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## BAITED PITFALL TRAPS FOR BEETLES

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Many beetles are attracted to dung, carrion, and other decaying organic materials. Various trapping methods have been devised which exploit this attraction to increase the ease and efficiency of collecting such beetles, and to permit control over the many variables of bait type and size, location, etc. for ecological studies. Many of these techniques are given in T. R. E. Southwood (1966. *Ecological methods*, with particular reference to the study of insect populations. Methuen and Co., London. 391 p.). Through much experimentation we have developed traps which are simple, inexpensive, easily transported and installed, and inconspicuous while in use. We have used them successfully for several years throughout the forested areas of temperate and tropical North, Central, and South America in studies on dung and carrion beetles. Because of the many people who have asked us about our trapping methods, we describe them below, especially for the benefit of others interested in collecting Scarabaeidae, Staphylinidae, Silphidae, Ptiliidae, Histeridae, Hydrophilidae, and Leiodidae (Catopinae = Leptodiridae).

Jars or cans may be used, but the best trap containers are deep flexible plastic ones of the type in which icecream is sold. These can be obtained readily from several manufacturers (e.g., Dixie Co. of Easton, Pa.) or local container distributors in sizes up to 1 gallon. They are light, do not rust or break, nest for easy storage and come with lids. The container is buried at a suitable site so that the top is level with the ground surface. A 1 to 2 inch depth of a liquid is then poured into the bottom of the container to drown the attracted insects which fall to the bottom. For short intervals of about 1 to 2 days, water to which a small amount of wetting agent (e.g., a squirt of Palmolive Liquid Detergent) has been added is suitable. For longer intervals, especially in hot weather or in the tropics, a preservative is necessary. The best one found suitable for trap use is an aqueous solution of about 5% each of chloral hydrate and sodium chloride (salt), to which a wetting agent is added as above (the salt may be omitted without much harmful effect). This has prevented decomposition of the trapped insects for a month in hot weather. On extended trips only the chloral hydrate need be carried, and the solution mixed up as needed. Another solution nearly as good, and perhaps easier to obtain, is a 50-50 mixture of ethylene glycol and water. Several brands of ethylene glycol base antifreezes have been used with no detectable damage to the beetles which might be caused by other compounds in the antifreeze.

Various kinds of dung, carrion, soft fungi, etc. may be used as bait. In our experience human dung is best of the readily available kinds, and we have relied on it almost exclusively. Dung of other omnivores and carnivores is good, but that of herbivores such as cattle and horses has given poor results. Squid and octopus make superb carrion baits that remain attractive longer than most others because of a tendency to liquify and hence resist drying. Beef or hog liver, chicken heads, and fish are good and inexpensive. In the absence of meat markets, dead birds, lizards, frogs, etc. will serve. About one-fourth pound of bait is recommended for most purposes; smaller amounts dessicate rapidly and lose effectiveness. The bait is wrapped in cheesecloth or other

open-weave cloth and tied with a plastic bag tie or piece of wire. It is suspended by the tie from the middle of a wire screen which is then placed over the mouth of the buried trap container. Malt or molasses syrups with a trace of propionic acid are well-known as scarab bait, but we have found the diversity of beetles to be much lower when compared to carrion or human dung.

One inch mesh chicken wire will admit all North American insects attracted to the bait while preventing most leaves and vertebrates from falling into the trap. Smaller meshes (one-half or one-fourth inch, sold in hardware stores as "hardware cloth") will serve in cool temperate areas where large Scarabaeidae are absent. A 1 foot square screen is convenient for a 1 gallon size trap. We have successfully used small versions of these traps in animal burrows, such as pocket gopher burrows in Mexico, after the gopher is removed.

The screen must be weighed down with rocks or logs to hinder disturbance by vertebrates seeking the bait (especially carrion). A large flat rock or piece of log is then placed on top to minimize entrance of rainwater and to conceal the trap from humans. Camouflage is especially important in Latin America where many people roam the forests hunting and collecting firewood (and plastic containers!), and further efforts such as not trampling vegetation in the vicinity, tossing excavated dirt far away, throwing leaf litter on the completed trap etc. may be necessary. In areas of high rainfall a piece of flat aluminum, Formica, or similar material wide enough to cover the trap and placed below the covering rock or log will prevent flooding. Where suitable cover objects are scarce a dome-shaped piece of aluminum will serve.

An optimum period of operation for the traps is about 5 days. Longer intervals may result in an accumulation of maggots which makes later sorting more difficult, and of course the risks of flooding and other disturbances increase with time. On the other hand a minimum of 1 full day is recommended for good results because of differing diel activities of attracted insects. The "catch" may be removed from the trap by pouring the agitated solution through a fine sieve (the type sold as tea strainers in supermarkets is good) and rapping or washing the contents of the inverted sieve into a jar. Alternatively, the trap liquid may be carefully poured off through the sieve (which catches the few floating specimens) and the insects remaining in the bottom of the container scraped or washed directly into the jar. The "wash" liquid above is the permanent preservative, such as 70%-80% ethyl or isopropyl alcohol (the chloral hydrate trap solution may be suitable but we have not tried it for more than a month). We have found that Barber's Fluid (a mixture of 265 parts of 95% ethyl alcohol, 245 parts water, 95 parts ethyl acetate, and 35 parts benzene) or a mixture of 70% acetone, 25% water, and 5% benzene will keep insect tissue in a relaxed state indefinitely, and hence facilitate later genitalia dissections, compared with alcohol-preserved material which tends to stiffen. Both of these solutions, however, are more volatile than alcohol and eventually ruin most common lid-sealing materials.

Baby food jars are useful field containers (the food isn't bad either!). Pint or quart size jars are often needed in the southeastern coastal plain of the U. S. and particularly in tropical areas where traps may be clogged with large Scarabs in 1 or 2 days. Heavy plastic bags such as the 18 ounce capacity Nasco "Whirl-Pak" bags (available from Turtox) are useful for air travel or reserve storage capacity. Of course, a label, preferably in india ink on good quality paper, should be placed inside each jar or bag.

