial treeholes should be useful devices for obtaining information about seasonal activity.

References Cited

Lewis, L. F., and D. M. Christenson. 1975. Residual activity of temephos, chlorpyrifos, DDT, fenthion, and malathion against *Aedes sierrensis* (Ludlow) in fabricated treeholes. Mosquito News 35(3):381–384.