ENCLOSURE DESIGN FOR CAPTIVE SLOW AND PYGMY LORISES

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ABSTRACT

While large numbers of slow and pygmy lorises are commonly kept in local zoos and rescue centers, information about enclosure design and minimal housing requirements is often lacking. We present recommendations for designing indoor and outdoor loris enclosures for exhibits, rescue centers, and sanctuaries. We discuss the advantages and disadvantages of each enclosure type and address construction specifications, furnishings, environmental requirements, social considerations, and keeper monitoring. Essential requirements for loris release into naturalistic outdoor enclosures are presented along with questions for future study.

Keywords: Loris, *Nycticebus*, primate husbandry, prosimian housing, cage design, free-ranging enclosures.

INTRODUCTION

Slow and pygmy lorises are nocturnal, arboreal prosimian primates. Slow lorises (*Nycticebus coucang* and *N. bengalensis*) occur throughout most of Southeast Asia and parts of India (Schulze, *et al.*, 2003), whereas, pygmy lorises (*N. pygmaeus*) are limited to Vietnam, Laos, and Southern China (Duckworth, 1994, Zhang *et al*. 1995). Their diets consist of fruits, insects, small fauna, tree sap, and other plant food such as floral nectar (Wiens, 2002; Fitch-Snyder and Thanh, 2002). (See also: http://www.loris-conservation.org/database/captive_care/nutrition.html.) Lorises use slow, deliberate movements to locomote from branch to branch; and they do not leap, as do most other primates. Urine scent markings have a strong characteristic odor and are an important means of intra-specific communication (Fisher *et al*., 2003). Female slow lorises are fertile throughout the year and have monthly estrous cycles (Izard and Weisenseel, 1989). Pygmy lorises are seasonally fertile during the months of July and August (Fitch-Snyder and Jurke, 2003). Infants are well developed when they are born after a gestation period of six months, and mothers often park their infants on branches while they leave to forage (Fitch-Snyder and Ehrlich, 2003). Slow lorises normally have singletons, while litter size for pygmy lorises is usually two or more (Fitch-Snyder, 1997, Weisenseel and Izard, 1998).

This paper provides recommendations for maintaining slow and pygmy lorises in captivity, especially for Southeast Asian zoos and sanctuaries. These facilities are often required to house large numbers of lorises, many of which are acquired through government confiscations or donations (personal observation). Some facilities can provide only minimal, off-exhibit housing, while others are able to build more complex environments that might also include public viewing. Basic information about enclosure design and minimal housing requirements is often lacking. Therefore, recommendations made here are based on conditions that have been successful in other loris facilities.

Wire Cages

In some facilities such as primate rescue centers, wire cages may be the best option available. An outdoor cage measuring 2.00 m x 2.50 m x 1.80 m can successfully house 1-3 slow lorises if the furnishings are sufficient. (See climbing structures and nest box sections.) Wire should always be free of rust or sharp edges. Poly vinyl coated wire is ideal

because it resists corrosion from moisture and loris urine marking. Wire gage of 2 cm x 2 cm is comfortable for lorises to grasp, and it will keep rodents and potential predators outside. Outdoor enclosures must also have a solid roof to protect lorises from sun and rain.

Maximum flexibility can be achieved by building several smaller cages (minimum size of 1.70 m x 1.00 m x .70 m per slow loris), which are connected with removable wire tunnels. Depending on whether the tunnel gates are open or closed, lorises can be kept alone or given access to other enclosures. If cages share common walls, double wire mesh or solid walls must be used to prevent lorises from biting their neighbor's fingers. Keeper doors should be large enough for a person to walk inside the enclosure or easily reach any area inside the cage. Doorframes must be made of a solid material that will not bend. Otherwise, lorises may be able to escape by squeezing their bodies through the small gaps between door openings. Cages should be elevated at least 15 cm above the ground to so that excreta and other waste will fall below. Indoor cages can easily be moved for cleaning if wheels are attached to the bottoms. Food dishes and nest boxes can be placed on wire shelves, which are also useful for loris resting places.

INDOOR ENCLOSURES

Advantages

The primary advantage of indoor loris enclosures is that the environmental temperature and light conditions can be controlled. By reversing the lorises' day-night cycle through manipulation of the photoperiod, these nocturnal primates will change their activity patterns to be active during daylight hours. This management technique is especially beneficial to keepers and the public because the lorises' activities can be observed during normal working hours. Additional benefits of indoor enclosures are the reduced possibilities of encounters with wild predators or disease-carrying wildlife.

Disadvantages

Slow lorises are especially sensitive to light cycles (Frederick and Fernandes, 1994), and they might not become active during the day if artificial lighting conditions are not adequate. Abnormal photoperiods can modify a lorises' reproductive cycle. For example, pygmy lorises are normally fertile in late summer, but they reproduce throughout the year when they are exposed to artificial photoperiods (Fitch-Snyder and Jurke, 2003). Seasonally changing environmental conditions has been found to also influence lorises' physiology (Streicher, 2002) the results of lack of these stimuli are not known. Changes in activity cycles can be due to insufficient contrast between day and night cycles or use of the wrong spectrum of light to simulate daylight.

Artificial lighting, environmental temperatures, ventilation, and humidity are all dependant on electricity to function properly in indoor enclosures. These environmental conditions could be seriously compromised during a power outage.

RECOMMENDATIONS

Climbing structures

Loris enclosures that feature large concrete climbing structures are not optimal. Branches that are small enough in diameter for them to grasp with their hands and feet are preferred. Some branches should be horizontal, with varying circumferences for comfortably sitting, climbing, and hanging. Small horizontal branches (1-2 cm in diameter) are especially important for breeding purposes, because copulation usually takes place in a suspended position with hands and feet clinging to horizontal branches (personal observation). Additionally, most behavioral postures are exhibited preferentially on horizontal branches (Glassman and Wells, 1984). Branches should be non-toxic natural wood that is flexible and allows species-specific natural activities. In the wild, lorises use their toothcomb to obtain gum (sap) from tree branches (Tan and Drake, 2001). This chewing behavior is also important for them to maintain dental health. Fresh

branches should be provided regularly to encourage dental scraping.

Branches must be arranged close enough to each other to form a continuous pathway in all directions. (See Figure 1 for maximum gap widths.) Because lorises can not jump across gaps (Schulze, 1998), they reach for one branch while firmly gripping another. The most desirable climbing structures should be situated so that the animals will spend their time in areas of their enclosure that are most visible to the public (Figure 1).

It is also important to furnish dense, leafy branches to provide cover for lorises (Bottcher-Law, 2001). Leafy branches are used for sleeping sites and they help to reduce stress caused by prolonged exposure to people or other lorises. While dense vegetation and perching is beneficial to lorises, keeper access and cleaning procedures are also important to consider when designing the perching network. Poorly positioned branches can be obstructive to the keeper as well as stressful to the lorises during prolonged chases to catch an animal.

In open enclosures, it is important for lorises to have suitable climbing structures that do not also provide potential escape routes. Cement barrier walls need to be completely smooth so the lorises are unable to climb up and escape. Branches should not hang over the outside of the enclosure or be close to outside escape paths. (See Table 1. to determine possible loris reach capabilities)

Food and water

Food and water must be accessible from several places to avoid competition. Feeding sources should be in elevated areas so that the animals are not forced to come to the ground. A shelf above the food dishes will prevent contamination by debris from above.

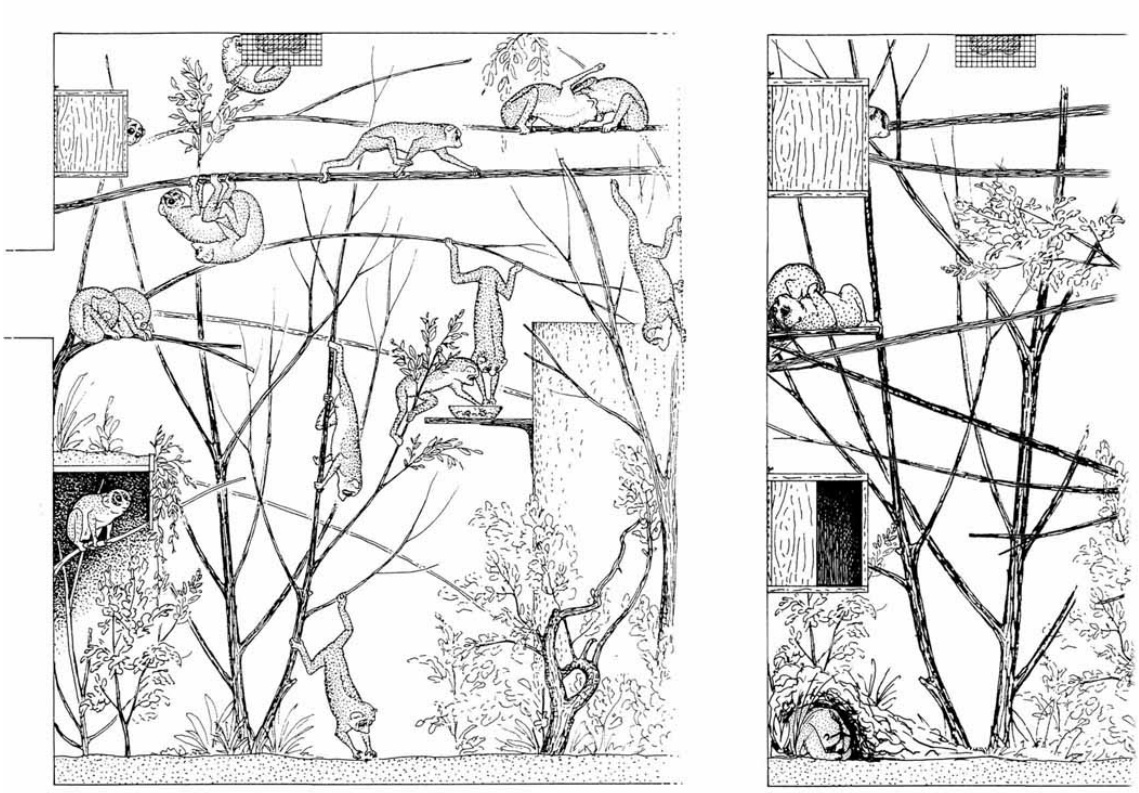

Figure 1. Examples of proper placement of branches and perches in an indoor enclosure. These figures are only for illustration of different ways to use substrates. Lorises must not be housed together in large numbers as suggested by the illustration on the left. (*Drawing by H. Schulze.*)

Fresh food should be offered close to the time when lorises normally wake up. Food deteriorates and can attract vermin if it is not eaten soon after it is provided

Whenever possible, lorises should be offered food items in ways that create a more enriched environment. For example, pieces of fruit can be attached to tips of branches to encourage lorises to forage naturally. See Bottcher-Law (2001) or http://www.loris-conservation.org/database/captive_care/manual/html/Habitat.html#Enrichment for additional ideas regarding enrichment for captive lorises.

Nest boxes

At least one next box measuring approximately 20 square cm and no smaller than 30 x10 x 16 cm must be provided for each loris to enable it to have a safe retreat. Nest boxes should be made out of wood, preferably, but an acceptable alternative is a PVC tube (minimum of 12 cm in diameter). Small cardboard boxes can be used as temporary nest boxes if they are discarded when they become soiled. Nest boxes can be disguised with moss or other natural items so they have the natural look of the exhibit.

A removable nest box situated in an easily accessible area is advantageous for handling or capture. (Figure 2.) The whole box can be removed while the loris is contained inside. With a hinged lid, a loris can be accessed with ease. The nest box should have a smooth surface so the loris can easily be removed without being able to grasp the box (Bottcher-Law, 2001). A Plexiglas panel on one side of the box enables the public and keepers alike to view the animal closely. Wooden nest boxes must be regularly replaced when they become urine-soaked or excessively worn from lorises chewing on the wood.

Lighting

The loris enclosure must provide a nocturnal and diurnal period in order to have a reversed light cycle. For a reversed light cycle, lights should be turned on for 12 hours during the night to encourage the lorises to sleep. A minimum of 75ft candles is required (Keeling, 1974). Simulated night time will then occur during the day. A dimming feature to simulate dawn and dusk is preferable to abruptly turning the "daylight" on and off. Neutral density acetate filters will create the most ideal simulation of natural moonlight (Pariente, 1980). This lighting scheme realistically depicts the forest at night and does not distort the animals' true fur and eye color. If neutral density filters are not available, green lights can be substituted (L. Bottcher-Law, personal communication). Red or blue light can also be used if necessary, but see Fredrick and Fernandez (1994).

Any light during the loris' inactive period of darkness may disrupt their circadian rhythms and can result in extended inactivity during the lorises ' active period (Fitch-Snyder, unpublished data). In a nocturnal house, access to the outside must have a "double door" system so the outside door is completely closed before the inner door is opened. With this modification, the enclosure will not be lit inadvertently.

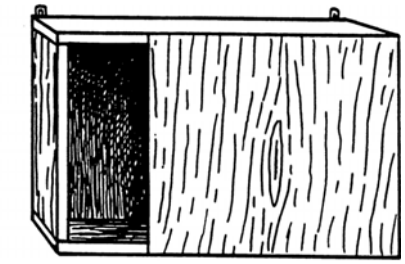

Figure 2. Wooden nest box for lorises. The lid should be attached with a hinge so it can be opened to view or remove the loris. (*Drawing by H.Schulze.*)

Plants

Leafy foliage is important for stress reduction because it provides visual barriers for lorises. Living plants will enhance the experience of both visitor and animal. Even with a reversed photoperiod, some plants can be grown indoors. Sensitive plants should be kept in moveable containers that can be periodically rotated outdoors for temporary recovery periods. Another option is to attach narrow water containers to climbing structures to hold fresh cuttings from leafy plants. Cuttings will stay fresh for several weeks if new water is added regularly. Artificial plants can also provide leafy foliage if no other options are available.

Ventilation

Air circulation is very important for indoor enclosures, especially for animals that scent-mark and communicate through olfaction. Ten to 15 air changes per hour are recommended (Anonymous, 1993). Recirculation of air is discouraged because it will result in a buildup of odors and ammonia levels. Lorises must be able to escape from potential drafts of cold air caused by air conditioning systems.

Temperature

Lorises should be kept within the normal temperature range of their native environment. With proper shelter, they can comfortably live in outdoor temperatures between 18° to 30° C. Thus lorises can be kept permanently outdoors in many facilities in Southeast Asia. In northern Vietnam and southern China, lorises in the wild endure cold temperatures of 5° C and below (Streicher, personal observation). However, captive indoor environments may not provide all the necessary furnishings for lorises to adjust comfortably to extreme ends of this range, and there may be forms from warmer areas that are not well adapted to low temperatures. Therefore, it is best to keep ambient temperature close to the middle of these limits and avoid rapid and extreme fluctuations. Lorises (especially *N. pygmaeus*) do not always choose warm sleeping places and have been found in a state of hypothermia after sleeping on cold substrates (Fitch-Snyder and Schweigert, pers obs). Torpor might be a physiological adaptation of pygmy lorises in a seasonal climate (Streicher, in preparation) but the effects of captive hypothermic stress can result in illness (Schulze, pers obs). It is therefore advisable to avoid possible hypothermia and insulate any sleeping substrates made from concrete or metal.

Humidity

Lorises normally live in humid natural environments, and it is important that indoor enclosures maintain a similar humid atmosphere. While too much moisture can encourage mold growth, regular spraying of vegetation counteracts the drying effect that often occurs when artificial heaters are used.

Cleaning

It is important that enclosures are regularly cleaned and sanitized to dilute the accumulation of urine and scent marks. If chemical agents are used, the animals must first be removed, and all traces of chemical agents must be washed away before lorises are returned. While hygiene is important, this should not be at the expense of environmental complexity and stimulation. Over cleaning will remove the animals' chemical signals and is likely to create an unfamiliar and possibly more stressful environment. This situation can be minimized by cleaning sections of the enclosure at intervals. Climbing structures, branches, nest boxes, and natural ground covers must be regularly replaced after several months as these items become especially worn or saturated with loris excreta.

Noise

Lorises and other animals are sensitive to loud noises from visitors and other sources such as ventilation systems. Indoor enclosures should be designed to absorb as much sound as possible to avoid an "echo effect". Natural substrates on the ground and insulated walls can help absorb unwanted noise. Lorises do not normally live near loud, fast-moving water sources. Therefore, continuous noise from waterfalls, for example, could be disturbing and should thus be avoided around loris exhibit areas.

Ground cover

A natural substrate on the floor of the enclosure will absorb excreta and muffle noise. Natural substrates could be leaves, bark, woodchip, or shredded coconut hulls. Sawdust should be avoided because it may cause respiratory problems (Fitch-Snyder, pers obs). Provision of plenty of well-insulated structures such as raised branches and next boxes will discourage the loris from sleeping on the floor or bare concrete surfaces. A thick layer of the suggested substrates will insulate a concrete floor. Some lorises prefer to sleep on the ground if they can hide under natural substrates, so care must be taken by keepers to not accidentally step on them when working in their enclosures.

Monitoring area

Lorises should be examined daily to monitor health and reproductive condition. Keepers must be able to clearly view the underside as well as the dorsum. A good way to do this is to install wire mesh windows between the enclosure and keeper areas. The wire gage should be approximately 1-2 cm wide and have a smooth surface (with no rust) so that lorises can climb on it comfortably. Using mealworms, grapes, or other preferred treats; lorises can be trained to climb on these wire panels. Keepers can then clearly view the lorises' ventral areas to check for injuries, signs of reproductive changes, and pregnancy.

Mixed species

Under rescue center conditions, mixing of species is generally not recommended. In zoos, mixed species exhibits can be useful tool for utilizing space, providing animal enrichment, and educating the public about sympatric or taxonomically similar species. Slow and pygmy lorises have successfully been housed in enclosures with the following other animals: aye ayes, bush babies, pottos, slender lorises, mouse lemurs, Malayan mouse deer, echidna, aardvark, giant fruit bats, Egyptian fruit bats, bettong, Asian crested porcupine, tree shrews, and sugargliders (Lester, 2001). Slender lorises have additionally been kept with pygmy lorises, fat-tailed lemurs, and hedgehogs (Lester, 2001).

Mixed species exhibits should always be closely monitored to ensure one species does not interfere with reproduction or other natural behaviors. Visual barriers are useful for reducing stress. A disadvantage of mixed species exhibits is that it may be difficult to prevent different species from eating each other's food. Scent marks, feces, or other activities of one species may be disturbing to the other. This may be especially true of the other species that are not native to Asia, such as the lemurs and tenrics.

Mixing different loris taxa together is not advisable if there is any risk of inbreeding. Analysis of loris reproductive data (Fitch-Snyder, 1997) indicates that *Loris tardigradus*, *Nycticebus pygmaeus*, and *N. bengalensis* do not interbreed in captivity. However, N. *bengalensis* and *N. coucang* varieties will readily reproduce together.

Disease transmission is a potential risk of mixed-species exhibits. Two lorises died of infection with *Pasteurella* after contracting it from a Provost's squirrel housed in the same enclosure and showing no signs of illness (Fitch-Snyder and Schulze, 2001). It is not advisable to house lorises with any carnivore, predatory bird, snake or potential prey. Pythons (Wiens and Zitzmann, 1999) and orangutans (Utami and Van Hooff, 1997) are known to prey on lorises. Lorises will kill and eat small birds, lizards, and rodents.

Indoor exhibit design

Lorises are traditionally kept in wire or concrete enclosures. These types of housing are functional and inexpensive and therefore often the most feasible option for rescue centers and sanctuaries. In contrast, for zoos and facilities aiming to exhibit lorises, open indoor exhibits can enhance both the visitor' experience and create a more stimulating environment for the lorises. (Figure 3.)

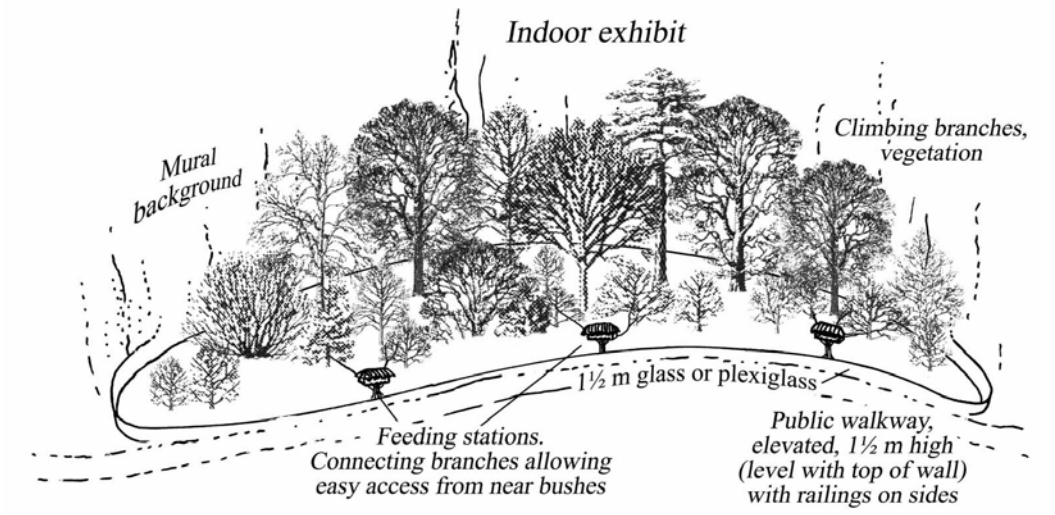

Figure 3. Layout of an open indoor exhibit. (*Drawing by H. Schulze.*)

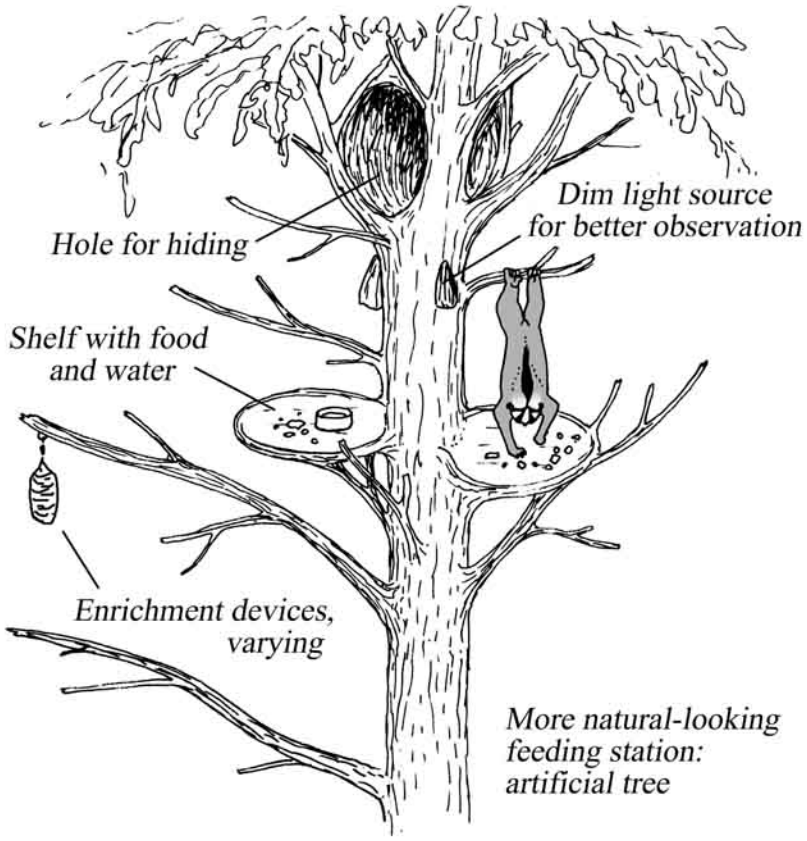

Figure 4. Feeding station design. Foliage on top of the station makes it more natural looking and provides a more protected feeding environment. (*Drawing by H. Schulze.*)

Outdoor Enclosures

Advantages

In outdoor environments in their native country, lorises are exposed to the natural lighting and weather conditions to which they are already well adapted. Exposure to these natural conditions encourages normal behavior and may influence important physiological patterns such as those associated with reproduction.

Disadvantages

A major disadvantage of outdoor enclosures is that lighting cannot be controlled. Lorises are strictly nocturnal, so they normally sleep through daylight hours. This makes a boring exhibit for visitors, and it is also more of a challenge for keepers to monitor the behavior of the animals and to check their health. Keepers and researchers will need to modify their normal work schedule in order to provide optimum care and to observe the lorises during their active period. With an outdoor enclosure, there is also a much greater risk of animal escape, predation, and transmission of disease from wild species.

Island Exhibits

Several SE Asian Zoos had problems maintaining lorises on outdoor islands (personal observation). For example, an island at the Schmutzer Primate Center in Jakarta was used to release groups of confiscated slow lorises. Most of the lorises disappeared or died within a few weeks, and the remaining lorises had to be removed from the island (F. de Haas, pers com). Possible factors responsible for the failure of the island enclosure are escape of the lorises, being preyed upon, unstable social groups, and poor initial health.

Escape

Lorises may have been able to escape from the island by grasping small concrete or metal outcroppings along the perimeter wall. Although they can't jump, lorises have a remarkable ability to bridge gaps by stretching their bodies or bracing themselves along uneven vertical surfaces. If a vertical support is available, the loris may use a "cantilever posture", in which the body weight is supported by one leg above and one grasping below. This allows the animal to assume a horizontal posture for some time before seizing a new support. In Table 1, bridging distances for various *Nycticebus* taxa are presented. When planning open enclosures, one should also recognize that lorises have the ability to use flexible twigs to enhance their reach to more distant supports. (F. Wiens, pers com)

Lorises may also have escaped from the island by climbing on over-grown branches that extended outside the enclosure. Before the second loris group was released, keepers modified the exhibit, trimming overgrown vegetation, adding climbing structures made out of rope, and modifying the water level in the moat to approximately 20 cm deep. It has been reported that lorises are unable to swim (Ryley, 1913), so keepers thought that the lorises would avoid the moat. However, two lorises had to be retrieved from the water: One loris went directly into the moat after the release. The other apparently fell into the water and was unable to get out without intervention (F. de Haas, pers com).

Predation

Wild animals or feral cats inside the zoo could have preyed upon the lorises. Wild predators such as civets, owls, or pythons might be responsible for some of the losses. One keeper reported finding clumps of loris fur on the island enclosure, which suggests possible predation by either a carnivore or raptor (F. de Hass, pers com). However, clumps of fur without the skin is more likely due to intraspecific fighting.

Unstable social groupings

In the wild, slow and pygmy lorises are normally found alone or in small groups of two to four (Fitch-Snyder and Thanh, 2002; Wiens, 2002). Six to eight lorises have been known to live successfully under captive conditions (Fitch-Snyder, pers obs), but these groupings are not usually stable and need to be closely monitored. In general, the larger and more complex the environment, the more likely that a loris will be able to establish their own territory and tolerate con-specifics. With the occasional exception of male

Table I. Bridging distances for *Nycticebus*. Maximum breadth of substrate gaps that can be crossed by "bridging". (For females carrying heavier offspring, gaps of this size may be too wide). *(Drawings by H. Shulze.)*

***Nycticebus* taxon**	Size of animal: head-body-length/ sitting height	Shoulder height when walking on a branch	Reach of hand, starting from a vertical branch for bridging	Maximum distance between attached feet during bridging	Maximum reach vertically up or downward	Length during hanging, fully extended
						
N. pygmaeus	Average 21.6 cm [4], 18 - 29 cm [5] / - [2]	Average about 14 cm, up to about 19 cm in large animals	Average about 30 cm, up to about 41 cm [2]	Average about 27 cm, up to about 36 cm [2]	Average about 37 cm, up to about 50 cm [2]	Average about 39 cm up to about 52 cm [2]
***N. coucang* (small)**	26.3 / 29.3 cm	About 17 cm [1]	About 37 cm [1]	About 32.5 cm [1]	About 45 cm [1]	About 47 cm [1]
***N. coucang* (medium)**	Up to 33 cm / - [3]	Up to about 21 cm [2]	Up to about 46 cm [2]	Up to about 41 cm [2]	Up to about 57 cm [2]	Up to about 59 cm [2]
***N. coucang* (large)**	Up to 34.6 cm / - [4]	Up to about 22 cm [2]	Up to about 49 cm [2]	Up to about 43 cm [2]	Up to about 59 cm [2]	Up to about 62 cm [2]
N. bengalensis	29.1-36.7 cm [3]	Up to about 24 cm [2]	Up to about 52 cm [2]	Up to about 45 cm [2]	Up to about 63 cm [2]	Up to about 66 cm [2]

[1] Measurements from photos, still video and / or dead specimens. [2] Measurement of a dead *N. coucang* and head-body size. [3] C. Groves, pers. comm. [4] U. Streicher, pers. comm. [5] From literature and museum specimen label

littermates of pygmy lorises, males will nearly always fight with each other if housed together. While the initial injuries may not appear to be severe, these bite wounds usually become infected and often result in death. In is important that any loris social grouping is closely monitored for compatibility for at least several weeks before and after releasing them to a less-structured environment. The stress of a new environment can also contribute to fighting after release.

Poor physical health

Lorises must be in excellent physical condition before being released into a large outdoor enclosure. The stress of this new environment can easily worsen any pre-existing health problems. Animals with dental disease, advanced age, or other potential handicaps are not good candidates for this type of housing. (See Streicher, *et al*. (this volume) regarding assessing loris health.) Lorises who are in otherwise good health but are lacking most of their front teeth could be candidates for this type of enclosure providing that they are able to consume a healthy diet. These lorises should not be mixed with dentally intact lorises that could harm them in the event of an aggressive encounter.

Recommendations

Island exhibits have the potential to be an excellent method of housing loris groups. However, no one has systematically tested this type of enclosure to resolve potential problems. In addition, the full extent of a loris's capabilities is not known. The best way to determine if island housing is suitable is to systematically study and thoroughly document the results of any future releases. This information is essential for planning future outdoor or other naturalistic enclosures, and it will provide new insight about natural loris behavior that cannot be learned by studying lorises housed in artificial indoor cages.

Questions for future inquiry regarding island housing

1. How do lorises escape from their enclosures?
2. What kinds of animals are preying on lorises?
3. How do lorises respond to potential predators?
4. How do lorises use their enclosures, for example, where they sleep? Where do various behaviors occur?
5. What types of fauna do lorises prey upon in their enclosure?
6. What kinds of moats or retaining walls work best to keep inside the enclosure?
7. How do the lorises interact with each other?
8. What method(s) are best to identify individual lorises?
9. What is the maximum population density possible under various housing conditions?
10. How can keepers identify signs of social stress, and how can it be minimized by factors such as group composition or environmental design?
11. How do confiscated lorises with absent teeth (usually removed by dealers) adapt to this disability? Which food items are they still able to eat?

Some essential release requirements when housing confiscated lorises

1. Ensure that lorises are in good health and individually recognizable through colored plastic leg bands or stainless steel ball-chain bracelets with attached colored tassels. (See: http://www.loris-conservation.org/database/for more information.)
2. Sort loris group by taxon and avoid mixing different subspecies together in the same enclosure. (See: Schulze and Groves, (submitted).)
3. Ensure that each loris is able to obtain food and water. This is especially important for compromised animals such as those with missing teeth.
4. Do not attempt to house a group of male lorises together in the same enclosure. They are likely to fight and inflict severe injury. In order to establish a small loris group, try housing one male and several females together under close supervision for several weeks before releasing them.
5. The island should be checked for potential problems such as escape routes (including the steps in the moat area), drowning opportunities,

loose electrical wires, and places where animals could become entangled.

6. It is strongly recommended that all feral cats be removed from zoo grounds. Not only are they predators, but they can carry potentially fatal zoonotic diseases.
7. Check the enclosure at night to make sure that there is enough light available for observers to clearly see the lorises and their activities. (The light should be no brighter than a full moon.) Colored filters should cover torches to keep the light from disturbing the lorises. Make sure that all areas of the enclosure are visible.
8. Systematic behavioral data should be collected on each loris throughout the first few nights after release. This could be a good project for college students. Ideally, two people at a time should watch to make sure all parts of the island are monitored. The observers should be as quiet as possible so that the lorises and any potential predators will not modify their behavior in their presence. Observers may need to rotate after four-hour shifts to prevent boredom. It might also be useful to monitor the island by infrared video cameras.
9. Locate each loris on a daily basis and check for injuries with as little disturbance as possible. Consider training lorises to come to specific areas of their enclosure whenever they hear a whistle or other unique noise. Provide special food rewards whenever they respond to this auditory cue.
10. Watch feeding stations to make sure all lorises get food and ensure that wild animals do not eat the lorises' food.

Once the initial group adjusts to the island and an effective monitoring system is in place, additional lorises can be added to the island. Around-the-clock monitoring should be done again for at least the first few days after each new loris is added.

Loris Sanctuaries and Free-ranging Enclosures

Suggested design

A large semi-natural enclosure could provide a suitable environment for a loris sanctuary or research center. A two-meter fence made from smooth plastic or metal sheeting may be sufficient to serve as a perimeter wall, but observation is necessary to ensure that lorises cannot leverage themselves up any connection points to climb up to climb to the top of the wall. An electric fence may be necessary to keep the lorises from escaping and to prevent potential predators from climbing into the enclosure. The electrical wires should be installed both inside and outside of the fence to be effective. Otherwise, predators can become trapped inside if there is electric wiring on the inside alone.

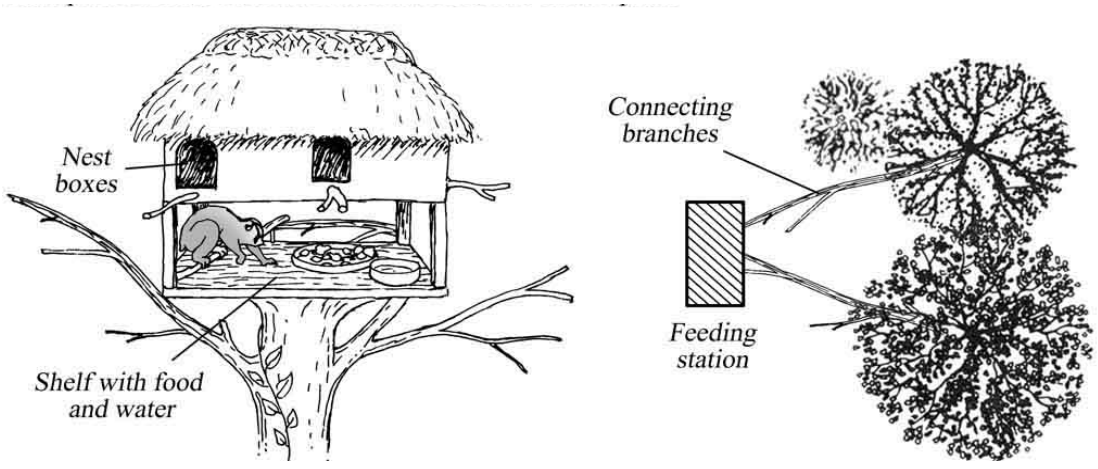

Figure 5. Loris feeding station. Roof protects food from rain and dirt and lorises from raptors. Branches connect trees with feeding stations. *(Illustration by H. Schulze.).*

The minimum size for a naturalistic enclosure such as this is 0.5 hector. The interior should be generously planted with trees and bushes. The goal is for the branches and other climbing structures to provide a continuous arboreal environment without the vegetation being so dense that it is difficult to see the lorises. The part of the enclosure closest to the keeper entrance should contain several feeding stations (Figure 5). These stations should be located in a fairly open area, but all be connected by branches or ropes to nearby trees or bushes. The number of feeding stations is dependant on the size of the enclosure and the number of lorises. Each feeding station should be build on stilts and consist of a platform large enough to hold several food and water bowls. The roof above the platform could be designed to include nest boxes to provide additional shelter.

Like the island environment discussed earlier, the success of this enclosure depends on the keeper's ability to monitor each individual. Radio collars may be useful for this purpose, along with bird rings or other methods of easy recognition by keepers and researchers. Each loris should also have a permanent means of identification such as a tattoo or transponder. It is especially useful to train the lorises to routinely approach the feeding station in response to an auditory cue from the keepers. Keepers can then do periodic inventories of the colony and be aware of any problems or changes in the population.

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