# Everything you have always wanted to know about live food…

*We have received a number of requests to publish an article on live foods. As proprietor of* ***Livefoods Unlimited****, with more than 10 years experience in the commercial production of live food items for the hobby,* ***Rob Porter*** *is eminently qualified to address this topic.*

Lizards and frogs have become popular choices as captive subjects over the last 20 years as many are relatively small, attractive, interesting and, by comparison with many pet birds and mammals, low maintenance in their care. One big problem for many species is their requirement for live insect prey as a staple or major part of their diet. Depending on the time of year this need for specialized dietary items can be somewhat overwhelming, particularly if a large herp collection is maintained and the option of collecting food from the wild becomes impractical. Thankfully most keepers can rely on the convenience and reliability of supplies of commercially bred insects to satisfy their charges' appetite. Compared to markets in Europe and the USA our choice of available insect species is severely limited, a by-product of Australia's stringent quarantine laws. However, there is currently a sufficient range of insects readily available from a handful of commercial suppliers to meet the requirements of the majority of insectivorous reptiles and amphibians. This article will cover general information on each of the most common species including how to maintain them to ensure they are in the best possible condition before becoming part of your herp's menu.

Currently there are four main insect species available from commercial live food breeders; the Wood or Madeira Cockroach (or "woodie"), the Brown Cricket and two mealworm species (the common and giant mealworm). In addition to these there are a few other species that are occasionally offered such as silkworms, garden snails, earthworms and very rarely waxworms (although the insects sold as waxworms are in reality often the larvae of a meal moth). Most of these are excellent food items but can be very expensive, seasonally available and are sometimes of limited appeal to some reptiles and amphibians.

**Wood Cockroaches (*Nauphoeta cinerea*)**

This species is also known as the Madeira, Lobster or Speckled Feeder Cockroach or more commonly the woodie. It is an introduced insect that has become naturalised on the eastern seaboard of Australia but has not become a pest like the familiar American or German cockroaches. Woodies are fairly long-lived, potentially reaching 8-10 months of age, although this is highly temperature dependant. All insects are ectothermic, meaning that like reptiles and amphibians they need an external heat source to fuel their normal body metabolism. Higher temperatures generally mean a faster metabolic rate, increased growth rates but also reduced longevity, so if you want your insects to live a little longer keep the temperatures slightly cooler (e.g. an ambient temperature of 20-25°C is fine for most insects).

Woodies progress through a series of skin moults as dark, glossy brown immature roaches until their final moult into mature winged adults with pale brown wing covers. The occasional white specimens seen in colonies are not albinos, as sometimes suggested, but individuals that have recently undergone a skin shed; the new skin beneath has not yet hardened and pigmented. A few days after the final moult mating takes place and about a week later the female produces an egg case. Unlike most other species this egg case is retained inside the female and actively incubated for four to five weeks until it is almost ready to hatch. The mother then exudes the batch of eggs and carries them around attached to the end of her abdomen for a short period of time until the tiny white babies emerge and disperse. The hatchlings reach maturity in two and a half to three months.

Generally woodies can be kept together as a colony of mixed sizes from hatchlings through to adults but some cannibalism may occur at really high population densities. One little trick is to place a couple of bunches of plastic drinking straws in their box for the babies to hide in. This is also a nifty way to collect juveniles for feeding out as well; just shake them out of the straws into a container.

On obtaining your batch of woodies by mail or from a

***Main photograph:*** *Ridge-tailed Monitor (Varanus acanthurus) in the process of consuming an adult 'woodie'.* ***Below:*** *Giant mealworms on their food medium, in this case wheat pollard but unprocessed bran is also suitable. Note the granular nature of some of the medium, these are mealworm droppings and indicate it is time to change the medium and provide fresh food. All photographs by Rob Porter.*

***Top left:*** *Wood Cockroaches (Nauphoeta cinerea). The mature adult cockroaches are the ones with the pale brown wing covers, the dark brown insects are immature cockrooches that have yet to go through the final moult, while the white individual at the top has recently shed its skin and will develop normal pigmentation over the next few hours.* ***Bottom left:*** *Example of a suitable set up for holding crickets until they are fed out. The dish contains rodent pellets but a good quality dog biscuit would also fit the bill. Vegies such as carrot can be supplied in large pieces and don't need to be sliced or grated. Note the large number of hiding places provided by egg cartons and cardboard rolls. This set up is also ideal for woodies with the addition of a barrier around the top of the inside of the box to stop them crawling out, such as Fluon or Vaseline.* ***Bottom right:*** *Example of a commercial facility for large-scale breeding of crickets at Livefoods Unlimited.*

pet shop they will need to be transferred into a suitable holding tub. Don't leave them in the bag or takeaway container they arrived in, as they will be dead within a couple of days. This applies to all commercial insects; there simply isn't sufficient ventilation and space in these containers for the insects to survive over a long period. The best option is one of the cheap plastic roller boxes available from most variety or hardware stores. The size will depend on the age and number of insects to be housed. In most cases a 60 litre container is sufficient, as this will adequately house 1,000-2,000 woodies of mixed sizes, but if you have a lot of mouths to feed, a bigger tub will ultimately hold a larger number of roaches. Before introducing the insects give the container a good scrub with warm soapy water and rinse thoroughly. No substrate is needed on the floor of the box, as this will only contribute to a build up of debris as the colony ages. You will, however, need plenty of hiding places so the inhabitants can get away from each other. Overcrowding leads to stress, cannibalism and poor breeding success so manage your numbers carefully. I prefer to stack up the hiding places at one end of the box leaving about a quarter of the floor space free for food and water. You can use various materials for hides (e.g. egg cartons, etc.) provided that the roaches can climb easily and that they create a complex area of many holes and crevices. Cardboard tubes from inside paper towel and cling wrap rolls are great as they can be flattened so more can be stacked into the box. It is a simple task to pick the rolls up full of insects and shake them into a container ready for feeding out.

The biggest problem with woodies is that they can climb anything. The smooth sides of an untreated plastic tub present no hindrance to their escape, often to the great annoyance of other human residents. There are a couple of solutions to this problem, such as smearing petroleum jelly or silicone spray around the top of the box, but these are very messy procedures and can often be more of a nuisance. The best course of action is to purchase a product called Fluon, which is a milky liquid that is painted on the top five to six centimeters of the inside of the cockroach box and left to dry. When fully cured it turns white, is completely dry to the touch and forms the perfect security barrier, as woodies simply cannot walk over it. Depending on how much use and handling the box experiences, the Fluon may need to be reapplied every couple of months. Unfortunately, there has recently been a supply problem with this product in Australia so it has been hard to source. Hopefully this issue will be rectified soon.

By using appropriate methods to make sure the woodies don't escape, it is possible to run your colony without requiring a lid. The benefit of this is that a healthy, well-ventilated environment is maintained within the box and your insects will thrive. Restricting the air circulation and, more importantly, air exchange will ultimately lead to the proliferation of pathogens, creating health issues for insects and consequently reduced longevity. Look out for a build up of condensation on the walls of the box and/or damp, smelly conditions on the floor as these are a sure sign that ventilation is inadequate. If you are concerned about even the odd insect getting out then use a lid but cut out most of it and replace it with alloy insect mesh, which should be melted into the plastic lid with a soldering iron. Do not use nylon insect mesh, as the insects will quickly chew holes through it and escape.

The other problem with these insects is that they are fast and very secretive. While it is possible to throw a handful of crickets into a cage and let the inhabitants slowly pick them off, woodies will dash about frantically and then find some tiny crack or crevice in which to hide. If enough roaches do evade their hungry hosts they will eventually start to breed and the enclosure can become overrun with hundreds of badly nourished insects that cause stress to the main inhabitants and may ultimately compromise their health. There are two solutions to this problem. The best option is to always feed out woodies using long forceps or tweezers. While this is time-consuming the advantages are that every insect is consumed in peak condition (and well dusted with multi-vitamin powder) and that each inhabitant of the enclosure receives its fair share of the food. The alternative is to place the container of insects in the fridge for an hour or so to slow them right down, making them easier to handle and catch, or to place them in the enclosure in a stable feeding bowl with Fluon around the top to stop them escaping.

Woodies are not particularly fussy about their diet but the more variety of nutritious food you can offer your insects the more your reptiles and amphibians will benefit in the long term. Many food insects are omnivorous, including cockroaches and crickets, so they will readily consume a wide range of food types. Start by providing a staple dry diet of a high protein food such as a good quality dog or rodent pellet, which can be left permanently in the box and topped up as required. Supplement this with a variety of fresh vegetables and fruits including carrot, pumpkin, lettuce, Asian greens, beans, peas, apple, orange, etc. Cabbage, silver beet and broccoli are nutritious but should be

offered sparingly as they are high in oxalic acid, which may cause other health issues with herps if fed regularly. If you are using green leafy vegetables always wash them thoroughly before feeding out. Although there is supposed to be a period immediately before harvesting of these crops when spraying of pesticides is not permitted, this is not always observed. By ensuring the insects have a regular supply of fresh vegetable matter it is possible to maintain the colony without having to worry about a separate water supply as these are constantly soiled and contaminated with cockroach droppings, deteriorating food particles and the odd drowned insect.

"Gut loading" is a term that has become very popular in recent times and one that I believe is somewhat flawed. The concept is basically to encourage insects to gorge on a high quality diet a short period before they are offered as food items. While there is undoubtedly some benefit in this technique, I believe this is limited especially if the insects are maintained on an inadequate diet at other times. Essentially what is then being supplied is a nutritionally deficient food item containing a tiny stomach-full of quality food. A much better option is to ensure the diet comprises highly nutritious food at all times. This will guarantee the nutritional quality of the whole food item at all times and will in my opinion unquestionably manifest itself in healthier reptiles and amphibians in the long run.

Woodies are a popular choice for keepers to establish their own breeding colony and try to become at least partially self sufficient in their live food needs. The key to establishing a viable colony is to be patient. My advice would be to purchase 1,000-2,000 woodies of mixed sizes (mixed sizes are usually slightly cheaper and by starting with a group of different ages you will ensure continuity of breeding), set them up in a box as described above and then do not harvest them for at least four months, until their numbers have built right up. In the meantime keep purchasing the insects you need for feeding out from a supplier.

**Brown Crickets (*Acheta domestica*)**

The Brown or House Cricket has been the mainstay of reptile and amphibian food internationally for decades. It is available in a range of sizes from hatchling through to fully-grown adults. Crickets are cheap, very nutritious, robust and relatively easy to handle. Their life expectancy is around two to three months depending on the temperature at which they are maintained; the cooler they are (within reason) the longer they will survive. During their life they will undergo several skin moults as they grow, the last producing the fully mature adult which is recognisable by the shiny wing covers on the back. Adult females can be distinguished by their long ovipositor which protrudes from their rear end. Crickets are easy to maintain but difficult to breed. They are extremely fussy about their environment and food and unless everything is perfect breeding will never be consistently successful. Commercial operations use climate controlled environments, food produced specifically for their optimum growth and development and strict hygiene protocols to maintain reliable production. My advice is to forget about trying to breed crickets. If you want to produce your own insects try cockroaches and stick to buying your crickets from a reputable supplier.

When you have received your crickets it is essential to transfer them to a suitable holding box as soon as possible as they are a lot more sensitive about their environment than woodies. The basic set up is the same as described for woodies but maximizing ventilation and reducing overcrowding is even more important for crickets which will quickly succumb in a stale microclimate and resort to wide scale cannibalism if numbers are too high or there are not enough hiding places. Maintaining a box without a lid is easy for crickets as they can't climb smooth plastic and, although they are good jumpers, they tend to leap more horizontally than vertically, so as long as the egg cartons and rolls are not built up too high escapes are usually few and far between. If you have to use a lid make sure most of it is aluminium insect mesh.

Although crickets like heat, it is best to maintain them at room temperature (20-25°) to maximise their life span until they are to be fed out. They are nocturnal in habit so no light is required and they can be maintained in total darkness if required. Protein is very important for crickets so it is a good idea to provide a staple dry diet of a high protein food (18-20% protein) such as a good quality dog or rodent pellet. They also have a higher moisture requirement than woodies so it is essential that they have access to moisture at all times. If you can't supply them with fresh fruit and vegies every day then it is wise to give them a separate water source. Unfortunately, crickets are not high on intelligence and usually see an open water body as an opportunity to end their lives by drowning. A better option is to provide a saturated sponge in a shallow dish from which they will extract their moisture needs. Strict hygiene standards must be

*Above: Common Scaly-foot (Pygopus lepidopodus) feeding on a Brown Cricket.*

*__Top left:__ Comparison of size of giant and common mealworms (larvae) and adult beetles. __Top right:__ Common mealworms (Tenebrio molitor). __Bottom left:__ Giant mealworms (Zophobas morio). The brown colouration of the outer skeleton indicates the presence of indigestible chitin so while these are a good food item they should only be fed in small quantities at each feed. __Bottom right:__ Adult Brown House Crickets (Acheta domestica) in a raising box. Note the differences between the sexes of the two crickets in the centre of the photo. The female is on the right with the long needle-like ovipositor protruding from the abdomen.*

maintained and the sponges and dishes should be replaced or cleaned and sterilized on a regular basis - preferably at least once a week. Another, albeit more expensive, option is to use a water gel product as a moisture source. There are commercial products available for insects, but a slightly cheaper alternative is to use one of the water-saving crystal products designed for use with plants. These are perfectly safe provided they do not have any additives such as fertilisers, soil conditioners or wetting agents.

Crickets are usually easier to handle than cockroaches making them more convenient as a food item. There may still be some benefits to cooling them for an hour or so before adding them to your herp's enclosure, but be warned that crickets do not tolerate thermal shock as well as woodies. The longevity of your purchased crickets will obviously depend on their age when acquired. Fully grown large crickets should last at least a week and possibly two to three weeks after purchase. Medium crickets should live for three to four weeks and smalls another week or two after that. If your crickets are only surviving a few days after arrival either the husbandry needs to be adjusted or you should look for another supplier.

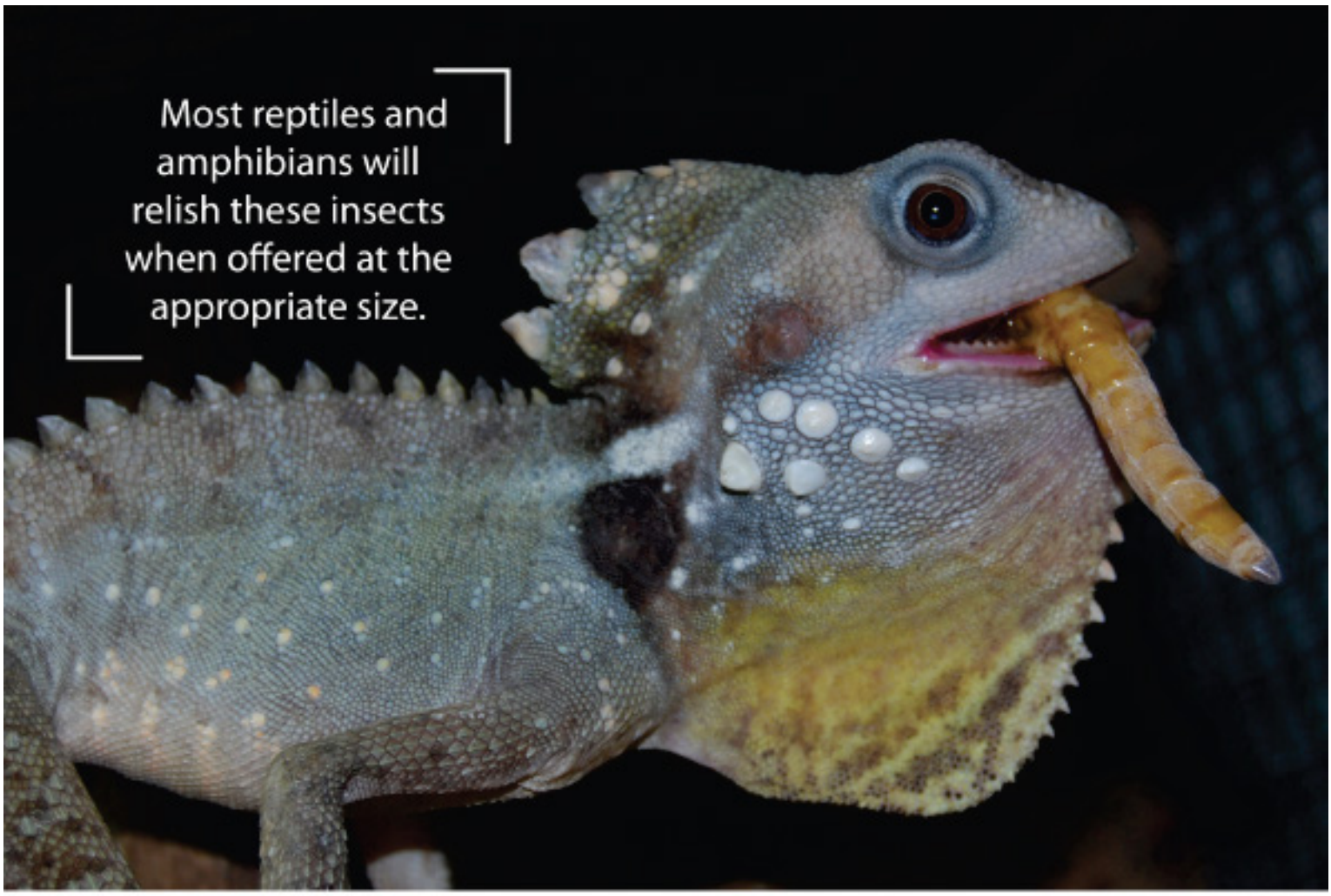
Crickets are soft-bodied insects, especially before they go through their final adult moult. This makes them very palatable for many herps particularly young lizards and frogs. Providing the right size of insect to your animals is very important and the general rule of thumb is not to offer anything larger than the gap between the eyes of your herp. There is a little more leeway with this rule for smaller crickets because of their soft texture. We receive lots of requests for pinhead crickets to feed juvenile bearded dragons but these are much too small for even newly hatched beardies. Ideally an "extra small" cricket about three to four millimetres in length should be the size of choice for these hatchlings.

**Giant Mealworms (*Zophobas morio*) and Common Mealworms (*Tenebrio molitor*)**

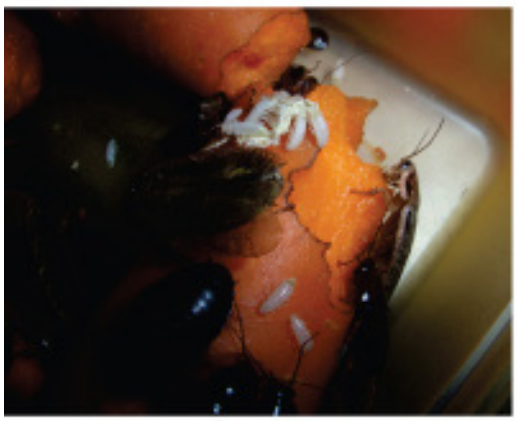
These two species will be dealt with together as many of their characteristics and much of the husbandry are similar. Both "worms" are actually the larval form of a beetle and, under the right conditions, they will transform into an adult insect. After the beetles have laid their eggs in bran or other grain meal medium, the tiny worms grow very slowly, moulting regularly for eight to twelve weeks until they eventually pupate. The pupa is a pale creamy yellow colour and will wriggle its tail end vigorously if disturbed. Some 10 days later the adult beetles emerge; they are initially almost white in colour and gradually become darker as they mature. It is the larvae that are favoured as food items by many animals; the beetles' hard black exoskeletons make them unpalatable to most species. Giant mealworms differ from the common species in that the mature worms need to be separated out individually to get them to pupate, whereas common mealworms will pupate as soon as they are ready regardless of population density. This means that a tray full of mature giant mealworms can have a shelf life of many months, unlike common mealworms, which often need to be stored in the refrigerator to slow down their life cycle. Never store giant mealworms in the fridge as they are a tropical species and temperatures below four to five degrees celcius for extended periods will kill them.

Care of mealworms is fairly straightforward if breeding is not planned. Transfer them as soon as possible into a container with three centimeters of fresh unprocessed bran or pollard, which is available from health shops or supermarkets. A shallow plastic tray is fine as they are unable to climb smooth plastic and no lid is required unless it is to keep intruders out. Place one or two pieces of fresh fruit or vegetables on the surface and cover with a couple of sheets of newspaper. Do not introduce too much fresh vegetable matter or use produce that is too wet, as this will quickly turn the bran mouldy. The newspaper provides cover and the worms also enjoy hiding between the sheets making them easier to harvest. When the medium in the tray becomes granular this is an indication that most of the food has been consumed and all that is left are the mealworm droppings. Use a sieve to separate the worms from the old medium, which can be discarded, and refill with fresh bran.

There are many myths about mealworms to the extent that some herp keepers refuse to offer them to their captives. The main reason behind this bad rap has been their reported contribution towards gut impactions in some animals. The mealworm's exoskeleton does have a high concentration of chitin, a hard substance which provides protection to the vulnerable larvae. Intestinal blockages have been caused by feeding large numbers of mealworms in a single sitting, culminating in a solid mass of this indigestible matter building up and causing an obstruction. The key to this problem is




***Above:*** *Male Boyd's Forest Dragon (Hypsilurus boydi) enjoying a meal of giant mealworm.*
***Middle:*** *Woodies eagerly consuming carrot which in this case is their sole water source.*
***Bottom:*** *These little white insects are new-born woodies that have just hatched from an egg case which has been carried around by their mother for a short period of time.*



to use them in moderation at all times. They can be offered at every feed if desired but never provide more than two to three suitably sized worms per animal. There are also many stories about mealworms eating their way out of the stomach of the reptile or amphibian they were fed to. This is totally untrue provided the appropriate sized worms are fed to healthy captives; food items are usually thoroughly chewed and killed before swallowing and those that are still alive quickly succumb to the acidic digestive juices in the stomach. Mealworms are a nutritious food item high in fat (about 10-15%) and so are particularly useful in adding condition to post-breeding females or growing juveniles, or as one component of a varied captive diet.

There is also some confusion over naming. In the USA *Zophobas* are often referred to as "superworms" or "kingworms". In Australia there is already a product called "superworm" available from one supplier and these should be avoided as they are merely extra large common mealworms that have been fed on a diet containing a chemical development inhibitor, which stops the worms pupating but allows them to keep growing. This artificial manipulation may well leave some unhealthy chemical residues in the insects. To avoid confusion we have adopted the name giant mealworm to differentiate *Zophobas* from the chemically modified common mealworms. Make sure you verify exactly what you are receiving before you purchase.

The size difference between the common and giant mealworms is substantial. A fully mature common mealworm is around 25mm long (chemically modifed superworms are approximately 30mm), while the giant mealworm larvae reach 60mm in length and weigh over one gram when fully grown. More recently, the giants have also been offered at smaller sizes to suit smaller herps. Most reptiles and amphibians will relish these insects when offered at the appropriate size. Ideally they should be offered either directly from forceps or in a smooth-sided dish deep enough to stop them crawling out, otherwise they will quickly burrow into the enclosure substrate and disappear before the inhabitants have a chance of turning them into a meal.

Care for both types of mealworms is relatively straightforward, although we have found the giants to be much more robust and productive; they have a much longer shelf life and are more versatile because of their larger size at maturity. The only common problems with mealworm cultures are infestations by pests such as meal moths and grain mites. The moths' caterpillars produce silk which binds the bran together making it very difficult to separate the worms from their food source. The giant mealworms tend to be much more vigorous in their activity, constantly churning up the media, which makes it harder for the caterpillars to become fully established and turn the tray into a "bran carpet". The mites are most common during warm humid weather and, because they are so tiny, are not usually noticed until a ring of debris appears around the outside of the tray. These are mite waste products and identification can be confirmed as this mite dust has a distinctive citrus smell. Control is usually fairly simply and involves increasing the ventilation and air flow over the mealworm tray. This may take several days but eventually the mites will disappear and stay away as long as increased air movement is maintained.

**Purchasing Live Food**

Most pet shops now carry a range of suitable live food products generally available in small plastic take-away-type containers. These tubs are relatively expensive but very convenient, especially if you are only feeding one or two animals. Before buying your tubs check them very carefully to ensure the majority of insects are still alive and healthy and don't look like they have been sitting on the shelf for several weeks; a sick or emaciated insect will often display a dark colour, almost black in severe

cases. Make sure there isn't excessive condensation build-up and ideally there should also be some relatively fresh looking food inside the container. When you get your tub home transfer the contents to a holding box as soon as possible if you are not planning to feed them out immediately. Crickets should live at least a week after purchase and generally two or three times longer than this depending on size, woodies and mealworms for several weeks or even months. If your purchases are not lasting this long on a regular basis complain to your pet shop or go somewhere else to buy your live food as either the supplier or the shop is doing something wrong.

If you have many mouths to feed small tubs become way too expensive and you really need to look at buying your insects in bulk. This can be arranged through several suppliers around the country, and some pet shops will also buy in bulk on your behalf. Again, when your order arrives unpack it into suitable holding facilities as soon as possible. There should be no more than 5-10% mortality during transit and most suppliers will overpack by at least this quantity to compensate for losses. If your order arrives with a significant number of deaths take a photograph and contact your supplier immediately. Reputable suppliers should provide a credit, refund or replacement for substantial mortality during transit. Excessive losses are not necessarily the fault of the supplier or their handling and packing techniques. All it takes is for a transport company to leave a box in the hot sun for 15-20 minutes to cause the demise of the contents, so ideally try to avoid ordering live food when excessively hot weather is forecasted (cold temperatures are not usually a problem at all in Australia). In most cases, however, you should still have confidence that your order will arrive at your door as ordered and in good shape and ready to satisfy the appetites and nutritional requirements of your hungry herps.

| | Pinhead | Small | Medium | Large |
|---|---|---|---|---|
| Cricket | 2mm | 4-6mm | 8-14mm | 16-20mm |
| Woodies | - | 5-10mm | 12-20mm | 20-30mm |
| Giant Mealworms | - | 15-25mm | 30-40mm | 50-60mm |
| Common Mealworms | - | - | - | 20-30mm |

*Above: Table showing approximate length of commonly available food insects.*

*Below: Suitable holding tray for mealworms, in this case giant mealworms. The cardboard tubes provide an extra hiding place for the worms and make harvesting easier.*