

INFANT CARE

Birth Management and Hand Rearing of *Lorisidae*

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Following the birth of a loris infant, involved staff should work together to evaluate the status of the neonate. In cases where abuse, neglect, or insufficient care is observed or suspected, animal care staff should closely monitor the situation, and discuss options for care and husbandry management.

Hand rearing

The term “hand rearing” encompasses a wide continuum of methods: from total isolation until past weaning age, to peer rearing and early reintroduction to conspecific family groups. In general, the extreme end of the hand rearing continuum appears to be detrimental at least in primates (e.g., Harlow and Harlow, 1962). However, measuring the results of the other end of the rearing continuum is more complex. Many species appear able to recover from hand rearing efforts when they are introduced to conspecifics at a very early age. However, almost all captive managers now support mother rearing whenever possible for all species, both due to the complexities of early introductions, and in the overall best interest of the individuals and the species. The Prosimian Taxon Advisory Group (TAG) strongly recommends that all institutions develop management programs that increase the likelihood that infants will be mother-reared within a social group.

Post-partum observations and evaluation

Following a birth, close monitoring of the mother and infant is critical. Some institutions such as the San Diego Zoo regularly schedule nighttime observations, allowing the collection of this critical data. Rogers and Davenport (1970) developed a scale for use in evaluating maternal care in chimpanzees immediately postpartum. Although chimpanzees are far removed from lorises, this protocol has general application to observation of primate maternal behavior. This protocol, including a scale from negative to positive maternal care where 0=negative and 4=positive, has been slightly modified to evaluate loris maternal behavior (see Table 10). Obviously, if a female is injuring her infant, it should be removed right away.

Alternatives to hand rearing

If observations of the infant postpartum indicate that the infant is becoming weak, dehydrated, hypoglycemic, and/or hypothermic, and that inadequate maternal care may be the cause, there are several possibilities short of removal for hand rearing. First, if the infant is being held correctly but is not nursing, or the female is not holding the infant in the appropriate manner, milk may be expressed from the mother’s breast to encourage the infant to suckle. Second, if the infant appears to be nursing but nonetheless seems weak, the infant may be pulled for medical evaluation. If the evaluation indicates that the infant is physically well but is not receiving enough nutrition, the mother’s milk may be lacking in nutritive content or volume. The infant can then be returned to the female and supplemented with formula feedings. Alternatively, if another female exists that has milk, crossfostering can be attempted, with proper follow-up care and monitoring. At San Diego, we were



Table 10: Scale of maternal care, where 0=negative care and 4=positive care (modified from Rogers and Davenport, 1970).

Scale Number	Description of Maternal Care
0	No observed contact between mother and infant, with the mother ignoring or actively avoiding the infant (these species <i>do</i> park infants for short periods of time; a 0 on this scale refers to a complete lack of contact and proximity).
1	The mother occasionally inspects and/or pokes at the infant but there is no prolonged contact or holding.
2	Infant is in contact with the mother some of the time but is either carried/held away from the maternal body or is parked for prolonged periods of time. (Approximate duration of parking will vary from species to species. <i>Loris</i> are not parked until they are approximately 30 days old. However, some institutions report that <i>Nycticebus</i> infants may be parked for short durations beginning on the first day. At San Diego, we have found that with <i>Nycticebus</i> , parking durations of 10 to 20 minutes, for instance, are not sufficient for concern. Durations of more than an hour would warrant concern and evaluation.)
3	Mother carries infant constantly (excepting short parking durations) but frequency of nursing is in question.
4	Mother carries the infant on the ventral surface, allows the infant to grasp, and responds to the infant's vocalizations by readjusting, examining, or clasping it; infant is parked only for short durations (10 to 20 minutes—again, <i>Nycticebus only</i>). Adequate nursing is observed.

successful at introducing a young infant to an unrelated female with milk. We continued to monitor the weight of the animal, and because the quality of milk from the female was unclear, we continued to provide supplemental feedings until weaning age.

If alternatives to hand rearing are unsuccessful, hand rearing should be implemented with the goal of early reintroduction to conspecifics. To the best of our knowledge, the following institutions have hand reared loris species: slender loris: London Zoo; Bengal slow loris: San Diego Zoo; Duke Primate Center; pygmy slow loris: Brookfield Zoo, Ogród Zoologiczny-Poland, Philadelphia Zoo, and San Diego Zoo. We have compiled the following recommendations for hand rearing based on information provided by Brookfield Zoo, Duke University Regional Primate Center, London Zoological Society, Ogród Zoologiczny-Poland, and San Diego Zoo.

Physical needs

Housing

Some zoological parks have central nursery facilities, whereas others may hand rear animals adjacent to the natal groups. Regardless, upon determination that hand rearing is required, the infant should be placed inside an isolette incubator set at 90° F (32° C). At the San Diego Zoo, the humidity is typically set to low; alternatively, the Philadelphia Zoo uses high humidity. The infant should be provided with an appropriate surrogate and a hot water bottle to simulate the maternal body. Surrogates are typically either plush animals or soft material such as artificial fur. All

surrogates should be prewashed and examined for possible shedding; only surrogates that do not continually shed should be used. A blanket also should be provided to create a hiding place for the infant. Blankets should be selected that do not have holes or loose strings in which the infant can become entangled.

At approximately five days of age, the neonate should be provided with some branching material of appropriate size, preferably used by the infant's natal group. This material can be safely propped up inside the incubator and provides the neonate with a chance to climb and accustoms it to the "parking" behavior of the dam, while also providing sensory cues associated with the natal group. Climbing behavior is generally not observed until approximately two weeks of age; early movements on the branch appear to be more oriented toward hiding than exploration.

At the San Diego Zoo, a gradual process is used to wean the neonate from the incubator. This process begins at approximately 19 or 20 days, when the neonate appears able to thermoregulate; by the age of 47 days the infant is housed entirely outside of the incubator. To accomplish this, the incubator temperature is dropped to 80° F (27° C), and the hot water bottle is discontinued. At this time, an adequate enclosure is set up including cage furniture (i.e., nest boxes and perches/browse) that has been scented or used by the natal group. The room temperature is kept between 78-80° F (25-27°C), and is kept free of drafts. A heat lamp is placed in one area of the enclosure so that the neonate can choose the best temperature area. An elevated sleeping and eating platform is also provided.

By 24-27 days the neonate should be removed from the incubator for an hour twice daily. If this is well tolerated and the neonate shows no signs of chilling, the length of time spent outside the incubator can be gradually increased. Using our procedure, by 30 days the neonate should be spending about 3 hours outside the incubator each day. The neonate should be allowed access to the surrogate at all times. The surrogate can be attached to the side of the cage or feeding shelf with a bungee cord or similar attachment. On the first week of climatization, it is advisable to furnish the enclosure with soft shock absorbing material on the floor in case of an accidental fall. By 40 days of age, the neonate should be spending all day in the enclosure, returning to the incubator only at night. At 46 or 47 days the incubator can be discontinued.

Alternately, the Philadelphia Zoo has moved more quickly through this climatization process. As soon as the infant was able to thermoregulate (at between 15-20 days of age), the neonate was removed from the incubator for daylight hours, and returned to the incubator in the evening.

The infant should be reintroduced to conspecifics as soon as possible (see later section on Social Needs).

Formula and Nipple Selection

Upon arrival, a veterinarian should evaluate the neonate. Dehydration, sepsis, and hypothermia should be corrected appropriately. Infants should not be fed if they are hypothermic. Obtaining a body temperature on an animal of this small size is extremely difficult, and it may be necessary to rely on touch to assess relative body temperature.

Initially it is safest to offer formula in a tuberculin syringe to provide more control. Special care and



attention should be paid in the first days to avoid aspiration of formula into the lungs. This is especially important due to the small size, active nature, and frequent vocalization of loris neonates. Neonates should be fed on the surrogate with the aid of a blanket to steady the body and limbs. In weak or injured neonates, the first feedings should be of pedialyte solution, until patent swallowing reflex is observed. When neonate and caregiver are settled into a comfortable routine, it is appropriate to try the animal on a nipple. We have found that the only nipple small enough and of the appropriate turgor is the short size macropod nipple. These nipples can be ordered (Multi-purpose short teats #T-3, Order from: Geoff and Christine Smith, 15 O'Shannassy St., MT Pritchard NSW, Australia 2170, 02-823- 9874), and are attached to the smallest size nip pet nurser bottle, although other institutions have made their own nipples from latex (Sodaro, 1993). Great caution should be taken when first trying nipples. In particular, it may be necessary to slow down the flow of the formula; one method for doing this is to hold the bottle horizontally. If the individual does not tolerate the nipple well, a syringe feeding method can be employed throughout the hand rearing process. At the Philadelphia Zoo these methods were combined. The macropod nipple was attached to a syringe of appropriate volume, and the animal was syringe-fed throughout hand rearing.

Table 11. Infant diet schedule.

Age (in days)	Food Item
2	Liquid esbilac and distilled water 1:1*
3	Liquid esbilac and distilled water 1:5
5	Straight liquid esbilac
26	Begin offering finely diced banana pieces
27	Add soaked primate biscuit
28	Add powdered psittacine biscuit and grape
29	Add cooked (steamed) yam and carrot
30	Add orange
33	Add mealworms (4 per day)
34	Add crickets (1 per day)

*During initial feedings the animal's hydration and blood glucose levels must be monitored closely. If the animal is dehydrated or hypoglycemic, some institutions combine formula with Pedialyte or D5W. Others supplement with subcutaneous fluids.

The diet and feeding schedules obtained from institutions that have hand reared lorises showed considerable variation. Those schedules utilized by the San Diego Zoo that met with success in both pygmy and slow lorises are outlined in Tables 11 and 12. Many responding institutions included sweet gruel mixtures in the diet, generally including baby food, bananas, peaches, yogurt, and so on. Some institutions successfully use such diets as transition between straight formula and solid food. For example, the Philadelphia Zoo feeds a mixture of esbilac, baby cereal flakes, and a small amount of banana by dish. At San Diego we have avoided these sorts of mixtures, due to the incidence of caries in older animals, and possible influence of such sweet diets on general nutrition.

Additionally, most institutions add insects, such as crickets and mealworms, to the neonatal diet.

Care should be taken to carefully monitor the amount of insects fed, as feeding large quantities of insects may be associated with bone problems later in life in these species (M. Edwards, personal communication, 1997). Age at weaning for hand reared animals varies between institutions (e.g., from 76 to 151 days). Mother-reared lorises may nurse for six months or longer, depending on the species. As a result, weaning certainly could be extended beyond the 76 days we have indexed below; however, we have shortened the weaning period to facilitate early socialization.

Table 12. Infant formula schedule.

Age (in days)	Number of times formula offered daily	Percent body weight
10 - 12	11 times daily	25 %
13 - 16	10 times daily q2h* (5 a.m. to 11 p.m.)	24 %
17 - 18	8 times daily q2.5h (5 a.m. to 10:30 p.m.)	24 %
19 - 24	7 times daily q3h (5 a.m. to 11:30 p.m.)	24 %
25 - 29	6 times daily q3-4h (5:30 a.m. to 10:30 p.m.)	24 %
30 - 36	5 times daily q4h (6:30 a.m. to 10:30 p.m.)	21 %
37 - 46	4 times daily (6:30 a.m. to 10:30 p.m.)	18 %
47 - 53	3 times daily (7 a.m., 1:30 p.m., 8:30 p.m.)	12.5 %
54 - 60	2 times daily (7 a.m., 7 p.m.)	8.6 %
61 - 73	1 time daily (7 a.m. only)	4.9 %
74 - 75	1 time daily (7 a.m. only)	1.7 %
76	weaned	

*q2h=every two hours, and so on.

Physical Needs: Species-Specific Concerns

Feeding. Loris neonates that are being hand reared vocalize frequently, particularly during any interaction or stimulation, such as when they are being fed. These neonates also are “squirmy,” and attempt to burrow into their surrogate or blanket, and reach out to grasp the nipple or syringe tip. Loris babies can aspirate easily, especially in the first few days of life. Aspiration is a particular risk when animals are vocalizing or moving during feedings. Therefore, special care should be taken not to rush feedings, and to wait until the neonate is sufficiently settled prior to feeding. One method of settling an overstimulated neonate is through grooming. For grooming, the handler may either use their fingers or a slightly damp gauze pad or soft brush. Initially, lorises should be offered formula via syringe, until they are nursing reliably and are comfortable with handling. As always, handlers need to be constantly alert for any change in respiration. Any such change should be reported to veterinary staff. However, when keepers and veterinarians are evaluating such changes, veterinarians should be made aware that at San Diego, nursery attendants heard one particular vocalization that actually sounds like a “raspy lung.” Although there was initial concern about aspiration, it was later determined it to be a vocalization rather than respiratory difficulty.

It is important to consider the amount of formula lost through unsuccessful attempts at hand feeding when gauging the total intake and formula calculations. When syringe feeding, the total amount of one feeding may be only 0.2ml. Therefore, each drop wasted or dribbled out of the mouth can represent a significant amount of formula with regard to the total daily intake. Handlers should consider these small increments and make adjustments accordingly.



Elimination. Manual stimulation is recommended until the infant is reliably urinating and defecating on its own (approximately four weeks of age). During the first two weeks, some institutions (including San Diego) report that this species has infrequent stool, and may not pass stool for two to five days. Alternatively, others report regular stool production beginning on the first or second day. After this time, they begin stooling reliably once daily. Stool character is uniformly firm and at times appears dry.

Drinking. Caution should be taken when offering water in a vessel or bowl, due to the animal's small size. Initially, a water vessel should be selected that is very shallow, such as the cap to a medicine bottle or plastic pet food lid.

Weight. It is sometimes difficult to assess vitality on a creature of this size. As a result, particular attention should be paid to the animal's weight. Weight is an excellent indicator of overall health status in lorises. Weights should be taken on an accurate scale, preferably sensitive to the onehundredth gram. Weights should be taken at the same time each day, preferably before the first feeding of the day. Solids can be weighed before and after feeding to determine amount consumed.

Surrogate selection. Surrogate selection is another important aspect of hand rearing. An adequate surrogate should have several characteristics: 1) The surrogate should ideally be of appropriate size and color to simulate the maternal body; 2) It should be pre-washed and carefully tested to insure that none of the nap or fur can be easily pulled out (some artificial fur is very fragile and sheds continuously regardless of the number of washings); 3) The surrogate should be free of any ornamentation which could be removed or ingested by the infant, including ribbons, bows, etc.; and 4) Several surrogates should be purchased so that there is always a clean dry surrogate ready to use.

Social Needs

It is ideal to begin a reintroduction of any hand reared loris infant as soon as possible after climatization is achieved. Determination of how quickly reintroduction commences will depend on location of the nursery. At San Diego, the nursery is far removed from the loris facility. As a result, this makes visits to the loris facility more difficult, particularly before the neonate is able to thermoregulate, thus lengthening the reintroduction process. Alternatively, at facilities such as the Philadelphia Zoo, neonate lorises are raised in the same area as the adult lorises, allowing speedier reintroductions. In Philadelphia, when the neonate is removed from the incubator it is placed directly in a cage inside the loris enclosure, facilitating the reintroduction process. Regardless of each institutions' particular facilities, the overriding goal is to attempt reintroductions as soon as possible.

The reintroduction site should be free of drafts and cold air, and should include a stable heat source for the neonate. The first step is to provide visual exposure and to accustom the neonate to the new facility or enclosure. Ideally, the visual introduction should be started in an enclosure similar to the one that will eventually house the animal, so that it can learn to use the space before the final introduction. At the Philadelphia Zoo, this is accomplished by placing the infant in a cage inside the loris enclosure. Alternatively, a "howdy" cage can be set up next to the loris enclosure, depending on your facility design. In any case, the howdy cage should be made comfortable for the neonate, including placing the surrogate inside.

Infant care

Initial introduction time can vary, depending on observations of the infant and the adjacent lorises. This can range from as brief a time as one hour, increasing gradually to a full day. At San Diego, the howdy cage initially allows only visual and olfactory stimulation, preventing tactile interaction by use of either very fine or double mesh. After the neonate is comfortable, limited tactile interaction is then allowed. Alternatively, the Philadelphia Zoo allows limited tactile interaction immediately, under close observation. After a period of time, the screen can be opened to allow the two animals full access to each other. In the Philadelphia Zoo's case, this has been accomplished as early as 20 days, removing the neonate from the female for feedings and for overnight housing in an incubator. Again, this will be strongly influenced by easy access between the nursery and adult loris facilities.

Additional care should be taken even after the full introduction has been successful to insure that the infant has adequate access to solid food via a creep or separation of the two animals at feeding times. Bottle feedings can frequently be woven into this reintroduction schedule and the neonate does not need to be weaned in order to start or complete an introduction. Table 13 below provides an example of a reintroduction schedule on a slow loris at the San Diego Zoo.

Table 13. Sample reintroduction schedule for slow loris at the San Diego Zoo.

Age (in days)	Introduction stage	Description
49	Visual reintroduction to dam	Infant was placed in an adjacent cage that was connected by a tunnel blocked off by a screen. Dam and neonate ignored each other. Introduction time was 9:00 p.m. through 7:00 a.m. due to nocturnal nature. Observer present initially and then occasionally to record behavior.
56		Increased interest noted between dam and neonate through introduction wire. Seen sitting next to each other, dam attempting to reach through the wire.
57		Dam started grooming the neonate through the wire.
63	Tactile screen removed/full contact.	No aggression noted. The two animals still separated during feeding to prevent the dam from eating all the food.
65		Neonate seen riding on dam's back and sleeping or sitting sideby-side majority of the time.

Summary

The primary goal of any hand-rearing attempt should be to raise an infant that can be resocialized and that will behave appropriately with conspecifics. The earliest possible reintroduction, combined with continuous monitoring for health problems, has proven the most successful in this regard.

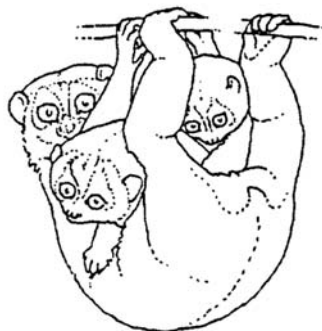


Figure 25: Female *N. pygmaeus* with twins at San Diego Zoo.