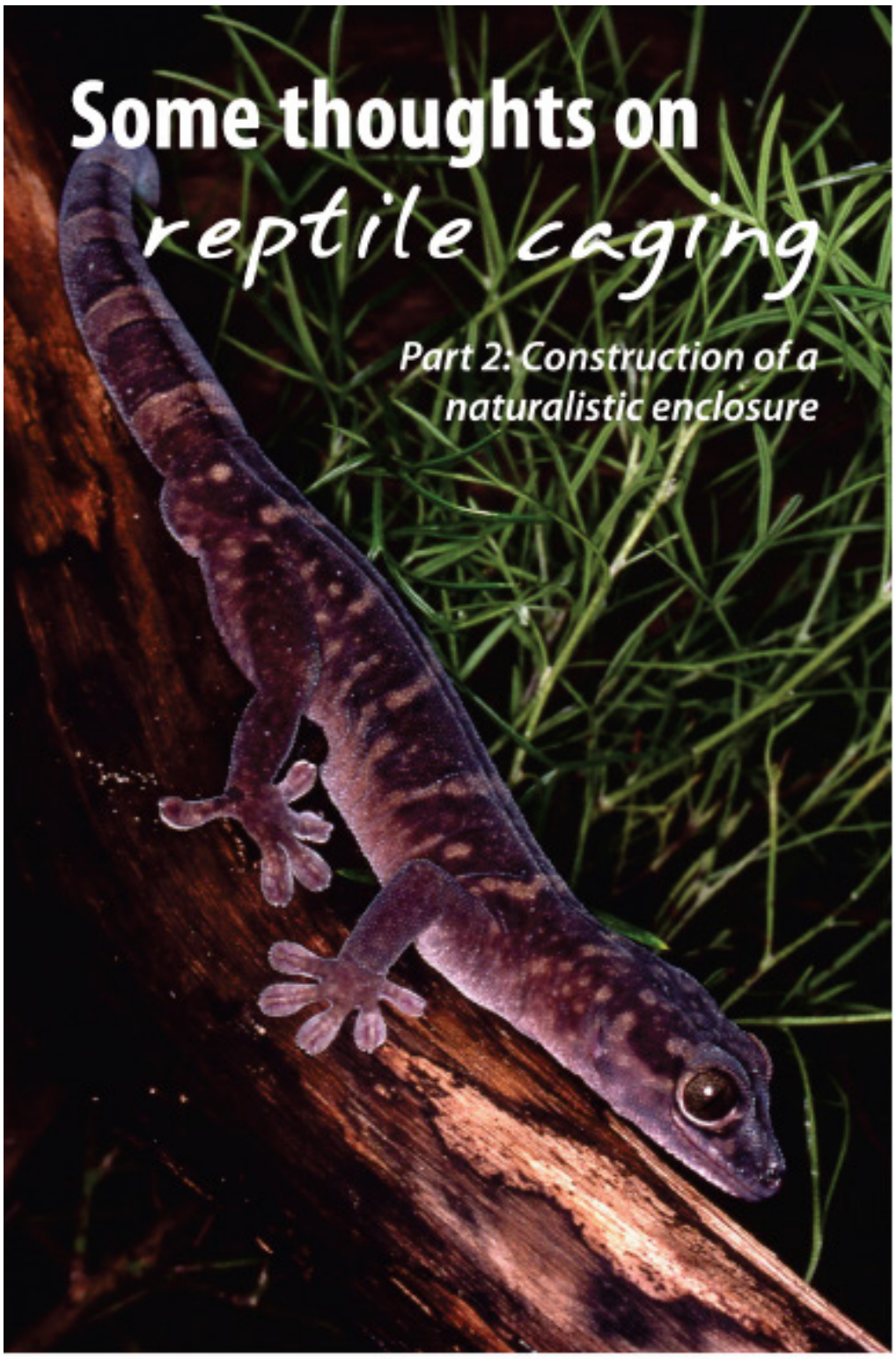
Some thoughts on reptile caging

Part 2: Construction of a naturalistic enclosure



*In the previous issue, **Rob Porter** highlighted the potential shortcomings associated with both "natural" and "minimalist" style enclosures. His solution was to design and construct "naturalistic" enclosures that are both practical to manage and aesthetically pleasing, while at the same time catering to the individual requirements of the inhabitants. In this second instalment, Rob details the materials and techniques required to create a custom-built naturalistic environment for your herps.*

In the last issue I spoke about the pros and cons of a naturalistic enclosure design for housing reptiles and amphibians and about my own experimentation with various materials for both the construction and decoration of the enclosure. These subjects were covered relatively briefly so I thought readers considering this type of caging might find it useful to see the full project in a step-by-step format. I always find photographs very useful when it comes to herp enclosures and husbandry. With this in mind I have tried to put together a photo sequence that will, hopefully, demonstrate the methods I have used in putting together a custom enclosure designed to house Kimberley (or Western) Giant Cave Geckos (*Pseudothecadactylus cavaticus*).

Framework

As discussed in the previous article, one material I have found extremely useful for herp enclosure construction is square aluminium tubing held together at joints and corners by rigid plastic fittings. The product is sold by several suppliers including Capral and Ullrich Aluminium and usually goes under a trade name such as "Qubelok" or "Speedframe". The benefits of this product are many, including:

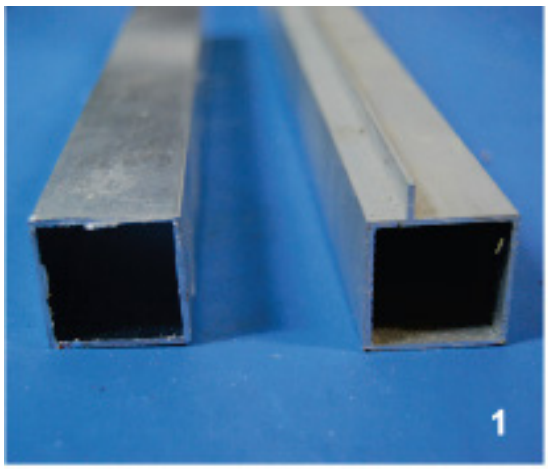
It is very strong.
It is very light.
It is relatively cheap.
It can be used indoors and outdoors.
It won't corrode.
No special tools are required for construction, which is quick and easy.
It can be painted in any colour.
There are different profiles such as one with an additional ridge for inserting glass, plastic or timber panels as a snug escape-proof fit.

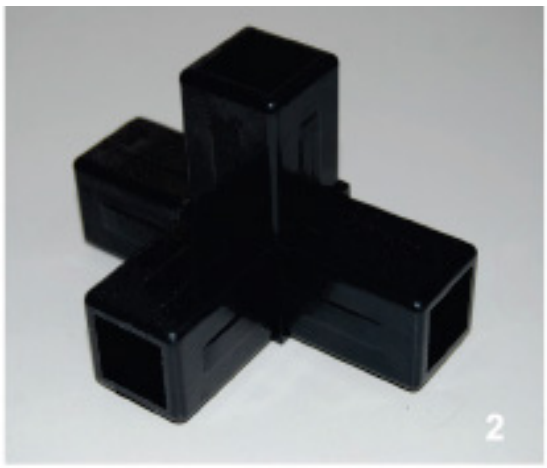
Once the dimensions of the enclosure required have been determined, it is then possible to calculate the tube lengths and number of fittings required to assemble the framework. Always keep in mind that the fittings have a central portion that does not slide inside the tube, and thus each fitting adds an additional 25mm to the dimension in which it is included. For example if a simple 600 x 300mm rectangular frame is required for the front access door there will be a fitting in each corner. Consequently, each dimension will have a fitting at each end and therefore the pieces of aluminium tube required will be 50mm shorter than the finished length, i.e. 550mm and 250mm. The easiest method I have found is to draw an 'exploded' view of the enclosure and its fittings showing overall sizes and then it becomes a relatively straightforward task to work out the lengths of each piece of tube required.

Armed with your list of tubing components and the necessary fittings to construct the enclosure, contact your local supplier and place your order. Most suppliers will cut lengths to size, but if you prefer to cut them yourself this is relatively easy to achieve with a power mitre saw and metal cutting blade or by hand with a hack saw and mitre box. Remember also that the tube comes in two formats, a plain square tube and a square tube with a ridge running down one side. The latter is useful if you want to block in a face of the frame with a sheet of glass or plywood as it holds these materials securely in place, so make sure you specify which profile is required. The plastic fittings come in a range of shapes including elbows, straight tees, corner tees, 4-way corners, etc. Check out some of the manufacturers' web sites to see the range and how they work.

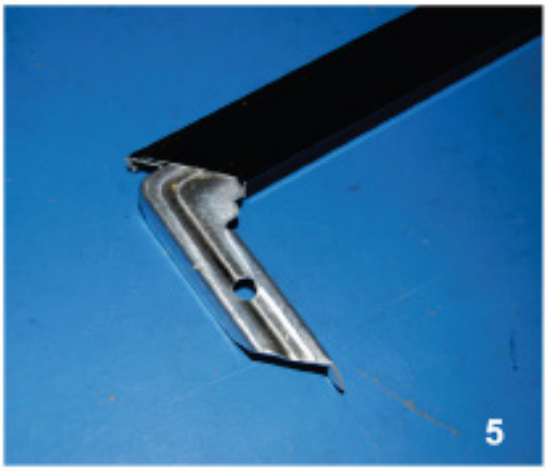
You are now ready to start construction of your new enclosure. The only tool you will need to construct your frame is a rubber mallet. Push the fitting into the end of the tube and then hammer it home until the tube sits tight against the raised centre portion of the fitting. If you make a mistake don't panic; it is possible to hammer the pieces apart again, but sometimes

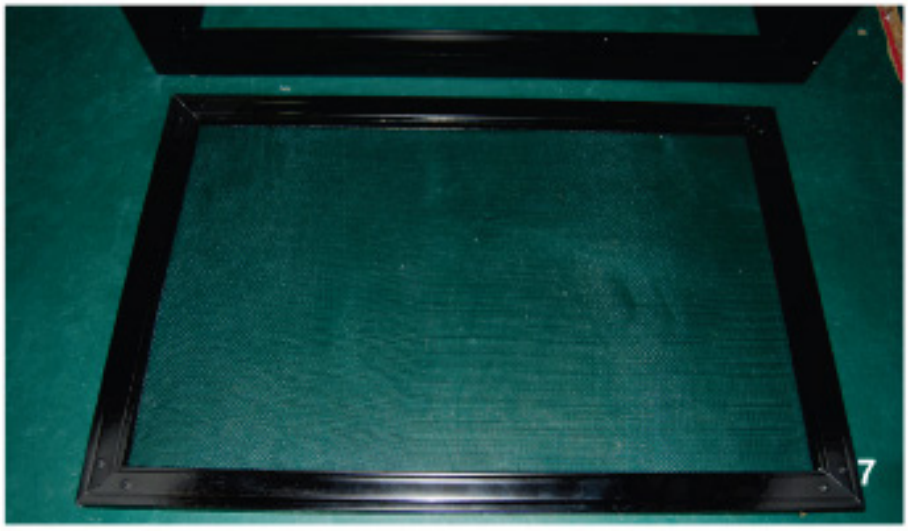
Kimberley Giant Cave Gecko (Pseudothecadactylus cavaticus). All photographs supplied by Rob Porter.





1. Two different profiles of square aluminium tube. Note the ridge on the top face of the tube on the right. 2. Example of plastic fitting used to join the aluminium tubing. 3. The plastic fittings are hammered into place using a rubber mallet. 4. Using a mitre box and hack saw to cut the pieces for the fly screen frames. 5. Corner inserts used to join sides of fly screen frames. 6. Using the spline roller to apply the rubber spline holding the fly screen mesh in place. 7. Completed fly screen.





the fittings or tube can be damaged so it is best to get it right the first time. When putting together a box-structure like a reptile cage it is easier to assemble each side of the frame separately and then knock the entire structure together. Your main framework is now complete and this is the time to paint the frame if you are not happy with the raw aluminium look. I used a satin black quick-dry enamel in a spray can, as it makes the frame less obtrusive and matches the colour of the plastic fittings. Before applying the finished colour though it is important to give the raw aluminium a coat of etch primer to make sure the top coat adheres to the metal.

Completing the Exterior

An essential part of the initial planning stage of the project is to decide on important aspects such as ventilation and access. The design and placement of these parameters will obviously affect the main framework and how it is assembled. I have always placed great emphasis on having ample ventilation in any enclosure by having a large vented area and positioning vents both at the top and bottom to promote efficient passive airflow. With this in mind a large opening was planned for the bottom of each side, complemented by another covering the entire top. I decided to cover the vents with aluminium framed fly screens, which would fit snugly into the openings and rest against the ridges on the aluminium tube. The materials to build these frames are available from larger hardware stores and comprise a rectangular profile aluminium tube with a channel along one side that accommodates a rubber tube or spline holding the insect mesh in place. The tube is cut to size with a 45-degree mitred corner on each end and plastic or aluminium L-shaped joiners are pushed into the open ends to hold the frame together.

Once the frames have been made the next step is to install the insect mesh inserts. Needless to say, it is absolutely essential that aluminium flyscreen mesh is used, and not the fibreglass type which is readily eaten by crickets and other food insects and is flimsy and easy to tear. The mesh should be cut around 25-30mm wider than the actual opening on all sides to allow for misalignment during installation plus the extra material that is pushed down into the groove when the rubber spline is installed. A spline wheel is an indispensable and inexpensive purchase for this job. It has a central handle with a plastic wheel on each end. One wheel has a flat edge and is used to push the mesh down into the channel before inserting the spline, the other has a concave edge designed to mirror the shape of the round rubber spline and press it into the channel over the mesh, thereby locking it in place. Start at one corner of the frame and carefully but firmly push the mesh into the groove. Then use the other wheel to push the

1. Homemade bracket and rubber fitting securing glass in front access door. 2. Framework with fly screens and timber panels installed. 3. Foam backdrop and hide box before carving. 4. Foam backdrop after carving. 5. Pipe inserts for fitting artificial plants. 6. Foam hide box after applying extra foam pieces.

spline in. Make sure the mesh remains square over the frame otherwise you will reach the end only to find it is out of alignment and too short and you will have to start all over again. On finishing the final side cut the excess rubber spline off and push the end into the channel - your frame is now completed. Install the mesh frames into the vent opening and secure in place with screws or mirror clips.

On the question of accessibility I am a firm believer that easy and unhindered access makes maintaining the enclosure less of a chore. Consequently, this cage was designed with the whole front opening up on side hinges making all areas of the cage easy to reach. The type of species planned for the enclosure may have some bearing on this design. Most geckos are slow and shy cage inhabitants so the likelihood of escape through a large door opening is fairly remote. A fast, skittish inhabitant such as a small monitor or skink on the other hand would be safer in a cage with a restricted door opening for everyday use, possibly with a larger door for general maintenance when required. In this case, the door was a simple rectangular frame of square tubing with the ridge orientated towards the centre in order to mount a glass front. Make the door with around a 2-3mm clearance from the main frame of the cage on all sides. The glass sheet is held in place by homemade metal brackets with small rubber gaskets between the glass and metal. Three mortised hinges are installed in one side and a window latch on the other. Mortised hinges were used as these are hidden when the door is closed but can be a little tricky to install. Standard butt hinges are just as effective but will remain visible at all times. It is usually a good idea to install some thin strips of flat aluminium around the inside of the door opening to act both as a door stop and also to cover the gap around the door to ensure feeder insects don't escape.

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The next step is to decide what material to use on the base, back and upper sides of the cage. As I was planning to decorate the sides and back with foam mock rock I decided to use 9mm plywood for the sides (again held in place using the ridges on the tubing) and 12mm plywood for the back and base, both screwed directly into main frame. Exterior grade plywood was used for durability and the outside and edges were further protected with an oil-based stain. At this point your cage construction is complete and the next stage is the fun part of decorating the interior.

Rockwork & Backgrounds

There are several options available when it comes to decorating the inside of the enclosure if a naturalistic set up is desired. I chose to use polystyrene foam for the basis of my backgrounds for several reasons, including its lightweight nature, availability, low cost, ease of handling and manipulation and versatility. Working with this material does require a bit of experimentation initially to get used to how it reacts when being cut, shaped melted, etc. but that is all part of the learning process. It is a good idea to obtain some scrap pieces to start with to trial and fine tune the different techniques and work out the layout and finish. Old fruit and veg foam boxes are ideal for this purpose and can usually be picked up at the local fruit shop.

The design of my enclosure requires three pieces of foam; a large piece (75mm thick) covering the entire back plus two smaller pieces (50mm) for the upper sides. Additional pieces of

Clockwise from top left: *Completed carved foam rockwork and hide box with heating cable installed. Initial painting of carved foam. Backdrop after application of several coats of substrate and glue.*

> Look at some photos of the kind of habitat you are trying to create so you can replicate the way it appears in nature.

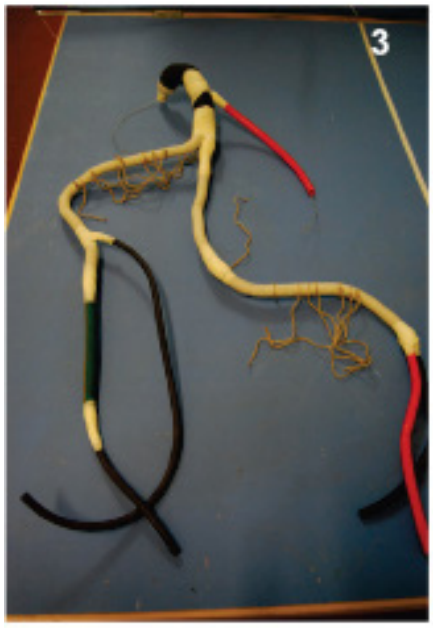
foam can also be glued to the main background to provide additional depth. The initial step is to roughly sketch out the planned design on the face of the foam indicating where you might want to put crevices, outcrops, tree roots, etc. In my set up the two side pieces are almost in contact with the back so I tried to keep some continuity with the design to make it look as if they are part of the same rock face. It is not a bad idea to look at some photos of the kind of habitat you are trying to create so you can replicate the way the rock layering, cracks and crevices appear in nature. Once you are satisfied with your plan it is time to take to the foam with a range of tools and implements to bring dimensionality and depth. Serrated knives, electric carving knives, craft knives, foam wire cutters, soldering irons, etc. are among the items you can use to create your desired effect. Don't be too fussy or careful, I found it is better just to hack into it and don't be afraid to remove large sections as this is often how rock faces weather in nature. Be warned though, this is a messy operation no matter how careful you are, so ideally be creative in a garage or shed not on the kitchen bench, and not outside especially if it is a windy day.

The next stage is an optional one but does contribute greatly to the finished product. When you have cut, chopped and sliced your foam to a finish you are happy with, a heat blower gun (such as those used for stripping paint) or even a powerful hair dryer can be used to gently melt the surface of the foam – but don't hold the blower in one place for too long. This will have three outcomes; firstly it will add a great natural texture to the rockwork; secondly it will smooth out and round off the cut edges of the foam again, and thirdly it will produce a tough outer coating on the foam making it more resilient to damage. The heat gun can also be used to make smooth walled caves or other rounded features that are almost impossible to cut out with a knife. Any repairs or small additions can be added by gluing on additional pieces of foam using liquid nails or by using the aerosol expanda foam products and carving them to shape once the foam has dried. This is also the time to add some locations for inserting artificial plants. I have found short lengths of plastic tube or pipe make ideal mounting holes for plants and these can be pushed into the foam at strategic places by using a soldering iron to make a small hole first. Any gaps around the tube can be filled with expanda foam; it doesn't matter if the pipes are still a little loose as the final coats of glue and substrate will eventually hold them in place.

A small foam box made from a modified mini esky was also added as a humid retreat for the lizards and as somewhere to safely lay their eggs where they wouldn't dehydrate. This was decorated by gluing small offcuts of foam to the outside and filling in any obvious cracks and joins with expanda foam. An access hole was cut into the lid and a depression was cut out of the bottom of the background foam into which the foam box fits snugly to give the impression it is part of the rockwork. It was then treated and decorated the same as the rest of the foam, to blend it in with the overall theme.

It was also decided that part of the rockwork should be heated to provide an area of thermoregulation for the lizards. This was achieved by using a soldering iron to melt a convoluted furrow in the foam over a suitably flat area. A hole was drilled through the foam and backboard near the top of the enclosure and a low wattage heat cable was inserted and pulled through. Its entire length was then pushed firmly into the furrow so it sat flush or slightly below the surface of the foam. The cable was eventually covered with glue and sand so ultimately there was no indication of its presence. In addition, retreat areas (including some over the heat cable) were made using extra pieces of foam with strips glued to the back as spacers. These were then installed over parts of the main rockwork and held in place with Velcro. This meant the lizards were still accessible if they needed to be caught.

The next step is to add some texture and colour to the foam. I prefer to use sand for texture because of its coarse and natural appearance. Fine red desert sand looks good but beach sand, coarse river sand or even decomposed sandstone or granite can also be used. I have found it is much easier to first paint the entire



1. Removable rock pieces covering refuges held in place by Velcro tags. 2. Completed rockwork installed along with artificial plants. 3. Artificial tree root system before application of glue and coco peat. Note the lengths of jute twine acting as aerial roots; these will become straight and more rigid after glue and substrate are applied. 4. Completed backdrop with some additional colour added around crevices. Note the position of the two removable hide rocks top left and centre right.

face of the foam sections with a background colour similar to the substrate to be used and then apply the substrate after. This way a more even coverage is achieved over the whole rock area. The paint was applied using cheap plastic spray bottles (the ones with trigger pumps are best) and acrylic paint diluted with water by about 50%. Two or three coats may be required depending on the colour but remember the paint doesn't have to completely hide the white foam, just help it blend into the background behind the sand, and more colour can also be applied after the sand has been glued on.

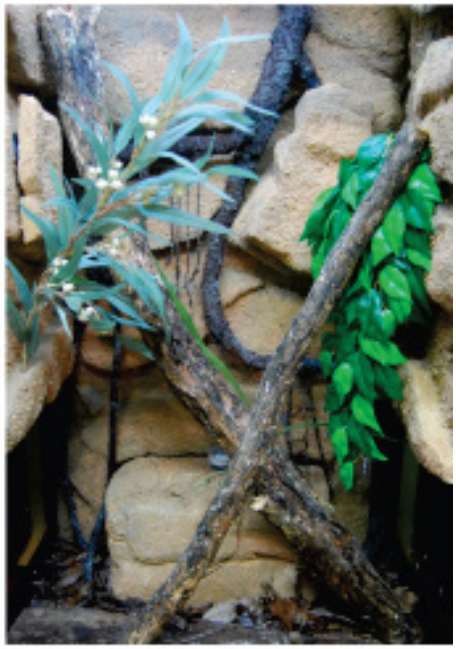
After the paint has thoroughly dried start applying the substrate using another spray bottle filled with 50% diluted PVA glue. Work on small areas at a time by spraying a coat of glue and then sprinkling the substrate on top, building up the layers gradually. I found you could apply two - three layers of each before leaving a section to dry and moving onto another area. If coarser sand is used better adhesion can be achieved if it is thrown into the glue rather than sprinkled on top. This technique is also useful for getting the substrate into cracks and crevices, although it is usually better to cover all the flat areas on the background first and then once dry reposition the foam so that problem areas can be treated.

Once a good coverage of sand has been applied and the glue is thoroughly dry, more paint can be sprayed on to help cover any imperfections or areas not totally covered with substrate. This is also a good time to add some additional colours to simulate the natural colouration and staining of the rocks. A very diluted black or dark grey can be used in and around crevices and caves along with browns and greens to simulate tannins, algae, moss and lichens. Keep an additional spray bottle of water handy and this can be used to dilute the paint further if applied too heavily and to give the effect of staining colours being washed over the rocks by running water. Again this is a fun experimentation stage so don't be afraid to try something different. If you don't like the colour or effects the paint produced use your water spray to wash it off and start again. As long as the glue beneath is completely dry you won't harm the work you have already done beneath the paint.

This is probably the most time consuming of all the stages depending on how fussy you are about the finished product. What is important though is to make sure that at least five - six thin coats of glue are applied to all surfaces to ensure the rockwork has a tough and resilient finish and if more paint is applied after the sand then apply another couple of coats to provide a protective film for the colours. It is possible to speed up the drying time of the glue between coats by directing a small fan heater over the foam but make sure the last coat is fully dry before progressing to the next. Once you are happy with your finished work of art it is time to add the final decorations and furnishings before introducing the new residents.

Furnishing the Enclosure

The final stage is really a matter of personal preference and providing the necessary furnishings required by the eventual inhabitants of the cage. In the case of the Giant Cave Geckos this comprised of two or three artificial plants installed on the rockwork, the hide box, some substrate on the floor of the enclosure covered



Above left: *Male Kinberley Giant Cave Gecko emerging from artificial rock refuge.* ***Top right:*** *Completed root system installed. Note how the right fork of the root is situated behind a refuge rock hiding the positioning of the thermometer probe.* ***Bottom right:*** *Completed enclosure with bottom substrate, leaf litter, branches, etc.*

with leaf litter and a few climbing branches.

I tried to manufacture a natural-looking tree root system to attach to the back wall of the enclosure using plastic and PVC pipe. The idea was that this would not only fit precisely into the carved features of the rockwork, but also act as a conduit for a hidden probe to monitor surface temperature adjacent to the concealed heat cable. The basic design incorporated a series of decreasing diameter pipes and tubes joined together with tape, with the natural root appearance further enhanced by a series of aerial roots made from jute twine. Once the structure had been assembled a similar process to decorating the foam rockwork was followed using diluted PVA glue but, instead of sand, layers of coco peat were applied. This gave a fibrous finish to the artificial root system but because of its highly absorbent nature a lot more glue had to be applied to make this outer layer rigid and durable. Glue and coco peat were also applied to the twine to give it a more realistic finish. Some olive green paint was sprayed on very roughly in certain areas to give the effect of a mossy finish and a final two - three coats of glue finished the process off. The top end of the root system was then inserted into a hole made in the foam backdrop and glued into place with liquid nails. One part of the root system passed behind one of the removable rock hides over the heated area and it was here the thermometer probe was located and attached to the surface with tape so it could be relocated if necessary. The heat cable itself was controlled by a dimmer to ensure it did not overheat.

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After adding a water bowl and some external lighting the new enclosure was ready to accept its new residents. Within a few days they seemed to have settled in well and had started to explore, appreciating the space and, who knows, perhaps the aesthetics of their surroundings. From my point of view it was a pleasure to view these lizards moving around the simulated slice of their natural environment and watch them carrying out natural behaviours as if they were perched on a real sandstone outcrop in the Kimberleys. Creating naturalistic enclosures really does add a whole new dimension to maintaining reptiles in captivity and along the way provides an enjoyable experience experimenting with different techniques and methods to mimic the natural features associated with these reptiles.