Journal of the Lepidopterists' Society
48(4), 1994, 373–380

A SIMPLE PORTABLE TRAP FOR MIGRATING BUTTERFLIES

THOMAS J. WALKER
Department of Entomology and Nematology, University of Florida,
Gainesville, Florida 32611, USA

AND

JAMES J. WHITESELL
Department of Secondary Education, Valdosta State University,
Valdosta, Georgia 31698, USA

ABSTRACT. An economical, easily built, 4-m wide trap for migrating butterflies was developed and tested. Made of thin-walled electrical conduit, nylon rope, and polypropylene netting, a "simplex" trap can be erected or taken down quickly, rolled into a compact bundle, and carried by one person.

Additional key words: migration, *Phoebis sennae, Agraulis vanillae,* Florida.

Migrating butterflies are peculiarly subject to trapping because they generally fly in a straight line near the ground, and upon encountering an obstacle, they attempt to fly over it rather than change directions. Starting in 1975, a series of traps was developed that took advantage of this behavior (Walker 1978, 1985b, Walker & Lenczewski 1989). These were used to monitor butterfly migrations in the southeastern United States (Walker 1985a, 1991, Walker & Riordan 1981, Lenczewski 1992).

Since 1986, one of us (JJW) has headed a project to promote the study of butterfly migration by high school science students throughout Georgia. A major goal of these studies has been to mark and release migrating *Phoebis sennae* (L.) (Pieridae) and *Agraulis vanillae* (L.) (Nymphalidae) in hopes of documenting their migration routes and distances. As an adjunct to this project, we worked together to develop a trap that was economical, easy-to-build, and effective. We succeeded in satisfying these criteria with a "semi-portable" trap that had a rigid 3.4 × 3 × 1.3 m frame of lumber and metal tubing (Walker & Whitesell 1993) but soon discovered that such traps, when used on high school grounds, were often vandalized or totally destroyed at night or over weekends. We therefore added the criteria that the traps had to be easily erected, taken down, and moved in and out of school buildings.

METHODS

An earlier trap was portable (Walker & Lenczewski 1989) but erecting it involved setting and adjusting eight guy ropes and took up to an hour. Furthermore, building it required difficult sewing, sheet metal work, and cutting and riveting hardware-cloth cages. We conceived, built, and tested a series of much simpler portable traps that shared these features: (1) end supports of just two lengths of thin-walled electrical conduit (EMT), held together by a single eyebolt near the top (permitting the ends to scissor shut when the trap was taken down), (2) the EMT supports of the trap were connected by 4-m lengths of 3.2 mm braided nylon rope, including one 2 m above ground level and two ≈5 cm apart at the eyebolt, (3) the trap was covered with polypropylene netting glued to the EMT frame and around lengths of rope with silicon caulk, (4) erecting the trap involved opening and positioning the end frames and putting the connecting ropes under tension with a guy attached at each end to the eyebolt (Fig. 1A & B), (5) trapped butterflies were retained in the triangular duct at the top of the trap rather than passing into hardware-cloth holding cages. We called these traps "simplex" traps and built and tested six types.

Five designs of end frames were tested—three sizes of "A-frames" and two sizes of "oblique frames" (Fig. 1C). For convenience, the designs were named by the lengths of the end-frame members expressed to the nearest meter. In pilot tests in fall of 1991, the 3×3 and the 3×5 designs proved inefficient.

The remaining three designs were compared 17 Sep to 21 Oct 1992 with each other and with two permanent traps that had been in service since 1984 (Walker 1985b, 1991). The 5×5 and 4×6 traps were covered with black, nearly invisible, polypropylene netting (≈8 × 10 mm mesh, Tenax Ornex SM®). Two 4×4 traps were tested, one with the black fabric and one with orange, daylight-fluorescent, polypropylene netting (≈6 × 6 mm mesh, Tenax Plurima®). The four traps were set in random order facing NNW in a line beginning at the west end of the permanent traps. The order was rerandomized after each quarter of the migratory season, with the restriction that each trap would occupy each position only once. Traps were serviced every one or two days. Catches by the simplex traps were compared by ANOVA. The permanent traps were excluded from the ANOVA because there was no control for position effects.

RESULTS

For neither *P. sennae* or *A. vanillae* were the numbers caught in the four simplex traps significantly different (P=0.08 and 0.85). For both species the greatest total numbers were caught in the 4×4 black trap (80 and 32) and the least in the 5×5 trap (33 and 25). The total catch *per meter* of simplex trap was 14.2 and 7.7 (*P. sennae* and *A. vanillae*) and, of permanent trap, 17.0 and 31.3.

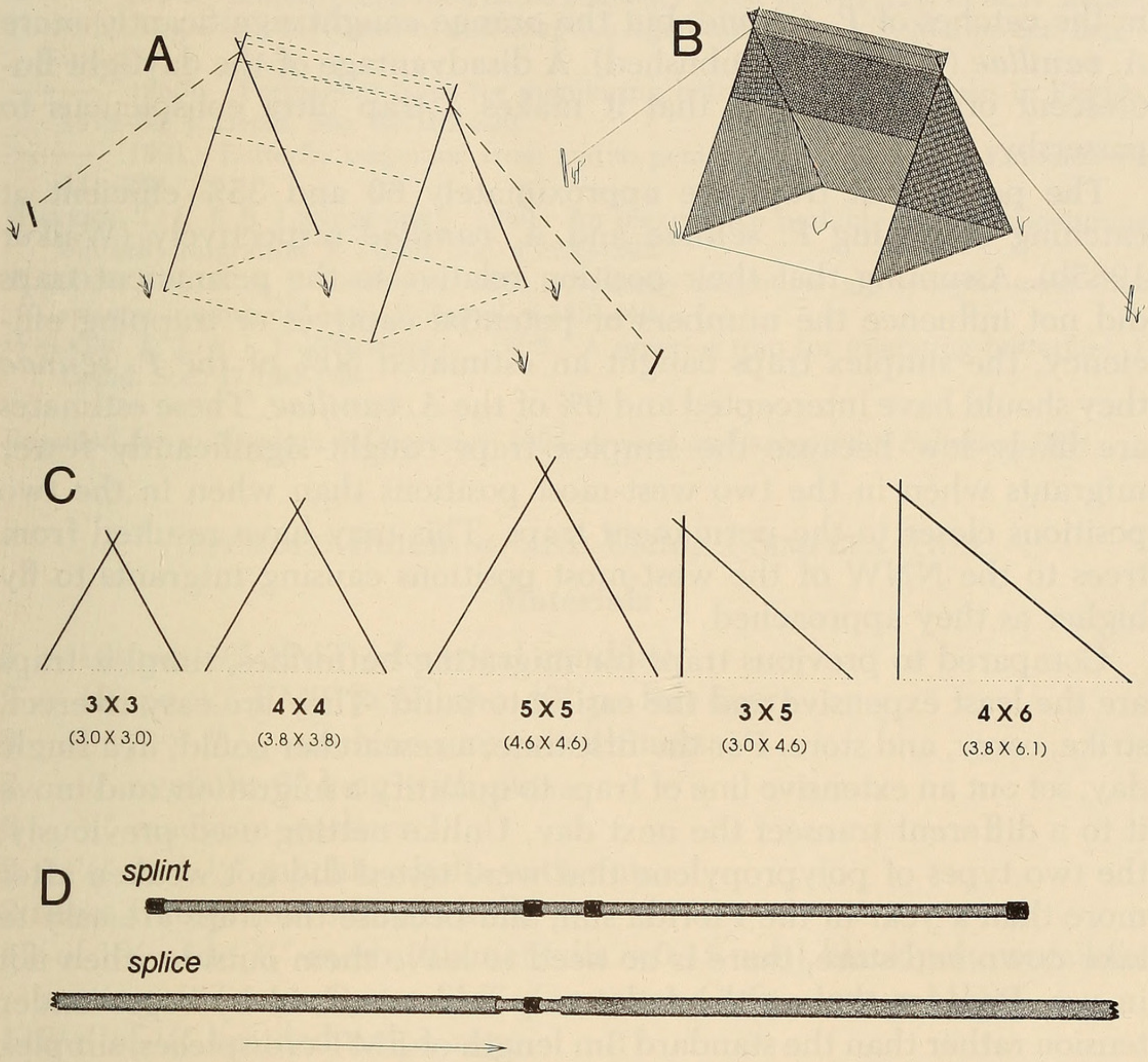

FIG. 1. Portable butterfly trap. A. Frame of simplex trap constructed of EMT (solid lines) and braided nylon rope (dashed lines). B. Same trap covered with polypropylene netting. C. End frame configurations that were tested, with EMT lengths, in m, below. D. Technique for splicing two lengths of EMT. Splint is 40″ piece of ½″ EMT with wrappings of tape in four places. Splice is made by sliding pieces of ¾″ EMT over splint.

DISCUSSION

Of the simplex designs tested, we recommend the 4 × 4 traps because they caught as many or more *P. sennae* and *A. vanillae* as larger, harder-to-build-and-service designs. Using the directions included in the appendix of this paper, Georgia high school students and their teachers have built and put in service at least 15 4 × 4 simplex traps.

The orange polypropylene netting was tested in hopes that it would be a magnet to *P. sennae*, which stops at red flowers (and red taillights in parking lots). It actually caught fewer *P. sennae* and *A. vanillae*, but not significantly fewer. A comparison of the two fabrics on a pair of semi-permanent traps likewise failed to reveal a significant difference in the catches of *P. sennae*, but the orange caught significantly more *A. vanillae* (Walker, unpublished). A disadvantage of the daylight fluorescent orange fabric is that it makes a trap ultra conspicuous to passersby.

The permanent traps are approximately 60 and 35% efficient at catching migrating *P. sennae* and *A. vanillae* respectively (Walker 1985b). Assuming that their position relative to the permanent traps did not influence the numbers of potential captives or trapping efficiency, the simplex traps caught an estimated 50% of the *P. sennae* they should have intercepted and 9% of the *A. vanillae*. These estimates are likely low because the simplex traps caught significantly fewer migrants when in the two west-most positions than when in the two positions closer to the permanent traps. This may have resulted from trees to the NNW of the west-most positions causing migrants to fly higher as they approached.

Compared to previous traps for migrating butterflies, simplex traps are the least expensive and the easiest to build. They are easy to erect, strike, carry, and store. For the first time, a researcher could, in a single day, set out an extensive line of traps to quantify a migration, and move it to a different transect the next day. Unlike netting used previously, the two types of polypropylene that were tested did not weaken after more than a year in the Florida sun; and because the traps are easy to take down and store, there is no need to leave them outside when not in use. Because the width of the trap is determined by ropes under tension rather than the standard 3m length of EMT crosspieces, simplex traps can take advantage of the full 4 m width of the fabric, increasing the reach of the trap by 33%.

The most serious disadvantage of simplex traps is that they are substantially less efficient in catching *A. vanillae* than the semi-portable traps. Lacking a valved catching cage, simplex traps must be serviced at 1 or 2-day intervals or captured butterflies will escape. Finally, the ease with which they can be taken down means that simplex traps are easily stolen (if left up).

ACKNOWLEDGMENTS

We are grateful to Evandro de Oliveira, Barbara Lenczewski, and James Lloyd for constructively criticizing the manuscript. This paper is Florida Agricultural Experiment Station Journal Series No. R-03545.

LITERATURE CITED

LENCZEWSKI, B. 1992. Butterfly migration through peninsular Florida. Ph.D. dissertation, University of Florida, Gainesville. 132 pp.

WALKER, T. J. 1978. Migration and re-migration of butterflies through north peninsular Florida: Quantification with Malaise traps. J. Lepid. Soc. 32:178–190.

———. 1985a. Butterfly migration in the boundary layer, pp. 704–723. *In* M. A. Rankin (ed.), Migration: Mechanisms and adaptive significance. Contrib. Marine Sci., suppl. vol. 27.

———. 1985b. Permanent traps for monitoring butterfly migration: tests in Florida, 1979–84. J. Lepid. Soc. 39:313–320.

———. 1991. Butterfly migration from and to peninsular Florida. Ecol. Entomol. 16: 241–252.

WALKER, T. J. & B. LENCZEWSKI. 1989. An inexpensive portable trap for monitoring butterfly migration. J. Lepid. Soc. 43:289–298.

WALKER, T. J. & A. J. RIORDAN. 1981. Butterfly migration: are synoptic-scale wind systems important? Ecol. Entomol. 6:433–440.

WALKER, T. J. & J. J. WHITESELL. 1993. A superior trap for migrating butterflies. J. Lepid. Soc. 47:140–149.

Received for publication 8 December 1993; revised and accepted 8 February 1994.

APPENDIX: BUILDING AND USING A SIMPLEX TRAP

Materials

5 – 10′ pcs, ¾″ EMT (electrical conduit)
2 – 10′ pc, ½″ EMT [will have 40″ pc left over]
8 – 1 ¼″ × $^{10}/_{32}$ machine screws with nuts
2 – ¼″ eyebolts 3″ long with nuts
6 – ¼″ machine washers
2 – ¼″ × 1 ¼″ machine bolts with nuts
2 tubes transparent silicon caulk
42′ of 13′-wide, ⅜″-mesh, [filament dia = 0.15 mm], black polypropylene netting. ("Tenax Ornex SM": Geotenax Corp., Jessup MD)
118½′ of ⅛″ braided nylon rope
40′ of $^{3}/_{16}$″ braided nylon rope
1 roll electrical or other tape
1 roll flag tape

Tools and Reusable Supplies

1 lb. 8d box nails
1 8′ step ladder
1 caulk gun
1 heavy hammer
1 tape measure
1 nail apron
1 pr. scissors
1 drill with ¼″ and $^{13}/_{64}$″ bits

Procedures

Prepare EMT, ropes, and stakes. Cut one of the lengths of ¾″ EMT into four 2.5′ pieces. Cut one of the lengths of ½″ EMT into three 40″

pieces; from the other, cut one 40″ piece and two 20″ pieces. Cut the $\frac{1}{8}$″ rope into seven 13.5′ pieces and two 12′ pieces. Cut the $\frac{3}{16}$″ rope into two 20′ pieces. Use a lighter or blow torch to melt the ends of the $\frac{1}{8}$″ ropes. Pull each melted end to a point to aid in threading the rope through snug holes. (Warning! Melted nylon is hot and sticky. Protect your fingers by using leather gloves or thick layers of cloth.) Melt the ends of the $\frac{3}{16}$″ ropes to prevent unraveling. To finish the stakes, drill a $\frac{1}{4}$″-dia hole about 1″ from one end of each 20″ piece of $\frac{1}{2}$″ EMT. Insert and fasten a 1 $\frac{1}{4}$″ machine bolt in each hole—to prevent the guy ropes from slipping off the tops of the stakes.

Make support poles. Make 12.5′ support poles by joining 2.5′ pieces of $\frac{3}{4}$″ EMT with 10′ pieces. The segments are joined by an internal splint made of a 40″ section of $\frac{1}{2}$″ EMT. To prepare the splints, wrap the four 40″ pieces of $\frac{1}{2}$″ EMT with tape at each end and at 1″ on either side of the midpoint (Fig. 1D, splint). At each of the four wrapping places on each piece the tape should increase the diameter of the EMT so that it will slide snugly into both to-be-joined pieces of $\frac{3}{4}$″ EMT. Join each 2.5′ piece of $\frac{3}{4}$″ EMT to one of the 10′ pieces by slipping a wrapped 40″ piece of $\frac{1}{2}$″ EMT 20″ into the two pieces to be joined (Fig. 1D, splice). Drill a $\frac{11}{64}$″ dia hole through the assembly at 1″ on each side of the junction of the pieces of $\frac{3}{4}$″ EMT. Secure with two 1$\frac{1}{4}$″ × 10–32 machine screws. Designate two of the support poles as eves poles and two as rear poles. Make the 2.5′ segment the upper end of each pole.

Measuring from the top of each eves pole, drill a $\frac{1}{4}$″-dia hole at 12″. In the same plane, drill $\frac{13}{64}$″-dia holes at 0.5, 13, 57, and 149.5″ (=0.5″ from bottom) (these are for the top, slot, eves, and bottom ropes). Drill, at 90° to the other holes, a $\frac{13}{64}$″-dia hole $\frac{1}{4}$″ from the bottom (for the end rope). Drill the rear support poles like the eves poles, but omit the hole for the eves rope (i.e., the hole 57″ from the top).

Assemble and erect the frame. Insert a 3″ eye bolt through the $\frac{1}{4}$″ holes to join the eves and rear poles of each end of the frame. Place a washer at the eye, between the poles, and next to the nut. The eyes establish the outside of each end, and one end must have the eves pole on the outside and the other must have it on the inside. Lay the ends on the ground several feet apart, one with outside (=eye-side) up and the other with outside down. Slightly spread the poles of each end making the front and rear poles of each end parallel to the corresponding pole of the other. Now thread the seven 13.5′ pieces of rope through corresponding holes of the two ends being careful not to cross the ropes and to thread the ropes from the inside of the ends. To secure the ropes to the support poles, tie an overhand knot in each end, leaving a tail of about 1″. Thread the two end ropes into the bottommost holes and secure them in the same way as the cross ropes. Attach a $\frac{3}{16}''$ guy rope to each eye.

Drive the two stakes into the ground ~40′ apart. With one person on each end, erect the support poles with eyebolt eyes outward. Open the end poles into A's, being careful to face the two eves poles in the same direction. Tie the guy ropes to the stakes. Check the cross ropes and end ropes for problems—viz., wrong insertions and crossed ropes. Undo, rethread, and retie as required. Use guy ropes to pull cross ropes taunt and move poles to tighten end ropes and to square the frame in all its planes.

Apply the netting. Cut the netting into one 19′ and two 11.5′ lengths. Starting at the bottom rear of the trap, thread the 19′ piece up between the slot ropes, outside and over the top ropes, and back down between the slot ropes. Once threaded, spread the netting laterally, and starting at the lower rear corners temporarily attach it around the frame, to itself, using 8d box nails as you would straight pins in cloth. Pull the netting around the bottom cross rope making a 1″ hem. At intervals of ca. 6″ insert two nails parallel to the rope and $\frac{1}{8}''$ and $\frac{3}{4}''$ from it. Pull the netting around each rear pole and insert nails at ca. 6″ intervals. Continue to the top of the trap and then down the eves pole. Upon reaching the eves, hem the netting around the eves rope in the manner described for the bottom rope. Now put a bead of silicon caulk between each pair of nails in the two hems, being careful to ensnare both layers of netting.

Wrap the selvage of an 11.5′ piece of netting around each end rope and use nails to hem as before. Temporarily attach the middle of the opposite selvage to the eye near the top of the trap. Now work from the bottom and stretch the netting between eves pole and rear pole. Use nails to tack it to the main net and around the lower portion of the eves pole. Make your work easier by cutting off surplus netting (as it becomes apparent what is surplus). Once you have the netting on each end loosely fit and trimmed, remove and reinsert the nails as you pull it tight for the final fit. When you have all the netting in place and stretched except for two small triangles that close the ends of the duct, glue the netting to the support poles with a bead of silicon running the full length of each pole. When the silicon has congealed, remove all nails.

Take two scraps of netting and use nails to sew them to each end of the duct. Loosely trim the netting and stretch the triangles so that they can be glued with silicon to the poles on either side and to the selvage of the main net above. When you apply the silicon be sure to close any holes (=potential butterfly exits) that remain where the main net changes from one support pole to another. When the silicon has congealed, remove the nails. Then check again for holes larger than the ⅜″ mesh of the netting and close them with silicon.

To make the netting visible to persons working around the trap, tie 1′ lengths of flag tape to the netting at 2′ intervals at 4′ above the ground.

Striking, transporting, erecting, and servicing the trap. To strike a trap, a person at each stake unties the guy rope and keeps it taunt as he/she walks toward the trap. Upon reaching the trap, each grabs a rear pole and tips the top forward causing the rear and eves poles to scissor shut while making sure the end netting tucks inside the closing poles. The support poles are then held horizontally with the main net stretched between and the guy ropes thrown toward the center. The two strikers walk toward each other as each rolls the netting around two folded poles. When the rolls meet near the center, one takes both rolls. The struck trap can now be transported on one person's shoulder. The rolls can be secured with a bungie cord or rope.

To erect a trap, two persons reverse the striking process, being careful not to tear the netting as it unrolls. Unless the end of the eye bolts and the splint-securing machine screws have been cut off and filed, the netting may have to be extricated from them. Drive stakes 45′ apart along a line that is perpendicular to the mean direction of migration. If there are not two bowlines in each guy rope, tie them now—first one to make the eye-to-stake length 18.5′ and then one to make that length 24′. Now erect the trap making sure that it is square, centered between the stakes, and facing into the migratory stream. With the inner bowline of each guy rope around a stake, the trap's cross ropes should be properly taunt. If they are not, adjust one of the bowlines.

To remove butterflies from the trap, partially collapse it by releasing the guy on one end until its outer bowline is holding the trap. Butterflies in the two thirds of the duct closest to that guy should now be easily reached. Restore the trap and collapse it in the other direction to reach butterflies in the rest of the duct.