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BEHAVIOR OF RED SPIDER MONKEYS IN PANAMA

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The general purpose of the investigation described in this paper was to supplement existing knowledge of the activities and social relations of non-human primates living under natural conditions. Red spider monkeys (*Ateles geoffroyi* Kühl) were selected as good subjects for a study like the one already made of howling monkeys (Carpenter, 1934). Adequate data were sought with a view to eventual comparative work on many important types of American and Old World primates.

The observational data which are the basis of this report were collected during two encampments in the Coto Region of western Panama. A total of forty-eight days was spent in the forest. At times it was possible to make daily and almost continuous observations on groups or parts of groups of spider monkeys. The first camp lasted from June 1 to 26, 1932, and the second from February 18 to March 12, 1933. Much remains to be done before the work on spider monkeys is complete. Therefore this is a preliminary report.

The La Vaca River flows through the poorly mapped and sparsely settled Coto Region which lies on the border of Panama and Costa Rica. Along this river, toward the foot-hills, the forest is dense and is occupied by an abundance of wild life that is almost entirely unmolested by hunters. There are to be found tapirs, deer, jaguars, pumas, ocelots, tayras, peccaries, many small mammals, and a great variety of birds. In addition, there are five types of monkeys: red spider monkeys (*Ateles geoffroyi* Kühl), very plentiful—possibly more than two hundred of them occurring on every square mile; capuchin monkeys (*Cebus capucinus*), more limited in number; howling monkeys (*Alouatta palliata palliata*), few in number and rarely seen, but occasionally heard howling in the distance; squirrel monkeys (*Saimiri örstedii örstedii*), fairly plentiful in the low bush regions; and marmosets (*Oedipomidas geoffroyi*), very scarce. It was in the region of this dense, undisturbed animal population that a camp was established in 1932 and occupied again in 1933.

Dr. Herbert C. Clark of the Gorgas Memorial Institute invited the author to join an expedition into the Coto Region in 1932. Dr. Clark initiated, organized and directed the entire expedition. He also assisted in arranging and supplying equipment for the second of the next year. It was possible for the writer to take advantage of the opportunities afforded him because of the approval and sponsorship of Professor Robert M. Yerkes of the Laboratories of Comparative Psychobiology, Yale University. The investigation, furthermore, was made possible by a National Research Fellowship in the Biological Sciences and by an additional grant to Yale University from the Committee for Research in Problems of Sex, National Research Council. The author gratefully acknowledges the many services of the United Fruit Company and the Chiriqui Land Company given through their representatives, Mr. Sterling Blair and Mr. Kenneth Block.

The expedition into the Coto Region in 1932 was a coöperative undertaking planned primarily for the purposes of collecting both live and dead specimens of red spider monkeys and of observing their natural activities and group life. The other monkeys of the region were of secondary interest. Apart from the author the following scientists engaged in the undertaking: Drs. Robert Hegner, Herbert C. Clark, George B. Wislocki, Adolph H. Schultz, and Carl M. Johnson. Their subjects of study were: Intestinal protozoa, pathology, reproductive anatomy, and physical anthropology.

The writer returned to the previously established camp in February, 1933, accompanied by Mariana Evans Carpenter and two natives. His purpose on the first expedition had been to gain experience in the bush along with experienced field naturalists, to explore the possibilities of making a comprehensive study of red spider monkeys in their natural environment, and to begin such a study if favorable conditions were found. The second expedition was carried out in order to supplement the data previously acquired, to collect a colony of live spider monkeys for use in the laboratory, to collect a series of female reproductive tracts for histological study and comparisons, and finally to obtain motion and still photographic records of the activities of spider monkeys.

PROCEDURE

Observational work was confined to a sector of forest near camp which was reserved for this purpose. It was found to be more advantageous to concentrate work in a small area and to become thoroughly familiar with the region and its animals than to work over a large unfamiliar territory. No hunting was permitted in this area, because hunting and successful observation are inconsistent. The sector, which came to be known as the Yale Quadrant, was thoroughly mapped, especially with reference to food trees, to trees where spider monkey colonies were found to spend the night, and to places where the groups tended to spend rather long periods of time resting and playing. A net-work of inconspicuous pathways was laid out through the area and direct paths were cut from food tree to food tree and between other loci of activity.

Four large groups containing a total of about one hundred animals inhabited the reserved quadrant of forest; thus there were plenty of animals for observation. Ordi-

narily, these groups of spider monkeys awoke at dawn and began travelling immediately; they fed, moved, rested, and played periodically during the day. At dusk they returned to one of several customary "abode" trees and settled down for the night. At times a group would spend eight or ten successive nights in the same tree or trees. Groups of these animals travel rather rapidly, thus making it difficult to follow them through the tangled forest. Even when undisturbed, bands of spider monkeys scatter over a considerable area when travelling; and when disturbed by an observer, the groups split up into a number of subgroups that may become separated by spaces of as much as four or five hundred yards.

It was necessary to be content mainly with observation of subgroups, for entire groups could not be followed for long periods of time. Two plans of observing were used. These were frequently alternated: (1) Animals were watched from ambush; and (2) subgroups were followed closely for the longest possible time during a day's work. It was impossible, during the relatively brief period spent with the animals, to accustom them to the presence of the observer.

Many dead specimens were available for close examination. Twelve live infants and juveniles were collected in 1932, and sixteen in 1933. Close range observation of these living animals aided greatly in classifying the monkeys seen in the wild with regard to sex and to stage of development. While working in regions other than the one reserved for behavioral observation, it was possible to collect females judged to be in a state of oestrous, to remove the reproductive tracts, and thus to correlate behavioral and anatomical information. Also, it was possible to collect pathological individuals, and even entire subgroups, e.g., a subgroup of males, in order to check field observations.

Experiments were made with methods of trapping live spider monkeys. It was found that the animals avoided suspended ropes with trigger releases, as well as other types of arboreal traps. Experiments were also made with tear gas. This method, although promising, was found to be impracticable under the prevailing conditions and with the help that was available. The primitive method of shooting the mother that carried a young one of desirable size and then recovering the infant from the dead animal was resorted to with success. Two well trained natives could thus collect an average of two young monkeys each day.

REACTIONS OF SPIDER MONKEYS TO MAN

When approached, these animals typically begin barking. Frequently they approach the observer. The usual terrier-like bark of great excitement may at times change to a metallic chatter repeated with great frequency. When males, and sometimes adult females, are closely approached they may growl in a strikingly "vicious" manner. Typically, the animals come to the terminal parts of branches, often to within forty or fifty feet of the observer, and shake the branches. This may be done with either the hands or feet; or both the hands and feet may be used while the animal hangs by its tail. Concurrently and almost invariably, vigorous scratching occurs. Of this there are varied patterns. The hands may be used either singly or together to scratch the sides, back and shoulders opposite to the hand that is being used. Occasionally both hands will be used to scratch one foot or both feet consecutively, or both feet may be used to scratch an extended arm. There may occur along with these actions, running movements of the hind legs while the animal hangs suspended by its hands or tail or by both together. These may possibly be incipient escape movements. If seated, the animal may sway back and forth and vocalize noisily.

The breaking off and dropping of branches is a conspicuous part of the reactions of spider monkeys to man. Very frequently these animals break off and drop limbs with close reference to the observer. Any experienced native will warn one of this source of possible danger. Green branches sometimes, but most often large dead limbs weighing

up to eight or ten pounds may be broken off and let fall toward the observer. One can well imagine the impact of one of these missiles when dropped from forty or fifty feet above the ground. This behavior cannot be described as throwing, although the animal may cause the object to fall away from the perpendicular by a sharp twist of its body or a swinging circular movement of its powerful tail. The dropping of objects from the trees with reference to a disturbing person may be considered, apparently, as a defensive adaptation arising from the more generalized habit of shaking branches. A significant variation of this habit occurs when the animal breaks off a limb and holds it for a time varying from a few seconds to half a minute or more before letting it fall, especially in situations where this delayed action results in the limb's falling closer to the approaching observer. Related to this behavior of dropping objects toward the observer is the common activity of releasing fecal matter and urine with reference to him. It seems quite clear that these behavior patterns can be classed as "instrumental acts" carried out with reference to particular defensive objectives.

The reactions of spider monkeys to man show three rather clearly differentiated variations:

1. Aggressive, moving-toward, "bluff" reactions occur most frequently. Almost always animals show this type of reaction when first approached and for a short time thereafter.

2. Following the initial reaction, during which time the excitement of the animals increases, flight reactions are shown. During these responses, the group splits up into a number of subdivisions.

3. Animals that have been hunted and shot at may remain perfectly quiet and partially concealed when they are approached. This type of defense reaction is very effective in causing one to overlook the animals. In general, spider monkeys behave toward man as they would toward an enemy; he is something to be driven away or to be fled from.

FOOD AND FEEDING ACTIVITY

Red spider monkeys have been classed correctly as frugivorous. It is estimated that about 90 per cent of their food consists of fruits or nuts. The animals may live for considerable periods of time on only the one or two kinds of fruit which are then in season. In June, 1932, "bogamani" or wild nutmeg formed a most important part of their diet; this nut is eaten for the mass of red aril which lies beneath the thick hull. As many as ninety of the kernels, which are as large as a small hickory nut and which are swallowed whole, may be found in the stomach and intestines of an adult spider monkey. "Berba" and "berbacilla," bean-like nuts found in abundance in the forests of the Coto Region, were also of great importance as monkey foods. These nuts are evidently rich in nutritive value, because the monkeys were exceedingly fat while they were feeding on them. In February, 1933, when only a few "berbacilla" were to be had, the animals looked much less well-fed than during June of the previous year, at which time the specimens collected were very fat. In February, 1933, they were eating "higo," "higeron" (wild figs), "bogamani," a few "berbacilla" which matured early, "sandi," "guyava," "cainito," and several fruits that were not identified. The following trees, named according to Standley (1933) are some of the most important sources of food for the spider monkeys: *Ficus costaricana, Ficus glabrata, Helicostylis latifolia, Virola panamensis, Virola warburgii, Persea americana, Licania platypus, Inga edulis, Inga goldmanii, Inga spectabilis, Dipteryx panamensis, Anacardium excelsum, Anacardium occidentale, Spondias mombin, Rheedia madruno, Gustavia superba, Psidium guayava, Chrysophyllum cainito.*

Little is known of spider monkey foods other than fruits. The animals may at times be seen searching through leaves, under bark and in dead limbs, apparently for larvae and insects. No evidence was found to indicate that they eat birds' eggs or young birds

from the nests. They consume small quantities of buds and flowers, but these constitute an insignificant part of their diet.

Spider monkeys begin feeding shortly after dawn. The most active period of feeding occurs between daybreak and about 10 o'clock; this period of heavy feeding is followed by one of comparative rest for the adults and play for the young. Feeding in the afternoon is less active and more sporadic than in the fore-noon. It may continue until dark.

LOCOMOTION

The locomotion of spider monkeys is developed more toward the orthograde type than in other platyrrhines. The brachiating movements of these monkeys approach the form of arboreal locomotion characteristic of gibbons. Normally, spider monkeys travel along the upper surfaces of limbs, using all four feet and carrying the tail arched over the back. It is principally while crossing from one support to another that brachiating occurs. At this time, too, the powerful tail is brought into play as a suspending appendage. During these movements the hands, arms, and tail are used to make contact with supports. Spider monkeys show a strong tendency to keep their heads upward; therefore, when descending a perpendicular limb, vine, or tree trunk, they go backward rather than head foremost like howlers. While passing along a horizontal limb, the long, four-fingered hands are turned outward on the support; during brachiation, the hand becomes an effective hook.

They frequently make long jumps outward and downward, covering at times more than thirty feet. While jumping, an animal spreads all of its appendages, thus increasing both the air resistance and the possibility of making contact with the objects toward which it is jumping. Several times animals have been seen to release all holds and drop straight downward for twenty or twenty-five feet to lower limbs or tree tops.

The average speed of locomotion is about that of a man walking at top speed. Generally speaking, they show a great variety of forms and speeds of locomotor activity. Their motions are much more flexible than those of howlers.

TERRITORIALITY AND NOMADISM

Groups of spider monkeys are semi-nomadic, that is, each group inhabits an area of the forest which, though fairly definite, may overlap the territory of other groups. Within this territory, they wander about with their activities centering around food and lodge trees. Shifts in territorial range undoubtedly occur, but apparently the change is slow. In June, 1932, there was, in the area reserved for observational work, a clan that could be identified from day to day with considerable certainty. Almost every night this group slept within ear-shot of camp in trees across the river. For eight successive nights the animals returned to the same clump of "nispero" trees. Throughout the day, the group travelled, in general, over the same routes from one food tree to another and to and from favorable places in the deep forest where the mid-day "siesta" occurred. Several other groups were regularly located in their own particular home areas. Experienced hunters know and make use of the fact that groups tend to inhabit special areas.

Little is known of the factors that regulate the limits and the shifting of territories of different groups. It may be assumed, however, that the size of the group, and the availability of food and of favorable trees in which to play, rest, and spend the night are influential. The competition of groups in adjacent regions would also be significant. It would be expected that changes in the territorial range would occur coincidently with the seasonal variations of the food supply.

It seems reasonable to suppose that a clan becomes adapted to a particular area partly because of the facilitation established through feeding, constant association, resting, playing, and other normal daily activities. The locations of food trees, of

arboreal travel routes, and of places favorable for other kinds of activity are soon learned. They then function as attractive "goals."

ORGANIZATION OF SPIDER MONKEY GROUPS

This preliminary study indicates that spider monkeys have a form of group organization which differs from that described previously for howling monkeys (Carpenter, 1934).

Typically, an observer finds spider monkeys in small groups. These may consist of (a) a female and one or more young, (b) a number of females with their respective young, (c) one or more males and many more females with their young ones, or (d) males only. If these smaller groupings are followed for a day, it will be discovered that they eventually join with others in various combinations. The subgroupings first observed may belong to a larger grouping that contains as many as forty individuals. To reverse the description, if the large group is found in the early morning and closely observed, it may be seen to divide into many smaller groupings that become separated from each other for varying distances and for different periods of time during the day. The divisions of the larger group or over-group will keep more or less in touch with each other by means of vocalizations that are exchanged among them. The individuals that make up the subgroups usually stay within sight of each other.

Table I gives the composition of 19 subgroupings which are random selections of types as observed in many clans and recorded in field notes. The variability of the groupings as to number and composition and the ratios of adult females to adult males is especially worthy of consideration. In addition to the groupings that are listed in itemized form in the table, seven other subgroupings were observed which contained only adult males with no females or young. These male subgroupings constitute a distinguishing characteristic of the organization of spider monkey societies.

A study of the temporary subgroupings of spider monkeys seems to warrant their classification into three categories: (a) male subgroupings, (b) female subgroupings (exclusive of the young found with them), and (c) mixed subgroupings. All three kinds of subgroupings are usually found, so far as available data indicate, in each large, relatively stable group or association.

With three exceptions the subgroupings listed in Table I contain both males and females. Subgroupings 7, 13, 16 and 18 may be considered compound in the sense that each contains male subgroupings which moved rather closely with the other individuals. The first subgroupings (no. 1) in the table consisted of a mother and an infant (still in the dark color phase) which she carried on her belly, and a semi-independent juvenile. Of the sixteen subgroupings which contain males, one has an equal number of adult males and females, four have more males than females (these counts include the exclusively male subgroupings) and eleven have more adult females than males. As yet the data are too limited to permit of statistical treatment of the groupings and it is impossible to ascertain the central grouping tendencies and the characteristic socionomic sex ratio (ratio of males to females living within groups).

The male groupings range in size from three to ten individuals; two subgroupings have three, two have five, and in the others there are four, seven, and ten adult male animals. All the animals forming several of these groupings were collected in order to show accurately what types of individuals composed them. A. H. Schultz and the author, judging from dentition and physical development, have concluded that the members of these subgroups range in age from early adulthood to senility. Some of the sets of teeth were perfect and well developed, others were "young," while still others were "old." These findings oppose the theory that all males living in unisexual subgroupings or as "solitary" individuals are so old or weak that they cannot meet the competition within the main group.

The subgroupings that have been described associate in various combinations to make up the typical society of spider monkeys. The total number of animals in one particular

major group was learned after intensive study and after several fortunate opportunities had occurred of observing the entire clan as it came into or left adjoining trees. In February, 1933, the group contained thirty-three animals of all classes. There were eight adult males, fifteen adult females (four of which carried infants), and six semi-independent juveniles. During the last week of the same month, this large group was repeatedly found broken up into the following more closely associated subgroupings: (a) a male subgrouping of three well matured and one immature male, (b) a subgrouping of four mothers with their infants, plus four females, five juveniles, and one male,

TABLE I

Subgroups of spider monkeys

NUMBER	MALES	FEMALES	MOTHERS	INFANTS[1]		JUVENILES[2]		TOTAL
				No. 1	No. 2	No. 1	No. 2	
1			1		1		1	3
2	1	1				1		3
3	3	1	1		1			6
4	2	3					1	6
5	3	1	1		1	1		7
6		3	1		1	1	1	7
7	5	1				1		7
8	1	6					1	8
9	1	2	1	1		3		8
10		2	3	1	2			8
11	1	4	1		1	1	2	10
12	3	4				1	2	10
13	7	2					1	10
14	1	4	2		2	1	1	11
15	2	3	2		2	2	1	12
16	5	4	3		3			15
17	2	5	2		2	3	2	16
18	5	4	2		2	3	1	17
19	4	4	2		2	3	2	17
	46	54	22	2	20	21	16	181

[1] Infants are those young that are in the dark color phase and are mainly dependent on their mothers. Infants classed as number 1 are carried on the mother's belly or side, those classed as number 2 are carried on the mother's back.

[2] Juveniles are those young that are semi-independent of their mothers but are closely associated with them in subgroups. Number 1 and number 2 juveniles are differentiated on the basis of size and their relation to their mothers.

(c) a subgrouping of six females, one juvenile and one adult male, and (d) a subgrouping of two adult females, one adult male and one juvenile. All that could be learned about the groupings of other clans substantiates the supposition that the one described is fairly typical for spider monkeys. Additional information is needed to give the range of variability in this type of primate grouping.

Available data do not permit generalizations regarding the socionomic sex ratio in spider monkey groups. Such facts as we have indicate strongly that, even including the males of unisexual subgroupings, there are more adult females in the groups than there are adult males. This is comparable with the condition found in howling monkeys

(Carpenter, 1934). Wislocki (1930, p. 177) and Schultz, by means of random collecting of animals, found "a great preponderance of females in the spider and howling monkeys."

REPRODUCTIVE BEHAVIOR

Copulation was not seen in the free ranging spider monkeys, but patterns of secondary sexual behavior were observed. These consisted in the male's manipulating the greatly developed clitoris of the female, embracing her, carrying her, and chattering.

Considerable qualitative evidence has been gathered that indicates that the red spider female has a rather definite oestrus period. At times females could be observed unusually closely associated with one or more males. On two occasions females were collected after prediction on the basis of their behavior that they were in oestrous. One of the females was associated with a single male and the other was associated with the several males of a mixed subgrouping. Recently formed vaginal plugs were found in both of these females. The walls and lumina of the vaginas were greatly enlarged as compared with those of females suckling young.

Spider monkeys in the wild have no distinct breeding season. In June, 1932, and in February and March, 1933, all sizes of infant and juvenile animals were seen, and representative stages throughout the development of embryos were examined. The conclusions reached by Wislocki (1930) and Schultz that these animals have no breeding season, and the same opinions expressed by other naturalists, are confirmed by the observations made during this study. There still remains the possibility, however, that there may be considerable fluctuation in the number of young born during the different parts of the year.

RELATIONS OF MOTHERS AND THEIR YOUNG

For a short while, possibly not more than one month, an infant spider monkey is carried on the belly of its mother, and after this interval it rides the mother's back in the sacral and lumbar region. During locomotion of the female, the tail of the infant is coiled around that of the mother close to its base. The feet of the infant clamp themselves into the mother's flanks and the hands grasp the hair of the mother's sides.

Young spider monkeys pass through a black color phase during approximately the first six months of their lives, as has been determined from a captive specimen. After this they begin to take on the reddish coloration of the adult; this color phase is fully developed when the animals are about ten months of age. During the black color phase, the young are almost entirely dependent on their mothers. They are rarely seen travelling alone during progression of the clan, and are usually found close by the mother while she is at rest. Such young are classed as infants in Table I. The period of "infant dependency" in spider monkeys is seemingly much longer than in either howlers or capuchins. The young spider monkeys are dependent to a large extent on their mothers until they are well into the reddish color phase, i.e., until they are about ten months of age. Then they gradually pass from a period of dependency to one of independence.

Sixteen infants were collected and some of the older of those caught were in the weaning period; others were in the early part of the reddish color phase. The weight of these animals ranged from 768 to 2270 grams. They averaged 1579±486 grams. The larger infants are rarely carried by their mothers. A captive specimen that weighed 2000 grams was approximately twelve months of age. The largest of the monkeys captured were just cutting their permanent incisor teeth, and this checks with the fact that a young animal raised in captivity cut her lower incisors when between eleven and thirteen months of age. When she was fifteen months old, all four incisors were fairly well developed.

Female spider monkeys appear to be more careful of their young than are howler

females. Spider monkeys have been seen to travel across several tree tops, catch their infants, put them on their backs and carry them away. At times the females behave as if guarding their young from other monkeys or from a human observer or hunter. Like howlers, spider monkeys help their semi-independent infants across difficult places in the arboreal pathways. This is usually done by pulling together the separated vines or branches over which a crossing is to be made. Sometimes there are periods of delay of forty or fifty seconds between the time when the female pulls the supports together and the young makes the crossing. At other times the females take the young ones on their backs, carry them across the difficult passage and then put them off on the other side. Most unusual is the observation of a female spider monkey that held a vine close to a tree trunk while five young animals, which could not otherwise have crossed, passed from the vine to the tree.

GROOMING AND PLAY

A few instances of grooming were observed in spider monkeys in the wild. This form of activity occurred particularly between females and their young ones. Usually, the females picked through the hair of their young without, as far as could be ascertained, putting their mouths to the hair or skin of the young animals. The females would make long downward currying movements of their hands over the infants. More finely adjusted movements were shown as one animal parted the hair and searched over the skin of an associate. In zoölogical gardens, spider monkeys have been seen to explore the hair and remove particles from one another in a manner similar to the grooming behavior of macaques. Apparently this activity is more prominent in capuchins than in spider monkeys. It is rarely seen in howlers.

A relatively great variety of play patterns is shown by young spider monkeys. Little if any behavior that might be interpreted as play occurs among adult animals. Individual play patterns consist of running, jumping from one branch to another or standing still and jumping up and down, swinging from a limb by means of one or several possible combinations of the appendages, and playing with sticks or other objects. Very young animals have been observed playing with their feet, tails and sexual organs. The greater amount of spider monkey play may be correctly considered as social, involving as it does more than one individual. Young spider monkeys may chase each other for hours over circuitous routes, or may catch and bite each other. Wrestling is a prominent form of play. This may occur when the young ones are sitting on a limb, but frequently it occurs when they are swinging by their tails. Once four young juveniles were seen swinging together from a limb and wrestling vigorously.

COÖRDINATION AND CONTROL OF GROUPS

The coördination and control of groups are mediated by complex behavioral patterns and responses to them. Means of control and coördination are contact or forceful control, gross movements, gestures and vocalizations.

A female may control the movements and postures of her infant by forceful directing. Thereby the behavior of the two animals may become coördinated. After repetition of this many times, possibly through a process of redintegration, the young come to respond to reduced cues; e.g., it is finally no longer necessary for the female to go to the infant, pick it up and put it on her back, for her movement toward the infant produces a response in the infant of mounting the female and assuming a position suitable for carriage.

Postures and bodily attitudes become means of communication among animals that are as closely associated as the individuals of a spider monkey clan. The posture of a receptive female or the posture of a male or a female that is preparing to attack, may call forth in other animals anticipatory behavior of either approach, attack, or flight.

Postures of certain animals seem to signify forth-coming action; associates seem to prepare for the subsequent action by responding to anticipatory postures.

Gestures and their significance in social coördination cannot be discussed adequately with the data available. Captive specimens show a great variety of facial expressions which undoubtedly become associated with certain states of motivation and call forth fitting responses in associates. The protruding lips, squinted eyes and wrinkled forehead seem to indicate an attitude of approach and friendliness. The half-open mouth emitting a series of grunts would seem to indicate sexual receptivity.

Only a few of the many types of vocalizations can be described along with the situations giving rise to them and the responses that they call forth from associates. The terrier-like bark occurs regularly when spider monkeys in the wild are approached by an observer. Defensive action or flight are concomitant types of response. The barking also occurs when two strange or neighboring groups meet. Within the group, the barking serves as a warning signal to other animals. This barking corresponds to the howls or barking roars of howlers (Carpenter, 1934). Growls are given by adult spider monkeys, mainly by males, when they are closely approached by an observer and when they are greatly aroused. This type of vocalization may also be heard when subgroups or groups are contending with each other. The third most frequently heard vocalization resembles the whinny of a horse, with a higher pitch and less volume. This vocalization occurs when subgroups or individuals become separated, and the apparent function of the sound is to coördinate the movements of separated subgroups within a clan. The whinnies of spider monkeys correspond to the caws characteristic of capuchin monkeys. These are just a few of the many stimulus acts characteristic of spider monkeys that aid in the coördination of the group.

Pugnacity is the natural force used to instrument social motivation and control in animal groups. The few instances of fighting that were observed consisted of males contending with each other. The males growled, clinched, bit, squealed, and then separated. Several specimens have been collected that showed large scars on the hands, shoulders and head; some had their ears torn. Biting is the effective way of fighting for these animals. It is just probable that the seriousness of the fight helps to determine the short duration of encounters and the infrequency of their occurrence.

Groups of spider monkeys seemingly have no highly centralized social control. In many types of animals, groups are dominated by a single leader, frequently an old male. Control in spider monkey groups is more diffuse. It seems to rest mainly with the adults, either male or female, of the subgroups. Females take an active but subordinate part in leading and defending the group and subgroup. When a group is disturbed, the males, including those in the male subgroupings, rush toward the place of disturbance and under these conditions, rudimentary types of coöperation are to be observed.

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