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prototypes produced. Work will soon start on some of the more robust calcareous algae such as Halimeda and various sponges. Such work is fascinating but time-consuming, not least because all materials used have to be tested in aquaria behind the scenes to ensure their suitability. It was at this stage that some novel problems arose. For example, we soon discovered that many species of fish attempted to eat the more life-like algae and corals and steps had to be taken to toughen them up, thus preventing all but the most persistent and best-equipped of them, such as Triggers and Parrotfish (which will be kept in other displays) from coming to an untimely end through blocked digestive tracts.

The numbers of species (370) and specimens (1460) currently on display have been deliberately depressed in order to minimise the considerable upheaval which inevitably results whilst producing new displays. However, once these are completed we will be able almost to double the number of species and include many unusual or demanding species never previously displayed at Liverpool. By so doing we hope to secure our position at the forefront of public aquarium display management, at least for the forseeable future, if not for the next 130 years!

Acknowledgements

My thanks are due to my colleagues in the Technical Services Department of the Liverpool Museum - Alan Dodson, Pete Spinks and Bill Sillitoe - for their skill and artistry in helping to prepare the displays. I am also grateful to John Edmondson, Keeper of Botany, for his advice on the preparation of this article at short notice.

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Vivarium Design for Public Display

Nigel Platt
Cotswold Wildlife Park

Displaying reptiles and amphibians for the public is not as easy as creating decorative vivariums, or basic vivariums for the home. When a display is set up for public viewing, there are three main considerations:

1 the animals - it has to offer security, be hygenic, and have the correct furnishings for the species;
2 the keepers - the cage must be easy to service, must not be time consuming, and arranged so that the minimum disturbance is caused to the animal;
3 the public - the cage must be presentable, and be as aesthetically pleasing to the viewer as possible.

When creating a vivarium from scratch, it helps to have some idea of the intended stock, then the cage can be designed accordingly. There will have to be an area for water. This can be in the form of a shallow dish, or a 'sink' type pool, that can be emptied by removing a plug. The 'sink' type pool is easily emptied and filled in a short space of time; it also makes cleaning out reptiles easier as they have a habit of defecating in the water. The pool should have a good drainage system, which can be easily serviced if necessary.

The first step in decorating an empty cage is to paint the walls. Emulsion paint provides an ideal wall covering, and there is a good choice of colours. Soft colours or pastel colours work best as they do not distract the viewer from the animal being exhibited.

The rockwork of the cage has to be planned carefully as this is normally a permanent fixture. Some rockwork can be cemented in position, so as not to cause any injury to the livestock. Local stone can be used to keep the budget down, and can be disguised by mixing garden pond sealer with cement colouring, which also helps protect the rockwork from strong reptile urates.

When making the rockwork, remember to slope it slightly so water will run into the pool when it is washed down. Small crevices and difficult angles cause problems as they are hard to clean.

Having created a base to work on, four other points have to be dealt with: substrate, furnishings, heating and lighting.

1 Substrate is probably one of the most difficult points to get right; there are various options:

1a sand is very fine and difficult to keep clean, when the animal is feeding it can consume small quantities which build up and cause impaction in the stomach;

1b soil cannot be kept clean, so frequent changes are necessary

1c peat, like soil, cannot be kept clean, and it is likely to harbour parasites and disease;

1d leaf litter also cannot be kept clean, but it is a good medium for nervous ground dwelling species, so long as it is changed frequently;

1e gravel is by far the best substrate, because it is easily removed and washed and is available in a variety of colours and grades. The smallest grade I would advise for use is 7mm; anything smaller could be consumed by the animal. For larger snakes, such as the pythons and boas, large pebbles are best.

2 Furnishing - the loose fixtures that are placed in the cage to create a more natural look, such as branches, logs, pieces of bark and rocks. These need re-newing or cleaning from time to time to keep the cage hygenic. The choice is purely a personal one, as one branch may be a good shape to one keeper but not to another. All loose furnishings should be positioned so as not to hinder the keeper when servicing the cage and to offer the animal a feeling of security.

The use of live plants in a display should only be attempted if natural daylight is available, although this point is much argued amongst herpetologists. Plastic plants are a good substitute, they add colour and provide the viewer with a more natural looking scene, and they can also be removed for cleaning.

3 Heating is the most important factor if healthy and lively stock are to be maintained. There are numerous ways of heating a cage:

3a Heat pipes running along the front or rear of the cage; these can be electric, oil or steam. At the Cotswold Wildlife Park we use oil pipes along the front of the cages controlled by a thermostat at source.

3b Cables can be positioned below a substrate or above the animals in the cage. These have a disadvantage in that they can be exposed and the chances of accidental damage to the animal are increased.

3c Spotlamps can be used to heat a small cage from above, or as additional heat to create hotspots. If they are the only source of heat and light they cannot be used to the full effect because thermostatic control of temperature will leave the cage dark for periods of the day.

3d Heatpads can be used under a substrate or can be fixed on to a wall out of view in small cages.

It is best to have all heat elements well covered so that animals cannot come into contact with them and they cannot be seen.

4 Lighting is an important aspect of creating a cage environment. Fluorescent tubes are probably the best as they come in various lengths and sizes; they are best positioned out of public view.

Blacklight is used by some herpetologists for some species but is the subject of considerable debate.

Snakes do not require the use of blacklight at all, it is only various species of lizard that thrive from its use. A tube we use at the Park is the Philips Blacklight 09, this peaks between 290nm and 310nm which is the desired range for the species we exhibit.

Ultra-violet lights should never be used as these can be harmful to the animals. All lighting should be set on a cycle so as to create a photoperiod for the animals; the photoperiodic timing varies according to the species.

Correct timing of heat and light cycles can induce breeding in the captive animals.

Finally when displaying animals for the public some form on interpretation is necessary. At the Park we use formica labels giving the family name, where the animal comes from, the common name, the Latin name, its distribution range and its diet. We keep the information simple to create an interest in the animal on the part of the viewer. Further information can be obtained by asking a member of staff or using a reference library. We find that labels containing too much information have an off-putting effect and are not read or not fully understood by our visitors.

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Sexing and Breeding Reptiles and Amphibians

Adam Wright, Herbert Art Gallery and Museum, Jordan Well, Coventry.

One of the more neglected areas of research in relation to live animal displays in museums is probably that of inducing captive livestock to breed. I believe that this should be a primary objective for the keepers of museum vivaria and many techniques are now available for inducing a mating response in display animals.

However, if breeding is to be encouraged both sexes must be present and, perhaps surprisingly, this can present problems for the keeper dealing with amphibians and reptiles. Whilst it is true that the males and females of some species are very difficult to distinguish, the majority of species can be sexed with a little care. This paper discusses the more commonly practised methods of sexing for these groups.

Anura - Frogs and Toads

One of the most easily discernible features of certain frog groups is the possession of inflatable vocal sacs which the males use to attract females - usually at night. When calling, the vocal sacs are filled with air and easy to see. On male specimens not in voice, the presence of a vocal sac can be determined by a folded wrinkly appearance to