
COLLECTION AND PRESERVING OF ORDERS OF INSECTS

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1. **Collection and preserving Entognatha (*Protura, Collenibola, Diptura*)**

Most species can be collected by sifting debris or by looking under bark or stones or in fungi. Soil, leaf litter, or other material that may contain these species can be sprinkled on to a white surface and the insects found can be picked up with a moistened brush or aspirator. Many forms are most easily collected by means of Berlesse funnel.

The best way to preserve these hexapods is in fluid – generally 80-85% alcohol. It is usually necessary to mount them on microscope slides for detailed study.

2. **Collection and preserving Apterygote insects (*Microcorphia and Thysanura*)**

Most outdoor species can be collected by sifting debris or by looking under bark or stones or in fungi. Soil, leaf litter, or other material that may contain these species can be sprinkled on to a white surface and the insects found can be picked up with a moistened brush or aspirator. Many forms are most easily collected by means of Berlesse funnel. The best way to preserve these insects is in fluid – generally 80-85% alcohol.

3. **Order: Ephemeroptera - Mayflies**

Most adult mayflies are captured with a net, either from swarms or by sweeping vegetation. One sometimes needs a net with a very long handle for swarms high above ground. Some mayflies may be taken at night at lights, especially when the nights are warm and the sky is overcast. Large numbers of adults can sometimes be obtained with a trap such as a malaise trap. Curtains of netting placed over a stream will serve as a surface on which emerging mayflies alight and from which they can be collected.

Adult mayflies are extremely fragile and must be handled with considerable care. They may be preserved dry, on pins or point or in paper enveloped, or in alcohol. Specimens preserved dry retain their colour better than those preserved in alcohol, both they sometimes become somewhat shriveled and are more subject to breakage. Adults preserved in alcohol should be preserved in 80% alcohol, preferably with 1% ionol added.

Nymphs are best put directly into modified carnoy fluid (glacial acetic acid 10%; 95% ethanol, 60%; chloroform, 30%). After a day or so, the carnoy fluid is drained off and replaced with 80% alcohol. A good substitute for carnoy fluid is Kahle's fluid (formalin, 11%; 95% ethanol, 28%; glacial acetic acid, 2%; water, 59%) This fluid should be drained off in about a week and replaced with 80% alcohol. If neither carnoy of Kahle's fluid is available, nymphs may be preserved in 95% alcohol.

4. Order: Odonata - Dragon Flies and Damselflies

The net used to capture Adonota should be open-mesh net with little air resistance so that it can be swung rapidly. The rim size should be relatively large and a long net handle.

Killing jars for Adonata should be relatively large and wide mouthed and should contain several pieces of cleansing tissue. Specimen should be removed from the killing jars as soon as they are killed, since they may become discolored if left in too long. Specimens collected in the field should be placed in enveloped, with wings folded above the body. Ordinary letter envelopes will serves this purpose, and the collecting data can be written on the outside. After returning from the field, the collector can sort out and mount the contents of the envelope.

Most often bright colour of the odonata fade after the insect dies. These colours are most likely to be retained if the species are dried rapidly in the sun, under a lamp or in the oven. If one collects odonata in numbers, they are kept in triangular paper envelopes, or one or two specimens in an envelope (never two species in the same envelope). If specimens are pinned, they must be pinned with the wings spread, with the help of a spreading board, or they may be pinned sideways. It is usually preferable to pin the specimen sideways, with the pin passing through the thorax at the base if the wings and the left side of the insect uppermost. Some specimens, particularly dragonflies, will usually have to be placed in an envelope for a few days before they are pinned, so that the wings will stay together above the body. It is often necessary to support the abdomen of a pinned specimen with crossed insect pins under the abdomen, with a strip of narrow cardboard on the pin under the insect, or bristling (a heavy bristle or a very slender insect pin shoved through the fresh specimen from front to anus).

The nymphs of odonata may be collected by various types of aquatic colleting equipment and methods. Nymphs should be preserved in 70-75% alcohol. Newly emerged adults and their exuviae should be preserved together in a pillbox, an envelope or (preferably) in alcohol. If full grown, nymphs are collected in the field, they may be brought back to the laboratory (preferably wrapped in a wet cloth or grass) and reared out in the fish free balanced aquarium. A stick must be provided for the nymphs to crawl out of the water, and the aquarium should be covered with a screen or cloth.

5. Order: Phasmida - Walking sticks and Leaf insects

Walking sticks are relatively large and slow moving and once found, are fairly easy to collect. Adults should be pinned on a piece of cardboard by pins otherwise it will sag at either end.

6. Order: Orthoptera - Grasshoppers

Many of the orthoptera, because they are relatively large and numerous are fairly easy to collect. The more conspicuous forms such as grasshoppers and crickets are most easily collected with a net, either by sweeping vegetation or by aiming for particular individuals. Some of the more secretive species may be collected at night by listening to their songs and then locating them with a flashlight or by means of various soils of baited traps. Some forms can be caught by putting molasses or a similar material at the bottom of a trap (e.g. pit trap, consisting of a can sunk in the ground). The insects so collected can simply be picked out of the trap.

Most nymphs and some soft-bodied adult species should be preserved in alcohol, but most adults can be pinned. Grasshoppers should be pinned, through the right side of the rear part of the pronotum or through the right tegem, in about the middle (from front to rear) of the body. If the specimen is very soft-bodied, the body should be supported by a piece of cupboard or by pins otherwise, it will sag at either end. In case of grasshoppers, it is desirable to spread the wings, at least on one side; in order that the colour and venation of the hind wings at least on one side; in order that the colour and venation of the hind wing can be seen. It is sometimes desirable to eviscerate some of the larger grasshoppers before they are pinned to facilitate drying and preservation. A short incision may be made on the right or left side of the body near the base of the abdomen and as much of the viscera removed as possible.

7. Order: Mantodea - Mantis

Mantis are relatively large and slow moving and once found are fairly easy to collect. The egg masses are large and fairly conspicuous, especially on the bare wings of trees.

Adults should be pinned through the right tegem, in about the middle of the body (from front to rear). If the specimen is very soft-bodied, the body should be supported by a piece of cupboard or by pins otherwise, it will sag at either end.

8. Order: Isoptera - Termites

Questions for practical – Write important differences between ants and termites.

Termites can be found by turning over dead logs or by digging into dead stumps. They may be collected with forceps or a moistened brush, or they may be shaken out of infested timbers onto a paper. Termites should be preserved in 70-80% alcohol. Most individuals are very soft-bodied and shrivel or become distorted if mounted on pins or points. It is often necessary to mount these insects on microscope slides for detailed study.

9. Order: Dermaptera - Earwigs

Earwigs generally must be looked for in various protected places; in debris, in cracks and crevices, under bark, and about the roots of grasses and sedges. They are not often collected with a net. Some will come to lights at night and some may be taken in pitfall traps. They are normally preserved dry, on either pins or points. If pinned, they are pinned through the right tegem, as are beetles and sweeping grasses. Some species are found under loose bark, on stone outcrops, in ground litter and in bird and mammal nests. Indoor species can be found in old papers and books, in stored grain and cereal products, and on wood surfaces. Individuals can be picked up with an aspirator or a small brush moistened with alcohol.

Psocides may be preserved in 70-80% alcohol, but some colour fading occurs in these preservatives. Specimens mounted on pins or points keep their colours better, but they shrivel and must be restored in liquids for study.

It is often necessary to mount specimens or parts, such as legs, wings, mouthparts and terminal abdominal segments, on microscope slides for study. For this, parts other than legs or wings should be partially cleared by scaling in a cold 10-15% aqueous solution of KOH for several minutes. They can then be washed in water and mounted in Heyer's medium, undigested material in the hindgut must be teased out with fine needles with specimen under water.

10. Order: Embiidina – Web-Spinners

In their natural habitats, these insects are probably most readily collected during and following the rainy season, while the soil is damp. Many specimens collected at this time may be immature, but they can be reared to maturity (males and females) in jars containing some dried grass and leaves that are kept somewhat moist. Web-spinners should be preserved in 70% alcohol. For detailed study, it may be desirable to clear the specimens in KOH and mount them on microscope slides.

11. Order Psocoptera – Psocids

Most of the species found in buildings are wingless and because they often live among books or paper are usually called booklice. The majority of the psocids are outdoor species with well developed wings. They occur on the bark or foliage of trees and shrubs, under bark or stones, or in dead leaves. These psocids are sometimes called bark lice.

The psocids that live outdoors can often be collected by beating braches of trees and shrubs.

12. Order: Hemiptera – Bugs

Question: Heteroptera and Homoptera. Give the students the two sub-orders for differentiation and give their sub-orders

The Hemiptera and Homoptera are very similar in many respects and are grouped by some authorities in a single order, the Hemiptera, with the two groups as the suborders Homiptera and Heteroptera (the latter including true bugs). The two groups differ principally in the structure of the wings and in the location of the beak. The front wings in the Homoptera have uniform texture throughout, either leathery or membranous, hence the name 'homo' meaning uniform and 'ptera' meaning wings. In the Homoptera, the basal portion of the front wings is usually thickened. The beak in the Hemiptera arises from the front part of the head, whereas in the Homoptera it arises from the posterior part of the head.

Terrestrial form of Hemiptera may be collected with a net (particularly sweeping vegetation), at lights, or by examining such specialized habitats as in leaf litter, under a back.

A laboratory squeeze bottle of 70% alcohol with along exit tube is sometimes useful in capturing active ground dwelling bugs. A hit with a squirt of alcohol will slow down the insect so that it can be picked up with forceps.

The best type of killing bottle for most Hemiptera is a small vial, which should be partially filled with small pieces of cleansing tissue or lens paper. One should have several such vials, since large and heavily bodies specimens should not be put into the same vial with small and delicate specimen. After specimens have been killed, they should be taken from the vial and placed in pillboxes that are partially filled with cleansing tissue or cellucotton.

Most Hemiptera are preserved dry on pins or points. The larger specimens should be pinned through the scutellum, and the smaller specimens through the right hemelytron. Care must be taken in pinning a bug not to destroy structures on the vertical side of the thorax that will be used for identification. Most Hemiptera less than 10 mm in length should be mounted on points. Specimens mounted on points should be mounted so that beak, legs and ventral side of the body are not embedded in glue. The best way to mount a small bug on a point is to bend the tip of the point down and glue the bug to the point by the right side of the thorax. If a specimen is mounted dorsal side up on the tip of the point, the point should not extend beyond the middle of the ventral side of the insect.

It is desirable to mount these insects, particularly the soft-bodies ones as soon as possible after they are captured. A field catch can be stored in 70 or 75% alcohol until the specimens can be mounted, but alcohol will cause some colours to fade. All nymphs should be preserved in alcohol.

13. Order: Homoptera – Hoppers, Psyllids, Whiteflies, Aphids, Scale Insects

Most of the active species of Homoptera are best collected by sweeping. Different species occur in different types of plants, and one should collect from as many different types of plants as possible to secure large numbers of species. The small hopping specks may be removed from the net with an aspirator or the entire net contents can be stunned and sorted later. Forms that are not too active can be collected from foliage or twigs directly into a killing jar, without using a net.

Cicadas, the various hoppers, whiteflies and psyllids are usually mounted dry, on either pints or points. If a larger hopper is pinned, it should be pinned through the right wing. White flies and psyllids are sometimes preserved in fluids and mounted on microscope slides for study. Aphids that are pinned or mounted on points usually shrivel. These insects should be preserved in fluids and mounted on microscope slides for detailed study.

Scale insects may be preserved into two general ways. The part of the plant containing the scales may be collected, dried and mounted (pinned or in a riker mount), or the insect may be specially treated and mounted on a microscope slide. No special techniques are involved in the first method, which is satisfactory if one is interested only in the form of the scale. The insects themselves must be mounted on microscope slides for detailed study. The best way to secure male scale insects is to rear them. Very few are collected with a net.

In mounting a scale insect on a microscope slide, the scale is removed and the insect is cleaned, stained and mounted. The following procedures are specifically recommended for mounting scale insects.

- (a) Place the dry scale insect or fresh specimens that have been in 70% for at least 2 hours, in 10% potassium hydroxide until the body contents are soft.
- (b) While the specimen is still in the potassium hydroxide, remove the body contents by making a small hole in the body (at the anterior and or at the side where no taxonomically important characters will be damaged) and pressing the insect.
- (c) Transfer the specimens to acetic acid alcohol for 20 minutes or more. Acetic acid alcohol is made by mixing 1 part of acetic acid, 1 part of distilled water and 4 parts of 95% alcohol.
- (d) Stain in acid fuchsin for 10 minutes or more, and then transfer to 70% alcohol for 5 to 15 minutes, to wash out excess stain.
- (e) Transfer the specimen to 95% alcohol for 5 to 10 minutes.

(f) Transfer the specimen to 100% alcohol for 5 to 10 minutes.

(g) Transfer the specimen to clove oil for 10 minutes or more.

Aphids should be preserved in 80 to 85% alcohol and can often be collected from the plant directly into a vial of alcohol. Winged forms are usually necessary for specified identification and should be mounted on microscope slides.

14. Order: Thysanoptera – Thrips

Thrips can be found on flowers, fruits, bark, foliage and fungi and inn debris. The species occurring on vegetation are most easily collected by sweeping. They may be removed from the net by stunning the entire net contents and sorting out the thrips later or the net contents may be shaken onto a paper and the thrips picked up with an aspirator or with a moistened camel hair brush. Dark species are best seen on a light paper and light species on a dark paper. If host data is desired, the specimens should be collected directly from the host plant. The best way to collect flowering-frequenting species is to collect the flowers in a paper bag and examine them later in the laboratory. Bark and bench-inhabiting species can be collected with a beating umbrella.

Thrips should be preserved in liquid and mounted microscope slides for detailed study. They may be mounted on points, but species so mounted are usually not very satisfactory. The killing solutions AGA, which contains 8 parts of 95% alcohol, 5 parts of distilled water, 1 part of glycerene and 1 part for glacial acetic acid. After a few weeks, specimens should be transferred from this solution to alcohol (about 80%) for permanent preservation.

15. Order: Neuroptera – Lacewing, Entilions

Most Neuroptera can be collected with insect nets, sweeping vegetation. The best way to collect many Neuroptera, particularly representatives of the less common groups, is with lights.

Adult Neuroptera are preserved in alcohol, or on pins or points, or in envelopes. All are relatively soft-bodies, and pinned specimens are often shriveled and become distorted. Many pinned specimens need some support for the abdomen, at least until the insect has dried. Very small forms can be mounted on points, but preservation in alcohol is better. Large elongate forms, such as antinion can be preserved in envelopes.

16. Order: Coleoptera – Beetles

Several general collecting procedures may be noted:-

(a) Many species may be taken by sweeping in a variety of situations.

- (b) Many species, often strikingly coloured, may be taken on flowers.
- (c) A number of species, such as carrion beetles and others may be obtained by means of suitably baited traps.
- (d) A number of species are attracted to light at night and may be collected at lights or in alight trap.
- (e) Beetles of many groups are to be found under bark, in rotting wood, under stones and in similar situations.
- (f) Many species may be obtained by sifting debris or leaf litter.

Most beetles are preserved pinned (through the right clytron) or on points. When a beetle is mounted on point, it is important that it is mounted so that the ventral side of the body and the legs are visible. The tip of the point may be bent down and the specimen attached to this bent-down tip by the right side of the thorax. It may sometimes be desirable to mount two specimens on the same point (when one is sure they are the same specimens), one dorsal side up and the other ventral side up. Many of the more minute beetles must be preserved in alcohol (70-80%) and mounted on a microscope slide for detailed study.

17. Order: Diptera – Flies

The general methods of collecting Diptera are similar to those of collecting other insects. To obtain a large variety, one must collect in a variety of habitats. Many of the smaller species can be best collected by sweeping, putting the entire catch into the killing bottle, and examine it carefully later. Various types of baits are useful collecting devices.

Most Diptera, particularly the smaller specimens should be mounted as soon as possible after they are captured because they dry quickly and are likely to be damaged in mounting if they are dried out very much. Many of the smaller and more delicate specimens, such as nudges and similar forms should be handled very carefully in order to avoid rubbing off the minute hairs and scales, which are often important in identification, particularly if the specimen is ever identified to species. The only way to get good specimens of many of these delicate forms is to rear them and to get them into a killing jar without using a net.

The larger Diptera are preserved on pins, and the smaller specimens are mounted on points, minute pins or microscope slides. In pinning a fly, particularly the muscoids, it is important that the bristles on the dorsum at the thorax be kept intact; the pin should be inserted to one side of the midline. If the specimen is too small to pin this way, it should be mounted on a point should be on their right side with the wings together above their body and lying along the point and the body at right angles to the point. If a

specimen to be mounted on a point dies with its wings bent down, the wings can often be snapped into the vertical position by gently squeezing the thorax with forceps. This procedure should be carried out as soon as possible after the insect dies. Some of the more minute specimens should be preserved in fluids and must be mounted on microscope slides for detailed study.

18. Order: Lepidoptera: Butterflies and Moths

Lepidoptera are generally fairly easy to collect, but they are more difficult to mount and preserve in good condition than insects in most other orders. Specimens must always be handled with great care because the scales, which give the specimens their colour, are easily rubbed off, and in every species the wings are easily torn and broken.

Lepidoptera may be collected with a net or they may be gotten directly into a killing jar without the use of a net. A net for collecting these insects should be fairly light mesh, light enough that the specimen can be seen through the net. Once netted, a specimen should be gotten into a killing jar or stunned as quickly as possible so that it will not damage its wings by fluttering and attempting to escape. Many collectors prefer to insert the killing jar into the net to get specimens into the jar without handling the specimens directly. The killing jar should be of sufficient toxic strength to stun the insect quickly. If the specimen is removed to the killing jar by hand, it should be grasped carefully through the net by body, pinched slightly to stun it and then placed in the killing jar. It is not recommended that delicate species be pinched. Large moths are more easily killed by the injection of alcohol into the thorax with a hypodermic needle (only a few traps are needed).

Many moths can be taken directly into a killing jar without the use of a net. A wide mouthed jar is simply placed over the specimen when it is resting on some flat surface. The jar should be strong enough to stun the insect quickly, before it can flutter about too much inside losing hair and damaging its wings.

The best place to collect most Lepidoptera is near the plant on which the larvae feed. Many species of Butterflies may be collected while feeding on the flowers they frequent. To obtain a large number of species, one must visit a variety of habitats and collect at all seasons. Many species occur only in certain habitats and many have a short adult life and are on the wing only a short time each year.

Many moths are mostly easily collected at lights, especially ultraviolet lights. They may be collected by traps, but specimens collected in this way are often in poor condition unless special precautions are taken. Traps should have a screen of 3/8 inch mesh near the bottom to keep large specimens away from the smaller ones, and there should be plenty of folded paper and the like to provide hiding places. A strong killing poison is needed and thus considerable care is need in the operation of the trap.

Specimens can be collected at light if there is a flat white surface near the lights for the insects to land on. The specimens can be taken directly from such a surface into a killing jar. Many interesting species can be obtained by sugaring.

One must take precautions to prevent specimens from becoming damaged after they are placed in the killing jar. The jar should be strong enough to stun a specimen quickly. Large and heavy bodied specimens should not be placed in a jar along with small delicate ones. The jar should not be allowed to become too crowded. It is advisable to remove the specimens soon after they have been stunned and then place them in paper envelopes. Small vials with ethyl acetate, with pieces of cleansing tissue inside will prevent the insects from touching each other too much.

The best way to obtain good specimens of many species is to rear them, from either larvae or pupae. By rearing, the collector not only obtains good specimens, but also can become acquainted with the larval stages of different species and the plants on which the larvae feed.

Specimen of Lepidoptera can be preserved in a collection in three ways:- (i) paper envelopes as in the case of Odonata and some other groups, (ii) spread and pinned, (iii) and spread and mounted under glass mounts. Envelopes are used for temporary storage or in cases where the collection is large and space is not available for large-numbers of spread specimens. The best collections of Lepidoptera have the specimens pinned and spread. Many collectors found it best to field pin the smaller moths and spread them later. Moths with a wingspread of less than 10mm should generally be pinned with a minute pin and double mounted.

All Lepidoptera that are pinned or mounted under glass should be spread. The specimens should be spread in an upside down position and mount them in a glass mount.

In a large collection of pinned Lepidoptera, spaces can be saved by putting the pins into the bottom of the box at an angle and overlapping wings of adjacent specimens. A collection must be protected against pests by having naphthalene or some similar repellent in the boxes. It should be kept in the dark, for many specimens will fade if exposed to light for long periods.

19. Order: Hymenoptera – Sawflies, Parasitic Wasps, Ants, Wasps and Bees

Species of Hymenoptera are found to be almost everywhere and to secure a large variety of species, one should examine all available habitats and use all available methods of collecting. Many of the large and showier Hymenoptera are common on flowers. The parasitic species may be reared from parasitic hosts, or they may be taken by sweeping. Passive trapping technique and fan traps are extremely effective in capturing a wide diversity of species that would otherwise go unnoticed. A number of species search for host or prey underground and are best collected by using Herlese funnels.

Since many of the Hymenoptera sting, it is well to exercise care in removing them from the net, and then put this fold into the killing jar until the insect is stunned. Another effective method is to get the insect confined in the end of the net (almost all winged aculeates will fly upward towards the light), grasp the end of the net from the outside just below the insect, and then reach inside with the killing jar and evert the end of the net into the jar, put the top over the net and slide the net out between the jar and the lid. Any large Hymenoptera should be handled with care. Many stinging Hymenoptera feeding on flowers can be collected directly into the killing jar without the use of a net. Most Hymenoptera can be easily killed using a jar charged with ethyl acetate. In addition, because they are generally sturdier than Diptera, for example, Hymenoptera can be killed and stored in alcohol and later dried and mounted. Often sweeping vegetation and dumping the contents into alcohol is the most time-efficient method for capturing micro-hymenoptera.

The smaller Hymenoptera should be mounted on a point, or if they are extremely minute, they should be preserved in liquid or mounted on a microscope slide. It is usually necessary to mount the more minute forms on microscope slides for detailed study. Some of the best characters for identification of bees are in the mouthparts; therefore the mouthparts of these insects should be extended if possible. All specimens whether pinned or mounted on points should be oriented so that the leg and thoracic characters and venation can be easily seen.