

HAND-REARING

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(Updated by Carol Sodaro)

INTRODUCTION

This chapter focuses on the management of orangutan infants in a hand-rearing situation. Please refer to the Development, Reproduction and Birth Management Chapter for information on pre-partum, birth and post-partum management.

SSP® Hand-Rearing Guidelines

The Orangutan SSP® recommends:

- **developing a birth management plan prior to the birth of every infant.** A sound birth management developed early in the pregnancy will address potential mother/infant care scenarios immediately post-partum. Contact the Husbandry Advisor, Carol Sodaro casodaro@brookfieldzoo.org for help in developing a birth management plan when a pregnancy is confirmed.
- **hand-rearing *ONLY* in cases where the infant has a health problem and/or as an interim step prior to reintroduction to the dam or a surrogate mother.** Management practices that including removing the infant from its mother at birth or at a very young age are strongly discouraged.
- **providing 24 hours a day, 7 days a week (24/7) continual care until reintroduction to the dam or surrogate.** Having caregivers that are dedicated to caring for and carrying the infant continually is critical to the psychological well-being of the infant. Carrying 24/7 mimics the maternal care offered by an orangutan mother while ensuring the infants ability to cling properly. Institutions that are unable to provide 24/7 care should contact the Species Coordinator, Lori Perkins lori410@mindspring.com for further direction.
- **Caregivers need to be familiar with and emulate orangutan behavior.** This can be accomplished by direct observation or via a videotape.
- **If hand-rearing is necessary, contact the Species Coordinator, Lori Perkins lori410@mindspring.com.**

INFANT SOCIAL ENVIRONMENT/REARING

From his field studies, MacKinnon (1974) observed that during the first year of life an infant orangutan is in almost permanent bodily contact with its mother, clinging tightly to her side as she travels, or clambering over her in an exploratory fashion when she pauses to feed or rest. Although these infants see, and often sample the foods their mothers finds in the forest, they are nourished almost entirely from her milk. By the second year, the infant is less dependent. Although never far from its mother's side, the infant is rarely carried and is capable of finding some of its own food. By the third year, MacKinnon (1974) states that the youngster is actively searching for playmates.

Juveniles remain with their parent until the birth of a new infant. Galdikas (1981) reported interbirth intervals of 5 years. From then on, the close bond between mother and offspring starts to change. Juveniles, particularly males, gradually wander farther from their family and spend increasing periods alone. Young females are less adventurous and often stay with their mother and play with the new infant. They probably learn the fundamentals of infant care at this time.

As successful mothering includes learned behaviors, maternal contact for young orangutans should be maximized. During maturation, it is recommended that individuals be given the opportunity to observe infant-rearing, if possible. It is thought that females lacking in maternal skills are more likely to rear successive offspring if given as much time as possible to establish a relationship and perform some maternal care with their present infant.

It has been well documented in the literature that the mother-infant relationship forms the basis of nearly all social behavior in many species of mammals. A lack of conspecific mothering during infancy has been linked to deficiencies in both sexual and maternal behavior in adulthood (Maple 1980). However, as with many higher mammals, those behaviors that are learned and those behaviors that are innate have yet to be clearly delineated. Further research on the development of orangutans in captivity is warranted.

TRENDS IN HAND-REARING

In the first edition (1997) of the Orangutan SSP® Husbandry Manual, a questionnaire was done in 1992 by the primary author (Eve Watts) pertaining to hand-rearing. This survey focused on orangutans hand-reared in SSP® collections and was done historically (i.e. how many animals had been hand-reared at an institution, not the number of

animals being hand-reared at the time of the survey).

Increased knowledge, improved animal management techniques and proper birth management plans have greatly reduced the incidence of hand-rearing. The success rate for infant reintroduction or successful surrogate mother situations has increased. In almost all cases, an extended infant hand-rearing is not necessary.

INTERVENTION TYPES (WHEN TO HAND-REAR)

Please refer to guidelines in this chapter for housing, feeding, socialization, etc. for all intervention types listed below.

If the infant can be returned to the dam in the immediate future

When an infant has been removed from the dam due to medical issues affecting either animal, full consideration should be given to reintroduction of the infant when the animal(s) medical condition improves (or as soon as possible).

If, in order to remove the infant, the dam needs to be sedated, her lactation status should be checked. If the medical condition of the infant is stable, the infant should be allowed to nurse from the sedated female. This will help stimulate further lactation and encourages natural infant suckling. If the infant is not able to nurse from the sedated female, breast milk should be collected and stored to feed the infant at a later time. This can be done via manual expression or a breast pump. *Be aware that milk collected during the beginning stages of lactation can appear thin and watery. It does not have the typical appearance of cow milk.*

The length of time an infant has been removed from the dam is one consideration that factors into planning a reintroduction. Other considerations are the ability for the infant to nurse naturally once reintroduced to the dam and the lactation status of the dam. Bottle-fed infants may have difficulty in returning to a natural “nursing” situation unless the reintroduction is planned for the immediate future. This is because it is much easier for an infant to drink milk from a synthetic bottle nipple than to nurse naturally from the dam’s nipples. Switching from a man-made nipple to the breast is also a change in the infant’s daily routine. During this time, the infant should be cared for in front of the dam’s enclosure. Contact the Husbandry Advisor, Carol Sodaro casodaro@brookfieldzoo.org for additional recommendations pertaining to your specific situation

If the infant can’t be returned to the dam in the immediate future but a reintroduction at a later date is possible. The earliest an infant has been

successfully reintroduced to her dam is 5.5 months of age (Sodaro and Weber 1993). In this case, both the infant and dam were involved in a training program prior to the actual reintroduction. A positive reinforcement training program should be initiated for both the infant and the dam. If possible, the infant should continue to nurse from the dam's breasts through the cage front. If this is not possible, the goals of the training program should include the infant learning to drink from a bottle (and eat solid foods if old enough) while housed in the dam's cage and the dam to allow the infant to be bottle fed (or eat solid foods) from caregiving staff.

If, due to the health status of the infant or the dam, an introduction can't take place in the immediate future, follow the guidelines for hand-rearing in this chapter. Animal management plans should focus on 24/7 care and emulating orangutan maternal behavior. Facilitating dam/infant contact should be encouraged as much as practical.

Contact the Husbandry Advisor, Carol Sodaro casodaro@brookfieldzoo.org for additional recommendations in developing a reintroduction and training plan for your specific situation.

If the infant can't be returned to the dam, and the infant will go into a surrogate situation

When the best rearing option for an infant is a surrogate mother, follow all general hand-rearing guidelines in this chapter. It is a "rare" situation for an infant to be sent to a surrogate mother that is lactating (Carol Sodaro, personal communication). With most recent surrogate situations, the infant was hand-reared at the birth institution before being sent to a surrogate mother at another institution. Please refer to the Surrogate Mother Case Histories (from the Houston Zoo) in this volume for more information on animal management plans and preparations for surrogacy. It is strongly recommended to not raise the infant in a "nursery" situation. It is preferable to raise the infant in the orangutan area so the infant can maintain at least visual and olfactory contact (and possibly even tactile contact dependent on the adult animals' personalities). Caregivers should carry the infant on a 24/7 basis.

PRELIMINARY EXAMINATION

Once the decision has been made to hand-rear an infant, it should be kept warm and medically evaluated. A dextrose stick can be used to determine if the infant has glucose which will assist you in determining if the infant has nursed. Ensley (1981) recommends preliminary care is given to the umbilical cord and examination of the placenta. An

unhealthy or abnormal placenta will assist in pointing out an infant that may require specific additional medical care. The neonate's body temperature must be stabilized at about 98.6° F.

If the infant's body temperature is below normal, the Orangutan SSP© recommends having a caregiver hold the infant close to their own body while placing a hot water bottle or heat source between themselves and the infant. Take the infant's temperature every 15 minutes to closely monitor body temperature changes. The ambient room temperature should also be increased until the infant's temperature is normalized.

Other methods to may be used to normalize the infant's body temperature. Although these methods will help to normalize the infant's body temperature they do not provide the infant the necessary physical contact that is important to its psychological well-being. The Orangutan SSP© strongly encourages 24/7 care of all infants. Less desirable alternatives include:

- incubator – ensure that temperature of incubator is continually monitored. If the infant must be housed in an incubator, constant contact should be given by the caregiver by putting their hands/arms through the arm holes at all times.
- radiant heaters that are commonly used for human infants in maternity wards
- a crib with a heating pad or on a hot water bottle covered with bedding. The only type of heating pad to use is the type with a thermostatic control that displays the actual temperature.
- With all of these options, provide a shaggy surface or artificial surrogate (stuffed animal) for the infant to cling to in an upright position. By placing the infant on its abdomen, it is able to cling to a comfortable surface with ease. Neonatal medical disorders are described in *The Medical Management of the Orang utan* (Wells et al.1990).

NUTRITION/FEEDING REGIME

Once the infant's condition has been assessed, a feeding regime can be implemented. Initially, a 5% dextrose solution or an oral electrolyte solution (Pedialyte™) is recommended until a stable sucking reflex is noted (usually during the first few feedings). This will prevent any accidental inhalation of the formula while adjusting to the bottle and nipple. The milk formula (or breast milk) should be diluted with dextrose, an electrolyte solution, or distilled water, when first introduced to the diet and increased gradually, to prevent digestive upsets. Infants initially can be offered formula (breast milk) at a ratio of 20 to 25% of their body weight divided by the number of daily feedings or feedings should approximate 100ml formula/kg body

weight/day (24 hours), increasing to about 200ml/kg/day by the 3rd week; or 120 kcal/kg body weight/day (24 hours). The percentage amounts need to be monitored and adjusted based on animal acceptance, hunger level and weight gains. Care should be taken not to overfeed as this can cause gastric distension, vomiting and aspiration. On average, the infant should be accepting full strength formula within 4-7 days. Neonates require feedings at 2-3 hourly intervals or on demand. As the infant matures, the frequency of feedings can be reduced as the amount fed per meal and the overall total increases. Positioning of the infant during feedings should approximate its natural position and burping should be encouraged during and after feeding.

Human infant formulas are recommended. The most commonly used are Similac™, Enfamil™ and SMA™. Prosobee™ and Isomil™, both soy based formulas, have been used for infants suspected of having allergies to milk protein or lactose. Human infant bottles with preemie or regular nipples are recommended and should be sterilized before use.

A vitamin supplement may be added to the formula from two weeks of age. Formula with added iron can cause constipation. Consult your veterinary and/or nutrition staff for advice on iron-fortified formulas.

WEANING

In certain cases, early weaning may be encouraged in order to facilitate an early reintroduction. Weaning should not be premature and should be done under the guidance of a veterinarian and nutritionist. Training the infant to accept a bottle through the cage mesh at an early age may eliminate the need for early weaning.

SOLID FOOD

Solid food can be introduced to the infant at the age of 3 months. Foods should be smooth in consistency to prevent being lodged in the throat. Consult with your nutritionist for recommendations of what food types to offer. Initially small amounts (approximately 1 teaspoon) of one food item should be introduced. Additional food items should be gradually introduced one at a time, to monitor for signs of gastric upset and digestibility. A suggested interval is one new food item every 3 days prior to adding a new item. This schedule will help to ensure proper digestibility and rule out any food allergy-related issues. Some suggestions for food items include ripe mashed banana, unsweetened applesauce, steamed, mashed sweet potatoes or infant rice cereal. It is preferable to offer fresh produce. In cases where this is not practical, human baby food that contains only pureed fruits and vegetables can be an acceptable substitute. A mixture of formula soaked monkey

chow which has been mashed can be offered once other foods have been introduced and the infant can process semi-solid foods

VACCINATIONS

The following vaccinations are recommended by the Ape Taxon Advisory Group and the Orangutan SSP® Veterinary Advisor:

- Killed rabies 1 ml intramuscular every 1-3 years, where applicable based on local rabies epidemiology and status.
- Tetanus toxoid 1 ml intramuscular every 1-10 years.
- Pneumococcal vaccination once in childhood with geriatric booster for orangutans.
- Influenza vaccination – Consider annual vaccination of animal care staff to enhance biosecurity.
- Measles vaccination – optional; colony specific decision. Measles is now considered a foreign disease in humans in the USA. Attenuvax modified live vaccine has been given to apes and primates in the past with no reported adverse effects, but risk of shedding live virus and susceptibility of pregnant females and fetus is unquantified.
- Consider childhood vaccination based on human schedule for all apes, including killed polio series and Haemophilus vaccination.

RECORD KEEPING

Infant records should be maintained daily. Daily records include weight, formula consumption, incubator temperature (if applicable), urine and fecal output and general health information. To record accurate and consistent weights, the infant should be weighed, naked at the same time of day, (i.e. prior to the first morning feeding). Other information to record may include reaction to environment or changes in environment, motor skills, and other physical developments such as dental eruption.

Hand-reared animals may reach developmental milestones at a different rate than a mother-reared infant. It is still important to record infant development using the SSP® Developmental Data Sheet (See Record Keeping Recommendations Chapter, this volume).

If the infant and dam will be introduced at a later date, keeping detailed records on the behavioral interactions of both animals (and other potential group members) prior to reintroduction will help assess the animals' progress.

INFANT HYGIENE

Ideally, diapers or other forms of swaddling should be avoided as this replicates a more natural situation for the infant. Diapers or other forms of swaddling may be used when stool consistency is poor. Diapers

should be changed frequently to help prevent rashes. It is recommended to clean the anogenital area after each diaper change. "Preemie sized" diapers work best due to the small size of an orangutan infant. Pampers® sells a preemie diaper which fits an orangutan infant well and can be found on the internet. Always remove a diaper prior to weighing the infant. In cases where the infant is having stool consistency issues and a diaper is used, it is recommended that the infant be allowed to go "diaperless" for a period of time each day. Remove diapers and other forms of swaddling when allowing tactile contact of the infant with conspecifics, when the infant is on public display or during photographs. The infant does not need regular "baths" or cleaning unless excessively soiled.

CAREGIVERS

As previously stated, 24/7 care of infants is strongly recommended. It is optimal for the infant to be carried at all times as this will encourage a good clinging response. Continual contact provides a more natural rearing situation and meets an infant's psychological need. Mobility is somewhat limited during the first 3 to 6 months of life, so the caregiver is the most important factor in the infant's life. Warmth and movement, which allows the infant to cling and to receive comfort when distressed, are considered of extreme importance. At several zoos, caregivers wear furry vests made from material which simulates the color and texture of an orangutan. The infant can cling while the caregiver moves and uses their arms freely. Although not optimal, carriers designed for human infants work well, too (Carol Sodaro, personal communication).

Dependence on a caregiver can be a result of species isolation not of too much handling (Fritz and Fritz 1985). The infant should have exposure to conspecifics immediately unless there is a health risk. This will help in the reintroduction process and may help promote further interest in the infant by its mother and vice versa. A balance between caregiver contact and peer contact is recommended. Forcing independence onto the infant should be discouraged because it may promote insecurities that will only inhibit development and exploration rather than encourage it.

All caregivers should familiarize themselves with orangutan behavior. It is optimal to observe mother-infant behavior directly but this can also be accomplished by watching a videotape. Refer to the Behavioral Biology Chapter, this volume for more information on orangutan behavior.

The number of caregivers involved in the hand-rearing process varies from one institution to another. Multiple caregivers are preferred to reduce unhealthy dependence on any given individual and vice versa. It is recommended to involve more than one staff member, primarily primate staff. Until veterinary staff has determined the infant's condition is stable, it is advised to limit the number of caregivers. This will allow the infant to have consistent care until a daily routine can be established.

Recruited volunteers should undergo an orientation process to become familiar with the protocols and techniques of hand-rearing. Consistency between caregivers is critical. Volunteers should be medically screened prior to contact with the infant.

CAREGIVER HYGIENE

It is recommended that caregivers wear protective clothing, masks and gloves when handling the infant. Medical screening for infant care staff should include a recent negative TB test, parasite screening and current vaccinations. Consult the Orangutan SSP® Veterinary Advisor for additional recommendations. Caregivers who are sick should never be in contact with the infant.

LOCATION FOR HAND-REARING

The detrimental consequences of prolonged isolation and surrogate rearing for certain species are well documented (Anderson 1986). Socialization with conspecifics at an early age is essential for the hand-reared neonate.

It is strongly recommended that infant housing be in the orangutan area and in front of the dam's enclosure. This allows the infant and the dam to have visual, auditory, olfactory and tactile contact with one another. Ideally, an orangutan cage within view or adjacent to that of the dam should be used. This location will acclimate the infant for a future introduction while providing a stable location from which to explore its environment. The same bedding and nesting materials provided to the adult orangutans should be used for the infant.

A nursery environment is a relic of the past and does not meet the psychological needs of the infant or the dam. Infants that are raised in a nursery situation and on public display should not be dressed in clothes. The Orangutan SSP® has a policy which prohibits public display of orangutans dressed in human clothes.

If there is a need for the infant to be viewed by zoo guests, a remote video monitor can be set up which allows guests to view the animal

while being hand-reared in the orangutan area.

PROVIDING FOR AN INFANT'S PSYCHOLOGICAL WELL-BEING

As the infant develops, stimuli should change and become more complex and challenging. Fritz and Fritz (1992) noted that lack of enrichment toys and climbing structures can seriously handicap a young chimpanzee's ability to develop motor skills. Zoos should provide a variety of enrichment to help promote psychological well-being. The same enrichment items provided to adult orangutans should be used with the infant (within reason). Interactions with caregivers should encourage species typical behaviors and locomotor skills which will help to promote normal development.

The following is a partial list of enrichment items that have been provided to hand-reared infant orangutans at other zoos: classical music, mirrors, photos of orangutans, blankets or hay (substrate) that have been used by the infant's mother, shaggy material, cardboard boxes, paper bags, access to orangutan cage structures), swings, fire hose, webbing straps, browse (if the infant is old enough), tapes played of orangutan vocalizations which include male long calls.

Caution: Ropes can cause strangulation. Contact the SSP© for appropriate and safe uses of ropes. Ensure that all enrichment devices have no dangerous features or sharp edges. Please refer to Behavioral Enrichment Chapter (this volume) for an enrichment safety checklist that should be used prior to use to evaluate all enrichment devices.

STEREOTYPIC BEHAVIOR PATTERNS

The provision of a stimulating environment (being housed in the orangutan area), 24/7 contact, enrichment from caregivers, and contact with other orangutans (preferably the infant's dam and natal group), abnormal behaviors can usually be avoided. Watts (1992) reported the following stereotypic behaviors in her hand-rearing survey of zoos: self clutching of hands and feet (although this behavior discontinued after the infant was given more stimuli) thumb and lip sucking (short-lived) and scratching of the entire body. Decreasing the number of feedings may also be implicated in many of the behavioral aberrations seen in hand-reared ape infants due to loss of body contact time (Fritz, Ebert and Carland 1985).

DEVELOPMENT OF AN INFANT MANAGEMENT/REINTRODUCTION PLAN

It is highly advisable to develop a management plan for the infant as soon as the infant is stable and into a regular feeding routine. This management plan should address the progression of steps needed to

properly socialize the infant, dam and other conspecifics (if applicable). Your plan may include positive reinforcement training for all the animals involved in the future reintroduction. Contact the SSP® Husbandry Advisor, Carol Sodaro (casodaro@brookfieldzoo.org) to assist you in developing a plan for your specific situation. It is important to periodically review your plan to determine if any changes are needed as the hand-rearing process progresses.

CONSIDERATIONS FOR REINTRODUCTIONS OF A HAND-REARED INFANT

There is a high success rate for infant reintroductions (Watts, 1992). These include introductions to mothers, surrogate mothers, peers, and older conspecifics (See Introduction Chapter, this volume). Here are some considerations for review when planning for a reintroduction:

1. Provide 24/7 dedicated care in front of the dam's enclosure to ensure visual, tactile, auditory and olfactory contact with conspecifics
2. Make sure the infant and dam (and other conspecifics) are healthy
3. Ensure interactions between infant and conspecifics are of a positive nature prior to introductions
4. Determine how the infant will be fed once reintroduced – this is a critical step and may involve positive reinforcement training.
5. Review your introduction plan. This plan should address all potential scenarios that could take place during the introduction. All orangutan keepers and management staff should be involved in the development of the reintroduction plan. *Introduction progress needs to be continually evaluated by caregivers and animal management staff. Management plans should be updated regularly based on the animals' behavior and progress.*
6. Reintroduce in a familiar place with familiar people. The infant should be very familiar with all aspects of the enclosures in which the reintroduction will take place. Baby doors have worked well in allowing a quick escape in case the introduction does not progress in a positive manner. These doors have been used successfully with gibbons, bonobos and gorillas (Dusty Lombardi, personal communication). Limit the amount of staff actually present for the reintroduction as to not overwhelm the animals involved. Do not allow unfamiliar observers to be present. If you want to videotape the reintroduction, make sure the animals involved have been desensitized to the presence of a video camera and lights prior to reintroduction. Once acclimated to a video camera, a remote viewing location set up with a monitor would allow additional staff to view the reintroduction with no disruption to the animals involved.
7. When all animals seem adjusted to a step, move on to the next. Let the animal's behavior dictate the progression of the introduction. Allow the animal's time to interact and adapt to change.

8. If staff time allows, formalized behavioral observations should be done to objectively assess the progress of the introduction
9. If the introduction initially dictates short introduction periods, ensure visual, olfactory and auditory contact between infant and conspecifics.

SUMMARY

In almost all recent cases of removal, infants have been successfully returned to the mother or have been reared by a surrogate mother. If infants have to be removed from their mothers, prolonged hand-rearing should be avoided. Preparations/planning for a reintroduction should begin immediately. An early reintroduction to the dam is the most preferred situation.

Thorough planning prior to any birth is crucial. If a female has previously rejected offspring or exhibits other questionable maternal skills, a positive reinforcement training program should be instituted prepartum (See Development, Reproduction and Birth Management Chapter and the Positive Reinforcement Training Chapter, this volume). The development of training programs in a number of zoos has enabled staff to teach female orangutans to nurse their infants or permit feeding of infants by caregivers.

24/7 dedicated care for the infant is strongly recommended and is critical in meeting the infant's psychological needs. Infants should be reared within close proximity to the mother to ensure necessary visual, auditory, olfactory and tactile contact for both the infant and the mother.

The introduction of hand-reared infants to conspecifics should be started as early as possible and detailed records should be kept. Contact the Species Coordinator, Lori Perkins (lori410@mindspring.com) for additional recommendations.

REFERENCES

- Anderson, J.A. 1986. Rearing and intensive care of neonatal and infant nonhuman primates. In: K.Benirschke, ed. *Primates: The Road to Self-Sustaining Populations*.pp.747-762. New York: Springer-verlag.
- Asano, M. 1967. A note on the birth and rearing of an orang utan at Tama Zoo, Tokyo. *International Zoo Yearbook*, 7:95-96.
- Bramblett, C.A.1976. *Patterns of Primate Behavior*. California:Mayfield Publishing Co.
- Chaffee, P.S. 1967. A note on the breeding of orang utans *Pongo pygmaeus* at the Fresno Zoo. *International Zoo Yearbook*, 7:94-95.
- Clift, J.P., and R.D. Martin. 1978. Monitoring of pregnancy and postnatal behavior in a female lowland gorilla, *Gorilla g. gorilla*, at London Zoo. *International Zoo Yearbook*, 18.
- Crissey, S. 1995. Handrearing great apes. In: W. Amand, ed. *Infant Diet Notebook*. AAZPA.
- Ensley, P.K. 1981. Nursery raising orang utans: Medical problems encountered at the San Diego Zoo. *American Association of Zoo Veterinarians*, Annual proceedings,pp.50-54. Washington.
- Fontaine, R. 1979. Training an unrestrained orang utan mother to permit supplemental feeding of her infant. *International Zoo Yearbook*, 19:168-170.
- Fritz, J., J.W. Ebert, and J.F. Carland. 1985. Nutritional management of great apes. In: C.E.Graham, and J.A. Bowen, eds. *Clinical Management of Infant Great Apes*,pp.141-156. New York: Alan R. Liss.
- , and P.Fritz. 1985. The hand-rearing unit: Management decisions that may affect chimpanzee development. In: C.E. Graham, and J.A. Bowen, eds. *Clinical Management of Infant Great Apes*,pp.1-34. New York: Alan R. Liss.
- Fulk, R. and C. Garland, eds. 1992. *The Care and Management of Chimpanzees in Captive Environments. Species Survival Plan (SSP) Husbandry Manual*.
- Galdikas, B.M.F. 1981. Orang utan reproduction in the wild. In: C.E. Graham, ed. *Reproductive Biology of the Great Apes*, pp.281-300. New York: Academic Press.
- , 1985. Adult male sociality and reproductive tactics among orang utans at Tanjung Puting. *Folia Primatologica*, 45:9-24.
- Kennedy, C. 1992. The early introduction of a hand-reared orang utan infant to a surrogate mother (*Pongo pygmaeus abelii*). *Proceedings of the National American Association of Zookeepers Conference*.

- Kingsley, S. 1977. Early mother-infant behavior in two species of great ape *Gorilla g. gorilla* and *Pongo pygmaeus*, *Dodo*, 14:56-64.
- MacKinnon, John. 1974. *In Search of the Red Ape*. Glasgow: Collins Sons and Co. Ltd.
- Maple, T.L. 1980. *Orang utan Behavior*. New York: Van Nostrand Reinhold.
- , and A. Warren-Leubecker. 1983. Variability in the parental conduct of captive great apes and some generalization to humankind. *In*: M. Reite, and N.G. Caine, eds. *Child Abuse: The Nonhuman Primate Database*, pp.119-137. New York: Alan R. Liss.
- Porton, Ingrid. 1992. Hand-rearing of captive chimpanzees. *In*: R. Fulk and C. Garland, eds. *The Care and Management of Chimpanzees in Captive Environments. Species Survival Plan (SSP) Husbandry Manual*, pp.77-87.
- Sodaro, C. 1988. A note on the labial swelling of a pregnant orangutan, *Pongo pygmaeus abelii*. *Zoo Biology*, 7(2):173-176.
- , and N. Greenblatt. 1994. Training caregiving behaviors in an adult pair of orangutans (*Pongo pygmaeus pygmaeus*) at the Chicago Zoological Park. *In*: J.J. Ogden, L.A. Perkins and L. Sheeren, eds. *Proceedings of the International Conference on Orangutans: The Neglected Ape*. California: Zoological Society of San Diego.
- , and B. Weber. 2000. Hand-rearing and early reintroduction of a Sumatran orang-utan, *Pongo pygmaeus abelii* at Brookfield Zoo. *International Zoo Yearbook*, 37:374-380.
- Wells, S., E.L. Sargent, M.E. Andrews, and D.E. Anderson. 1990. *Medical Management of the Orangutan*. Louisiana: The Audubon Institute.