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Cage Design and Configuration for Arboreal Reptiles

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The use of nonmammalian species in biomedical research has been increasingly reported in recent years. In 1985 the National Academy of Sciences issued a report describing this increase in the use of nontraditional models for biomedical research (1). A more recent volume on nonmammalian animal model alternatives used in biomedical research offered in depth discussion on the use of new models and emphasized the emerging utility of these species with their specialized attributes (2). These species include fish, amphibians, birds and reptiles.

In our laboratory, reptiles, specifically arboreal reptiles, have emerged as an animal model of considerable interest and potential. Historically, reptiles have not been commonly reported in the biomedical literature. This is clearly changing as evidenced by the Biology of the Reptilia (3) series which now includes 16 volumes as well as other recent publications (4,5). In their chapter on reptile models for biomedical use, Greenberg, *et al.* (6), discuss "...that several unique qualities of reptiles may provide models useful for research on a diverse array of problems of biomedical interest including developmental, endocrinological, neurological, and cellular aspects of stress and affective disorders, feeding, and reproductive dysfunction." Finally, most reptiles are small, inexpensive, easily cared for, and robust subjects for many kinds of manipulations including surgery due to their ability to heal quickly under aseptic conditions (6).

With this rise in interest by the research community comes the dilemma of how to provide for the appropriate acceptable cage environment. Most animals used in biomedical research have federal regulations which govern their care and use. Interestingly, because they are poikilotherms, reptiles are not subject to the regulations of the Animal Welfare Act (7), which only applies to homeotherms. It should be noted, however, that as reptiles fall within the definition of "animal" listed under the *Public Health Service Policy on the Humane Care and Use of Laboratory Animals (8),* (because they are vertebrates) and they are subject to the requirements of those applicable regulations. The Public Health Service Animal Welfare Policy uses the *Guide for the Care and Use of Laboratory Animals* (9) as its interpretation of animal care and use activities including caging and animal social environment, and provides guidelines for appropriate macro and micro environments (e.g. temperature, humidity, ventilation, illumination, etc.).

Unfortunately, the *Guide* was written for more traditional laboratory animals and, does not specifically provide guidance for reptiles. It does however, provide some general principles which should be followed when addressing the issue of appropriate caging. Caging should be designed to meet research requirements, facilitate animal well-being and minimize experimental variables. The cage should be appropriate in size for the species being housed and should be designed with the safety of the animal and handler taken into consideration. The cage should be mobile and be constructed of sturdy, durable materials and designed to minimize cross-infection between adjoining units. The cost and ease of construction should be balanced with the durability of the final product.

We report here a cage design for arboreal reptiles which addresses all of these requirements. In the course of designing the cage, we sought to accommodate the aforementioned criteria as well as the following specific requirements for reptiles. Reid (10) points out that by far the greatest problem in designing reptile cages is that the needs of the animal are often opposite to the needs of the investigator. From the reptiles' point of view the cage must provide a suitable temperature and humidity, it must be hygienic, and it must contain the right furnishings (hide boxes, water bowls, branches for climbing, etc.). However, from the investigator's point of view the cage must be secure (prevent escapes), it should be easy to clean with minimum disturbance of the inhabitants, and it should provide some safety to the investigator housing venomous or aggressive species.

We have reviewed the commonly used reptile caging systems that include glass aquaria, plastic kitchen tubs, and cages constructed of wood and wire screen. Problems associated with these designs include broken glass or sharp edges which may be harmful to both animals and investigators. Decaying or warping wood construction and rusted metal fixtures can be a problem. Finally, most of these designs are difficult to sanitize. As none of the cages currently

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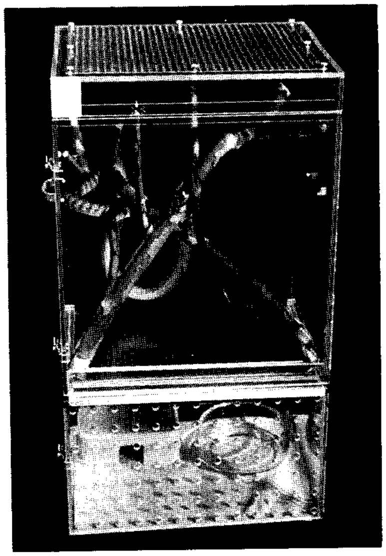

Figure 1 The brown tree snake, *Boiga irregularis,* depicted in its usual posture in our caging system. The aluminum panel inserted as shown, provides safe and easy access of technicians to the water-bowl, hide box and bedding.

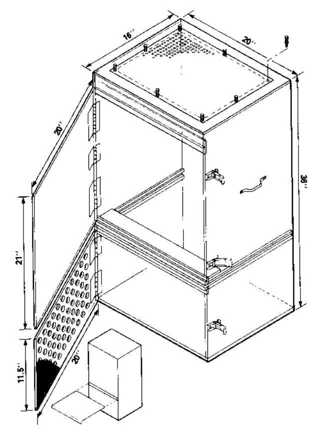

Figure 2 Schematic of cage design showing details of hardware. Inset demonstrates the insertion of the aluminum panel.

in use could meet both our needs and the *Guide* requirements, we sought to design our own.

The assembled cage in use is shown in Figure 1, illustrating a sliding metal plate positioned such that the animal is isolated from the investigator. The sliding panel was designed to minimize disturbance to both the animal and investigators during daily maintenance such as cage cleaning. The design sketch for the cage is shown in Figure 2. Except for the top, the cage (35″ h x 16″ d x 20″ w) is constructed of 3/8 inch plexiglas sheets bonded together with GC-25, a commercial adhesive for plexiglas that leaves no residue. The top of the cage is comprised of a sheet of 1/16 inch perforated stainless steel, type 304, fastened with eight #10 thumb screws. The two doors have plexiglas hinges and latches, two on the top door and one on the bottom door. The bottom door has a series of 0.5 inch holes (1.5 inches center to center) provided for ventilation. A fine nylon mesh screen is affixed to the inside surface of the bottom door. A set of 0.25 inch x 0.25 inch plexiglas strips serve as a track for the aluminum panel that separates the top half of the cage from the bottom. For portability, the cage has two aluminum lifting handles on each side so that the cage may be moved by one person or two.

In twelve months experience we have found that our design meets all of our research requirements. It also meets all current federal requirements for the care and maintenance of laboratory animals. The cage may be sterilized by using sterilant such as Alcide® , or sanitized with hot water and antiseptic soap. If autoclave sterilization is desired, the cage should be built with polycarbonate (Lexan®) and stainless steel hinges and latches, as plexiglas may distort at high temperatures. Ventilation in the cages has been sufficient with apparently good air flow as evidenced by no persistent odors remaining in the cage. By spraying the cage inside on all walls daily we have managed to maintain the high humidity required by our subjects. Because of the clear sides we have found the visualization of animal behaviors to be accomplished easily. These panels also contribute to our continuing efforts to monitor the animals' health status visually without the additional stress of frequent handling. We are videotaping the animals and have found that the camera may be situated anywhere in the room and provide satisfactory results.

Currently, we are studying the chemical ecology of the Guam brown tree snake, *Boiga irregularis.* We have utilized this cage to house snakes in excess of 2 meters in length and weighing up to 2 kg. The brown tree snake is an arboreal species which is both aggressive and rear-fanged. We sought to limit their contact with the animal handlers. By sliding the metal panel into the slots, one can isolate the snake in the top of the cage and enable the animal handler to have safe access to the bottom of the cage to change the bedding, water, etc. (Figure 1). This significantly reduces the stress to both the animals, animal technicians and investigators.

This cage may be modified for use with many other species. Because of its transparency, the cage is ideal for animals that need to see each other. For those that do not, a simple barrier may be placed between them. Although we do not currently use live plant material in our research effort, we believe these cages should accommodate live plants well. These cages may prove ideal for the housing of many species including lizards, small arboreal mammals, birds, and small arboreal non-human primates such as tamarins or owl monkeys.

Acknowledgments

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