THE SOCIAL AND REPRODUCTIVE BEHAVIOR OF GOLDEN LION TAMARINS, *LEONTOPITHECUS ROSALIA*, IN THE OKLAHOMA CITY ZOO

By

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Scope and Method of Study: This study is concerned with the ontogeny of socialization in offspring and in newly established pairs of golden lion tamarins (Leontopithecus rosalia). Focusing upon differences by sex between long established pairs of captive-born tamarins to long established wild-born tamarins and behavioral differences in pairs before and after offspring were born, this study hypothesizes the ontogeny of the pair bond. Behavioral parameters considered were grooming, scent marking, arch posturing, tongue protrusion, genital inspection and food sharing.

Findings and Conclusions: Comparisons by sex between the mean frequencies of behavioral occurrences in the various pairs of tamarins indicated few significant differences between wild-born and captive-born pairs established together two years or longer. Significant differences by sex were noted between long established and newly established pairs of tamarins. Significant differences by sex also were noted before and after offspring were born. Observations closely parallel the theoretical ontogeny proposed.

ADVISER'S APPROVAL Bryant P. Glass

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PREFACE

This study is concerned with the ontogeny of socialization in offspring and between partners in pairs of golden lion tamarins. The primary objective of the study is to improve the understanding of the factors involved towards accomplishing successful captive breeding programs.

The author wishes to dedicate this study in memory of Dr. Hobart F. Landreth, Director of Research at the Oklahoma City Zoo 1970-1973, for his guidance and assistance in establishing the research programs of the Oklahoma City Zoo Research Center through which this study was conducted.

Special recognition and thanks is given to Dr. Bryan P. Glass, major adviser, and Mr. Lawrence Curtis, Director of the Oklahoma City Zoo, for their invaluable assistance during the course of this study. Thanks also are extended to Dr. Tracy S. Carter and Dr. William D. Warde for their assistance in development of the anlytical methods and data orgnization.

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CHAPTER 1

INTRODUCTION

Of the 283 species or subspecies of mammals listed in 1976 as rare, endangered or vulnerable by the International Union for the Conservation of Nature (IUCN), 48 are species or subspecies of primates and account for more than 10 percent of all living primate species (Southwick et al., 1970; IUCN, 1976). One of these endangered primates is the golden lion tamarin (Leontopithecus rosalia rosalia). As illustrated in Figure 1, golden tamarins were originally distributed along a large strip of coastal mountain forest in Brazil approximately 500 by 100 kilometers, but deforestation for plantations and urbanization has reduced the range to an area of about 900 square kilometers, which is less than two percent of the original range (Bridgewater, 1972). Although the wild population was estimated by him to be about 500 in 1972, Coimbra-Filho (pers. com. 1975) estimated that less than 150 remain. Two other subspecies, the golden headed tamarin (L. r. chrysomelas) and the golden rumped tamarin (L. r. chrysopygus) also have been virtually decimated (Coimbra-Filho and Magnanini, 1972) and the only specimens found in captivity outside of Brazil are at the National Zoo, Washington, D.C.

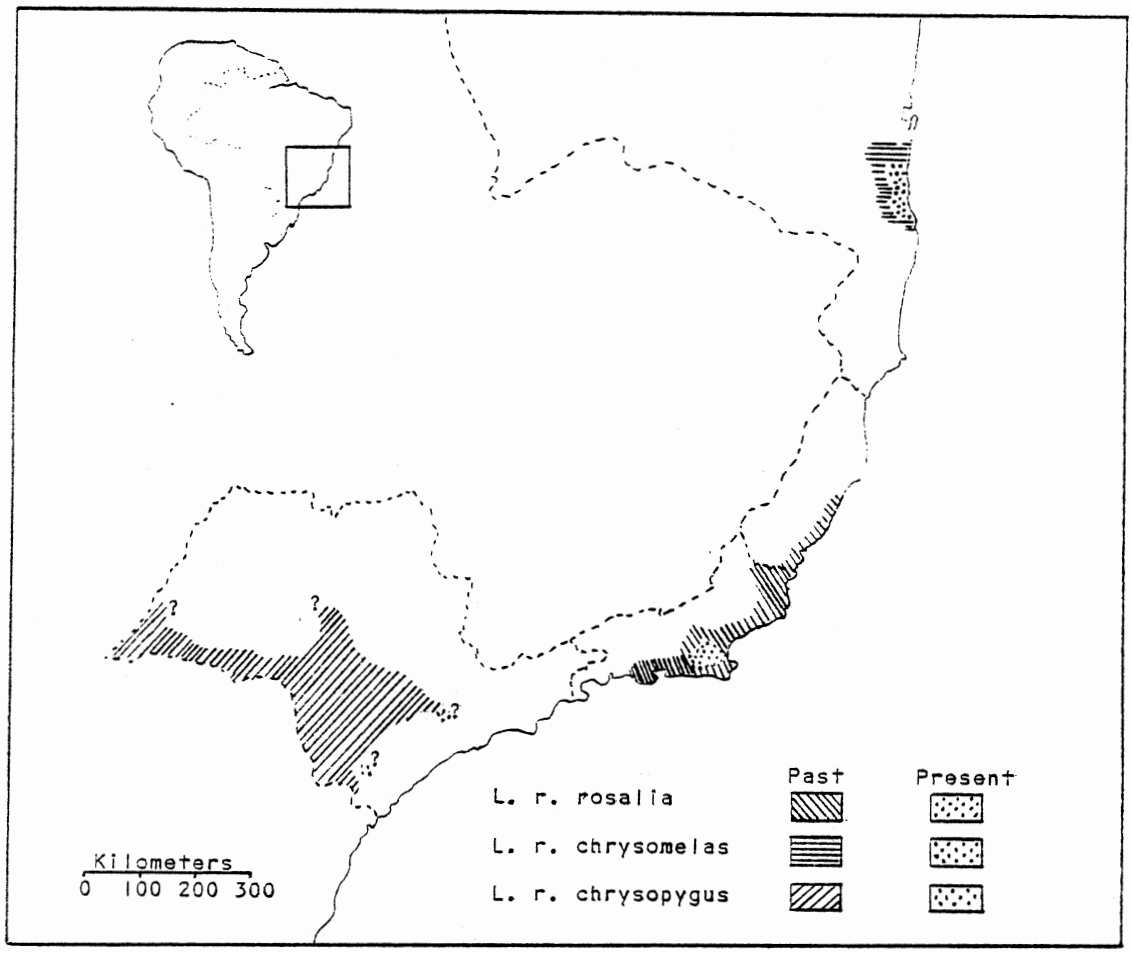


Figure 1. Map Depicting Past and Present Ranges of the Three Subspecies of Leontopithecus.

The number of golden lion tamarins in American zoos has been decreasing in recent years (Bridgewater, 1972). Of the 55 wild-born animals reported in 1968 only 25 were alive in 1971 (Perry, 1972). Captive-born golden lion tamarins totaled 43 of the 67 animals reported in the 1972 American census (Bridgewater, 1972). Although this high number of captive-born animals seems encouraging, a Wild Animal Propagation Trust (WAPT) Golden Marmoset Committee survey revealed that only two second generation captive births had occurred (Perry, 1972).

DuMond (1971) emphasized the urgent need for research on the social and reproductive behavior of the golden lion tamarin. He maintained that problems of health and nutrition in the animals have apparently been defined in recent studies. He stated that importation was prohibited in 1966 and the most recently imported wild animals have been in captivity for at least six years. The maximum life expectancy for golden lion tamarins in captivity is ten years (Crandall, 1964). DuMond stated that most captive-born golden lion tamarins have failed to reproduce or appropriately rear their offspring. The WAPT Golden Marmoset Committee has further verified this. Problems encountered in multi-generation reproduction must therefore be solved if the golden lion tamarin is to continue in captive existence since the number of wild-born animals in captivity would soon become negligible (DuMond, 1971).

Considerable confusion appears to exist in the literature on the usage of the common names marmoset and tamarin. Hershkovitz (1977) stated "tamarin" should be used as the common name for the genera Leontopithecus and Saguinus. This designation is based on tamarins having relatively short, spatulate incisors. The term "marmoset" is suggested for the genera Callithrix and Cebuella based on their relatively elongate, cylindrical lower incisors. For simplicity, the term "tamarin" is used throughout this paper.

CHAPTER II

LITERATURE REVIEW

Snyder (1972) described the tamarin social structure as organized units of family groups composed of an adult pair, late juvenile offspring and new-born infants. She assumed this to be similar to that found in the wild. This basic family social unit has been reported in numerous tamarin species (Coimbra-Filho, 1965; Epple, 1967, 1970a, 1972a; Moynihan, 1970).

Group sizes of various tamarin species observed in the wild have generally varied from 2 to 12 individuals, with specific observations on golden lion tamarin group sizes ranging from 3 to 8 individuals (Epple, 1972a; Thorington, 1968). Perhaps these variations in group sizes could be due to sightings of groups varying from newly formed pairs to family units composed similar to those described by Snyder (1972). Vogt (1978) described an increasing spatial independence with increasing maturity in a captive family group of six saddle-back tamarins (Saguinus fuscicollis).

Hampton et al. (1966) described the typical social structure of captive tamarins, Saguinus oedipus in particular, as consisting of an adult pair with late juvenile offspring being driven off when the adult pair are ready to

conceive or give birth. Female intolerance of other females and prominent scent marking by the female were also cited as characteristics of tamarin social structure.

Eisenberg et al. (1972) described the typical tamarin social structure as a parental family consisting of an adult bonded pair and their immature descendents. They define the pair bond as grooming, huddling and other non-sexual behaviors engaged in on a daily basis. They also reported a primate parental care unique to tamarins, in that the male is actively involved in the rearing of the offspring.

Stellar (1960) provided information that lends further support to a pair bonding theory, stating that adult tamarins in a group tend to split into male-female pairs. He stated that a stable dominance pattern develops when a large group of pairs, up to four males and four females, are required to feed from a single food source.

Kavanaugh (1972) indicated that food sharing behavior of Douc monkeys (Pygathrix nemaeus nemaeus) in captivity does not correlate with the dominance hierarchy of the group. However, he implied that there is no single food source but that feeding is accomplished in a manner that allows all of the monkeys to partake at the same time. He described a continuum of food sharing from passive to active donation. Perhaps the dominance hierarchy exhibited by tamarins required to feed from a single food source as described by Stellar (1960) is an exaggeration of the hierarchy which would normally exist. Wilson (1976) described a

similar continuum for golden lion tamarins and Brown and Mack (1978) suggested how food sharing behavior may enhance successful reproduction.

Epple (1967) reported that apparently only one adult pair is sexually active regardless of group size. She indicated that periods of intense scent marking correlated with breeding activities in several species of tamarins. This may also be true in the golden lion tamarin. As Kleiman and Mack (1980) have suggested in their report on changes in scent marking frequencies of golden lion tamarins correlated with age, reproductive status and group composition, there are few sex differences in social behaviors. Both sexes in Callithrix jacchus and Saguinus fuscicollis are reported to scent mark more frequently than their mates (Box, 1977; Epple, 1977).

Coimbra-Filho (1965) proposed the most suitable breeding enclosure be 5 x 3 x 3 meters, furnished with branches and nest box. Several other researchers have proposed that reproduction would be enhanced by providing a semi-natural environment. DuMond (1971) has done considerable work in this area at Monkey Jungle, south of Miami, Florida, where the climate facilitates maintenance of a jungle habitat. The San Diego Zoo (Hill, 1970) also made attempts to enhance reproduction with a semi-natural environment and by keeping several pairs of tamarins from public view.

DuMond (1971) designed cage facilities so that the offspring from adjacent cages were permitted to form

relationships. He stated that if these relationships indicated or were suggestive of pair bond formation, the animals would be placed together in a vacant cage. He utilized this concept in allowing the animals to select their mates, and of two such pairings, one, a captive born male and wild born female, achieved a successful breeding.

The National Zoo, Washington, D.C., is involved in a similar program (Pers. obs.). In addition to the concepts of DuMond, they have provided additional cage space for the offspring to expand into as they grow older and separate from the parents, either voluntarily or otherwise. Moynihan (1970) speculated that in the wild the siblings separate from the parents, encounter other siblings, and that new mated pairs may be established from these encounters.

Visual displays have been reported to play an important social function in New World primates (Moynihan, 1969, 1970; Epple, 1967). From the literature and personal observations, the behavior of walking in an arched posture with erectopilation and tongue protrusion (Epple, 1967; Moynihan, 1970) appear to be the most significant visual displays in social interaction, both apparently serving as some type of dominance, threat or aggressive display. Moynihan (1970) described a continuum of pilo-erection displays in the rufus-naped tamarin, all apparently serving as some type of dominance, threat or aggressive display. It should be noted that generalizations about arch posturing are difficult to make inasmuch as motivations and observed contexts vary as

well as differences in postural components among Callitrichid genera (Rathbun, 1979).

Tactile contact between tamarins also appears to have significant importance in social interactions (Shadle et al., 1965; Snyder, 1972; Stellar, 1960; Moynihan, 1969, 1970). Personal observations confirm the literature descriptions that tactile contact in grooming of the partner, inspection of partner's genitals and simple body contact while sitting, play an important role in establishing and maintaining social relations.

Olfactory signals are also reported to be of importance in social interactions (Epple, 1970b, 1967, 1972a; Hampton et al., 1966; Shadle et al., 1965; Moynihan, 1969, 1970; Snyder, 1972). These olfactory signals are cited as being frequently exhibited in the form of scent markings and olfactory inspection of the mate's genitals.

CHAPTER III

DESCRIPTION OF PROBLEM

Kleiman (1972) has made basic recommendations on the areas of reserach that should be undertaken in tamarin social and reproductive behavior. These recommendations include the determination of estrous and estrous cycle length and the influence of an adult male or female tamarin on the age of reproductive maturation in the young male and/or female tamarins. She stated that these areas are currently under research. Additional research recommendations cited by her were studies of the importance of experience in interacting with younger animals for the successful rearing of their own offspring, and the determination of age limits at which young can be removed from their parents without retarding the development of viable social and reproductive relations.

To study the latter two research problems recommended by her, it is necessary to know what constitutes viable social and reproductive relationships. The impact of experience or non-experience in interactions involving younger animals could then be determined by comparison with recognizably viable relationships. Similarly, if the age at

which an offspring is removed from its parents is important in the establishment of viable relationships, what constitutes these relationships must be known to determine the effect age at removal has on the relationships.

CHAPTER IV

METHODS AND MATERIALS

A. Subjects

Subjects of the study consisted of seven pairs of golden lion tamarins (Leontopithecus rosalia rosalia) all housed at and the property of the Oklahoma City Zoo. Table I provides a summary useful in differentiating clearly the background of pairs as delineated for statistical comparisons.

B. Observation Methods

Observations were conducted from April 1972 through February 1975. Observation periods of one hour minimum were concentrated between 0700 and 1000 to reduce public interference with the researcher and animals.

Observations were recorded on Observation Sheets (see Appendix A) for one-hour periods indicating the frequency of performances for each behavioral component. Duration of specific behaviors and unusual or infrequently observed behaviors also were recorded.

TABLE I

BACKGROUND SUMMARY OF GOLDEN LION TAMARINS STUDIED AT THE OKLAHOMA CITY ZOO

Pair	Sex	Birth Status	Time Together	Date of Birth	Studbook Number
1	M	Wild	Over two years	estimate 1963	64-B
	F	Wild		estimate 1963	64-D
2	M	Captive	Over two years	II-IV-1970	70-9B
	F	Captive		I-VIII-1969	69-15B
3	M	Captive	Over two years	8-III-1968	68-4A
	F	Captive		II-VIII-1970	70-12
4	M	Wild	Newly established	estimate 1963	64-B
	F	Captive		II-VIII-1970	70-12
5	M	Captive	Newly established	16-VI-1971	71-15B
	F	Captive		23-XI-1973	73-12A
6	M	Captive	Newly established	19-XII-1972	72-13A
	F	Captive		23-XI-1973	73-12B
7	M	Captive	Newly established	II-IV-1970	70-9A
	F	Wild		estimate 1963	64-C

In this study the following components of behavior were recorded by frequency of occurrence:

Food Sharing

Tongue Protrusion

Arch Posture

Scent Marking

Grooming

Genital Inspection

In addition to being relatively frequently observed behaviors in the baseline study, these behaviors also are consistently cited in the literature as reviewed.

C. Analysis Method

For the purpose of statistical analysis, it was assumed that the wild born animals (pair #1) represent a normal population with unknown mean and unknown variance. Comparisons were then made using the t-distribution which is dependent upon the number of degrees of freedom expressed as one less than the sample size. All significance statements are based on $t_{.05}(n-1)$.

Statistical analysis using the t-distribution was limited to pairs 1, 2, 5 and 6 except where noted. Data from Pair #3 were not included in analysis because the animals were siblings. Data from Pair #4 were not included in analysis because the wild-born male of that pair was the same male as in Pair #1, and apparently recognized and consistently oriented to the principal researcher during

TABLE II

MEANS AND STANDARD DEVIATIONS (IN PARENTHESIS) OF BEHAVIORS OBSERVED IN VARIOUS PAIRS OF GOLD LION TAMARINS

Behavior	Sex	Pair				
		#1 Without Offspring	#1 With Offspring	#2 Without Offspring	#2 With Offspring	#5 & #6 Combined
Takes Food	M	0(0)	.2 (1.0)	1.6 (1.3)	.4 (.8)	0 (0)
	F	.1(.43)	.04(.2)	.7(.9)	.4 (.8)	0 (0)
Tongue Protrusion	M	0(0)	1.2(.19)	0(0)	0(0)	0(0)
	F	0(0)	0(0)	0(0)	0(0)	0(0)
Arch Posture	M	.32(.65)	.3(.7)	.6(.9)	.5(.9)	.3(.6)
	F	0(0)	0(0)	.5(.7)	.2(.5)	0(0)
Scent Marking	M	2.3(3)	1.6(2.5)	2.8(3.8)	4.5(7.1)	.4(1.2)
	F	.05(.2)	.2(.6)	.7(1.5)	2.4(3.4)	0(0)
Grooming	M	2.6(4.5)	.7(1)	3.8(3.3)	.9(1.6)	.08(.2)
	F	2.4(3.3)	.2(.7)	2.1(2.8)	2.9(6.6)	.58(1.2)
Genital Disposition	M	.9(1.3)	.5(1.3)	2.5(2.5)	.4(.8)	.3(.38)
	F	.1(.3)	.04(.3)	.2(.7)	.7(1.4)	0 (0)
Hours Observed		22	48	19	23	24

data collection attempts. Data from Pair #7 was not included in analysis because the female was wild-born, over ten years old and had never reproduced. She, as well as the four-year-old captive-born male, also had been previously introduced to one or more mates. Data from these pairs (#3, #4 and #7) are included in Appendix B and are occasionally referred to in the narrative. Table II presents a summary of means and standard deviations for behaviors by sex for pair #1 and #2 and the combined means and standard deviations for pairs #5 and #6.

Initial comparisons by sex were made between the wild-born pair and captive-born pair to determine any significant differences in captive-born animals. Comparisons by sex were made between the wild-born pair before offspring and when offspring were present to determine the significance of the impact of offspring on behavior. Finally, comparisons by sex were made between the wild-born pair without offspring present to the mean frequency of the two newly established pairs in an effort to determine the ontogeny of socialization. In the latter comparisons the wild-born pair had been established for more than two years, while the two newly established pairs were introduced at the beginning of data collection.

CHAPTER V

RESULTS AND DISCUSSION

Socialization is the phenomenon of behavioral modification and interaction between two or more members of a species with individual survival coordinated towards propagation of the species as the final directed outcome. For the purpose of this study in describing the pair bond, its ontogeny and the ontogeny of socialization in the young, several behavioral components were examined.

A. Food Sharing

Comparison of the wild-born male to the wild-born female (pair A) before offspring were born and then again after offspring were born indicates no significant changes ($t=1.22$, $df=47$) in female behavior but shows a significant ($t=1.48$, $df=47$) increase by the male in taking food from the female when offspring are present.

Offspring showed significant preference for taking food from the male in both wild-born ($t=2.1$, $df=47$) and captive-born ($t=10.48$, $df=23$) pairs.

Comparison of the wild-born pair by sex without offspring present to the mean frequency of the newly introduced pairs (A and B) by sex showed no significant difference for females ($t=.989$, $df=22$) and no observations in males.

Food sharing is generally assumed to be voluntary; involuntary food sharing perhaps is better categorized in terms of aggression. Capuchin monkeys in food deprivation experiments have been observed to "hand" food through the bars to one another, and Markowitz (1973) reported gibbons and diana monkeys sharing food tokens and cooperating in bar situations. However intriguing these sharing situations may be, they cannot be categorized as normal even within the realm of captive behavior studies. .

Although chimpanzees (Goodall, 1965), spider monkeys (Dare, 1974) and olive baboons (Harding and Strum, 1976) have been observed in the wild to share food, most observations of food sharing have been made in captive species; gorilla (Schaller, 1963), chimpanzees (Nissen and Crawford, 1963; Mason, 1970), douc langur (Kavanaugh, 1972), gibbon (Berkson and Schusterman, 1964), and tree shrew (Hasler and Sorenson, 1974). To this relatively short list of normal situation food sharers may be added the golden lion tamarin.

The importance of food sharing behavior in tamarins is understood better with a brief description of their social organization which can be described as a parental family unit consisting of an adult bonded pair and their immature offspring of perhaps more than one litter. This parental family unit is rare in nonhuman primates and is known only in gibbons and tamarins. Eisenberg et al. (1972) described a pair bond as grooming, huddling and other nonsexual behaviors performed on a daily basis. The father in a tamarin

family typically takes the offspring from the female two to seven days after parturition and carries them about four weeks while returning them to the mother only for periods of nursing. This type of nonhuman primate parental care in which the male is actively involved is unique in tamarins (Eisenberg et al., 1972).

The diet of tamarins in the wild consists mostly of insects, smaller vertebrates, eggs, foliage, fruits and nuts (Izawa, 1975). The agility required to secure proper amounts of food is obvious and would place a pregnant female or any tamarin carrying offspring at a distinct disadvantage.

During the course of the study, tamarins were observed not to feed continuously at the feeding dish, but instead to take a piece of food in their mouth or one hand and carry it a short distance before starting to eat. Consequently feeding time is very active with frequent trips to the feeding station because the small pieces of food are either taken by other tamarins, eaten or dropped to the ground.

Wilson (1976) proposed that food sharing behavior in primates can be divided into three categories:

1. Passive food sharing is when one animal allows another to take (share) food without resistance even though the sharing is not solicited.
2. Active food sharing has the added facet of the sharer apparently seeking association with another individual ("sharee") although the food is not actively offered or presented (given or handed) to the individual.

3. Overt food sharing involves active sharing with the overt or active donation or carrying of the food to another individual. This is the highest level of food sharing behavior, correlating with at least the beginnings of advanced social contact systems similar to those of early man.

A single female offspring born to pair #2 on 25 March 1974 was 34 days old when first observed to eat solid food. In 17 hours of observation during the next 26 days, the offspring was observed to take food from the father 32 times and from the mother only 6 times. In view of the high degree of male interaction in the rearing of offspring, this disproportionate difference is not surprising. On one occasion the mother was observed to take food from her offspring. Additional observations of pair #4 and their twin male offspring indicated similar food sharing patterns with occasional passive food sharing between the offspring.

Pair #7 were first introduced by use of a 10-foot long cage divided by a wire partition. After several days of sight contact the partition was removed. During the first part of the introduction the male was observed to retrieve a food item from the floor and carry it to the wire divider directly adjacent to the female. The female reached through the wire divider and took the food item. No resistance on the male's part was noted, nor assistance other than carrying the food item directly to the female. This behavior would clearly be a case of active food sharing and adds

further support to the importance of food sharing behavior in the establishment and maintenance of the pair bond in tamarins.

From the data it appears that food sharing appears early in the development of a pair bond and plays a relatively constant role in a pair of tamarins until offspring are born when the male assumes a dominant role in taking food from the female. It further appears that the offspring share food more frequently with their father and begin to consume solid food while relatively young (34-52 days).

B. Tongue Protrusion

In the tongue protrusion or pump, the mouth is held partly open and the tongue extended and withdrawn rapidly two or three times, usually accompanied by a jerky rotation of the head. Typically the tamarin preceded the actual tongue pump with an intent stare at the other tamarin and continued the stare briefly after the actual tongue pump. The tongue protrusion is consequently a very short duration display. Actual number of movements of the tongue were recorded in 60 of the 65 observations with an average number of tongue flicks per display of 2.78.

Comparison of data on tongue protrusion displays was limited in that tongue protrusion only occurred in pairs with offspring. The wild-born male tongue-protruded significantly more than the captive-born male ($t=1.72$, $df=23$). In females, the wild-born female did not tongue protrude

significantly more than the captive-born female (t=1.28, df=23). Although these data significances appear mixed, it may be as a direct result of the small population being compared. When one considers other circumstances related to the tongue protrusion display it seems significant that tongue protrusion only occurs when offspring are present.

Of the 61 male-performed tongue protrusions, all but two of the observations occurred during periods when the offspring were vocalizing as if in distress (e.g. when left alone in the nest box or when either parent refused to carry the offspring). On one occasion the adult male of pair #2 stood on a limb outside the nest box entrance and tongue flicked at the offspring vocalizing inside the nest box. The offspring did not stop the distressed vocalizing until a few minutes later when the adult male entered the nest box and emerged with the offspring riding on his back.

In the two observations not focused around vocalizing offspring, one occurred during an arched posture display in the male of pair #1. The other observation was directed by the male of pair #2 at an offspring during a feeding period. The offspring immediately presented itself for grooming to the male.

It is also interesting to note that tongue protrusion, which was not observed until the respective offspring in both pairs were 32 days and 47 days old, closely parallels the ages of 32 days and 53 days at which these offspring were first noted to take solid food.

From these data it appears that the tongue protrusion manifests itself as a dominance or threat display typically used only by an adult male towards its offspring or, rarely, as a dominance display by the female towards her offspring. It appears that in addition to being primarily responsible for the care of the offspring up to weaning, the male typically disciplines the offspring during adolescence.

C. Arch Posture

The arched posture display is the most striking behavior pattern of tamarins. It is reminiscent of a ritualized displacement activity in that it does not appear relevant to the situation at hand and appears as a stereotyped, definite display.

The arched posture display was achieved by the tamarin acutely arching its back and bringing its forefeet and backfeet closely together. In a stationary position, the forefeet are placed outside the hindfeet, exaggerating the flare of the elbows. When moving in the arched posture, the limbs all appear to be moved stiffly.

Arched postures occurred throughout the day and although the display is obviously intimidating, never appeared to be directed towards another animal, the observer, zoo visitors or animal care personnel. The mate typically did not watch the display nor become involved in it.

The arched posture was observed 69 times in the course of the study. Males were observed to assume the arch

posture 54 times as compared to only 15 observations for females.

Occasionally the animal posturing would traverse an upper area of the display one or two times with vigorous walking gestures. Of 36 displays in which any distance traveled was recorded, only 13 actually involved movement. The average estimated distance traveled was 7.2 feet per display when movement occurred.

Comparisons of the frequency of arch posture in the wild-born and captive-born males showed no significant difference as to whether offspring were present or not ($t=1.06$, $df=23$ and $t=1.49$, $df=19$). Comparisons for females produced questionable results as the captive-born female arch postured both with and without offspring while the wild-born female was never observed to arch posture. It should also be noted that neither of the females in the two newly established captive-born pairs were observed to arch posture. Further, neither the mean frequency or arch posturing for males in the newly established pairs nor the long established captive-born male differed significantly from the wild-born male ($t=1.16$, $df=23$ and $t=1.49$, $df=19$).

All these factors appear to indicate that the arch posture display is a predominantly male behavior and, along with tongue protrusion, may achieve a secondary function. This may be as simple as intimidation or it may function more as reinforcement of a social relationship. Highly ritualized postures and gestures in social species serve as

a system of communication to reduce conflict and fighting. It seems reasonable that these intimidating gestures, in the presence of a conspecific stranger, would serve to warn off the intruder and at the same time reinforce that familiar animals (i.e. a mate) are secure or accepted by the dominant or displaying tamarin.

D. Scent Marking

Scent marking is generally accomplished by the tamarin actively rubbing either or both the sternum and circumgenital region on conspicuous logs, limbs and rocks. Rubbing of the circumgenital region and occasionally the anal region is generally accompanied by urination. Several prominent locations in a display are typically scent marked most often.

Comparisons of scent marking frequency indicated no significant difference ($t=.66$, $df=19$) between the wild-born male and the captive-born male. The captive-born female indicated a significantly higher ($t=1.91$, $df=19$) frequency than the wild-born (normal) female. Wild-born animals showed significantly higher ($t=7.7$, $df=22$ and $t=.09$, $df=22$) scent marking frequency by sex than the mean frequency of the two newly established pairs (A and B).

Both male and female of the captive-born pair #2 with offspring showed a higher significant frequency ($t=2.07$, $df=23$ and $t=2.08$, $df=23$) of scent marking than the wild-born (normal) male and female with offspring present. This may

be attributable to the larger enclosure afforded to the captive-born pair which provided more physical locations to scent mark.

It appears from this that scent marking plays little significance in the early development of the pair bond but may have importance in maintaining a stable pair bond in a reproducing pair.

E. Grooming

Grooming observations were limited to incidents of grooming without relation to duration as either partner was frequently inclined to move away abrupty thereby ending the grooming bout. A ritualized presentation for grooming in which one tamarin would prostrate itself in front of another or interject its head, neck or ventral surface in front of another was only occasionally observed. As mentioned earlier, an offspring was observed to present itself for grooming to the male after the male had initiated a tongue flicking display at the offspring. Grooming generally appeared spontaneously and ended suddenly.

No significant differences ($t=1.6$, $df=19$ and $t=.56$, $df=19$) were noted between grooming frequencies of captive-born (pair #2) and wild-born animals by sex without offspring present. In comparison with offspring present, only the captive-born female showed a significant difference ($t=.79$, $df=23$ and $t=1.99$, $df=23$) which was an increase in frequency over the wild-born female. This may have been due

to the general observation that the captive-born female groomed the male when he presented to her the offspring that were on his back instead of her taking the offspring from him.

Both male and female of the wild-born pair showed a significant decrease ($t=17$, $df=48$ and $t=22$, $df=48$) in grooming when offspring were present. This indicated either that more grooming effort may have been directed at the offspring or that grooming was curtailed due to the presence of the offspring.

Both the wild-born male and female groomed more frequently ($t=1.02$, $df=24$ and $t=12.4$, $df=24$) than the mean frequency of the males and females of the two newly established pairs.

Although these comparisons indicate a higher grooming frequency in both wild-born and captive-born longer established pairs, it is significant to note that grooming does occur early in the relationship between newly introduced animals.

F. Genital Inspection

Observations of genital inspections were limited to incidents typically involving both olfactory and tactile inspection of the mate's genitals without relation to duration as either partner was frequently inclined to move away abruptly.

In comparisons of data without offspring present, the captive-born male (pair #2) initiated genital inspection more frequently ($t=2.73$, $df=19$) than the wild-born male. No significant differences ($t=.45$, $df=19$) were noted between females of the captive-born and wild-born pairs when without offspring. In comparison of data with offspring present, only the captive-born female genital inspected significantly more frequently ($t=2.5$, $df=23$) than the wild-born female. These mixed differences may be a direct result of the small population being compared.

Both individuals of the wild-born pair indulged in genital inspection more frequently ($t=10.1$, $df=24$ and $t=4$, $df=24$) than the mean frequency of the two newly established pairs (5 and 6). It is significant to note that genital inspection does occur early in the relationship between newly introduced animals. However, it should be noted that males in all categories without offspring present demonstrated a higher mean frequency for genital inspection than females. This may indicate that genital inspection is a predominantly male behavior and is oriented toward determining female sexual receptivity.

CHAPTER VI

SUMMARY

A theoretical ontogeny of the pair bond in the wild would commence by two animals first seeing each other and perhaps traveling together in a non-xenophobic relationship. Two animals traveling and subsequently living together will obviously have to make some arrangements at resting times during which grooming plays an important initial contact role. Subsequently feeding time creates additional opportunity for further development of the pair-bonding process through food sharing and grooming. After these initial stages have developed, displays of socio-sexual context such as genital inspection and scent marking establish a bond conducive to reproduction.

Complex food sharing behavior and dominance or threat displays become more developed the longer a pair are together and become pronounced during the rearing of offspring. Observations of newly established pairs of golden lion tamarins with long established pairs closely parallels this theoretical ontogeny.

It is apparent from reproductive records that offspring removed from their parents prior to the next birthing and subsequent rearing are somewhat retarded in their capacity

to develop a successful reproductive relationship. In reviewing the theoretical and captive ontogeny of pair bonding and the ontogeny of socialization in the offspring, it is reasonable to assume that the parents play a significant role in the development of appropriate behavioral response conducive to subsequent pair-bonding and successful reproduction.

Since beginning this study, it has become common practice in zoos to leave offspring with the family unit until at least one additional sibling has been born and reared through weaning. While in 1972 only two second generation captive births had occurred in the total of 43 captive-born animals, as of December 1979 the captive-born population had grown to 156 golden lion tamarins. The remaining problems faced for survival in captivity of this endangered species include analysis of the genetic composition compounded by recent genetic defects, determination of the minimum population size required to maintain genetic viability and the development of a collective captive breeding program insuring that zoos can provide a sufficient carrying capacity for long-term propagation (Kleiman, Pers. com.).

LITERATURE CITED

Box, H. O. 1977. Social interactions in Family Groups of Captive Marmosets (Callithrix jacchus). In Biology and Conservation of the Callitrichidae (Kleiman, Ed.), Smithsonian Institution Press, Washington.

Bridgwater, D. D. 1972. Introductory Remarks with Comments on the History and Current Status of the Golden Marmoset. In Saving the Lion Marmoset (Bridgwater, Ed.) Wild Animal Propagation Trust, Oglebay Park, Wheeling, W. Va.

Brown, K. and D. S. Mack. 1978. Food Sharing Among Captive Leontopithecus rosalia. Folia Primat. 29:268-290.

Coimbra-Filho, A. F. 1965. Breeding Lion Marmosets, Leontideus rosalia, at the Rio de Janeiro Zoo. Int. Zoo Yb. 5:109-110.

Crandall, L. S. 1964. Management of Wild Mammals in Captivity. University of Chicago Press, Chicago, Ill.

DuMond, F. V. 1971. Comments on Minimum Requirements in the Husbandry of the Golden Marmoset (Leontideus rosalia). Lab Prim. Newsletter 10(2):30-37.

Eisenberg, J. F., N. A. Muckenhirn and R. Rudron. 1972. The Relation between Ecology and Social Structure in Primates. Science 176(4037):863-874.

Epple, G. 1967. Vergleichende Untersuchungen uber Sexual and Sozialverhalten der Krallenaffen (Hapalidae). (English summary by author) Folia Primat. 7:37-65.

_____. 1970a. Maintenance, breeding and development of marmoset monkeys (Callithricidae) in captivity. Folia Primat. 12:56-76.

_____. 1970b. Quantitative studies on scent marking in the marmoset (Callithrix jacchus). Folia Primat. 13:48-62.

_____. 1972a. Social Communication by Olfactory Signals in Marmosets, Int. Zoo. Yb. 12:36-12.

_____. 1972b. Social Behavior of Laboratory Groups of Saguinus fuscicollis. In Saving the Lion Marmoset (Bridgwater, Ed.) Wild Animal Propagation Trust, Oglebay Park, Wheeling, W. Va.

_____. 1977. Notes on the Establishment and Maintenance of the Pair Bond in Saguinus fuscicollis. In Biology and Conservation of the Callitrichidae (Kleiman, Ed.) Smithsonian Institution Press, Washington. 1977.

Hampton, J. K., Jr., S. H. Hampton, and B. T. Landwehr. 1965. A special breeding cage for small primates such as marmosets. Lab Animal Care 15(2):178-183.

_____. 1966. Observations on a Successful Breeding Colony of the Marmoset, Oedipomidas oedipus. Folia Primat. 4:265-287.

Hampton, J. K., S. H. Hampton and B. M. Levy. 1971. Reproductive Physiology and Pregnancy in Marmosets. Medical Primatology. Proc. 2nd Conf. exp. Med. Surg. Primates. Karger, Basel. pp. 527-535.

Hershkovitz, P. 1977. Living New World Monkeys. University of Chicago Press, Chicago and London.

Hill, C. A. 1970. The Last of the Golden Marmosets. Zoonooz 43(1):12-17.

IUCN. 1976. Red Data Book 1. IUCN, Margos, Switzerland.

Izawa, K. 1975. Foods and Feeding Behavior of Monkeys in the Upper Amazon Basin. Primates 16(3):295-316.

Jennison, G. 1927. Table of gestation periods and number of young. A. & C. Black, Ltd., London 8pp.

Kavanaugh, M. 1972. Food-sharing Behavior within a group of Douc Monkeys (Pygathrix nemaeus memacus). Nature 239:406-407.

Kleiman, D. G. 1972. Recommendations on Research Priorities for Lion Marmoset. In Saving the Lion Marmoset (Bridgwater, Ed.) Oglebay Park, Wheeling, W. Va.

Kleiman, D. G. and D. S. Mack. 1980. Effects of Age, Sex and Reproductive Status on Scent Marking Frequencies in the Golden Lion Tamarin, Leontopithecus rosalia. Folia Primat. 33:1-14.

Lucas, N. C., E. M. Hume and H. H. Smith. 1937. On the breeding of the common marmoset (Hapale jacchus) in captivity when irradiated with ultra-violet rays. II. A ten years' family history. Zool. Soc. (London), Proc., 107:205-211.

Moynihan, M. 1969. Comparative aspects of Communication in New World Primates. In Primate Ethology (Morris, Ed.) Doubleday and Co., Inc., New York. pp. 306-342.

_____. 1970. Some Behavior Patterns of Platyrrhine Monkeys. II. Saguinas geoffroyi and some other Lamarins. Smith. Contrib. to Zoology. 28:1-77.

Perry, J. 1972. In Danger - Golden Lion Marmosets. Smithsonian 3(9):49-53.

Rabb, G. B. and J. E. Rowell. 1960. Notes on reproduction in captive marmosets. J. Mammal. 41:401.

Rathbun, C. D. 1979. Description and Analysis of the Arch Display in the Golden Lion Tamarin, Leontopithecus rosalia rosalia. Folia Primat. 32:125-148.

Shadle, A. R., E. A. Mirand, and J. T. Grace, Jr. 1965. Breeding Responses in Tamarins. Lab. Animal Care 15(1):1-10.

Snyder, P. A. 1972. Behavior of Leontopithecus rosalia (the Golden Lion Marmoset) and Related Species: A Review. In Saving the Lion Marmoset (Bridgwater, Ed.) Wild Animal Propagation Trust, Oglebay Park, W. Va.

Southwick, C. H., M. R. Siddiqi, and M. F. Siddiqi. 1970. Primate Populations and Biomedical Research. Science 170:1051-1054.

Stellar, E. 1960. The Marmoset as a Laboratory Animal. Lab. Animal Care 53(1)1-10.

Thorington, R. W., Jr. 1968. Observations of the tamarin Saguinas midas. Folia Primat. 9:95-98.

Ulmer, F. A. 1961. Gestation Period of the Lion Marmoset. J. Mammal. 42:253-254.

Vogt, J. L. 1978. The Social Behavior of a Marmoset (Saguinus fuscicollis) Group. Folia Primat. 29:250-267.

Wilson, C. G. 1976. Food Sharing Behavior in Primates: Another Species Added. Arkansas Academy of Science Proceedings, Vol. XXX:95-96.

_____. 1977. Gestation and Reproduction in Golden Lion Tamarins. In The Biology and Conservation of the Callitrichidae, (Kleiman, Ed.) Smithsonian Institution Press, Washington, D. C.

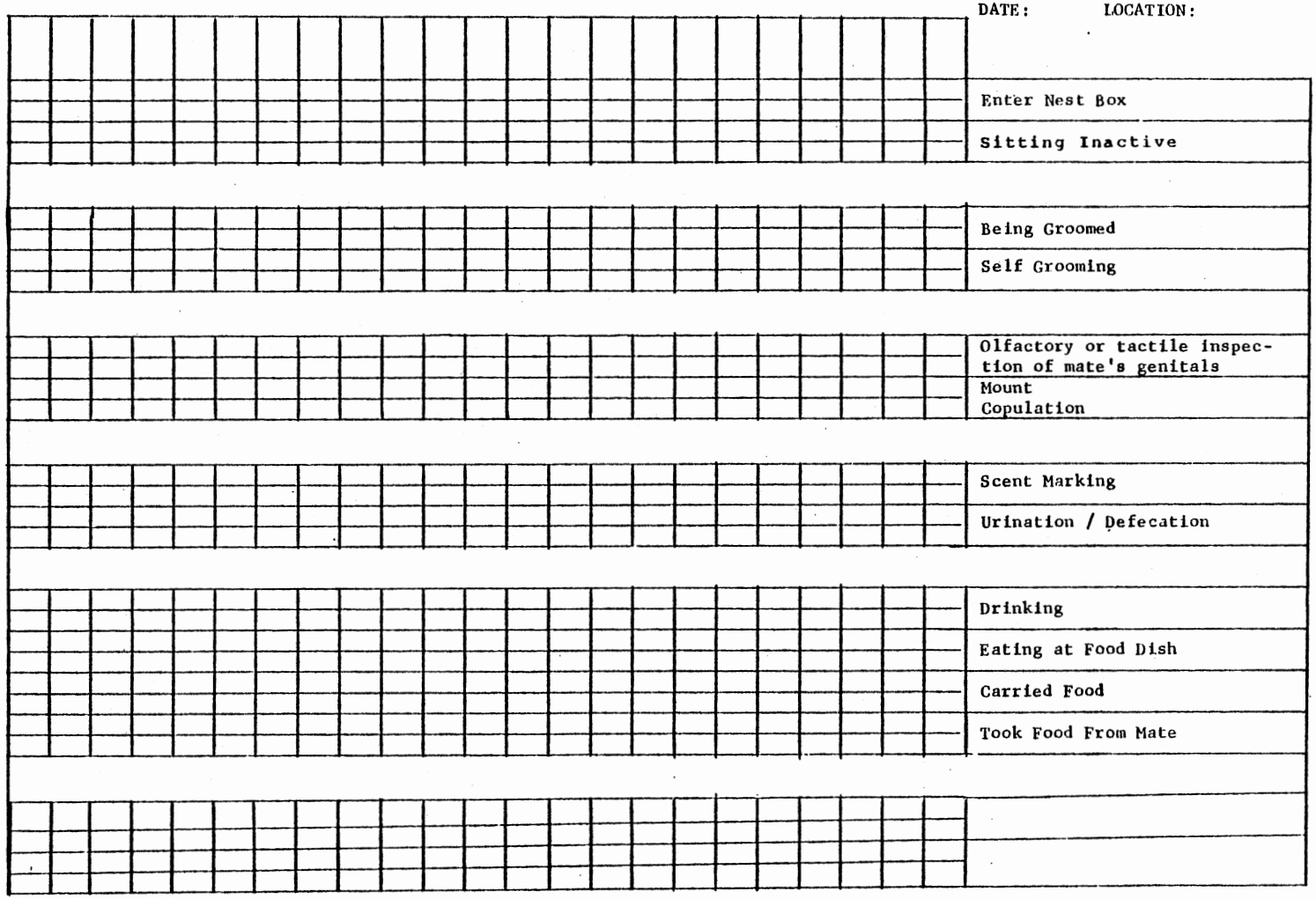
APPENDIXES

APPENDIX A

SAMPLE DATA COLLECTION SHEET

GOLDEN LION MARMOSET

DATE: LOCATION:



APPENDIX B

DATA SUMMARY TABLES

TABLE III

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS WITHOUT OFFSPRING PRESENT IN PAIR #1 OF GOLDEN LION TAMARINS

Behavior	Sex	Date																						
		June 72	July 72				Aug. 72									Sept. 72			Oct. 72		Nov. 72		
		24	8	16	22	27	4	8	10	12	16	18	22	24	26	9	17	30	13	28	5	11	25
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	1	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	3	3	2	4	0	2	2	0	3	1	0	0	1	2	6	1	1	14	3	2	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Grooming	M	11	0	1	4	0	8	4	3	4	0	1	0	2	12	0	12	0	0	1	2	3	5
	F	9	0	0	3	0	0	4	5	4	2	0	2	2	1	0	13	2	0	4	1	1	0
Genital Inspection	M	3	2	2	0	0	4	1	3	2	0	1	0	0	0	0	0	0	1	0	2	0	0
	F	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0

TABLE IV

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS WITH OFFSPRING PRESENT IN PAIR #1 OF GOLDEN LION TAMARINS

Behavior	Sex	Date																								
		Dec. 72	Jan. 73									Feb. 73								March 73						
		21	8	9	10	11	12	20	21	27	28	3	4	10	11	17	18	24	25	3	4	17	18	19	20
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	0
	F	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	1	3	0	0	0	1
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	2	2
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	0	4
	F	0	0	0	0	1	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grooming	M	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	4
	F	0	0	2	0	2	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genital Inspection	M	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	0	1
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0

TABLE V

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS WITH OFFSPRING PRESENT IN PAIR #1 OF GOLDEN LION TAMARINS

Behavior	Sex	Date																								
		March 73			April 73								May 73													
		23	24	31	1	7	8	14	15	21	22	28	5	6	12	14	15	16	17	18	20	21	22	23	24
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	2	1	0	3	4	11	0	1	6	0	2	2	1	0	3	1	3	2	3	1	2	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	1	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	0	0	1	2	5	1	1	1	3	2	1	1	2	4	12	1	3	9	1	3	3	2	1	2
	F	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grooming	M	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	F	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Genital Inspection	M	1	3	0	0	0	2	0	1	2	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE VI

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS WITHOUT OFFSPRING PRESENT IN PAIR #2 OF GOLDEN LION TAMARINS

Behavior	Sex	Date																		
		Aug. 72									Sept. 72				Oct. 72		Nov. 72		Dec. 72	
		3	5	9	11	15	17	19	23	25	2	10	16	23	8	20	4	12	26	1
Takes Food	M	2	1	2	2	1	0	0	2	5	2	3	1	1	0	4	1	1	1	0
	F	0	2	1	0	1	2	0	2	0	3	1	0	0	0	1	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	1	2	0	2	2	0	1	0	0	0	0	3	0	0	0	1	0	0	0
	F	1	2	0	0	0	0	0	1	1	0	1	2	0	0	0	0	1	0	0
Scent Marking	M	6	5	0	1	0	12	0	0	2	6	3	0	0	2	0	10	7	0	0
	F	1	1	0	0	0	6	0	0	2	0	0	1	0	0	0	2	0	0	0
Grooming	M	0	10	6	0	2	0	7	5	8	8	3	6	3	4	6	5	0	0	0
	F	0	3	0	0	2	1	3	3	0	7	10	4	4	2	0	0	0	0	0
Genital Inspection	M	0	1	3	2	3	2	3	3	1	4	5	0	0	6	10	3	1	1	0
	F	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0

TABLE VII

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS WITH OFFSPRING PRESENT IN PAIR #2 OF GOLDEN LION TAMARINS

Behavior	Sex	Date																							
		March 74	April 74							May 74									June 74						
		29	1	22	24	26	27	28	30	2	3	4	11	14	15	19	25	26	2	10	15	16	22	23
Takes Food	M	1	0	0	1	0	1	1	2	1	3	0	0	0	0	0	0	0	1	1	0	0	0	0
	F	0	0	0	1	0	1	1	0	0	3	0	0	0	0	1	0	0	2	1	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3
Arch Posture	M	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	3	3	0	0	1	0	2	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0
Scent Marking	M	0	3	0	0	1	0	0	0	12	6	0	0	0	15	0	0	0	0	15	1	10	17	24
	F	0	5	0	0	8	8	5	1	3	0	0	0	1	3	0	0	0	1	0	2	12	6	0
Grooming	M	0	3	1	2	0	1	0	1	0	0	0	1	0	0	3	0	2	1	7	0	0	0	0
	F	6	1	2	3	0	0	0	0	0	0	16	0	2	0	4	8	4	0	23	0	2	15	2
Genital Inspection	M	3	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	2
	F	0	0	0	0	0	0	0	2	0	6	3	1	0	0	0	2	1	0	1	0	0	0	1

TABLE VIII

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS IN PAIR #3 OF SIBLING GOLDEN LION TAMARINS

Behavior	Sex	Date																		
		Feb. 73															March 73			
		11	12	13	14	15	16	17	18	19	20	21	22	26	27	28	1	2	3	4
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	1	1	0	0	0	1	0	0	2	0	2	0	0	0	0	0	0	0	0
	F	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Grooming	M	1	0	0	0	1	0	2	0	0	0	0	1	1	0	0	0	0	1	0
	F	1	2	0	2	1	0	5	0	0	0	1	0	0	1	0	0	1	1	4
Genital Inspection	M	3	0	2	0	0	0	0	0	1	2	2	0	3	1	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

TABLE IX

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS IN PAIR #4
OF GOLDEN LION TAMARINS

Behavior	Sex	Date														
		Nov. 73				Dec. 73					Jan. 74			Feb. 74		March 74
		3	4	11	17	1	2	10	15	30	3	24	31	5	26	28
Takes Food	M	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0
	F	3	0	1	2	1	3	3	1	1	2	1	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	0	1	1	2	1	0	1	0	0	0	3	4	2	2	3
	F	0	0	0	0	0	0	0	0	1	2	1	1	0	1	3
Grooming	M	0	1	7	10	1	7	4	11	1	2	0	2	0	0	0
	F	0	5	9	6	9	16	4	2	0	10	0	6	1	1	0
Genital Inspection	M	0	0	0	5	5	2	1	4	0	1	0	2	4	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0

TABLE X

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS IN PAIR #5
OF GOLDEN LION TAMARINS

Behavior	Sex	Date											
		Feb. 75											March 75
		16	17	18	19	22	23	24	25	26	27	28	1
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	1	0	0	3	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	0	1	0	5	3	0	0	0	0	0	0	1
	F	0	0	0	0	0	0	0	0	0	0	0	0
Grooming	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Genital Inspection	M	1	1	0	1	0	0	0	0	0	0	0	1
	F	0	0	0	0	0	0	0	0	0	0	0	0

TABLE XI

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS IN PAIR #6
OF GOLDEN LION TAMARINS

Behavior	Sex	Date Feb. 75											
		9	10	11	12	13	14	15	16	17	20	22	23
Takes Food	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0
Grooming	M	0	0	0	0	0	0	0	0	1	0	0	0
	F	0	0	0	0	0	0	2	2	3	3	4	0
Genital Inspection	M	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0

TABLE XII

OBSERVED HOURLY FREQUENCIES OF BEHAVIORS IN PAIR #7
OF GOLDEN LION TAMARINS

Behavior	Sex	Date												
		June 74	July 74											August 74
		26	2	3	4	6	9	11	13	16	20	21	25	15
Takes Food	M	0	0	0	0	0	0	1	0	0	0	1	0	0
	F	0	1	0	0	0	0	0	0	0	0	0	0	0
Tongue Protrusion	M	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0
Arch Posture	M	0	0	2	1	0	0	1	0	0	1	3	0	2
	F	0	0	0	0	0	0	0	0	0	0	0	0	0
Scent Marking	M	3	0	1	4	3	7	1	0	0	15	4	2	3
	F	5	0	0	0	1	12	8	0	0	0	1	0	0
Grooming	M	0	0	0	0	0	0	2	0	1	0	0	0	0
	F	1	2	0	0	0	0	1	4	0	0	0	0	1
Genital Inspection	M	0	0	0	0	0	0	0	0	0	1	0	0	0
	F	0	0	0	0	0	0	1	0	0	2	0	0	0

VITA

Charles Glen Wilson

Candidate for the Degree of

Master of Science

Thesis: THE SOCIAL AND REPRODUCTIVE BEHAVIOR OF GOLDEN LION TAMARINS, LEONTOPITHECUS ROSALIA, IN THE OKLAHOMA CITY ZOO

Major Field: Zoology

Biographical:

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