VERSATILE MOSQUITO TRAP

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DESCRIPTION. The trap (Figures 1 and 2) is a modified version of the double-baited cage trap described by Worth and Jonkers (1962). It consists of a wire frame and eight rods; a removable two-tone net bag with no rigid parts; and a water repellent black cloth roof sandwiched between two wooden slats supporting a dry ice container. With a zipper or sleeve on the bag it is possible to insert a brace so other attractants such as heat, odors, and suckling mice can be used. The trap weighs four pounds without dry ice. When not in use the empty net bag, rods and brace can be rolled up inside the roof, and the wire frames "nested" to save space.

OPERATION. The trap can be assembled quickly. Slip the tops of the wire frame between the slats and tighten wing nuts near groove. Place the funnel end of the bag over the spokes of the frame. Slip the rods through the cloth strips on the bag so that their ends rest on the outside of the frame. Tie the drawstring that holds the roof down, add the dry ice and hang the trap. If other attractants are used, place them and the brace in the trap after all rods, except the 24″ rod by the zipper or sleeve, are in place, then continue as above.

When in use the trap turns slowly with the least breeze, and movement is discernable because of the shape of the trap. The shiny dry ice container repels heat, and in combination with the black roof attracts mosquitoes. They rest on the outside of the trap, especially the drab-olive part, and fly about underneath, but soon follow the CO_2 gradient up the funnel, through the entrance, then fly immediately toward the light-colored sides of the bag, but eventually rest on the ceiling and elsewhere, seemingly content and unaware of the CO_2.

The net bag of mosquitoes can be easily and quickly removed from the frame. Release the drawstring and remove the two rods on the bottom of the trap. Then reach up the funnel and gather the entrance shut, pull it down a little between the spokes and attach a rubber band. If additional attractants were used, remove the 24″ rod by the zipper or sleeve and take the equipment out of the bag. Remove the remaining rods and the bag of mosquitoes is free to be put in a chill box or fumigating bag. After inactivating the catch, remove the rubber band and pick the bag up at the top so the funnel drops, and the mosquitoes fall out.

FABRICATION AND SPECIFICATIONS. The frame, rods, and brace are galvanized hard drawn steel wire #8 American standard gauge. For frame shape and dimensions see Figure 2. There are also two rods of each length—14″, 18″, 24″, and 26″. The

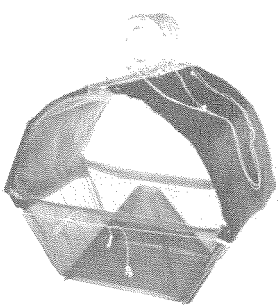


FIG. 1.—Photograph of "Versatile Mosquito Complete Trap."

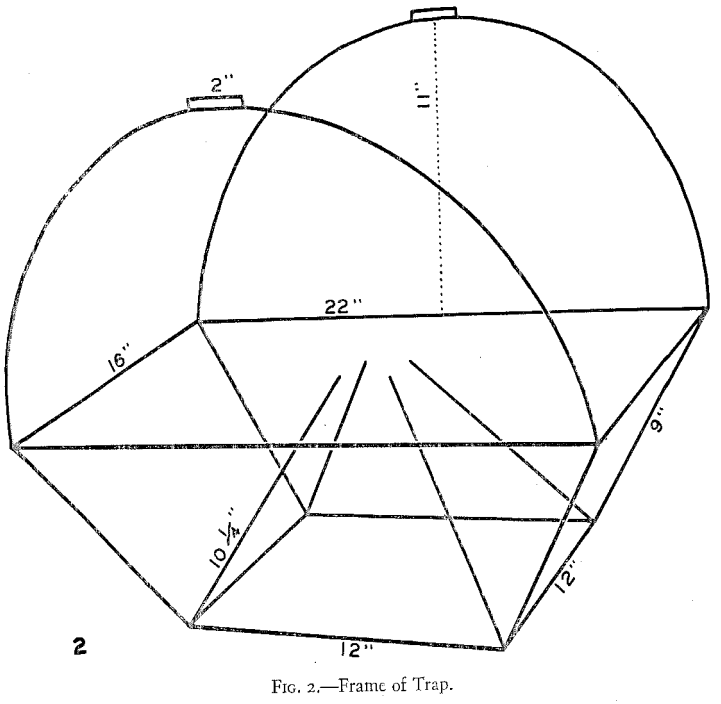


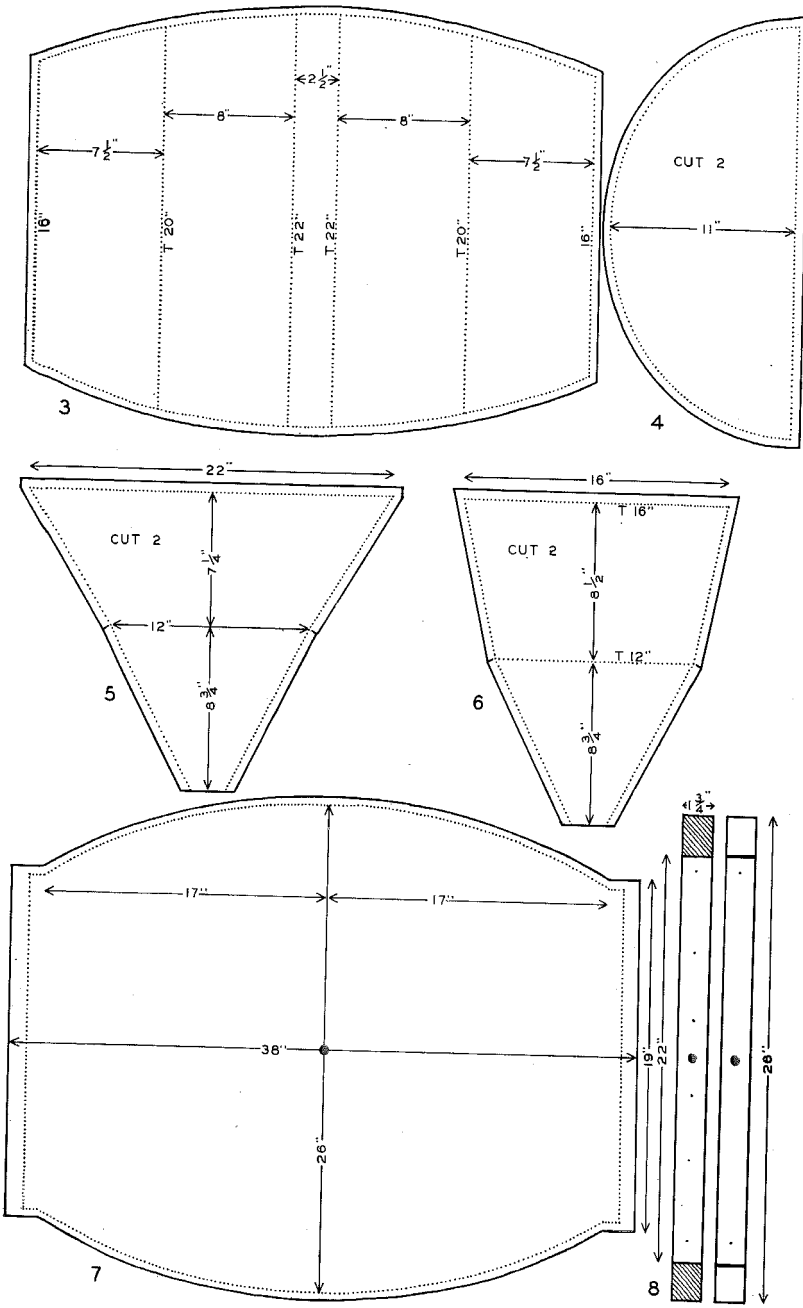
FIG. 2.—Frame of Trap.

brace is 4½" x 22½", with the long wires on top extending ½" beyond the cross wires. These ½" ends fit into tiny pockets on the net bag, which rest on the frame when the trap is in use.

If additional attractants are not to be used, the zipper or sleeve, and tiny pockets can be omitted. In Figure 1, the location shown for a zipper or sleeve is unsatisfactory because it is difficult to insert the brace at an angle. The best location is by T20 in Figure 3.

The upper part of the mosquito bag, Figures 3 and 4, is off-white nylon netting with about twenty holes per inch, and the lower part, Figures 5 and 6, drab-olive cotton netting used for tent doorways, etc. The cloth strips for the rods are nylon 2" wide and as long as indicated by "T" on Figures 3 and 6. A half-inch is allowed for seams on the netting and all seams are on the *outside* of the finished bag.

In assembling the bag, fold back the ends of the nylon strips ¼" toward the outside, to facilitate insertion of the rods when the trap is being used. Fold the strips lengthwise and stitch ⅜" from the fold, then ⅜" from that stitching sew to the netting where indicated by "T" dotted lines on Figures 3 and 6. This provides twin "tunnels" for each rod, allowing some adjustment so the bag will fit the frame properly. Install the zipper or sleeve. To make the brace pockets on the 16" ends of the three pieces of netting, sew two pieces of tape (1" x 1½") along their 1" side, to the inside surface at the seam line, each 1¾" from the center. Fold the tapes at the stitching so they extend out. Sew the four drab-olive pieces to the three off-white pieces skipping the tapes. Then sew the tapes together around their margins to form the tiny pockets. Sew the three big sections together and clip the seams where indicated on Fig-



FIGS. 3–8. Pattern for Trap.

ures 5 and 6. There is no hem at the end of the funnel, so the 2″ x 2″ entrance-exit hole is as smooth and inconspicuous as possible.

The roof pattern, Figure 7, allows for side hems, making a neater and more serviceable finish than that shown in Figure 1. To facilitate assembling the trap in the field, the under surface, at the ends of the upper slat, Figure 8, is shaved off to more than compensate for the thickness of the cloth which is stapled there. A drawstring passes through the wide hem at each end of the roof. The dry ice container consists of a 1-lb. coffee can inside a 2-lb. can with insulation between. A 2″ length of 9/16″ OD rubber tubing passes through the ½″ hole midway on the side of both cans and through the 9/16″ hole in the slats and black cloth. The large can, bolted to the upper slat, is covered with crinkled aluminum foil.

Using heat as an attractant, or in conjunction with other attractants or suckling mice, requires the attachment of a platform to the top of a hand warmer (Joné, giant size) to hook across the brace. The platform is sheet aluminum 5″ x 3″ with the corners clipped off and a ¼″ right angle bend along the 3″ ends. A cloth bag, like the one accompanying the heater, is needed for application of each attractant. For use with sentinel mice the heater platform is covered with a nylon cloth having a drawstring through the side hems.

DEVELOPMENT. During June and early July of 1963 several CDC miniature light traps, developed by Sudia and Chamberlain (1962), were tested here in the Cook Inlet area of Alaska, along with a double-baited cage trap, slightly modified from that described by Worth and Jonkers (1962). A single removable slat spanned the top of the arches so the trap was free to turn. Muslin or burlap was substituted for metal window screen on the bottom, and water repellent blackout cloth or semi-transparent plastic sheeting (visqueen) was used instead of sheet metal for a roof. White mice with suckling young were the bait.

All traps were set in the afternoon, visited occasionally during the night, and picked up before 10:00 a.m., except for a few daytime trials. The mosquitoes flew about and landed on the traps but very few went in. Some even landed on the underside of the light trap lids within an inch or two of the center, then flew off. During the peak of the mosquito season, at this latitude (approximately 61° N) it does not get dark at night, which may partially explain why the light traps were ineffective. Still fewer mosquitoes, occasionally none, entered the double-baited cage traps, especially those with a visqueen roof.

In mid-July, after the peak of the mosquito season, some of the CDC traps were temporarily altered for use with dry ice as the attractant (Bellamy and Reeves, 1952). The hood support bracket, light bulb, and trap lid were removed. A substitute bracket about three inches longer was attached to the underside of a temporary lid with an inverted styrofoam bowl and cover on top at the center. A 3-lb. chunk of dry ice under the bowl furnished CO_2 that escaped through four holes near the center of the cover and lid. Three of these modified CDC traps were used for the remainder of the 1963 trapping season, and in 1964, along with one to three unaltered CDC light traps. Those with dry ice consistently captured many more mosquitoes than those with lights.

There were several disadvantages to these three kinds of traps used in 1963 and 1964 besides the fact that two of them captured very few mosquitoes. The turning of the double-baited cage traps, intended to attract mosquitoes, was occasionally detrimental. Sometimes when a mosquito entered, the entrance slot turned to intercept its flight path as it descended, and out it went. Also, while the few captured mosquitoes were being removed on the spot, individually with an aspirator,

many mosquitoes outside the trap fed eagerly on the collector. The mosquitoes in the trap could not bite the suckling mice because the mother tucked them under her to keep them warm. When used without a mother, the suckling mice died of exposure. "Nesting" the trap frames wore holes in the muslin or burlap. The batteries of the CDC traps are heavy and cumbersome, need daily care, and occasionally the acid got on clothing. If the motor stopped, or the propeller dropped off, the trapped mosquitoes, attracted by the CO_2 gradient and the light, escaped through the cylinder. The propeller drew in fog and mist along with mosquitoes, some of which were injured by the propeller or wind, and others died stuck to the moist bottom of the bag.

In the summer of 1966 the trap shown in Figure 1, was designed to overcome the difficulties mentioned above, and to combine, in a simple non-mechanized trap, the use of various mosquito attractants such as CO_2, movement, contrasting colors, heat, odors, and suckling mice. The traps were tested when the mosquito population was declining but those with dry ice consistently captured more live mosquitoes than the nearby CDC traps likewise baited with dry ice. Unfortunately it is not economically practical to use dry ice as an attractant in mosquito traps here in Alaska where it can be obtained only in the larger cities, and costs 22¢ or more a pound.

The end of the mosquito season terminated preliminary work with other attractants. As mentioned earlier, however, some equipment and techniques for use with this trap were devised. Substances such as Lanlay (an oil extracted from wool), oil from the gland at the base of a bird's tail, blood, sweat, etc., were applied to the hand warmer bags. Some substances attracted unwanted insects. Of course heat alone is attractive to mosquitoes, and they probed even clean flannel bags and were very persistent and reluctant to leave.

In these field studies in the Cook Inlet area white mice have not been attractive to mosquitoes, so techniques for their use as sentinel mice were explored. Three pieces of wool jersey 3″ x 3½″ were folded over one-third of the way on each side and pinned at one end to the hand warmer platform covers. A suckling mouse was placed in each "blanket" and the other end pinned down. The mouse could move but not roll over and kill or injure the mosquitoes when they bit. The double layer kept the mouse warm on top and the single layer underneath allowed the heat to penetrate. The mice survived 18 hours of such "exposure" to mosquito bites, and this unnatural treatment. If the equipment used in the trap bag is not paired, it is necessary to weight the trap for balance by tying a small stone etc. to the bottom of the frame.

DISCUSSION. In Trinidad, Worth and Jonkers (1962) took almost two thousand mosquitoes in a single setting of their double-baited cage trap, which was essentially the same size as this trap. They mentioned the importance of the relation between trap size and amount of CO_2 or other emanations of the bait. Newhouse *et al.* (1966) have also shown that dry ice greatly increases the efficiency of the CDC miniature light traps when used in the southern United States. The trap described above has not been tested when mosquitoes were available by the thousands, but on the basis of the above comments and the results obtained with this trap when operated simultaneously with CO_2-baited CDC traps here in Alaska, it seems likely that this trap, in its simplest form, with only CO_2, would function well at lower latitudes. It may be useful for experimental work with attractants, or for studies involving suckling mice. When an inexpensive attractant as good or better than dry ice is discovered, then mosquito investigations involving the use of non-mechanized stationary traps may be economically feasible at this latitude.

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and wooden parts of the duplicate traps, and Mr. Gerald Kelly for the photographic work.

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A LOW COST AIRBOAT FOR USE IN MOSQUITO CONTROL [1]

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Orange County Mosquito Abatement District

The Orange County Mosquito Abatement District, consisting of 777 square miles, has approximately 450 square miles of this area under surveillance and treatment. In this area there are abandoned sand and gravel pits used for holding waste water. These pits cover approximately 5 to 10 acres each, and are from 40 to 50 feet deep. The location of these pits eliminates the possibility of larviciding by hand or power equipment.

In addition to the above sources, there are natural depressions, earthen dams and other low areas that are filled with rainwater during the winter months. With normal rainfall, about 16 inches per year, these sources hold water well into the summer months. We have 131 such rainfilled depressions with a total area of 186 acres. Many of these depressions are too deep to walk, and inaccessible to conventional equipment.

The District has a 6-foot dinghy which is used for making inspections but is inadequate for larviciding due to its small size and capacity. The use of airboats in mosquito control is not new; however, after seeing "Brian's Breezy Bathtub," [2] it was felt that such a boat could be adapted to Orange County problems. Figure 1 shows the Orange County adaptation in operation.

Controlled Airstreams, Inc. was contacted for information on portable air thrust units. This company constructs air thrust units primarily for fire fighting (foam), smoke removal and controlled burning. Their larger machines are used to create hurricanes, wind or sand storms for the movie industry. In addition to the above units, this company markets the McBride Air-thrust Portable Power Unit for small boat propulsion. The 24" unit (priced at $240.00) is the one used by Orange County Mosquito Abatement District at present. The advantages of an air thrust unit over traditional propelling methods are:

1. Economy that can't be beat because the engine is capable of operating 45 minutes at full throttle on only 1½ quarts of fuel. Therefore, if you should, for instance, average 8 miles per hour, you would travel 6 miles on 1½ quarts of fuel.
2. Increased maneuverability to the extent that you can spin a perfect 360 degree circle, and shift into reverse by rotating the unit 180 degrees, which lets the harmless airstream expend its energy over the bow without any discomfort to you or passengers.
3. Elimination of shoring problems, shear-

[1] Presented at the 1967 Joint Annual Meeting of the American and the California Mosquito Control Associations, at San Francisco, California, February 8, 1967.

[2] Controlled Airstreams, Inc., 1734 W. El Segundo Blvd., Gardena, California.