

**Basically Bats Wildlife Conservation Society Presents...**  
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## Chapter Fourteen

# MAINTENANCE OF INSECT COLONIES

For cost-effectiveness, commercial dealers must sell insects in relatively large quantities; therefore, it may be less expensive to culture them when maintaining only one or two bats. Unfortunately, insect cultures often become contaminated with arthropod pests such as grain mites (*Tyrophagus* spp.). While the mites are not usually harmful to bats, they do compete with them for nutrients that would otherwise be available to the bats. These mites also have occasionally caused unspecified dermatitis in bats housed adjacent to a [tenebrionid] culture. Of recent concern, however, is the possibility of hydroquinone poisoning from bedding that may become contaminated from secretions by adult tenebrionid (mealworm) beetles. The reader is directed to the discussion on *Poisoning* in Chapter 9.

For workers who keep more than one or two bats, it is much less labor-intensive to purchase food insects. These can be refrigerated for varying time periods. For example, mealworms (*Tenebrio molitor*) can survive 1 to 2 months under refrigeration, waxworms (*Galleria mellonella*) about 1 to 3 weeks and crickets (*Acheta domestica*) approximately 24 to 60 hours. Avoid freezing insects because bats may refuse to eat them. Also, dead insects begin decaying immediately after they have been defrosted, and the potentially spoiled food could cause a bat to become sick.

Although dealers suggest that insects be refrigerated in the container in which they are shipped, to do so over a prolonged period of time may produce dietary deficiencies in bats (also see Chapter 7, FEEDING ADULT BATS). I have found that mealworms eat significant amounts of food even under refrigeration, and for this reason, newly purchased mealworms should be removed from the shipping box as soon as possible, and placed into a vegetable crisper or similar container (FIG. 108). To each container of 2,500 mealworms, add the following ingredients:

- Oat bran . . . . . 1 cup
- Wheat bran . . . . . 1 cup
- Powdered multivitamins containing vitamin D3 (e.g., Theralin®) (FIG. 61, Chapt. 7) . . . . . ½ cup
- Bone meal powder (sterilized) (FIG. 60, Chapt. 7) . . ½ cup
- Leafy greens, unchopped (e.g., collards, spinach, cabbage, Mustard greens, kale, etc.) . . . . . 1 cup
- Potato or apple . . . . . ½



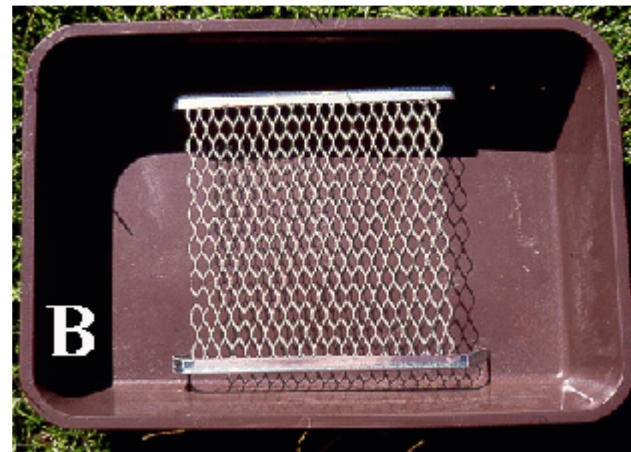
**Fig. 108.** A refrigerator crisper is an ideal container for storing between 10,000 and 20,000 mealworms (*Tenebrio molitor*).

Mix the mealworms and additives thoroughly. This recipe can be adjusted accordingly to the number of mealworms purchased. Do not cover the container, as mealworms require plenty of oxygen. Replace leafy greens when they dry out.

When purchasing large quantities of mealworms, hand-sorting them from the substrate, shed skins, and dead mealworms, can be time-consuming. Instead, place the approximate number of mealworms to be fed off in a large strainer. Sift out the fine particles, then pour the mealworms and coarse debris onto a clean, loosely woven dishcloth, laid flat on a paint grid, within a [kitty-litter] pan (FIG. 109). Set the pan 1-2 feet from a 60 W lamp. The live mealworms will migrate under the dishcloth to avoid the light, leaving the debris on the surface of the cloth where it can be discarded easily. The live mealworms can then be counted and fed to the bats.



**Fig. 109.** A) mealworms (*T. molitor*) can be sorted from growing medium and other debris if they are placed on loosely woven fabric such as a dishcloth. B) mealworms sort more easily if the dishcloth is placed on a paint grid.



For anyone wishing to culture insects, the following can be maintained as food sources for all species of captive, insect-eating animals. When fed in combination, they offer a reasonably diverse diet.

## MEALWORM (*Tenebrio molitor*) COLONY

### Materials:

1,000 mealworms (FIG. 110)  
(preferably of mixed sizes)

1 wide-mouth gallon jar or other  
appropriate-sized container  
(FIG. 111a)

Cheesecloth

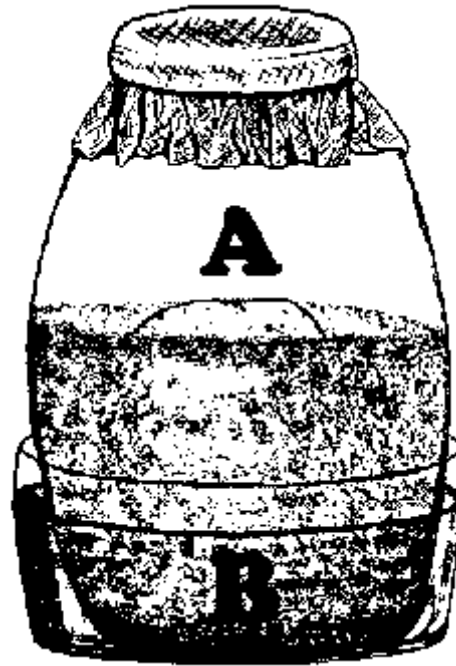
String or rubberband



**Fig. 110.** Mealworms (*T. molitor*). Inexperienced people caring for wildlife may confuse mealworms with earthworms when receiving instructions on their care. Bats do not eat earthworms (photo courtesy of Gregory C. Greer, Marietta, GA)

Mite trap (bowl of water) (FIG. 111b)

10-inch forceps



*Fig. 111. Wide-mouth gallon jars (A) make suitable containers for culturing mealworms (*T. molitor*). It is, however, advisable to place them in a dish of water (B) to serve as a mite trap (from Barnard, 1986)..*

### Medium:

Enough Quaker® oats to fill jar half-way

¼ cup bone meal powder (sterilized brand) (FIG. 60, Chapter 7)

¼ cup multivitamin powder (e.g., Theralin®) (FIG. 61, Chapter 7)

½ potato or apple (necessary for moisture)

Thoroughly mix the oats, bone meal and multivitamin powders in the jar. Add the mealworms and gently swirl them into the medium. Place ½ potato on top of the medium and secure the cheesecloth cover with a piece of string or a rubberband. For reasons explained below, place the jar in a bowl of water.

Ground monkey chow, dry dog food, laboratory rodent chow, and chick starter, have all been used for growing mealworms, but these commercial animal diets often contain arthropod pests that can contaminate the culture. A medium intended for human consumption is less likely to contain such contaminants. Nevertheless, grain mites (*Tyrophagus* spp.), commonly found in stored food, are always a potential problem because their eggs may adhere to the mealworms purchased. When these mites infest an insect culture, they can develop large populations. Placing the mealworm jar in a bowl of water prevents mites from dispersing into the surrounding area. If mites or other pests are observed, discard the infected colony.

A mealworm colony should be changed several times a year to fresh medium. First pour ALL contents from the old jar into a clean one, discarding only the moist, hard sediment on the bottom. Add enough fresh oats to fill the clean jar half-way. Mix in cup multivitamin powder and cup bone meal. Place ½ fresh potato or apple on top of the new medium, but never discard old potatoes or apples because mealworms lay their eggs in them.

To prevent hydroquinone poisoning, never feed bats mealworms taken directly from a



culture. Always refrigerate them for approximately 2 weeks, in the medium discussed on page. Mealworms are removed easily from the jar with 10-in. forceps. An appropriate number should be placed in a 100 x 20 mm **glass** Petri dish when feeding bats (see Chapter 7 under ROUTINE FEEDING OF INSECTIVOROUS BATS).

## WAXMOTH (*Galleria mellonella*) COLONY

### Materials:

1 starter-culture of waxmoth larvae (FIG. 112) (see APPENDIX I for availability)

1 5-gal. plastic container with tightly sealing lid (cut hole in lid and cover with metal screen) (FIG. 113a)

Mite trap (pan of water; FIG. 113b)

Lamp with 60-100 W incandescent bulb

½ lb. medium\*

\* Medium (modified from Dutky et al., 1962):

1-lb. box mixed Gerber's® baby cereal

¾ cup glycerine

½ cup sugar

½ cup tap water

12 drops Avitron® multivitamins (FIG. 57, Chapter 7)

2 Tbsp. bone meal powder (FIG. 60, Chapter 7)

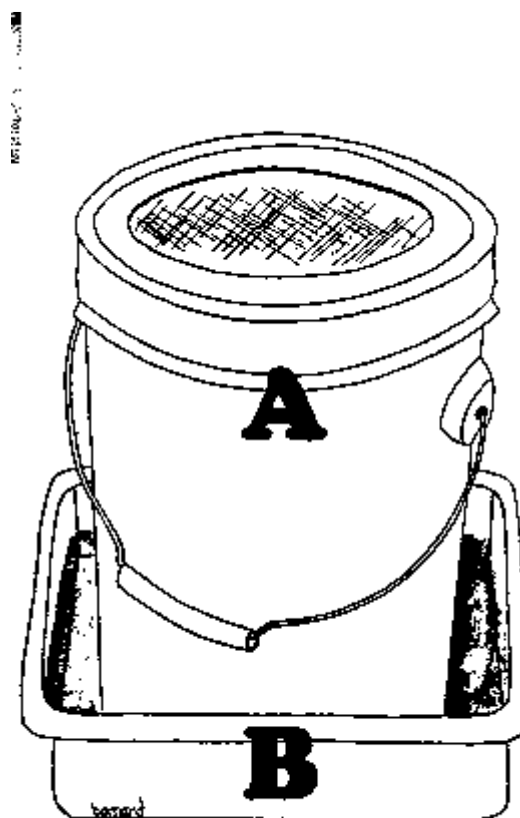


**Fig. 112**  
Waxmoth larvae (*Galleria mellonella*), also called waxworms, are parasites



of beehives and must not be released into the wild (photo courtesy of Lee Gilman, Charlotte, N.C.)

**Fig. 113A & B.** A five-gallon plastic bucket (A) makes a suitable container for culturing waxworms (from Barnard, 1986). To prevent larvae, or their parasites, from escaping into the environment, place the bucket in a pan of water (B).



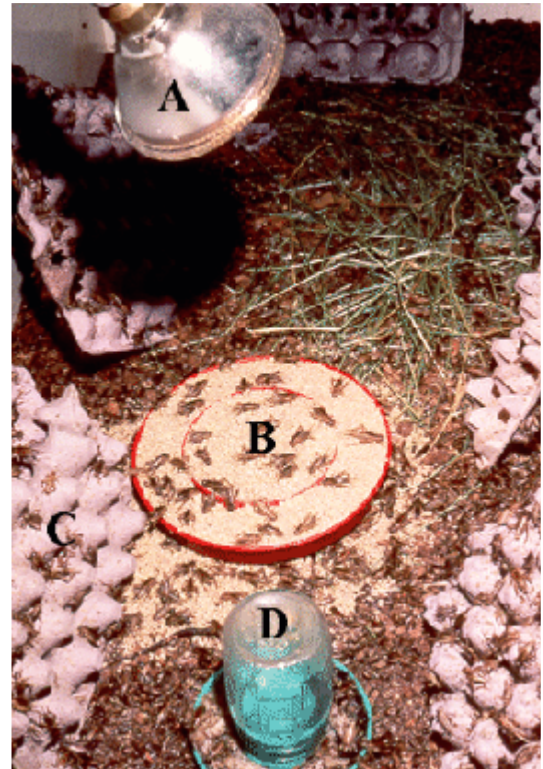
Place the larval starter-culture on the bottom of the container with the medium. Cover the container and place it in a pan of water to prevent pest infestation (as discussed above), and also to prevent any waxmoth larvae, also called waxworms, from migrating outside the container. Set the lamp about 6 to 8 in. from the pan (be careful that the lamp does not melt the plastic container or pan). Waxworms develop most rapidly at temperatures between 80-90 F (26.7-32 C).

Check the culture periodically for appropriate-sized larvae to feed to bats. Do not feed bats too many moths, both because they are necessary to continue the culture, and they are not as nourishing as the larvae. Add more food when the medium appears to be riddled with larvae and cocoons. If portions of the contents become moldy, remove them immediately. Surplus waxmoth food can be stored in the refrigerator for several months if sealed tightly in a plastic bag.

**IMPORTANT NOTE:** excess waxmoths should never be released because they parasitize bee hives. When a waxmoth culture becomes too large, part of it can be given to owners of insect-eating pets, or unwanted portions may be destroyed under scalding hot water.

### **CRICKET (*Acheta domestica*) COLONY**

**Fig. 114.** Crickets may be intermediate hosts for bat endoparasites. Only feed those that are available commercially. A) heat lamp; B) wild bird food; C) egg carton; D) poultry water dispenser (also see **Figure 115**).



### Materials:

1,000 or more crickets for large culture\*

1 or 2 doz. crickets for small culture\*

1 wooden bin (approx. 2 ft. wide X 2 ft. high X 1 ft. deep) with screen lid (FIG. 115)

Enough peat moss to cover bottom, about 2 to 3 in. deep

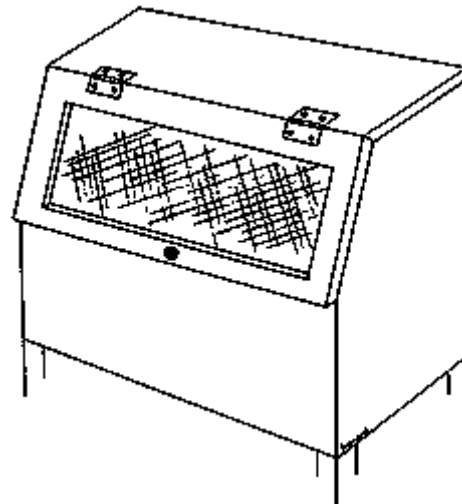
Chick starter or game-bird chow in any type of flat dish

Fresh greens (collards, clover or grass, etc., that are free of toxic chemicals)

1-pt. poultry water dispenser (FIG. 116; also see FIG. 114)

Paper towels

Cardboard egg containers (these are usually shipped with the crickets)



**Fig. 115.** A plywood box with a screened, metal lid, can be constructed for housing crickets (from Barnard, 1986).

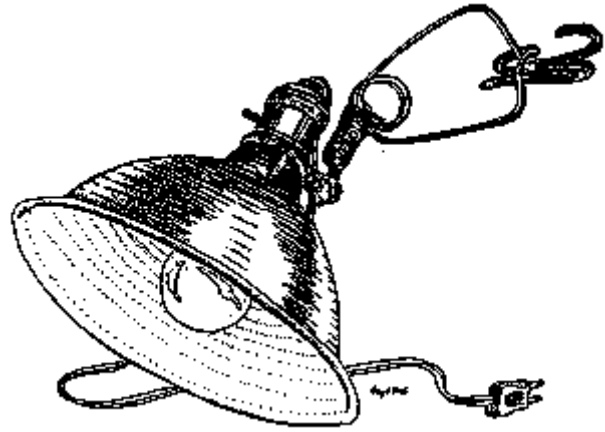


**Fig. 116.** A poultry water dispenser can be used for providing moisture to crickets. To prevent the insects from drowning, place paper towels in the base (from Barnard, 1986).

Lamp with 60-100 W incandescent bulb (FIG. 117)

Appropriate-sized collecting jar and funnel

\*See FIG. 118 (bottom of page) for available sizes of crickets.



*Fig. 117. Clamp-on lamp used frequently in zoological institutions for auxiliary heat (illustration courtesy of Cathy Taibbi, Jonesboro, GA).*

When housing 1,000 or more crickets, the bin can be made of ½-in. plywood. Carefully sand the inside walls smooth to within 4 in. of the top of the container and apply glossy paint (crickets cannot climb on this surface). Spread dry peat moss over the bottom of the box and place the chick starter, water and greens in the center. The poultry water dispenser should be lined with 2 or 3 paper towels to prevent the crickets from drowning; they will drink from the soaked towels. Add the crickets to the bin and cover with a metal screened top. Place the lamp over the screened top to provide warmth (approx. 75 F; 24 C). To prevent the cricket bin from becoming infested with pests, it may be necessary to place each leg of the bin in a container of water, or to ring each leg generously with vasoline.

The water dispenser should be cleaned and paper towels replaced when necessary. Remove old greens and replace with fresh material every 2 to 3 days, and replenish the chow as needed. The peat-moss bedding should be kept dry and changed every 1 to 2 weeks. To do this, remove the water, greens and chow. Place the egg cartons at one end of the bin and wait until the crickets have migrated to the cartons. Change one half of the bedding; place the egg cartons at the opposite end of the bin, and repeat. Replace the water, greens and chow when finished. When collecting crickets from the bin, insert a funnel into a collecting jar and shake the crickets from the cardboard egg containers. Because adult crickets live about 2 weeks, use them as soon as possible. Before feeding crickets to bats, remove their jumping legs to assist the bats in catching them. For a diverse diet, feed in combination with mealworms and waxworms.

The ["feed-off"] bin is solely for cricket storage, as they cannot be refrigerated for more than 24-60 hours. Therefore, to breed and raise crickets, it will be necessary to have on hand the following additional supplies:

2 10-gal. aquariums (1 for breeders; 1 for hatchlings)

Misting bottle (FIG. 119)

2 lamps with 25-40 W incandescent bulbs

4 jar lids or Petri dishes

*Fig. 119. Misting bottle used for*

2 cardboard egg containers

Potting soil or peat moss

Newspaper



*maintaining moisture in substrate containing cricket eggs (illustration courtesy of Cathy A. Taibbi, Jonesboro, GA).*

2 small sponges

1 appropriate-sized bowl

Line the bottom of one aquarium with newspaper and the other with about 1 to 2 inches of potting soil or peat moss. Into the aquarium lined with newspaper, place about 2 to 3 dozen crickets at a sex ratio of approximately 1:6 males to females (females have long ovipositors protruding posteriorly from their abdomens). This will be the breeding aquarium. Also place a cardboard egg container and two Petri dishes in each aquarium. Two Petri dishes are for food (feed with diet discussed above) and in the other two, place well-soaked sponges. In a corner of the breeding aquarium, place a bowl filled with potting soil or peat moss. Be sure the soil or moss is kept damp, not wet. This can be done with the misting bottle. Cover the aquarium with a lid, and place it next to the lamp to maintain the temperature at 80 F (26.7 C). Remove moistened soil or moss containing the eggs from the bowl weekly, and add it to the other aquarium reserved for raising the hatchlings.

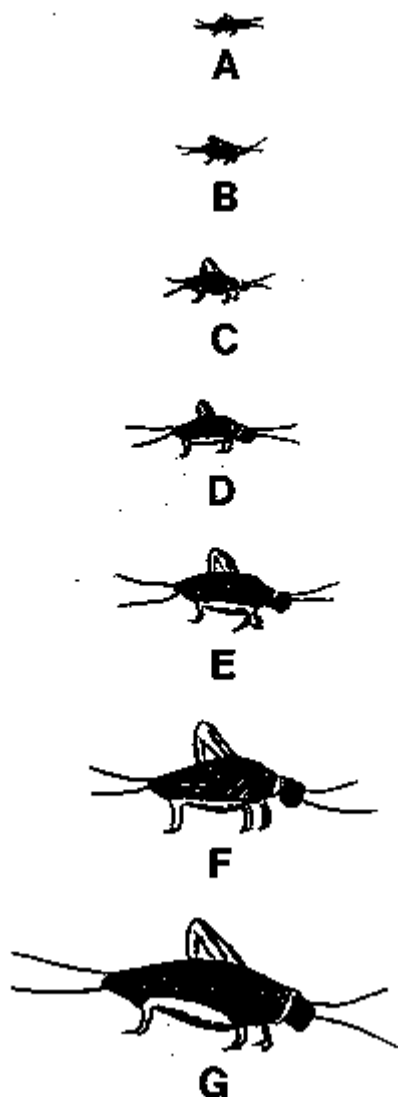
After the first eggs have been placed in the second aquarium, maintain the aquarium in the same manner as the feed-off and breeding containers. The substrate containing eggs must be kept damp. It is important not to mix the hatchlings with adults, as the adults may eat them.

Eggs require 3 to 4 weeks to hatch, and young mature within 3 to 4 months. Additional aquaria can be used to separate hatchlings according to size. When hatchlings approach adult size, they can be placed into the feed-off bin.

**Fig. 118.** Cricket sizes that are available commercially. A) pin-head, 1/8 in. (~0.3 cm); B) one week old, 3/16 in. (~0.5 cm); C) two weeks old, 1/4 in. (~0.6 cm); D) three weeks old, 3/8 in. (~0.95 cm); E) four weeks old, 1/2 in. (~1.3 cm); F) five weeks old, 3/4. (~2 cm); G) adult, 1 in. (~2.5 cm) (from Barnard, 1986).



## Actual Sizes



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