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The Early Development of Behavior and Independence in Howler Monkeys, *Alouatta palliata mexicana*

Introduction

The growth of independence and the development of behavior in howler monkeys, *Alouatta palliata mexicana*, during the first few weeks of life has received relatively little attention to date. While several studies have been conducted on other subspecies of howler monkeys (Carpenter, 1934; Altmann, 1959 and Baldwin and Baldwin, 1973, 1978, concerning *Alouatta palliata palliata* in Panama; Mack, 1979 and Neville, 1972 concerning *Alouatta seniculus* in Venezuela; and Glander, 1975 and Clarke, 1990 concerning *Alouatta palliata palliata* in Costa Rica), only two studies have been conducted on *Alouatta palliata mexicana*, (Cabrera-Rojas, 1993; Serio-Silva and Rodríguez-Luna, 1994), and only the second of these reports has been published.

Both the studies on *Alouatta palliata mexicana* were conducted on a habituated troop of howler monkeys which were translocated to the Agaltepec Island, Catemaco, Veracruz, Mexico, in a program conducted by the Parque de la Flora y Fauna Silvestre Tropical of the Universidad Veracruzana, in 1988 and 1989, when nine individuals were introduced into this habitat (Rodríguez-Luna *et al.*, 1993). The program has been successful and the group numbers continue to grow steadily. The island offers good conditions for the observation of these primates, which are now completely habituated to the presence of human observers.

The objective of this research was to observe all the behaviors exhibited by the infant and of its social interactions with other group members, with the aim of establishing when and how the infant becomes progressively more independent of the mother in the first few weeks of its life.

Methods

Study Site: Field work was conducted on the Agaltepec Island (18° 27' - 18° 28' N and 95° 02' - 95° 3' W; altitude 360-390 m), Lake Catemaco, Veracruz, Mexico. The island covers approximately 10 ha (83,719 m²). All the trees with a diameter at chest height of more than 30 cm have been numbered and identified (López-Galindo, in press), making identification of the vegetation ingested and of the established feeding routes of the monkeys easy to record. The vegetation of the island consists of patches of semi-evergreen tropical forest, gallery forest, secondary growth, pastures and shoreline vegetation. There are a series of paths running around the island making the location of the primates simpler; combined with the fact that the sides of the island are steep and the canopy level low, and it is possible for the observer to get close to the subjects during observations.

The climate is warm and humid, and there is a rainy season between July and January, with most rain falling between August and October (5%-10% of the winter rain). The local annual precipitation is 4500 mm and the mean annual temperature is 24°C , with a maximum of 36.5°C and a minimum of 11°C (Acosta *et al.*, unpubl.; Serio-Silva, 1992).

Subjects: At the time of this study there were approximately 40 individuals on the island. They were in the process of dividing into groups but were still nearly always found in close proximity to one another. Individuals could be identified by their natural markings or by colored collars used to mark half of the eight females first translocated to the island along with one male in 1988 and 1989. The infants could be recognized by their close proximity to the mother.

Two individuals were born just before and one during the study period. The oldest two infants were born on approximately 10 August, Infant-a (female) and Infant-b (male), and the third, Infant-c (male) was born on approximately the 16 September, 1995.

Procedures: The study period took place between 16

August and 20 October, comprising 11 weeks of data collection and approximately 200 hours of observations, and covered only the wettest months of the wet season. Most observations could be taken with the naked eye but, when necessary, Bushnell 7x35 binoculars were used.

Daily observation covered 10 hours, between 08:00 hrs and 18:00 hrs, although most observations were taken in the morning. They consisted of *ad libitum* and focal sampling. Focal samples lasted 5 hrs, and the focal individuals were observed for equal sessions each week. The "Observer Program" in a handheld computer (Psion Organizer II, Model LZ64) was used to collect the data. The observations were recorded onto a specific schedule, which included locomotion, rest, feeding, play, and social interactions with other members of the group. In addition to data recorded within these categories, supplementary notes were taken using the notebook in the program and by hand.

Results

Locomotion on the Mother: During the first weeks of life, locomotion is almost entirely on the mother, and during the first three weeks the infant is almost exclusively carried ventrally. The mother has long hair on her sides and ventral surface which enables the infant to maintain a firm grip on her when resting and traveling. This effectively allows the mother to move with relatively little care, and mothers were observed moving rapidly and jumping large distances during troop movements even with very young infants. With increasing age, the infants become increasingly more aware of their surroundings, and correspondingly by the fourth week of age they begin to spend more time traveling on the mother's side and back, which affords them a better view. By the fourth week their prehensile tails have become more functional and they begin to use them to ensure a better grip, for example, wrapping them around the mother's leg. By the eighth and ninth week of life, during any major troop movements the infants were observed traveling on the mother's tail. By this age the infant's tails are large and strong enough to wrap around the base of the mother's and from this position they can sit up and observe their surroundings more effectively than in any other position. When traveling small distances, for example, when the mother is feeding and the infant is off her back, when she begins to move the infant will grab onto her wherever it can, usually her back and may shift its position to the mother's tail if she begins to travel for any long distance.

Independent Locomotion: The first time that an infant was observed out of contact with the mother, traveling independently, was at 5 weeks of age. At first this independent travel was tentative, the infant exploring only the environment around the mother and always within reach of her. By 7 weeks of age the infants were frequently observed to travel independently when the mother was feeding. This independent travel was of an exploratory nature and consisted of a "rubber-ball" pattern of frequent leaving and returning. It tended to occur only when the mother was feeding, and the infants always returned to the mother when she began to move, or they were retrieved by the mother before she accompanied any major troop movements. During 8-11 weeks of age, independent travel increased progressively, the infants moving greater and greater distances from the mother and spending more time away from her before returning. In the seventh week of life independent locomotion comprised 16.8% of the individual's time budget but was always observed within 1 m of the mother. By the eleventh week independent travel increased to 34.4% of the infant's time budget, when the furthest distance traveled was between 5-10 m from the mother. This behavior reflected the physiological changes that occurred in the infant because with time the infants became progressively larger, stronger and more capable of traveling on their own.

Interestingly, there existed a significant difference in the behavior of the individuals. One infant spent far more time traveling independently. Infant-a spent 45.5% of time in independent locomotion in the eleventh week compared to only 27.0% by Infant-b, climbing off the mother as soon as she remained still for more than a few seconds and exploring greater distances from the mother for longer periods of time. Correspondingly the behavior of this infant's mother included aspects not observed in the other. On several occasions this mother was observed to increase her interindividual distance from the infant, Infant-a, by moving in the opposite direction when it was traveling independently and she was also observed to push it away from her on several occasions.

Mother-infant movements were often coordinated by the mother giving a stereotyped "present-neck" posture, to which the infant responded by climbing onto her. She may also start to move off very slowly, allowing the infant to return to her and grasp onto her wherever it could before she gained speed and started to move more rapidly.

Rest: During the first three weeks of life the infant spends most of its time resting ventrally on the mother. By the fourth week, with an increasing awareness of the environment comes an increase in the amount of time spent resting dorsally, as opposed to ventrally, affording the infant a better view of its surroundings. With an increasing interest in its surroundings comes a corresponding decrease in the amount of time spent

resting, particularly from the seventh week of age when the infant begins to start exploring more and more during independent locomotion. For example, 49% of the time was spent resting on the mother during week 5, but by week 7 this decreased to 28.5%.

Feeding: Infants nursed from the mothers throughout the study period. The mother's nipples are generally 3-4 cm long, which allows the infants to suckle from several different positions on the mother's body, but usually this was from her ventral side. From three weeks of age the infants were observed "mouthing" leaves.

The earliest observation of independent feeding occurred at the beginning of the fourth week of life. The infant was observed eating mature leaves of *Bursera simaruba*. Independent feeding continued to increase with increasing age, particularly from the seventh (A0 - 0.1%) to the eleventh (A0 - 1.5%) week, corresponding with the increase in independent locomotion at this time. The infants generally fed on the same vegetation, simultaneously with the mother. Exploratory feeding began in the tenth and eleventh weeks.

Exploration: Some exploration of the environment was noted from the first week of life. As mentioned previously, the infant begins to become significantly more aware and interested in its surroundings by the third and the beginning of the fourth week of life and it is at this time that exploration increases significantly. Exploration usually began with the infant clambering around on the mother's body, particularly on her back, testing its motor skills, which become greater with age and corresponding physiological changes in size and strength. By the fourth week the infant begins to explore the external environment by touching and pulling nearby leaves and branches and by "mouthing" leaves. This behavior increases significantly into the fifth and sixth weeks of life.

By five weeks of age the infant begins to travel independently of the mother, constituting its first truly independent exploration of the external environment. This exploratory behavior increases with time. The mother may encourage this behavior by resting or feeding near to small branches, which offer an easier environment for the infant to explore.

Play with Other Individuals: This was first observed in the eleventh week (3.6% of time) and tended to substitute time spent exploring the environment alone. The infants were seen to initiate play themselves, but more frequently other individuals initiated this behavior, which generally involved chasing and being chased, as well as prodding and tickling. This behavior was observed most frequently with juveniles, generally a group of them. Play was also observed to occur with adult females and with the mother. These play bouts were not rough and did not exceed more than 10 minutes.

Social Interactions - Frequency: The presence of a new infant in a troop of howler monkeys presents a great attraction, and correspondingly the mother and infant are frequently approached by juveniles, males and in particular females who stare intently, sniff, lick and, if possible, physically examine the infant. These females are commonly termed "aunts". Interestingly there existed differences in the amount of social interactions received by each infant, some receiving many more contacts than others.

Social Interactions - Type: Nearly all interactions were of an affiliative nature and resulted from interest or desire to care for the infant on the part of the interactors. No injurious interactions were observed in this study. The infants were removed from their mothers, or voluntarily left, in three different ways, namely: they were kidnapped, taken or they were transferred. Kidnapping was observed only once. Infant-b was forcibly removed from the mother by another female, in the sixth week of it's life. Throughout the period of this kidnap, which lasted about 5 minutes, it emitted desperate vocalizations. The mother closely followed the kidnapper baring her teeth and emitting aggressive vocalizations at her. She forcibly tried to retrieve her infant throughout this period. When the kidnapper eventually gave up the infant, the mother grasped it firmly to her ventral surface before moving off to a safe distance and examining it.

Infants were taken by other individuals, this behavior being observed from the first week of life in the most recently born infant, Infant-c. However, on the whole, this phenomenon was not common. This was chiefly because the mother was observed to be protective of her infant, often not allowing other individuals to touch it for very long, and successfully preventing other individuals from taking it by holding it protectively in a ventral position or turning her back on interactors. This was particularly obvious when adult males approached the infants. Transfers became progressively more frequent with time, generally not occurring frequently until the ninth week. This behavior usually occurred in response to a "present neck" posture by the interactor. (By the ninth week of its life the infant's coat had changed from a light gray coloring to the characteristic dark brown of the adult's coat).

Social Interactions - Responsiveness of the Infant: During the first three weeks of life the infant is generally noncommittal to interactions with other group members. Negative reactions were generally not noted, except in cases when another individual tried to remove the infant

for example, in the case of the kidnapping. During the seventh week of life the infants start to become more positive to social interactions. By the seventh week they also started to become emissors of social interactions, actively reaching out for certain individuals within close range. This behavior continued to increase with increasing age. During the ninth, tenth and eleventh weeks the infants were reacting positively to nearly all interactions and transfers were fairly common.

Social Interactions - Interactors: The interactors encompassed all group members, but by far the most common were adult females, including other mothers with infants. Often a second female was observed traveling in convoy with a mother and sitting close by her whenever she stopped to rest, and when the female would frequently try to touch the infant or display a "present-neck" posture to it. Social interactions with the infant tended to occur at periods when the troop was either resting or feeding. They thus often occurred when several individuals were near the mother. However it was observed that group members interacted with an infant individually or simultaneously with another individual, but generally not in groups.

Conclusions

The pattern of the development of behavior and of the growth of independence in howler monkey infants found during this short study corresponds well with the two other studies carried out on the group of howlers on the Agaltepec Island (Sério-Silva and Rodríguez-Luna, 1992; Cabrera-Rojas, 1993), as well as other studies of the behavioral development of howler monkeys in different study sites (for example, Clarke, 1990). The infant's behavior and dependence develops gradually with time and is positively correlated with physiological changes, such as increase in size and strength which allows it to explore its environment more and more; a feature which goes hand-in-hand with an increase in the desire of the individual to do so and in the encouragement of this behavior by the mother and other group members.

The most obvious changes that occur within the group with the presence of a new member is that the new infant presents a powerful attraction which stimulates many social interactions. Clarke (1990) has previously suggested that predictions of behavior relating to this phenomenon cannot be based on inclusive fitness, and that interactions with infants do not function to bond social groups because howler monkeys leave their natal group as juveniles or young adults and migrate to new groups, and thus share little or no genetic material by descent with other adults within their group. However, the study site of Agaltepec Island represents a very special case because the monkeys are confined to the island. The original eight females and one male make up the entire genetic stock of this group of primates, and therefore the majority of this group, which now numbers approximately 40 individuals, does share genetic material. Similarly, at present these howler monkeys cannot migrate to other groups when older, therefore suggestions that interactions with infants can be explained by increasing inclusive fitness or functioning to bond the social group are appropriate in this case.

This study has revealed some important observations not recorded in previous studies of this species. In particular, the age observed for the first ingestion of solid food (leaves of *Bursera simaruba*) by an infant in this study, namely at the beginning of the fourth week of life, is earlier than had been previously observed. The age reported for the first instances of the "rubber ball" pattern of frequent leaving and returning to the mother are similarly earlier than previously documented. Compared to the previous report of the subspecies, *Alouatta palliata mexicana*, the observations of increased positive responsiveness of individuals to other group members, shown by behaviors such as an increased rate of transfer and of play behavior were observed relatively early.

An important point that has come to light, that has possibly not been investigated in any depth in previous studies involving larger sample sizes, but is very apparent in a study such as this involving only a small sample, is that of individual differences between the infants. For example, between the two oldest infants who were the same age, some very apparent differences existed. Infant-a gained increasing independence much more quickly than her contemporary Infant-b. For example Infant-a ingested solid foods much earlier, was much more responsive to social interactions, spent proportionally more time in independent travel (during which it also traveled further), and was observed playing more often.

There are several reasons to explain why these differences might have occurred. The first and most obvious is that these two individuals are of different sexes. Clarke (1990) suggests that major differences exist between the behavior of male and female howler infants. She found that females were generally more adventurous and reacted more positively to social interactions at an earlier age than did male howler monkey infants. Apart from sex differences, there are also several other reasons why differences might arise between individual infants. These most probably concern the mother. For example, differences might exist between the sociability or position in the social hierarchy of the mother which consequently affects the frequency of social interactions received by the infant. Differences may also occur between different

individual's mothering styles which either accelerate or decelerate the development of behavior and of independence in the infant. Further studies could easily address these possibilities.

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El Trafico De Monos Araña En México: El Estudio De Un Caso

Para los traficantes de fauna silvestre en México, el mono araña (*Ateles geoffroyi*) constituye uno de los elementos con mayor valor comercial, debido a su popularidad y demanda tanto a nivel nacional como internacional. Desafortunadamente para las poblaciones silvestres de este primate, los animales que son vendidos como mascotas continúan siendo extraídos de las selvas: los capturadores no se interesan por los adultos, pues resultan agresivos y en ocasiones peligrosos, en contraste, los infantes se muestran temerosos y sus mordidas no pueden causar un daño grave, además de ser más atractivos a los potenciales compradores; por lo tanto, estos pequeños son el objetivo final de la captura. La manera tradicional de obtener a estos infantes es matando con arma de fuego a madres que transportan a sus crías sobre el cuerpo. Los infantes son capturados y se convierten al poco tiempo en mascotas.