AN EFFICIENT AND INEXPENSIVE PITFALL TRAP SYSTEM[1]

William H. Clark[2], Paul E. Blom[3]

ABSTRACT: An inexpensive pitfall trap system which allows for rapid and easy field collection of invertebrates is described. The system is constructed from metal cans and plastic jugs which are common household materials and would normally be discarded. Ethylene-glycol antifreeze works best for a preservative, protecting specimens for several years in the field. This system has proven successful in the western United States and Baja California, México.

Pitfall traps have been used over the years to collect a wide variety of animals (arthropods: Beirne 1955, Peterson 1959, Knudsen 1966, Freeman 1974, Borror *et al.* 1989, Dunn 1989; reptiles and amphibians: Gibbons and Semlitsch 1981, Corn and Bury 1990; and mammals: Smith *et al.* 1975, Gibbons and Semlitsch 1981, Clark and Yensen 1982, Williams and Braun 1983, American Society of Mammalogists 1987, to list a few). Variations in applications have included the addition of covers (American Society of Mammalogists 1987), ramps (Bostanian *et al.* 1983), funnels (Best 1977), and/or the use of drift fences (Gibbons and Semlitsch 1981, Clark and Yensen 1982); and baits (Greenslade and Greenslade 1971) to enhance efficiency of collecting specific taxa.

An inexpensive pitfall trap system constructed from readily available and usually discarded household materials is described which allows for rapid and easy field collection. We have used this system for ten years in the western United States and Baja California, México, with excellent success.

MATERIALS AND METHODS

This pitfall trap design follows Morrill (1976) who used 16 oz. plastic Solo® cups. Our needs were for a more permanent trap of a larger capacity since the traps were to be left unattended for long periods of

[1]Received September 7, 1991. Accepted December 19, 1991.

[2]Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell, Idaho 83605 USA and Department of Plant, Soil, and Entomological Sciences, Division of Entomology, University of Idaho, Moscow, Idaho 83843 USA.

[3]Department of Plant, Soil, and Entomological Sciences, Division of Entomology, University of Idaho, Moscow, Idaho 83843 USA

time. Traps were constructed from metal cans and plastic jugs (Fig. 1). The outer liner of the system was a 3 lb. 'coffee' can buried flush in the ground. A few holes were punched in the bottom to allow for drainage of excess rain water. The plastic lid, which comes with most three pound cans, was used to keep soil from falling into the outer liner during initial installation or later maintenance and for closing the trap during non-sampling intervals. The outer liner remained in the ground until the pitfall trap was discontinued. The inner liner was either plastic (i.e. bottom of 16 oz juice bottles) or metal (the bottom of a smaller 'coffee' can), filled with preservative and placed inside the outer liner. Invertebrates were channeled into the inner liner by a funnel cut from the top of a round, 1 gallon plastic jug (Fig. 1). A large cover (rock, board, etc.) helped in keeping out precipitation and excess debris and deterring larger animals attracted by the preservative (see Hall 1991). Additionally, the cover may have helped in attracting thigmotaxic invertebrates seeking covering objects. We selected an ethylene glycol-based anti-

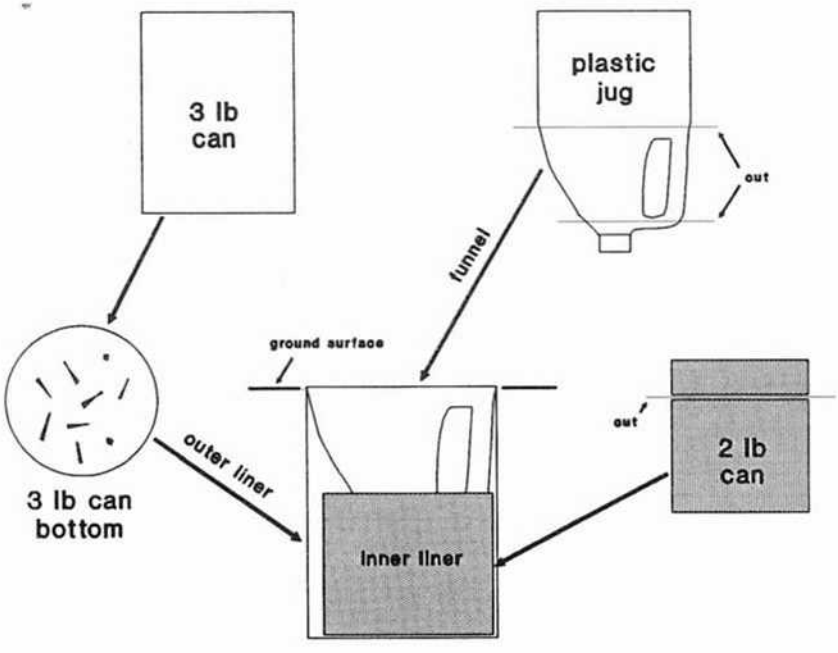

Figure 1. Assembly of the pitfall system from 'household' components.

freeze as the killing agent for its relatively slower rate of evaporation and preservation characteristics, protecting specimen integrity during several years of field exposure. Also, the antifreeze was readily available in a variety of outlets if the supply had to be supplemented in the field. Proper disposal of the ethylene glycol after its use and protection of vertebrates from pitfall traps containing it are recommended since it is an environmental hazard (Hall 1991).

To service the trap the contents were strained through a wire mesh household strainer. A fine fabric mesh (such as mosquito netting) was placed inside the strainer when collection of smaller invertebrates was desired. If the preservative was clean, it was collected in a container for reuse; if too dirty or diluted it was placed in a container to receive proper disposal. The sample and inner liner were rinsed with water, and the sample placed into a labeled jar with 70% ethyl alcohol (ETOH). T.D. Miller (pers. comm. April 1991) suggested a first rinse with soap and water to more thoroughly remove the ethylene glycol. The recharged liner and funnel were reset and the cover placed back over the trap. Time at the trap location was further reduced by exchanging old for new precharged liners, and straining the sample later.

A band saw was useful for trimming the inner liners and funnels. Storage of the components was facilitated by nesting the parts in the three pound can liners, which could then be stacked in boxes or on shelving. Components for approximately 100 traps were easily accumulated in one year via a standing request with friends and colleagues.

RESULTS AND DISCUSSION

We have collected well preserved samples from traps that had been out for up to three years in the Central Desert of Baja California, México. When a long collection interval was anticipated the antifreeze was used undiluted, allowing for future dilution by precipitation, and thereby minimizing specimen deterioration. For shorter periods, the more common 50:50 antifreeze to water ratio was employed. When traps dried completely, a great many of the specimens could be successfully rewetted for processing with ETOH or water. In a few wetter locations some molding was encountered over longer periods of exposure (i.e. >1 yr), though this was usually of little consequence in the xeric habitats we sampled. The system works just as well over short time periods.

A major advantage of this system was the short time (five minutes or less) required to service. This both optimized field time and drew less attention to the trap location in populated areas. If field conditions dictated that the initial rinse be minimal, a more thorough rinse was

made before final pinning or alcohol storage. We have observed that generally, specimens taken in the ethylene glycol mixture tended to retain more flexibility even after pinning than insects killed in cyanide or ETOH. This was expecially true of the medium to large sized beetles. In areas of high litter fall we encountered some filling and blockage of the funnel by leaves. Under such conditions the traps need to be serviced more frequently or screened in some fashion for optimal efficiency.

Our pitfall trap system has yielded many interesting species and distribution records (Papp 1989; Triplehorn *in prep*). Many other studies using specimens from this collection system will be published in time. While precise collection dates could not be determined when the traps were used for extended periods, they did provide information on the presence of species in various habitats. This preliminary information has served as the starting point for more detailed investigations.

ACKNOWLEDGMENTS

This research was supported, in part, by grants from EARTHWATCH and The Center For Field Research of Watertown, MA. Dave Ward, Jr.; Mary, Ellen, and Cindy Clark; Gary Shook; and others have assisted with the field testing of this pitfall trap system. Shook and Ward reviewed an earlier draft of this paper and James B. Johnson and Frank W. Merickel provided comments on a later draft. Albert Allen has sorted many pitfall samples and offered valuable suggestions. Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper #91766.

LITERATURE CITED

American Society of Mammalogists. 1987. Acceptable field methods in mammalogy: preliminary guidelines approved by the American Society of Mammalogists. Jour. Mamm. 68(Suppl.): 1-18.

Beirne, B.P. 1955. Collecting, preparing and preserving insects. Publ. 932, Canada Dept. Agric., Ottawa, Canada. 133 pp.

Best, R.L. 1977. The pitfall trap. Carolina Tips. 40(5):1-18.

Borror, D.J., C.A. Triplehorn, and N.F. Johnson. 1989. An introduction to the study of insects. Saunders Coll. Publ., Philadelphia, PA. 875 pp.

Bostanian, N.J., G. Boivin, and H. Goulet. 1983. Ramp pitfall trap. Jour. Econ. Entomol. 76(6):1473-1475.

Clark, W.H., and E. Yensen. 1982. Nuevo registro de la musarana deserticola *Notiosorex crawfordi* (Coues), de desierto central de Baja California, Mexico. Ann. Inst. Biol. Univ. Nal. Auton. Mex., Ser. Zool. 53:439-441.

Corn, P.S., and R.B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. Gen. Tech. Rpt. PNW-GTR-256, U.S. Dept. Agric., Forest Serv., Portland, OR. 34 pp.

Dunn, G.A. 1989. Bibliography of information on pitfall trapping. Young Entomol. Soc. Quart. 6(3):41-42.

Freeman, P. 1974. Insects, instructions for collectors No. 4a. British Mus. Nat. Hist., London, England. 169 pp.

Gibbons, J.W., and R.D. Semlitsch. 1981. Terrestrial drift fences with pitfall traps: an effective technique for quantitative sampling of animal populations. Brimleyana 7:1-16.
Greenslade, P.J.M., and A. Greenslade. 1971. Use of baits and preservatives in pitfall traps. Jour. Austr. Entomol. Soc. 10:253-260.
Hall, D.W. 1991. The environmental hazard of ethylene glycol in insect pit-fall traps. Coleop. Bull. 45:193-194.
Knudsen, J.W. 1966. Biological techniques. Harper and Row., New York, NY. 525 pp.
Morrill, W.L. 1976. Plastic pitfall trap. Environ. Entomol. 4:596.
Papp, C.S. 1989. Notes on the Stenosini genus *Araeoschizus* LeConte from Baja California, Mexico. (Coleoptera: Tenebrionidae). Entomography 6:335-340.
Peterson, A. 1959. Entomological techniques. Edwards Bros., Inc., Ann Arbor, MI. 435 pp.
Smith, M.H., R.H. Gardner, J.B. Gentry, D.W. Kaufman, and M.H. O'Farrell. 1975. Density estimations of small mammal populations, pp. 25-53, *in:* Small mammals: their productivity and population dynamics. Internat. Biol. Prog., Vol. 5. Cambridge Univ. Press, England.
Triplehorn, C.A. *In Prep.* The genus *Eleodes* of Baja California, Mexico (Coleoptera: Tenebrionidae).
Williams, D.F., and S.E. Braun, 1983. Comparison of pitfall and conventional traps for sampling small mammal populations. Jour. Wild. Manag. 47(3):841-845.