

# Cotton-Top Tamarins: The importance of natural cooperative care behaviors in a managed setting

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## Introduction

Cotton-top tamarins (*Saguinus oedipus*) are critically endangered primates found only in northern Colombia (Price, 1990). These small New World monkeys are easily recognized by their crest of long white hair on the top of their heads. They move around using quadrupedal locomotion through multiple layers of the forest, from the understory to the canopy. In the wild, the cotton top's diet includes fruits, insects, and nectar (Cawthon, 2005). In human care, they enjoy a similar diet, which also includes vegetables, Marmoset chow\*, Callitrichid gel\* and fresh cut browse (a variety of plants, tree trimmings, and flowers).

These small primates were classified as an endangered species in 1973 after an estimated 20,000-40,000 tamarins were exported to the United States to be used in biomedical research (Hoffner, 2018). Following a census of the wild population in Colombia in 2005, where only 1,900 cotton-top tamarins were found, the species was upgraded to the status of critically endangered by the International Union for Conservation of Nature in 2008 (Hoffner, 2018). This brought to light the need for conservation programs to protect this species (Savage et al., 2016). Conservation efforts for the species have made significant advances toward developing a self-sustainable captive breeding population, largely due to the

efforts of the Association of Zoos and Aquariums (AZA), and their Species Survival Program (SSP) (Hoffner, 2018). This program now has over 300 cotton-top tamarins managed in more than 80 AZA accredited zoos in the United States (Hoffner, 2018).

Like all tamarin species, cotton top tamarins use cooperative care to raise young within the colony. Cooperative care is a strategy used in groups where individuals help raise offspring that are usually related to them but are not their own (Zahed et al., 2010).

*Photo by Phoenix Zoo Senior Primate Keeper Amy Dietz*



Some of the benefits of a cooperative care strategy include breeders gaining fitness by lowering their energy costs and helpers gaining fitness by ensuring siblings survive that carry their same genetics (Price, 1990). In the wild, cotton-top tamarins commonly live in groups of three to nine individuals (Zahed et al., 2010). However, the colony will only have one breeding pair, with the dominant female suppressing the other females' ability to breed through hormone suppression (Snowdon and Cronin, 2007). This means the dominant breeder's other offspring only have the opportunity to gain fitness by helping their parents raise their siblings.

Cooperative care is also important to the survival of infants in tamarin colonies because new, inexperienced parents are more likely to reject or fail to successfully raise their offspring than experienced parents (Snowdon and Cronin, 2007). In one study, the survival rate of infants with mothers who had previous infant care experience prior to mating was 81%, compared to 43% infant survival rates for mothers with no previous experience (Cleveland and Snowdon, 1984). Infants are carried on the parent's back exclusively for the first month of life (when no helpers are available), and then on and off for the next few months. This can be physically exhausting for the parents, and tamarins are known to lose up to 10% of their body weight during this time (Snowdon and Cronin, 2007). Research has shown that the more helpers available, the less weight parents are likely to lose (Snowdon and Cronin, 2007). These helpers are mostly older siblings in captivity, but also may be unrelated members of the group in the wild (Cawthon, 2005).

The Arizona Center for Nature Conservation (Phoenix Zoo), an AZA-accredited facility, participates in the cotton top tamarin Species Survival Program and aims to aid in the SSP's goal of developing a healthy ex-situ population and prevention of species extinction (Phoenix Zoo, 2018). The colony of cotton-top tamarins housed at the Phoenix Zoo consists of a single breeding pair, Stripe (male) and Lola (female). On the 26<sup>th</sup> of October, 2017, the colony expanded with the birth of female twins, which is more common

Code	Description
T-I	Older sibling attempting to touch infant
T	Older sibling touching infant
A-P	Older sibling attempting to take infant from parent
A-I	Older sibling attempting to take infant that is independent from parent
C-P	Older sibling taking infant from parent and carrying
C-I	Older sibling taking infant that is independent from parent and carrying
A-F(NV)	Older sibling attempting to food share with infant without verbalizing
A-F(V)	Older sibling attempting to food share with infant while verbalizing
F-NV	Older sibling food sharing with infant without vocalizing
F-V	Older sibling food sharing with infant while vocalizing
A-NP	Aggression (Non-physical) from older sibling toward infant
A-P	Aggression (Physical) from older sibling toward infant
P	Older sibling engaging in play with infant(s)

Table 1. Code behavior and definitions.

for callitrichids over producing a single offspring (Zahed, 2010). In the wild, a tamarin's ovulation is linked to the season and food availability (Cawthon, 2005). However, the captive tamarin reproductive cycle allows them to become pregnant almost immediately after giving birth, with pregnancy lasting about 130-183 days (Zahed, 2010). In June of the following year, Lola gave birth to her second set of twins, one male and one female.

Lola and Stripe's first set of twins, Marimonda (Mari) and Tunda, who were approximately seven months of age at the time of their younger siblings' birth, will be extremely important to the success of their sibling's upbringing. They should share in the burden of carrying the infants, and aid in teaching the infants important lessons, such as which foods are of the highest value, and how to avoid predators (Zahed et al., 2010). They should also assist in teaching them foraging behavior prior to weaning, which occurs between four and seven weeks (Snowdon and Cronin, 2007).

It is important that animals in captive care exhibit natural behaviors as they would in the wild for their physical well-being and mental health, as it could affect how successful they are at producing offspring. Behavior for successfully raising offspring is learned and not instinctual (Cawthon, 2005). At the Phoenix Zoo, Mari and Tunda

are learning from their parents how to successfully raise offspring so they will have the skills and knowledge to properly care for their own offspring in the future. However, as this is the older twin's first experience with infant care, it leads to the question, how will their behaviors compare to natural behaviors seen by both wild and captive tamarins in other studies? This study will examine this question, as well as look at how the older twins' care compares to one another, and what factors might influence behavioral differences.

### Methods

Observations were carried out while the colony was in full view of the public in their exhibit. The exhibit is constructed out of 1"x3" wire on 3 sides with a solid wall along the back and a dirt floor. Inside the exhibit, there are live plants, wood perching, and various movable structures for climbing. The colony also has access to an off-exhibit nestbox, which is not viewable for public and no observations were made in this area. All individuals were normally housed together at all times, and only removed for exams or medical purposes.

An ethogram was created which consisted of behaviors related to cooperative care (Table 1). The ethogram was specific to behaviors between the older set of tamarin twins, females Mari and Tunda, which were born on the 26<sup>th</sup> of October, 2017, and the new set of infant twins, which were



Cotton-top tamarin exhibit at the Phoenix Zoo. Photo by Elizabeth Fochtman.

born on the 1<sup>st</sup> of June, 2018. These behaviors were taken from similar studies done on cooperative care in captive cotton-top tamarin colonies, and reflect general behaviors that should be taking place in captivity or the wild. Aggression was placed in the ethogram for the keeper's personal records, and was not used for the purpose of this study. The ethogram included behaviors from the older siblings towards the infants in two forms, attempting the behavior or actually performing the behavior. The behaviors recorded were: touching, taking from a parent and carrying, taking when independent of parent and carrying, food sharing while vocalizing, food sharing without vocalizing, physical aggression, non-physical aggression, and engaging in play.

The entire observation period was done over the first three months of infant development, from the date of infant birth, June 1, 2018 to August 31, 2018. However, no observations were carried out in weeks seven and eight due to the older siblings being absent from the exhibit for medical purposes. The observation period of three months was chosen because this is the time when the tamarins are the most reliant and learn the most from their parents and siblings

(Snowdon and Cronin, 2007). The ethogram was used to record personal observations, which were the main form of study. Personal observations were carried out once a day in the afternoon, three times a week for a period of 20 minutes. The ethogram was also posted along with a log sheet in the keeper area of the tamarin complex exhibit. From the infant's' birth, the keepers working that area recorded data that they observed based on the behaviors on the ethogram. Keeper observations were carried out three times a day during cleaning and feeding times. There was no set time for keeper observations, they were simply asked to record any behavior they witnessed while servicing the exhibit. This consisted of the primary keeper of the area most of the time, but also included a variety of eight other keepers, including other primate and relief keepers.

A camera trap was also placed in the exhibit to collect video data to supplement direct observations. This also allowed for the collection of unbiased data, as captive animal behaviors can vary if there is any individual present. Although the parents have previous experience with the camera trap, none of their offspring had any previous exposure so there is

little risk of it influencing the specific behaviors being monitored for this study. The camera trap was set to record 20 seconds of video when triggered by movement at any time and set to rest for the length of one hour after the initial trigger to keep recorded data at a manageable amount. The camera traps were active for the last two months of data collection. This video was then viewed and any behaviors that were observed were recorded in order by date.

### Results

A total of 25 20-minute personal observations were carried out, 35 ethogram log entries were made by keepers, and approximately 750 videos were reviewed from the camera trap. A total of 52 behaviors were recorded over the three-month period (Figure 2), with the first behavior recorded on Day 6 as one of the older twins, Tunda, attempted to touch an infant. She was then observed touching an infant five more times that first week. The 13<sup>th</sup> day was the first time Tunda was seen taking an infant and carrying it. Tunda was then observed carrying infants with consistent numbers from week three to week six, with a peak of carrying observed in weeks five and six. Following week six, the carrying tapered off and mostly play behaviors were seen. The other older twin, Mari, was observed showing more touch behaviors throughout the study, but was only observed carrying an infant in weeks five and six. She was also observed exhibiting play behaviors in the same later weeks as her twin, Tunda. Behaviors involving food sharing were only observed one time from each twin on the same occasion and no aggressive behavior was seen.

### Discussion

Observations began the day the infants were born, however, no behaviors were observed and recorded until the 6<sup>th</sup> day. One reason for this could be that the family spent most of the first days in a nest box, a box structure connected to their outside area. This enclosed area is mostly concealed and the colony was given extra space to feel comfortable and secure. It is possible that behaviors were displayed that were not seen. In the wild, mothers and fathers do



most of the carrying initially due to a constant feeding schedule with the infants (Price, 1992). Mothers are the primary caregiver immediately after birth (Achenbach and Snowdon, 1998) and tend to keep potential helpers away at first (Price, 1990).

Tunda was seen carrying for the first time at the end of Week 2, which is believed to be the first time she successfully carried an infant. According to Achenbach and Snowdon (1990), siblings are rarely seen carrying in the first two weeks; however, Zahed et al. (2010) states that helpers may start carrying as early as Day 1. Siblings carry the most during Weeks 3-6, with declined carrying seen in Weeks 7-10 (Achenbach and Snowdon, 1990). This supports Tunda's observed behavior. Another study states that peak carrying time for siblings is in Week 7, which coincides with parents' peak refusal to carry (Zahed et al., 2010). Both twins peak carrying behaviors were seen in Weeks 5 and 6, however, they were absent from the exhibit for Week 7 so no observations were able to be made. Infants should be completely independent of carrying by Week 12. At this point only Mari was observed carrying on one occasion (Figure 3).

While Tunda's behavior supports outside research mentioned in this study, Mari showed slower development in her care, as well as being observed exhibiting helper behaviors less. This observation is likely due to Mari being absent from the family for a period of six days from the 6<sup>th</sup> of June until the 12<sup>th</sup> of June for medical reasons. She was also removed for another period from July 6<sup>th</sup> to August 10<sup>th</sup> due to continuing medical issues, and her twin was taken with her as support for approximately two weeks. During these weeks, Weeks 7 and 8 of the study, no data were recorded due to the older twins being away from the colony.

While Tunda's absence did not seem to affect her care behavior, Mari was absent for critical time periods shortly after the infant's births where learning important lessons on care from parents may have been occurring. This may have contributed to her showing less care toward the infants. However, she was still observed interacting with them

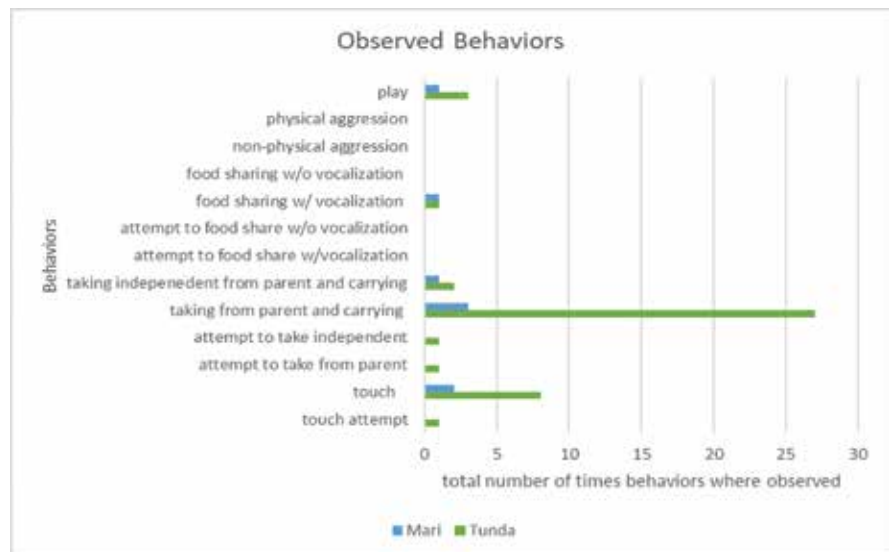


Figure 2. All recordable observed behaviors by older siblings over 3-month period.

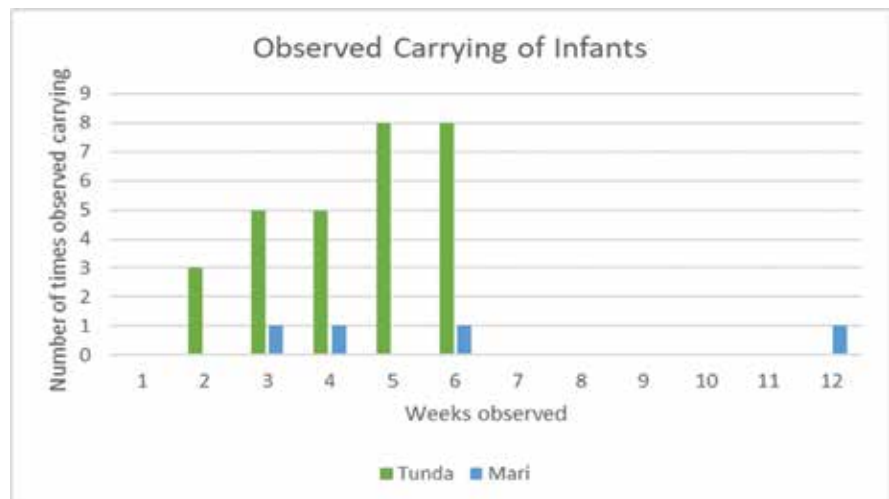


Figure 3. Amount of observed carrying behaviors performed by each older sibling

and no aggression or negative care was observed. Her medical condition, which may have left her with developmental issues, could also account for her showing less cooperative care when compared with her sister. Zahed et al. (2010) found in their study that even with variation in care behaviors by individuals in a colony, infants still received equivalent care due to the cooperative nature of the group as a whole.

Food sharing was not an observed behavior for either older sibling, which could be attributed to a lack of experience (Price, 1992). Keepers reported observing the infant twins begging for food in the early stages of

their weaning. However, once the infants became more confident, they were observed multiple times simply taking the food from their parents and older siblings. This behavior was not defined and could not be recorded as "sharing." In future research, both begging and food stealing would be included in the ethogram to get a better idea of whether food sharing is not being taught by the parents or if this is just an individual case of behavioral differences in a group. Epplé (1975) believed that tamarins may need experience from more than one set of infant siblings to develop proper parental care behaviors. If this is the case, the older twins would need to gain experience from at least one more set of siblings to be consistent with their

care behaviors and truly be successful as mothers themselves.

### Conclusion

Although only one of the twins showed behavior consistent with previous studies on cooperative care behavior, it is believed that the other's behavior can be explained by extenuating circumstances, and that she eventually caught up to a similar level of care behavior as her twin. Although variation in care behavior by individuals does not seem to affect infant care as a whole within a group (Zahed et al., 2010), the older siblings may need to gain more experience from participating in the care of another set of infant siblings before they have fully learned all of the knowledge they need to become successful mothers in the future (Epple, 1975). In the wild, inexperienced adults become unsuccessful caregivers (Cawthron, 2005). Therefore making sure individuals have acquired enough knowledge to be successful caregivers before becoming part of the SSP must be considered in managed care as well.

The data collected from this study can contribute to the overall data

on cooperative care in cotton-top tamarins, and possibly be relevant to future studies on the same colony at the Phoenix Zoo. Overall this colony had a successful year breeding two sets of twins, which greatly contributes to the critically endangered cotton-top tamarin population. Both sets of twins have developed into healthy, active individuals. This can be partially attributed to their keepers, managers, and vet staff at the Phoenix Zoo and partially attributed to the cooperative care that has been successfully displayed by the parents and siblings of this colony. It is important that these natural species-specific behaviors are seen in managed groups, which reflect professional knowledge of the species and that they are provided the proper environment to thrive. If not, studies have shown that unnatural or stereotypic behaviors may be seen that could be detrimental to future attempts at successful parenting (Cleveland and Snowdon, 1984). Because of this, cooperative care is an essential part of the behaviors that are required for successful breeding of the species, and helping to maintain a healthy and sustainable population.

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\*Zupreem® Marmoset Chow -10504 W. 79th Street Shawnee, KS 66214 <https://www.zupreem.com/>

\*Mazuri® Callitrichid Gel - P.O. Box 66812, St. Louis, MO 63166 <https://www.mazuri.com/>

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