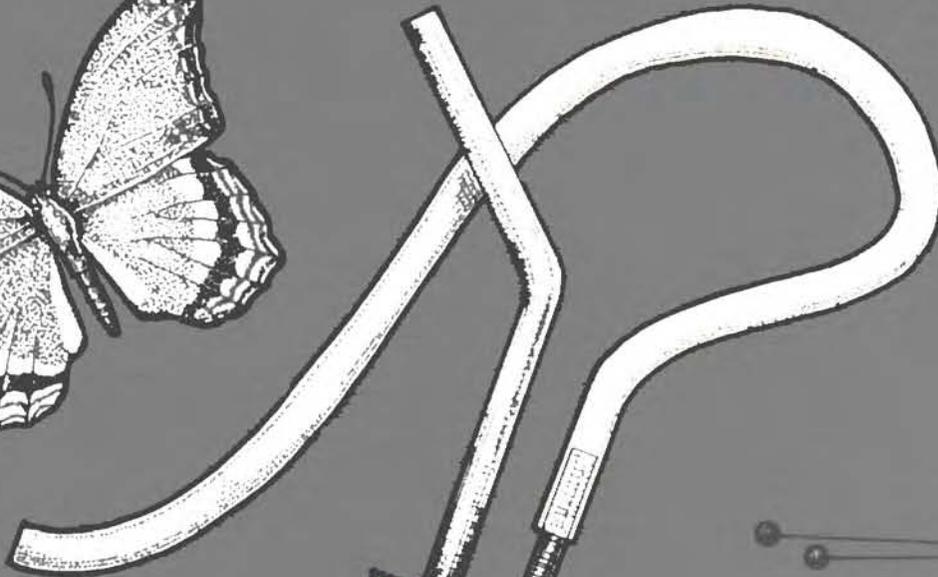
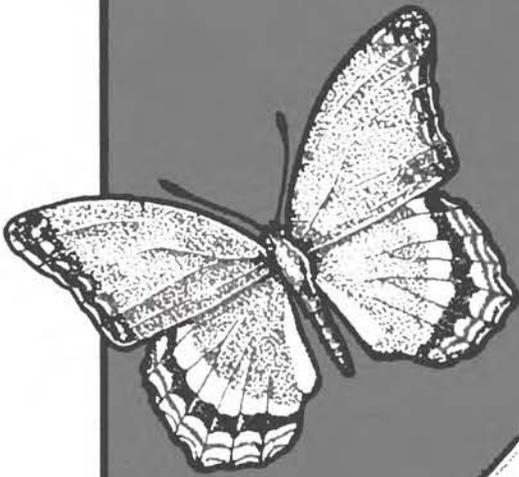


ADVANCED ENTOMOLOGICAL TECHNIQUES

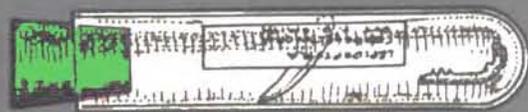
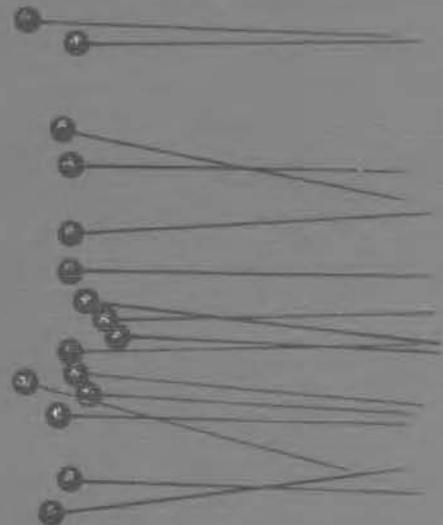
2 Manual



EastLansing, MI
29 June, 1988
Coll. 30-9mm
Ex. Apple

Chrysomelidae
Rose Leaf Beetle
Det. J.D. Smith

EastLansing, MI
1 June, 1988
Coll. M.M. Reiter
Ex. Potato



AUTHOR

This manual was written by Gary A. Dunn, Extension 4-H Youth Entomology Specialist from 1979 to 1991.

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Welcome to 4-H Entomology

Welcome to the 4-H entomology project area. It will introduce you to many new and exciting experiences. As well as being fun, it will help you learn how important insects are in the lives of everyone. It may even help you prepare for the study of insects as your life's work.

This manual gives instructions for advanced entomological techniques and activi-

ties. There are additional 4-H entomology publications for beginners or people interested in other entomological projects. Information on how to obtain these other publications can be obtained from your leader or county 4-H Youth staff.

Introduction

Entomology (en-toe-mol-o-gee) is from the Greek work **entomo**, meaning insect. Entomology is the science dealing with the study of insects. The scientist who specializes in studying insects is called an entomologist. However, you do not need to be an entomologist to learn something about the important and fascinating world of insects.

The principal objectives of this 4-H entomology project manual are to acquaint you with unique collecting methods, advanced specimen preparation, and specialty collections, and to encourage you to interact with other entomologists.

This manual is designed to acquaint you with the advanced techniques and skills used by serious entomologists. You may want to use many of these techniques to:

1. Become a better, more efficient collector, thereby diversifying your collection.
2. Develop basic skills necessary for use in life cycle or behavior studies.
3. Be better able to cooperate with other interested entomologists.

Advanced Collecting Techniques

The key to becoming an effective insect collector is to keep one important idea in mind at all times: to collect a diversity of insects, you must know when, where, and how to check the many insect habitats in the world around you.

This sounds complicated, but it really isn't because all insect habitats can be placed into one of the following five habitat types: (1) aquatic, (2) terrestrial, (3) plant-associated and arboreal, (4) animal-associated, and (5) aerial.

Each one of the special techniques or skills described in this manual is more or less suited to one (or two) of these habitat types, and each produces uniquely different results. Therefore, try a variety of these techniques and skills if you want to diversify and enlarge your collection.

AQUATIC INSECTS

A variety of techniques can be used to extract insects from their watery habitats. Some of the most widely used techniques include dip netting, treading, emergence trapping, and aquatic light trapping.

Dip nets. The easiest way to make your own dip net is to obtain a large mesh kitchen strainer and attach it to a suitable pole (an old broom handle works nicely) with automotive hose clamps (fig. 1). In addition, a shallow white plastic pan or bucket is needed when sorting through the contents

of the dip nets. Forceps and an eyedropper are very helpful for picking out specimens and placing them in a vial of preservative (see page 15 for more information on preservatives).

The technique for using the dip net is simple. Select an aquatic habitat with an abundance of plant life. Move the dip net through the vegetation to dislodge and capture the specimens. Be sure that the rim always faces the direction of travel! After several passes, empty the entire contents into the white pan. Add a little water if necessary. Most insects will begin to move about in the shallow water, but some will have to be removed from the vegetative debris in the pan. Swishing the plant material back and forth in the water will usually accomplish this. Now you are ready to pick out any desirable specimens and put them in a vial with preservative.

Treading. This technique requires only a few pieces of equipment, a pair of rubber waders (or old boots), and collecting bottles. **Do not tread with your bare feet!** In addition to the waders and bottles, a short-handled dip net, a white pan, forceps, and an eyedropper will be very helpful.

The treading technique is quite simple and easily mastered in a short time. First select an appropriate habitat. Freshwater marshes, shallow ponds, wet meadows,

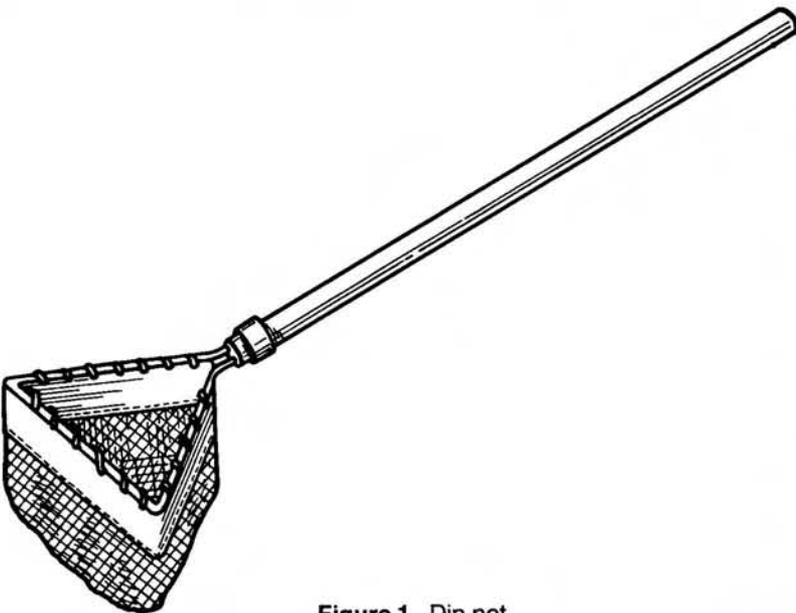


Figure 1. Dip net.

bogs, and woodland pools are especially productive.

Start in an area where there is emergent vegetation and where the water is between 2 inches and 1 foot deep. Begin thoroughly stomping (treading) a small area (2 feet by 2 feet) of vegetation into the water with your feet. Continue this process for several minutes and then step back and watch the area. Various insects will begin to come to the surface of the water in the treaded area. Some only pop to the surface momentarily, so be ready with your dip net (kitchen strainer). This activity will generally last for several minutes before subsiding.

Sometimes the murky water makes it difficult to see some insect specimens, and this is where your white pan (or small pail) comes in handy. Dipping water out of the treaded area will often enable you to collect hard-to-see specimens. After the activity has subsided, move to another spot and repeat the process. Your results will vary according to the type of habitat, vegetation, water depth, and season, so be sure to try this technique in a variety of situations.

Emergence traps. This type of trap is suspended over aquatic plants to capture adult aquatic insects after they emerge from the water.

There is no specific design for emergence traps. Most are constructed of a wood frame covered with nylon mesh (window screen material). The trap may be square, triangular, or cone-shaped (fig. 2), and should be equipped with a trapdoor or opening at the top to facilitate specimen removal. (In this regard, "peaked" traps work best.) The trap may be designed so it is held above the water by floats or stilts, or by suspending it from an overhanging tree branch.

Select any aquatic habitat where there is abundant vegetation and where the water is not too deep. Freshwater marshes and the edges of ponds and slow-moving streams are ideal and will generally be most productive.

Aquatic light trap. These traps are used to attract and capture nocturnal aquatic insects below the surface of the water. Use a ¾- to 1-inch-thick board to form a plug at one end of the trap (fig. 3). At the other end of the trap, form a funnel from window

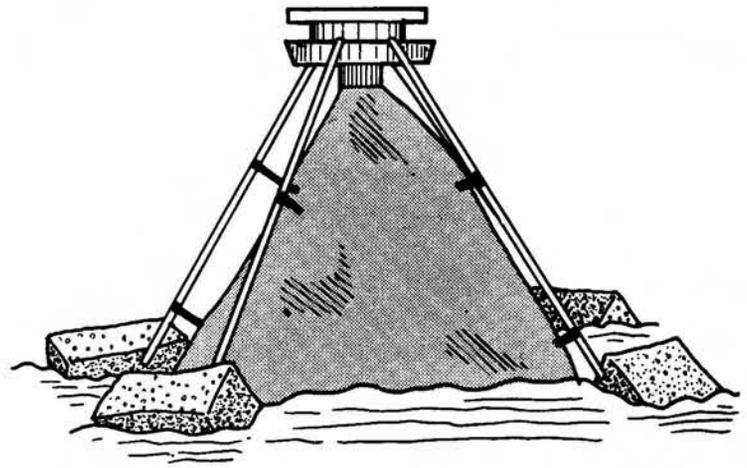


Figure 2. Emergence trap (cone-shaped/aquatic).

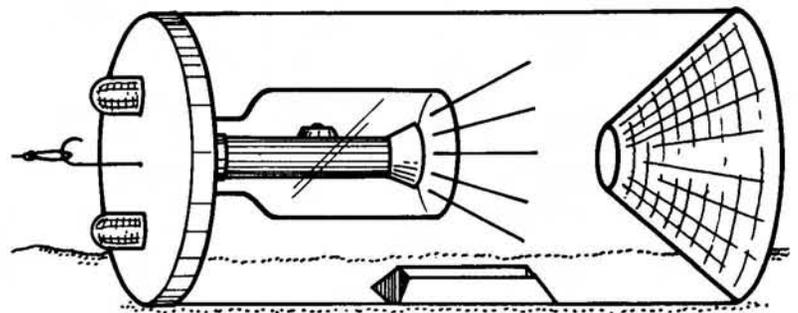


Figure 3. Aquatic light trap.

screen material. Drill two 1½-inch holes in the end board and form screen tubes to insert in these holes. Obtain either an airtight jar and suitably sized flashlight or a special waterproof flashlight to place in the trap. If you use the jar and flashlight, use molding clay or putty to hold the flashlight in place. Sometimes you will need to use a stone or other weight to keep the trap underwater.

When retrieving the trap, keep the board end down and the trapped insects will collect in the screen tubes. Next, remove the wood plug and empty the screen tubes, placing your specimens in a suitable preservative.

TERRESTRIAL INSECTS

A large number of insects live near the ground, burrowing in the soil or moving among the soil humus and leaf litter. Thousands of insects may be in the soil at your very feet! However, because they live in a hidden world and often only come out at night, they remain undetected by many collectors. Thus it becomes necessary to use a variety of traps and techniques to collect these insects.

Pitfall traps. Pitfall trapping is a simple technique that can be modified to suit any collector's needs. The basic pitfall trap is nothing more than a container (glass, plastic, or metal) buried in the soil with the rim flush with ground level. Pitfall traps range in diameter from 1 inch to 6 feet, but 4 to 8 inches is the most practical size.

The most efficient pitfall trap is one that employs two containers (fig. 4). One container is buried in the ground for the entire duration of the trapping operation. The other cup is designed to fit inside the outer container and remains removable. This greatly simplifies the job of specimen removal. Other "accessories" which can be used with pitfall traps are covers, barriers, baits, and preservatives. Each of these items can vastly improve the performance of a plain pitfall trap.

Pitfall trap covers can be constructed of any readily available flat objects such as

shingles, pieces of boards, or stones. The cover sits up on several small stones so that there is about a half inch of space between the cover and the ground. Placing a large rock on top of this cover is one way to keep skunks, raccoons, and rodents from digging up your traps.

A barrier can be used to increase the effectiveness of a pitfall trap. A barrier is simply a 4-inch-high by 3-foot-long fence that is placed between two pitfall cups. Wandering insects are intercepted by the fence and directed into a cup at either end of the trap. Barriers are most easily made from strips of Plexiglas, wood, or aluminum (garden edging).

A greater variety of insects can be taken in pitfall traps if baits are used. Each type of bait will produce different results. Many types of natural and artificial baits can be used. The bait used by lepidopterists (people who study butterflies and moths) works well. It consists of sugar, molasses, mashed overripe fruit, and beer. Or try mixing active dry yeast with molasses, sugar, and water. Both of these baits work best if given some time to ferment before they are used.

Animal refuse also attracts a wide variety of insects. Fish, beef lung, raw hamburger, chicken bones, and other meat scraps work well. As with any bait, the smellier it is, the better! Animal dung also can be used. When using dung as a bait, it is best to use it in a liquid state by mixing the dung with liberal amounts of water. This procedure keeps the dung from drying out and thereby losing its attractancy. More importantly, it keeps the trapped insects from burrowing into the dung, making them difficult to extract. With the liquified dung, all you need do is skim the insects off the surface with a strainer.

The use of preservatives in pitfall traps allows a greater interval between trap checks. Live traps (that is, those without preservatives) must be checked on a daily basis to prevent loss of specimens due to predation, cannibalism, escape, and decomposition. On the other hand, traps filled with preservative only need to be checked on a weekly basis. This becomes particu-

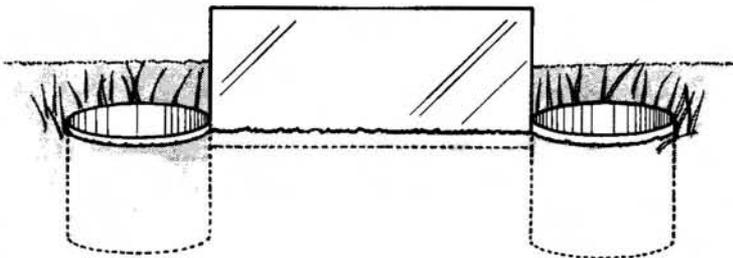


Figure 4. Pitfall trap (double-cup/barrier).

larly important if you have large numbers of traps, or if the traps are set up in distant locations.

While it has been shown that some preservatives act as attractants and others act as repellents, this should not cause any concern to the general collector. The best all-around pitfall trap preservative is ethylene glycol, and this material is readily available in the form of automotive antifreeze/coolant. Purchase the cheapest brand you can find and dilute it with water. During periods of little rain, or if your traps are covered, use a 50/50 mixture of ethylene glycol and water. If you anticipate frequent rains, use more of the ethylene glycol — the rain will gradually dilute the solution.

When you check your traps, take along a mesh strainer to remove the specimens. If the solution is overly diluted with rainwater, discard the solution; if it is not, add only a small amount of fresh solution. Try to keep the container one-quarter full.

Pan traps. Pan traps are used in the same manner as pitfall traps. The only difference is the type of trap container. The typical pan trap is made from a disposable aluminum pie or cake pan. It is installed in the same fashion as a pitfall cup and can be supplied with baits or preservatives.

Hidden insect extractions. Many insects are hidden in organic materials such as leaf litter, rotten wood, beach drift, flood debris, and soil. Several techniques and simple pieces of equipment can be used to easily collect specimens from these materials.

One of the most widely used devices for extracting hidden insects is the **Berlese funnel**. The basic components of a Berlese funnel are a light (60 or 75 watts), a plastic or metal funnel, a mesh screen, and a sample container. You can construct your own Berlese funnel by studying figure 5.

The first step is to obtain a habitat sample. Rake up small amounts of leaf litter (the layers closest to the ground contain the most insects), rotten wood, beach drift, or flood debris, and place it in plastic bags for transport to your home.

To operate the funnel, carefully place small amounts of the habitat sample on the mesh screen in the funnel and then turn on



Figure 5. Berlese funnel.

the lightbulb. The light will begin to heat the sample, forcing the specimens deeper into the sample until they fall through the screen and into your collection jar. Your jar, of course, should be filled with a preservative such as alcohol. The extraction process generally requires several hours.

Many hidden insects can also be extracted by **sifting**. Collect a habitat sample just as if you are going to use a Berlese funnel. Instead of using the funnel, however, spread a large white sheet on the ground and dump your sample onto the center. Have your killing jar, forceps, and aspirator (see next section) handy as insects should begin to move about on the sheet. After the activity has subsided, spread the sample out in a larger, shallower circular pattern. Gather up any specimens. Repeat this process several times, or until the activity ceases.

You can also separate insect specimens from organic debris by using the **flotation method**. Obtain an old wash tub, pail, or similar large container and fill it halfway with water. Obtain your samples of organic debris, and then place small amounts (several handfuls at a time) into the water. All of the heavy debris will sink to the bottom while the lighter insects and debris will float to the

surface. Have your forceps or a strainer handy to pick out the specimens.

You can also use a variation of this flotation method, referred to as **flooding or splashing**, when you are collecting outdoors in the vicinity of ponds or streams. Use your hands or a small pail to splash water up onto the banks of the pond or stream five or six times. Many insects will be washed down into the water, so be ready to pick them up before they float away. Soon after the remainder of the splashed water has soaked into the bank, many insects will emerge from the soil and from beneath stones and debris and begin to move up to higher ground. You can also dunk or rake handfuls of leaf litter, rotten wood, and other debris into the water and collect the specimens as they float to the surface.

Aspirators. An aspirator is a very useful tool for gathering large numbers of small, active insects. An aspirator works much more efficiently than fingers or forceps. An aspirator is a simple suction device that consists of a glass or plastic vial, a tight-fitting stopper, and tubes. Study figure 6 if you wish to construct your own aspirator.

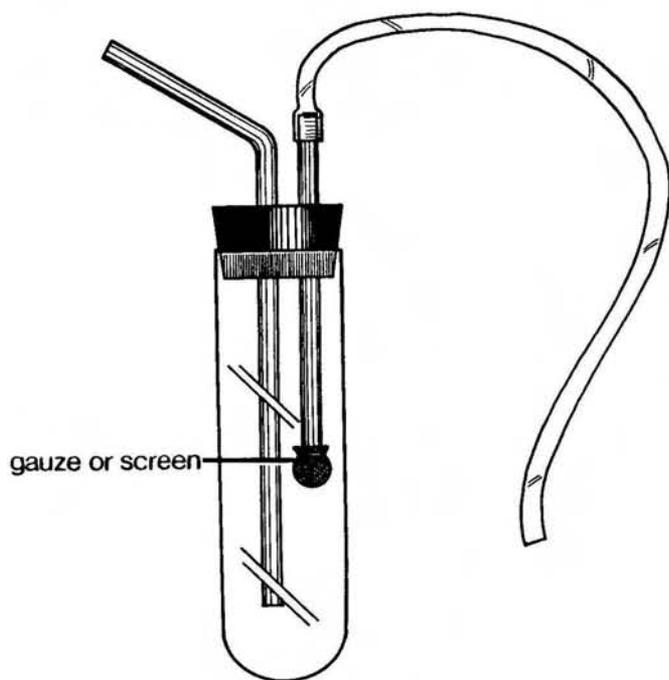


Figure 6. Aspirator.

To use the aspirator, place the intake tube next to the specimen and supply suction by inhaling abruptly. Note that the "screen" on the suction tube prevents you from inhaling specimens. **Do not put any type of killing agent in an aspirator.** Instead, dump the contents of the aspirator into your killing jar when you are finished aspirating or when the aspirator is full. Occasionally you may find that the intake tube becomes clogged with moisture and debris. An ordinary pipe cleaner or short piece of coat hanger wire can be used to clean out the clogged tube.

Headlamps and flashlights. Many terrestrial insects are nocturnal — that is, they are only active at night. Areas you visit during the daylight hours may appear to be devoid of insects, whereas a nighttime visit often reveals a great deal of activity. In order to see this activity, you will need some type of portable light, such as a flashlight or headlamp. Either of these devices can be used, but you will find a headlamp is more efficient since it leaves your hands free. A headlamp has a light that is strapped to your head and a battery that clips to your belt. The best areas to check with a headlamp are trails and openings in woods, beaches, sidewalks, or mudflats. Any relatively open area where you can see the ground should do nicely.

Baiting. Base your bait choice on the type of insects you wish to collect. Examples of three different types of baits are suggested here, but these are by no means the only effective baits. It is important to experiment with different bait materials if you want to collect a diversity of insects.

One widely used baiting method is known as sugaring, and it is effective for attracting night-flying moths and beetles. The standard bait mixture consists of sugar, fruit scraps, and molasses. Some collectors also like to add small amounts of beer or rum. Mash the overripe fruit (bananas and peaches work well) in a blender, then add a small amount of sugar and liberal amounts of black molasses. Allow the mixture to sit and ferment; it is best to prepare your bait early in the spring or at least several weeks before use. The bait should be both sweet and odoriferous.

Use a paint brush to apply the bait mixture on a selected row of trees at a convenient height before it gets dark. At this time, it is also a good idea to clear away any dry twigs and other obstacles so that your approach to the baited insects is unobstructed and as noiseless as possible. If the bait is left on the trees for 20 to 30 minutes after dark, the specimens are less cautious and easier to collect. Patrol the baited trees cautiously with a dim flashlight and wide-mouthed killing jar. Desirable specimens are collected by placing the open jar over the feeding insect and holding it in place until the insect slows down its fluttering. The jar is then quickly removed and capped.

Late summer and early fall are the most productive times for moths and other desirable species. Be sure to check any remaining bait the following morning, since many butterflies and diurnal (day active) insects are likely to be attracted.

Another type of baiting is the oatmeal trail. No bait preparation is necessary with this technique. Use uncooked oatmeal straight from the box. Just before dark, sprinkle small amounts of oatmeal along a woodland trail, open glade, or other open area. Patrol the trail with your flashlight or headlamp and a killing jar. The white oatmeal flakes are easily seen when illuminated by your light, and you are likely to observe insects as they feed on or attempt to carry off your oatmeal.

Another baiting method uses chicken bones. Save the bones from a family dinner or other source for use later on. Place the bones on the ground in woods, along riverbanks, or other areas where insects are likely to be found. Patrol the bait after dark with a headlamp and killing jar. Other types of meat scraps or fish may be used to produce different results.

Emergence traps. These are the same style of traps as discussed on page 3. The traps are basically mesh cages with one open side. The open side is placed on the ground over insect-infested plants. Any insects emerging from the soil or the plant will be captured in the trap. Some collectors even make large, mesh "tents" to cover entire small trees or shrubs!

AERIAL INSECTS

The collection of aerial insects is not restricted to the use of nets. A large number of different insects can be captured with win-

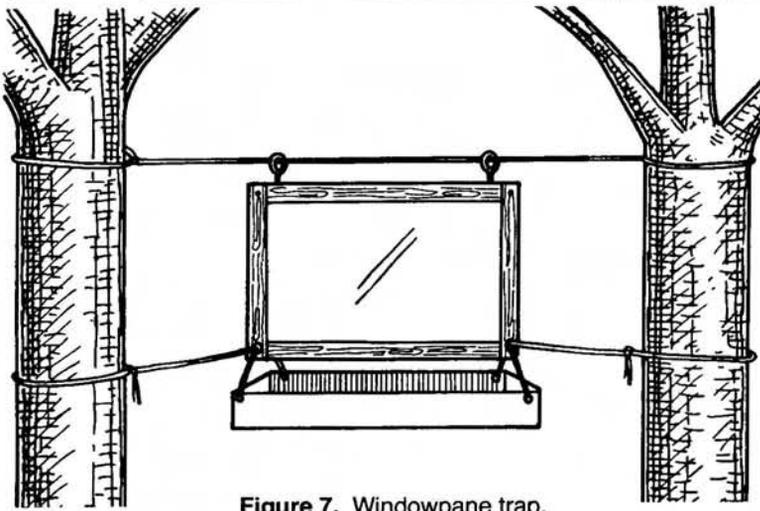


Figure 7. Windowpane trap.

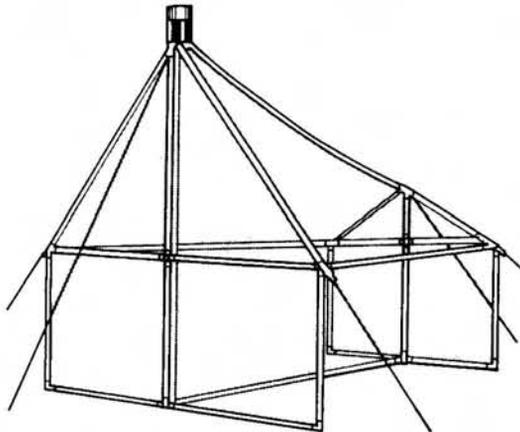


Figure 8. Malaise trap.

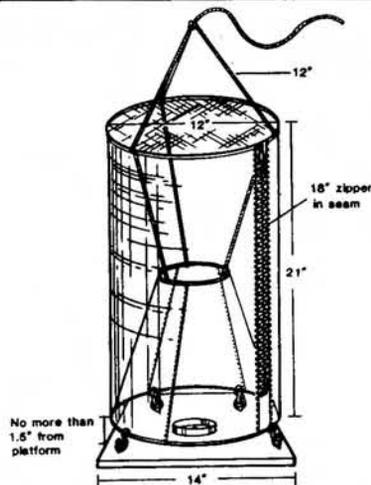


Figure 9. Bait trap designed for capturing night-flying moths.

dowpane traps, malaise traps, bait traps, and light traps. As with many other collecting methods, each of these techniques captures different types of insects.

Windowpane traps. These traps are simply transparent pieces of plastic suspended into open areas where insects fly about. Figure 7 shows the construction and use of a simple windowpane trap. The trap consists of a transparent piece of Plexiglas (any convenient size larger than 18 x 24 inches will do), a trough, and a couple of eye hooks for hanging the trap. The best locations in which to place the trap are small open areas among continuous vegetation. Woodland trails, small clearings, and openings in hedgerows are ideal. If you place the trap at different heights, you will catch different types of insects. After hanging the trap, fill the trough with a preservative (ethylene glycol) or soapy water.

Malaise trap. These traps are large versions of windowpane traps constructed of mesh cloth instead of transparent plastic (fig. 8). The standard malaise trap is 6 to 8 feet across and 6 feet high, usually with a peaked roof. Insects that fly into the trap move up the walls, into the peak, and ultimately into a collecting bottle. Malaise traps are placed in the same types of areas as windowpane traps; however, due to their large size, they are frequently subject to vandalism. They are also very expensive to purchase or make although they do capture tremendous quantities of insects.

Bait traps. Two types of bait traps are commonly used by entomologists. One is designed to capture night-flying moths; the other is for day-flying flies and other scavengers. A bait trap for capturing night-flying moths is illustrated in figure 9. This simple trap is designed to be hung from a tree and baited with the same "brew" described on page 6. The bait is placed on paper toweling on the bottom platform. When moth specimens finish feeding, they fly up into the mesh cloth "cage" and are captured. The zipper in the top of the cage makes it easy to extract any desirable specimens.

One of the bait traps designed for flies is similar to the moth trap. However, instead of soft mesh cloth, the trap is constructed of stiff window screen and stands on short legs (fig. 10). The other design uses a small wood box with the inverted "V" entry way. The trapped insects are attracted to the lighted collecting bottles and are easily removed when the jars are changed. Use a bait consisting of fish, raw meat, or other meat scraps. Allow the bait sufficient time to become putrid.

Blacklights and light traps. Many night-flying insects are attracted to ultraviolet light (blacklight), as well as other bright lights. Collecting these insects can be done by visiting street lights and brightly illuminated signs with your killing jar in hand. Or you can try putting a blacklight bulb in your porch lamp. These screwbase blacklight bulbs are often available in novelty, gift, and party stores. Fluorescent-style blacklight tubes are also available at many stores. These lights work best if they are set up in front of a large white sheet (fig. 11). An alternate design for a light trap is also shown in figure 12.

When tending a blacklight to see and choose the desirable specimens, you will find a headlamp is extremely helpful because it leaves your hands free. When you see a specimen you want for your collection, open your killing jar and place the lower tip of the open jar against the sheet below the specimen. Then slowly move the jar up to and, if necessary, over the specimen. Most specimens will drop down into the jar, but some may attempt to fly. Don't worry if you miss a specimen; they frequently return a short time later. One hint to help prevent losing specimens that drop to the ground is to place the lower portion of the sheet on the ground to catch any evasive specimens. If you are in an area where there is no electricity to run a light trap, you will have to use a trap that can be run off of a car battery (DC power). You can also use a camp lantern. However, these lanterns get very hot and should only be used with adult supervision.

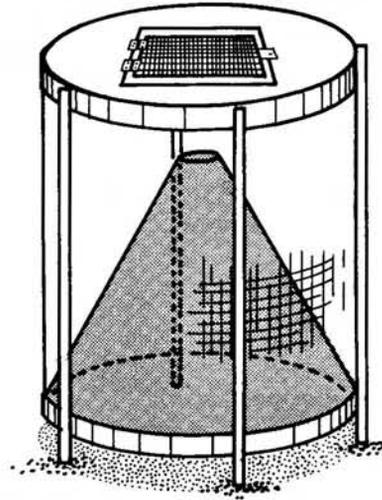


Figure 10. Bait trap designed for capturing day-flying flies (fly trap).

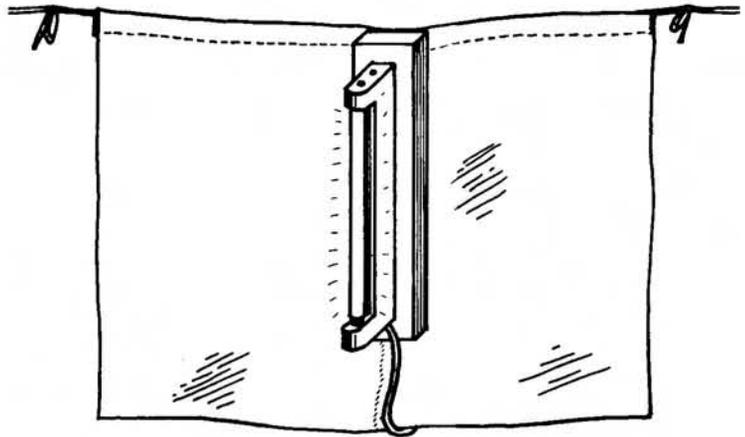


Figure 11. Light trap used with sheet.

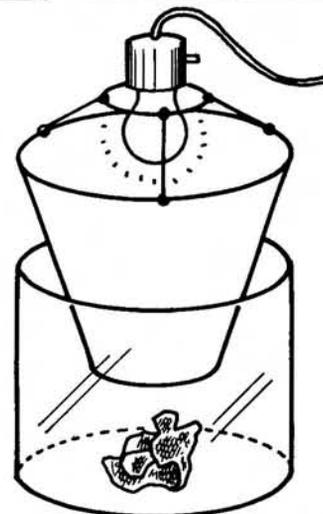


Figure 12. Alternate light trap with funnel.

PLANT-INHABITING INSECTS

Virtually every species of plant has a handful of insects associated with it, so it should be no surprise that plants are a good place to look for insects. Some insects are easily seen and collected because they feed on exposed parts of the plant, like flowers and foliage. However, there are many insects that reside within the plant itself — in wood, stems, twigs, leaves, and fruits. Use the following techniques to collect these types of insects.

Beating sheets and trays. On any given plant, especially trees and shrubs, there may be an abundance of insects among the branches and masses of foliage. Searching for and hand-collecting specimens in this

situation is both time-consuming and inefficient. Using a beating sheet or beating tray is much more efficient. Beating sheets are easy to construct (fig. 13) and can be made in any number of convenient sizes. In fact, some entomologists spread white bed sheets on the ground beneath small trees and shrubs and collect from the entire plant all at once. A beating tray can be made from any shallow white or light-colored pan. Some collectors construct a wire mesh cover for the tray to exclude plant debris (fig. 14).

To collect insects with a beating sheet, tray, or ground cloth, place the sheet, tray, or cloth beneath the branch (or branches) to be sampled. Sharply rap the branch with a stout stick, old ax handle, bat, or other convenient club. Insects jarred from the vibrating branch will drop into the sheet/tray/cloth where they can be picked out and placed in a killing jar.

Aspirators. These entomological devices were discussed earlier in the section on collecting terrestrial insects (see fig. 6 for details). The aspirator is used in the same way here, except that the insect specimens are collected from the plant rather than from the ground.

Separator boxes. Many insects that inhabit wood, branches, leaves, galls, or fruits and cones can only be collected at the time they emerge. Unless you happen to be very lucky, it is unlikely you'll be in the right place at the right time to collect these types of insects. Fortunately, all you need to do is make a separator box (fig. 15). The size of the separator box is determined only by the size and quantity of plant material you want to place inside. Choose an appropriate cardboard or wooden container with a tight-fitting cover. Plastic generally doesn't work well because the moisture from the material cannot escape and frequently causes molding.

Collect plant parts that show evidence of insect infestation. As mentioned this could include wood and branches infested with borers, leaves infested with leafminers, plant galls infested with bugs, and insects on infested fruits and cones. Place the sam-

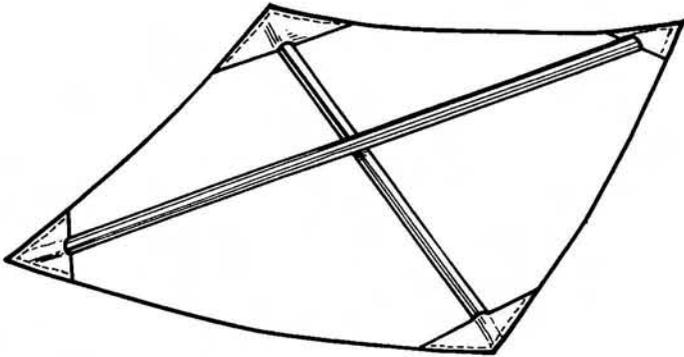


Figure 13. Beating sheet.

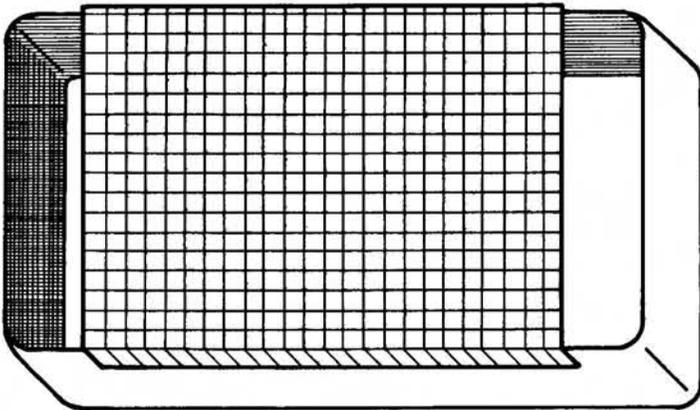


Figure 14. Beating tray with mesh cover.

ple in the separator box, put on the lid (seal it with duct tape if necessary), and set it aside. It's a good idea to write down the contents of each box and make a note of the date and collecting location.

The next step is to wait for the insects to emerge. Depending on the type of insects, this could occur in several days, weeks, or even months. Keep the box in a place where it is not subject to extreme temperatures or moisture conditions. Be patient when insects begin to emerge. They will show up in the glass container protruding from the box. Remove the insects from the collecting jar and place them in your killing jar. Be sure to make a note of the material from which the specimens emerged.

Emergence traps. Some plant-inhabiting insects cannot be extracted from plant material in separator boxes because they thrive only in **living** plants. In these cases you will have to fasten a mesh cage around the infested plant or infested plant part (fig. 16). There is no standard design as each emergence trap has to be made according to the size and shape of the plant.

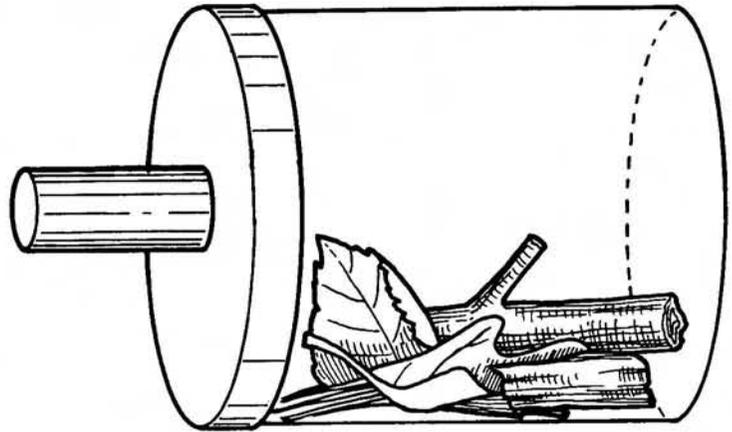


Figure 15. Separator box.

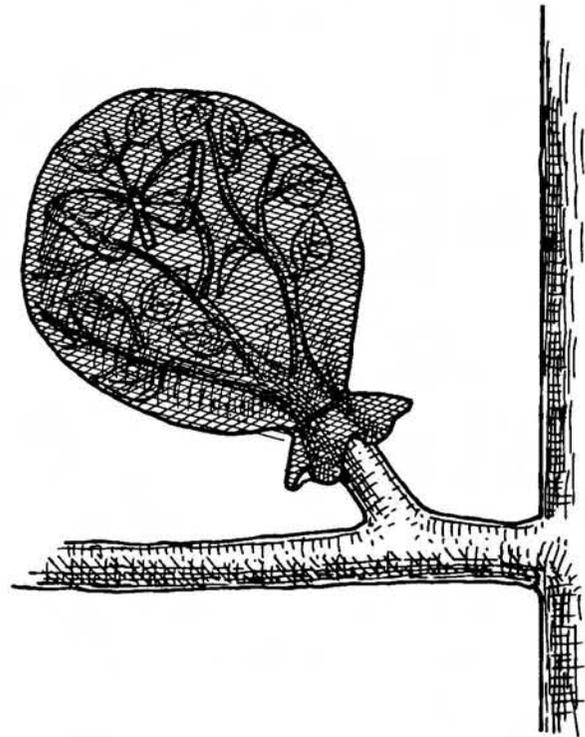
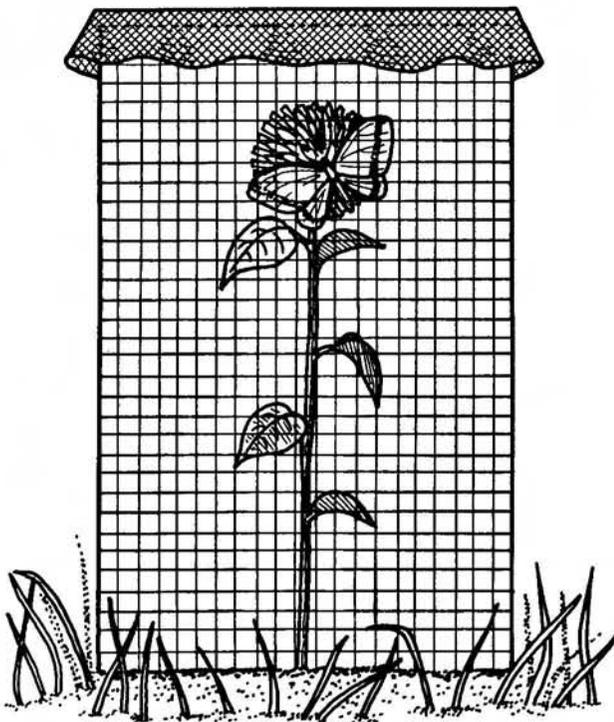


Figure 16. Emergence trap.

ANIMAL-ASSOCIATED INSECTS

Ectoparasitic insect collection techniques. Ectoparasitic insects live on the exterior of a host. The collection of these insects is generally not very easily done. One of the few successful methods is to extract specimens from recently killed birds and small mammals using soapy water or separator boxes. One note of caution is necessary, however. Obviously many of these carcasses may harbor germs and disease organisms. **Therefore, use rubber gloves when handling these animals and wash your hands with hot, soapy water immediately after you are done.** Also, it is recommended that you do this only under adult supervision.

After obtaining a suitable animal specimen, the ectoparasites can be extracted in three ways:

1. Place the specimen in a paper sack. The ectoparasites will vacate the dead host and be captured in the bag. Stun the insects in the bag with a small amount of killing fluid on tissue paper.
2. Place the specimen in a plastic bag and wash with soapy water. Pour the soapy water through filter paper or fine mesh cloth to extract the insects.
3. Place the animal specimen in a separator box (fig. 15).

All of the ectoparasitic insects should be killed and preserved in alcohol.

Animal nests collection techniques. Many animal nests provide habitats for ectoparasitic and scavenger insects. The collecting technique you choose will depend upon the type of nest involved. For example, recently abandoned nests can be hand-searched for specimens, or you could use a separator box, water flotation extraction, or a sifter. The aquatic nests of muskrats can be treaded into the water to obtain specimens. Insects that inhabit the nests of burrowing animals can often be collected by wrapping a piece of strong-smelling meat or cheese in a bundle of straw or dried grass and placing it in a nylon mesh sack (onion sack). Tie a long cord to the neck of the sack and throw it down a suitable burrow. It is best to bait several burrows since some animals may remove your sack. To check the bait, remove the sack from the burrow and extract the insects from the straw by hand or with a sifter or Berlese funnel.

Advanced Specimen Preservation

Now that you are well-acquainted with the many techniques and types of equipment used to collect insects, you can focus your attention on some important techniques for the preservation of insects and other arthropod specimens. The use of proper preservation techniques will ensure that your collection efforts are not wasted and that your specimens will last for many years. Proper preservation also adds greatly to the scientific value of your specimens.

Generally speaking, insect (and other arthropod) preservation is done by two methods. Hard-bodied insects are preserved by

dry mounting, while soft-bodied insects are preserved in liquid. Hard-bodied specimens are those whose external shapes are not altered by the drying of internal organs. Most adult insects are hard-bodied. Soft-bodied insects, on the other hand, undergo substantial shrinkage and distortion as their internal organs dry and decompose. Therefore, most immature insects (nymphs, naiads, and larvae) and some adult insects (for example, lice, aphids, termites, thrips, springtails, Psocoptera, and Thysanurans) are considered soft-bodied.

PRESERVING INSECTS

Temporary storage of specimens. As a rule, it is always best to mount hard-bodied insects as soon as possible after you have captured and killed them. Working with freshly-killed specimens will prevent damage from handling and pinning. It also allows you the opportunity to arrange the appendages (legs, wings, and antennae) in a manner which is neat and orderly.

However, it is not always possible to mount all of your specimens after each trip into the field. Therefore, it becomes important to know the methods for temporarily storing your specimens until you have time to work on them at a later date.

Most insect specimens can be temporarily stored in a refrigerator for up to a week. After you get permission to use the family refrigerator, obtain a plastic or glass container with a tight-sealing lid. Line the container with paper toweling, then put your specimens **and** a small green leaf inside. The green leaf prevents the specimens from drying out. Specimens can be indefinitely preserved if you place them in the freezer instead of the refrigerator. If you use a freezer, be sure you have a container that seals very tightly or your specimens will become freezer-burned (freeze-dried). When you remove specimens from a freezer, allow time for the container to reach room tem-

perature before removing the lid. This will prevent moisture from condensing on the specimens and possibly damaging them.

Many hard-bodied (adult) insects can be temporarily stored in a liquid preservative with satisfactory results. Occasionally some specimens will be partially covered with a yellowish or brownish stain. This stain is a grease that forms from insect body fluids which have dissolved in the alcohol preservative. If you see your alcohol turning yellow, replenish it with a fresh supply.

If you don't mind having to "relax" specimens, hard-bodied insects can be indefinitely stored in paper triangles (see 4-H 1335, *Basic Entomology*, page 14), glassine envelopes, or layered in small boxes.

Layering specimens is quite easy. Obtain a small container of plastic, cardboard, or wood, and line the bottom with several layers of tissue. Do not use cotton, as the legs and antennae get caught in the cotton fibers and are easily broken. Place a small number of specimens on the tissue "bed," allowing enough room so that none of the specimens are touching each other. Add another layer of tissue and repeat the process until the container is nearly full or until you run out of specimens. Fill any space left above the last layer of tissue with additional layers of tissue to ensure that

there is no movement of specimens when the container is closed.

Before closing the container for storage, be sure to include a label (with locality, date, and collector's name) on top of the last tissue layer. Try to use one container for **each** locality (in order to avoid mixing up the

specimens). If you must place specimens from **different** localities (or dates) in one box, be absolutely sure to separate them in **different** layers within the container. In this case you will need to put a label in each layer.

PERMANENT PRESERVATION DRY-MOUNTS

All hard-bodied insects should be dry-mounted on pins or points, depending on size. It is best to work with fresh specimens or specimens that have been temporarily stored by refrigeration, by freezing, or in alcohol.

Relaxing specimens. It is possible to mount dried material by relaxing the specimens using one of the following methods to restore moisture to them, thereby making them flexible and soft. If you try to pin a dried, unrelaxed specimen, it will crumble or the legs will fall off.

Relaxing chambers can be made from any tin or glass container with a tight-fitting lid. Tall containers work best. Place damp paper towels or 1 inch of clean, moist sand in the bottom to provide a humid atmosphere. A small amount of moth flakes or ethyl acetate should be added to prevent mold. The dried insect specimens should be laid in a flat, open dish rather than directly on the damp paper or sand. Use forceps to carefully arrange the specimens so they do not

touch one another. Place the chamber in a warm, sunny spot and check it daily to see if the specimens are flexible enough to mount. Depending on the size of the specimens, this could take from overnight to a week. Do not leave specimens in the relaxing chamber any longer than necessary.

Many specimens can be safely relaxed using steam. All you need is a pan or glass (e.g., Pyrex) container with a lid, a short glass jar, and a heat source such as a stove (see fig. 17). Place the short glass jar in the pan in an inverted position, then fill the pan with two inches of water. Place your dried specimens in a shallow dish and put it on top of the upside-down jar in the pan. Put the lid on and heat the water until it is near boiling, then reduce the heat. The steamy atmosphere will relax the dried specimens in a matter of minutes. When you remove the lid, do so by tipping it at an angle so that water does not drip onto your specimens and damage them.

Many hard-bodied insects, except those covered with scales or hairs (e.g., butterflies, moths, caddisflies, and bees), can be relaxed by placing them directly in very hot water. Sometimes hot tap water will do the trick for small specimens. Usually though, you will have to heat the water in a pan until small bubbles appear at the bottom of the pan. Then reduce the heat to keep the water from boiling vigorously. Place the specimens in the water (most will float on top) and remove them after several minutes.

Cleaning specimens. Many specimens, especially if they are taken from light traps, will be covered with dust, scales, grease, and other debris. This not only detracts from their appearance, but it may make it difficult to identify them later on. Always clean fresh or relaxed specimens to avoid damaging them. Place dirty specimens in a small con-

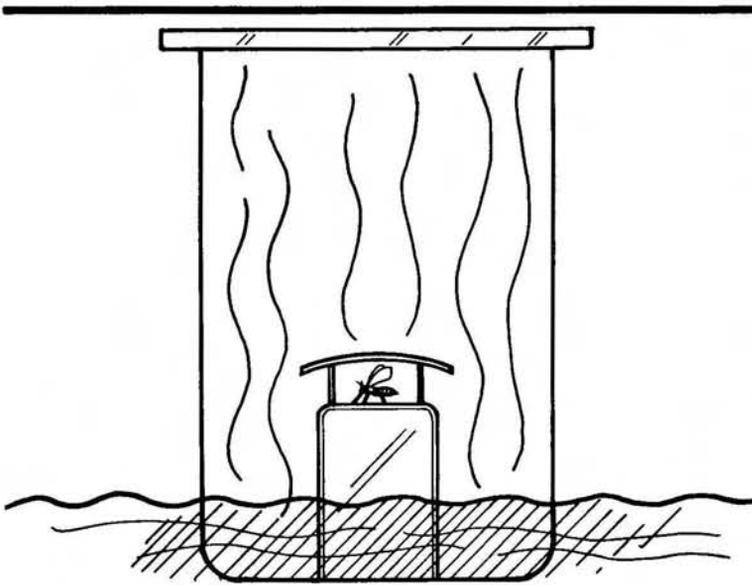


Figure 17. Relaxing a specimen using steam.

tainer filled with diluted household ammonia or household liquid detergent. Be sure to work in a well-ventilated area. After soaking for a few minutes, pick each specimen up with forceps and gently remove any debris with a soft camel-hair brush.

Repairing specimens. It can happen to anyone — you transfer a specimen from one box to another and break off a leg or antenna! Fortunately, many specimens can

be repaired by gluing the broken appendage or body part in its original position. Use a small amount of clear fingernail polish, model airplane glue, or white glue to fasten the broken part back in its original position. Be careful not to overdo it with the glue or damage the specimen further.

PERMANENT PRESERVATION IN LIQUIDS

All soft-bodied insects should be preserved in liquid preservatives. Alcohol is almost always used as an insect/arthropod preservative. **Never** use formaldehyde.

Two types of alcohol can be used: ethyl (grain) alcohol and isopropyl (rubbing) alcohol. Ethyl alcohol is preferred and is generally used in a 70 to 80 percent concentration (the rest being water). If you must use isopropyl alcohol, it is best to further dilute it with water; use distilled water, if possible. Store-bought rubbing alcohol usually comes in a 70 percent concentration. To be used as a long-term insect preservative, it should be used at a 40 percent concentration. Therefore, you must dilute the store-bought rubbing alcohol with a nearly equal amount of distilled water.

If you use the proper concentrations of ethyl and isopropyl alcohol, your specimens will remain preserved indefinitely without shrinking or hardening.

Loss of color in alcohol-stored specimens cannot be prevented. However, the black

discoloration that can occur can be prevented. This discoloration is caused by bacteria which are not killed quickly by alcohol. They must be killed by a process known as fixation. To "fix" a specimen before preserving it in alcohol, place the specimen in near-boiling water for several minutes. Do not allow the water to boil as this can cause some specimens to explode!

Finally, be sure that all of your alcoholic material is properly labeled. Include a complete locality label made out in indelible ink in each vial.

Vials are normally stored in the upright position. At least once each year, you should check the vials for cracked lids and leakage. Change old, yellowed alcohol. Do not allow vials to go dry, as this will permanently ruin specimens. If you wish to display your vials, place them on their sides and keep them in place with criss-cross pins. Prepare a locality label for each specimen and place it in the vial. Vial racks are also available and can be used.

PRESERVING OTHER ARTHROPODS

You may wish to start a collection of noninsect arthropods such as spiders, mites, ticks, scorpions, harvestmen, centipedes, millipedes, or isopods. All of these noninsect arthropods can be preserved and stored in alcohol. Even though many of these arthropods are hard-bodied, they are

not dry mounted because many of their delicate appendages (which are used for identification) would be destroyed in the process of pinning.

Storage and Care of Collections

Proper storage and care of your collection will ensure that it will last for a long, long time. You must take every effort to protect your collection from jarring and vibration, dust, light, pests and dampness.

Always keep your specimens firmly pinned to the bottom of a covered box. Keep your collection away from younger brothers and sisters, other nonentomologists, and pets. Whenever possible, keep your collection in a dark, cool location to retard speci-

men color fading. Protect your collection from pests and fungi (molds) by using a fumigant (moth balls, flakes, or crystals — paradichlorobenzene or naphthalene type), and by avoiding moist, humid situations (or use a silica gel desiccant). If specimens are properly cared for, they can last a hundred years or more!

Specialty Collections

If you're tired of making a general insect collection, try a specialty collection. Specialty collections might include destructive insects, beneficial insects, immature insects, aquatic insects, life cycles of specific insects, a specific order or a family, or gall-making insects. Use your imagination to think of additional specialty collections.

The Entomological Community

As an insect collector, you are not alone. Many people in your own community, state, country, and around the world share your interest in the insect world. You have no doubt already made friends with other collectors in your own community or county, but do you know how to go about contacting other people who live outside of your area or perhaps even on the other side of the world? It's not really as hard as you might think since many entomologists belong to various clubs or organizations.

The Michigan Entomological Society is composed of amateur and professional entomologists from Michigan, the Great Lakes region, and beyond. This organization publishes a journal and newsletter, entomology fact sheets, and collecting tips, and has an annual meeting each spring. For further information, write to the Michigan Entomological Society, c/o Department of Entomology, Michigan State University, East Lansing, Michigan 48824-1115.

The Young Entomologists' Society (Y.E.S.) is a group that caters to the young amateur entomologist, but it does have many older members too. The group publishes a journal with articles submitted by members. The group also encourages the exchange of information and specimens among its membership. This is a good group to join if you want to make contact and correspond with other collectors. For information, write to the Young Entomologists' Society, c/o Gary Dunn, 1915 Peggy Place, Lansing, MI 48910-2553, U.S.A.

Guidelines for corresponding with other entomologists. By following a few commonsense rules, you can become a reliable part of the entomological community. When you write to others, be friendly and courteous. When someone writes to you, respond as promptly as you can. Remember, if you expect to receive prompt, informative replies, you must be willing to do your part. Offer your comments, answers, opinions, and technical information freely

and you will undoubtedly establish lasting friendships with other entomologists. Someday, if you're lucky, you may even get to meet and collect with your friend.

Guidelines for exchanging specimens.

After you have collected insects in your home community for a number of years, you will probably want to collect insects from other states, regions, and countries. If you are very lucky, you can travel to these distant places and collect the specimens yourself. For many reasons, this is often not practical or possible. However, there is another way — exchanging or trading. All you need to do is contact a collector who lives in or near the desired area and ask if he/she is willing to swap some specimens. Oftentimes other collectors would like to have representative specimens from your area. Don't worry if the particular person you contact is not interested; try contacting someone else.

If you are successful in finding a willing trading partner, here are a few things to keep in mind:

1. Arrange the trade (number and type of specimens) by letter *before* sending any specimens.
2. After agreeing to a particular exchange, send the specimens as promptly as you can. If for some reason you are unable to keep up your end of the agreement, return any specimens you may have received (to preserve your reputation and good standing).
3. Send only perfect, undamaged specimens, and pack them carefully to avoid damage (see next section).
4. Generally speaking, it is illegal to mail **live** insects without a special permit from the U.S. Department of Agriculture. (The exceptions are native, nonpest insects.) If you have questions about shipping live insects, contact the nearest USDA office or the 4-H — Youth entomology specialist at Michigan State University. **Dead** specimens require no permits.

Mailing insect specimens. Because of rigorous handling during shipment, all pack-

ages of insect specimens must be carefully and properly prepared (see fig. 18). To successfully mail specimens, you will need two boxes: one for the specimens and one for the specimen box. The larger outside box should be big enough to accommodate the specimen box *plus* several inches of space on all sides.

To package your specimens, put them in the specimen box. If the insects are papered or unpinned, layer them between tissue paper (see page 13). If they are already pinned, firmly anchor them in the pinning bottom (which should be at least ½-inch thick). Large, bulky specimens should be held in place with additional pins. This keeps them from swinging about on their pins, thereby damaging adjacent specimens. Cut a small cardboard lid so that it fits **inside** the specimen box on top of the pins. Fill the space between this lid and the box top with layers of tissue. Fasten the box top in place with tape or elastic bands. Now, fill the larger box with several inches of packing material. Use Styrofoam chips, excelsior, crumpled paper, shredded rags, or cotton batting.

After placing the specimen box on top of

the packing material, proceed to fill the remainder of the space with packing material. Fill the box until the packing material holds the specimen box firmly in place, but without crushing it. Now you can tape up the box and address it. In addition to the address label, you should include a separate label which states: "**FRAGILE** . . . Dried Insects for Scientific Study . . . Handle With Care . . . No Commercial Value." Mark the other five sides of the box "**FRAGILE.**"

If the box is being sent outside the United States, you must complete and attach a postal customs declaration, which basically states that your box contains "dried insects for scientific study" with "no commercial value" so that it can be sent duty (tax) free. These forms and additional information can be obtained from any post office.

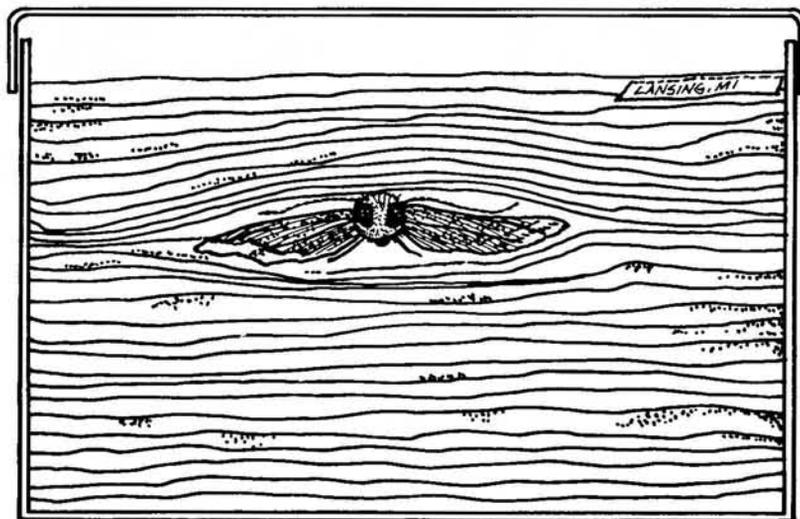


Figure 18. Properly packaged specimens.

Summary

Other project ideas and skills beyond the scope of this manual can be found in other 4-H entomology project manuals, newsletters, and other publications. Ask your 4-H leader or your county Michigan State University Extension office about these.

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NOTES



4-H Youth Programs
Michigan State University Extension

