

Regressive Growth Periods as a Mechanism for Herd Formation in Siberian Ibex (*Capra ibex*)

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With 6 Figures

Young mammals during development proceed through periods of high and low contact levels with their mother. These recurring high contact periods have been termed regressive periods of growth because of their infantile quality (Horwich 1974a). Regressive growth was noted in 12 species of monkeys and additional data from the literature showed that the phenomenon exists through a wide variety of mammals (Horwich 1974a). The fact that other behaviors show a fluctuation in frequency during development was noted earlier in squirrels (Horwich 1967; 1972). Some of these behavioural fluctuations observed alternate temporally with the high mother-infant contact periods (Horwich 1974b). The times at which the regressive phases occur seem to come at relatively regular times during the ontogeny, according to the species, and are thus a normal phase of the species' ontogenetic process (Horwich 1974a). A similar kind of description of human development has been written (Ames and Ilg 1964).

In the present study of Siberian ibex, *Capra ibex*, we had hoped to see if the regressive phenomenon extended to ungulate species. The degree to which it occurred in ibex suggests that mother-infant contact fluctuations are related to mammalian sociality rather than characterizing a certain group or species. In the ibex and other social ungulates the regressions seem to occur at crisis periods, during rut and calving, when the older calf would have the most trouble maintaining contact with its mother. Thus, it may be the basic mechanism which holds together the matriarchal group structure, yet allows for seasonal variation in herd social structure.

Methods

Extended observations were made on a single mother-infant pair of Siberian ibex and additional observations were made on 10 other infants born during the spring, 1974 in the ibex herd exhibited at Brookfield Zoo. The total herd was composed of 42 individuals at the start of the study on May 31, 1974; a few ♂♂ were removed from the group before the end of the study on December 13, 1974. Many of the ibex, including all infants, were ear-tagged and all of the mother-infant pairs could be individually recognized. Much of the ground work for identification and social behaviour on this herd was laid by Carlstead (1973). The herd resides on a large oval granite island approximately 65 m by 40 m. This structure is surrounded by a dry moat 2.5 m deep. The island has several peaks on it, the highest being 11 m high and a number of caves which provide shelter and secluded calving areas. There are two hay rack feeding stations located in two underpasses through the peaks with several troughs for grain set nearby on the ground.

100 hours of observation were made on "Lady", a 10 year old ♀ and her ♂ infant "Tramp", from May 31, 1974 when "Tramp" was 9 days old until December 13, 1974

when he was 7 months of age. Observations were made several days a week for 1-2 hour periods between 8-10 A.M. CST, before the zoo was open to the public and before any keepers entered the island for feeding and cleaning. A check list was used to record the following behaviors: distance between mother and infant at the beginning of each half minute interval, duration and frequency of sucking bouts, frequency of unsuccessful attempts at nursing, and whether the mother and infant were moving at the beginning of each half minute interval. Ad lib notations were made on other behaviors. Additionally, at the beginning of each hour of observation, the distance between each of the ten other mothers and their infants was recorded. Then the average number of infants within 15 feet of their mother was totaled per week.

Results

Distance between mother and infant. Mother-infant distance exhibited changes in the infant's needs for the security of contact or being near its mother. 3 positions of interanimal distances were recorded: 1. the infant was next to or within 2 feet of the mother, 2. the infant was between 2-15 feet of the mother, and 3. the infant was beyond 15 feet of its mother. Fig. 1 exhibits the average number of half minute intervals that

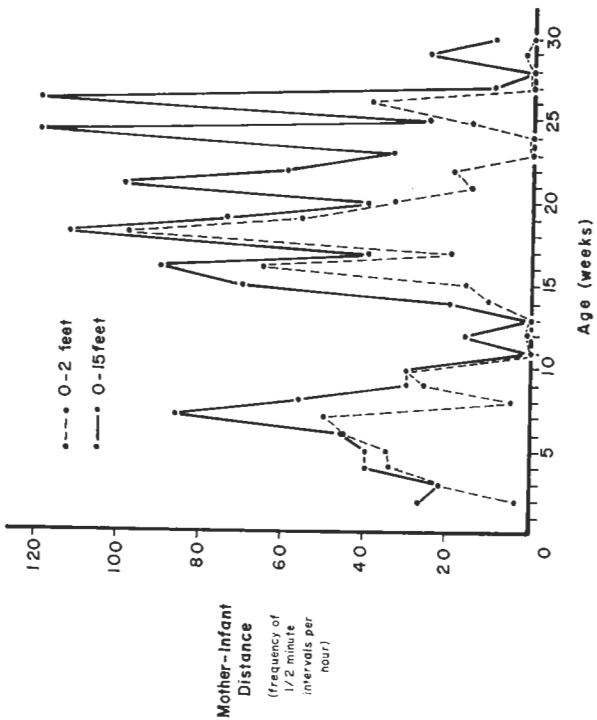


Fig. 1. The average number of half minute intervals per hour in which the infant was within 2 and 15 feet of its mother as a function of age in weeks.

the infant was within 2 and 15 feet of its mother per week. In the early weeks, the infant was often by itself in a resting spot where the mother had left it. "Lady" would return to nurse "Tramp" and to check its security. Later as "Tramp" became more active he began following "Lady" more often and kept near her on his own initiative. Fig. 1 shows that the number of intervals of close mother-infant distance increases to a peak at 7 weeks. It then declines as the infant begins performing more locomotory behaviours and wanders farther from its mother. He spends virtually no time within 15 feet of his mother

from 11-13 weeks after which there is a sudden change in his behaviour and he begins to seek more contact with her. The maximum mother-infant contact (within 2 feet) occurred between 16-20 weeks, the beginning of the first regressive period. Generally he was close (within 15 feet) from weeks 15-26 though there was considerable fluctuation during that time. This period includes the rutting period at Brookfield which occurs during the latter part of the regressive period. A dramatic drop off occurred by week 27 until the end of the study at 30 weeks.

A confirmation of this normal regressive growth phase in the infant "Tramp" is seen in Fig. 2 which exhibits the average number of infants (excluding "Tramp") which were within 15 feet of their respective mothers during hourly checks, per week of observation. All infants were born within a month of each other and the average age of the 10 infants was 2 weeks older than "Tramp" or the graph was shifted 2 weeks. A similar trend is

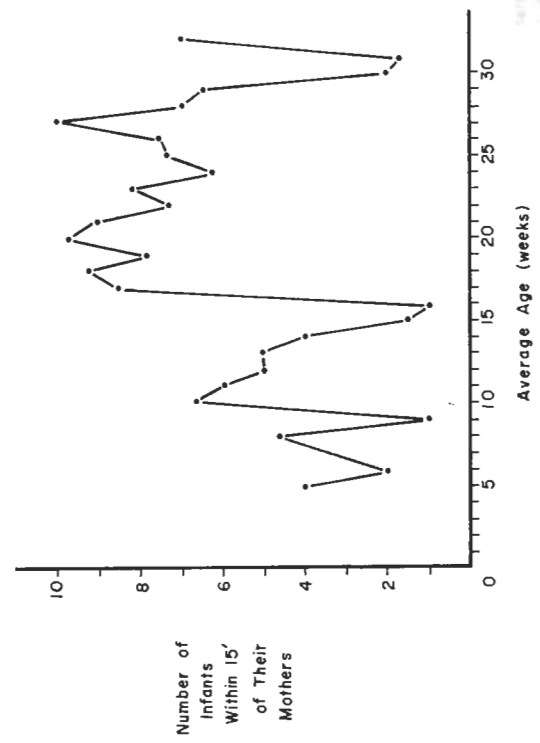


Fig. 2. The average number of infants (excluding "Tramp") which were within 15 feet of their respective mothers during hourly checks as a function of the average age of the infants in weeks.

seen between Figs. 1 and 2. There is an increase in the number of infants near the mother until an average of over 6 infants were near their mothers by week 10. This then receded until a low level was reached during weeks 15-16. A regression then occurred during weeks 17-29. Following this, few infants were near their mothers and perhaps a second regressive growth phase was beginning again at week 32.

Nursing. The infant initiated all direct nursing attempts although the mother interrupted them with varying degrees of frequency. The infant approached its mother to nurse both from her rear or side but the side approach was most usual and the infant approached from the rear only when it was hard to nurse from either side. "Lady" would break off the nursing by lifting her leg on the side from which the infant was nursing and usually move away. Nursing bouts showed an average length of 10 seconds.

Fig. 3 shows the average number of sucking bouts per hour, the average time spent per hour on the teat, and the average number of unsuccessful attempts to nurse. During

the first 2–3 weeks of age, "Tramp" was successful three times per hour in attaining the nipple. There were no unsuccessful attempts during this time. The actual time on the teat during this period was from 30–60 seconds per hour (Fig. 3a), the longest time observed during the study. After 4 weeks there is a higher frequency of unsuccessful attempts and "Lady" became more persistent in not allowing him to suck. From 9–13

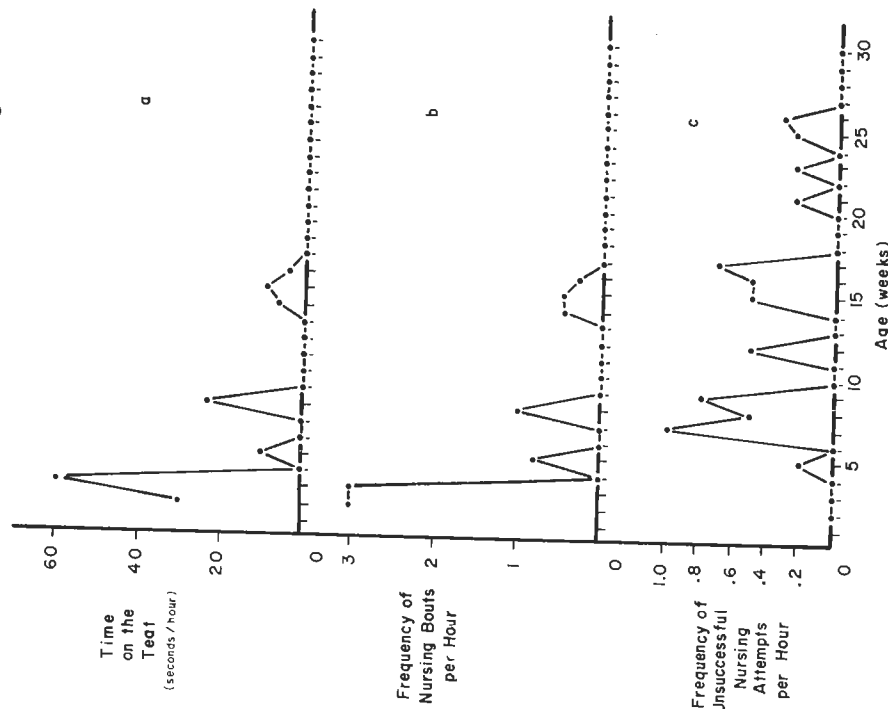


Fig. 3. a) The average time spent on the teat per hour, b) the average frequency of nursing bouts per hour, c) the average frequency of unsuccessful nursing attempts per hour, as a function of age in weeks.

weeks, "Tramp" was never seen to successfully suckle from "Lady", nor did he make frequent unsuccessful suckling attempts. He made one attempt during a 2 hour observation period in the twelfth week and he seemed generally quite uninterested in trying to suck at all. Similar to Fig. 1, a regressive phase occurred in reference to nursing and from 14–16 weeks "Tramp" again nursed successfully. However, this was followed by many unsuccessful attempts during weeks 15–17. From the seventeenth week on, "Tramp" never was seen to nurse again although he did make some attempts. It was quite evident that "Lady" was the cause for this break off of nursing. After 27 weeks "Tramp" discontinued his attempts completely and his closeness to "Lady" decreased radically (Fig. 1).

Fig. 4 shows a graph of the percentage of success of the infant in attaining nursing privileges. It can be seen that the infant was highly successful at obtaining the teat during the first 9 weeks. He never made many attempts nor did he attain the teat during

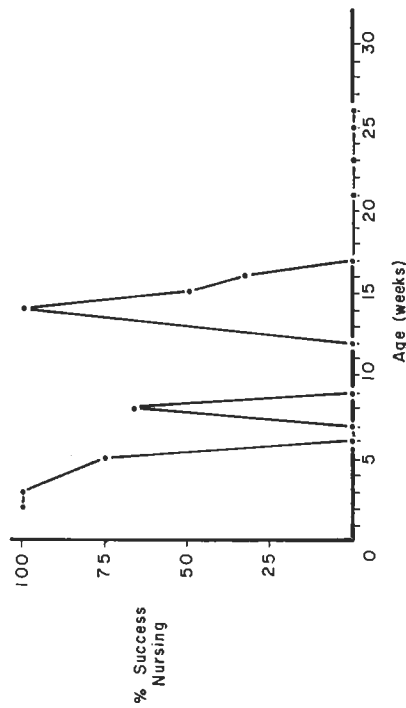


Fig. 4. The percentage of success in nursing as a function of age in weeks

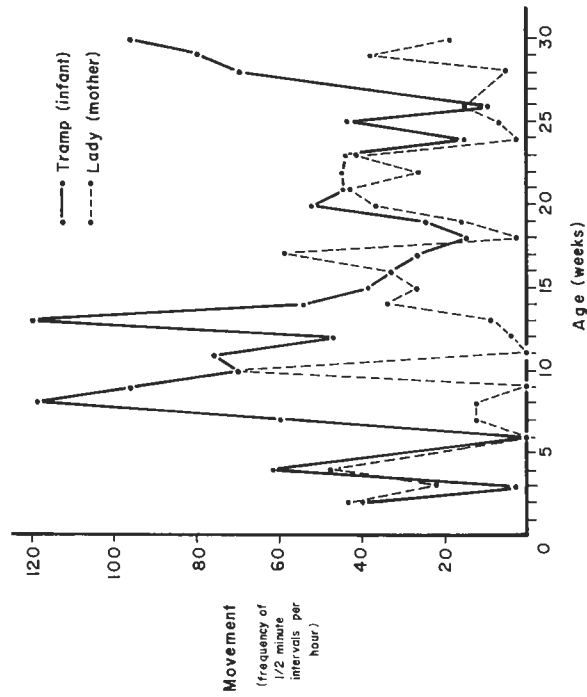


Fig. 5. The average number of half minute intervals per hour in which movement occurred for "Lady" and her infant "Tramp" as a function of "Tramp's" age in weeks.

his one attempt from weeks 10–13. Then during the resumption of nursing on week 14 he had total success which quickly reduced to complete lack of success by week 17 when it appeared that final weaning took place.

Locomotor movement. Movement was operationally defined as any time an animal was locomoting in any manner and was not standing or laying. When the average number of half minute intervals in which movement occurred is observed for "Lady"

and "Tramp" (Fig. 5) it can be seen that early in infancy until 6 weeks, movement is low for "Tramp", and corresponds to his mother's low level of movement. At this period they are moving together. From 7-13 weeks, prior to the regressive period, "Tramp" is very locomotory and does not spend time near "Lady". After 15 weeks, "Tramp's" movements reduce to the low variable level and seem to parallel "Lady's" movements until week 27 when he again seems to become much more mobile than "Lady".

Discussion

Although regressive growth periods have not been noted as such in ungulate field studies, one instance in waterbuck is noteworthy. Kiley-Worthington (1965) observed that young waterbuck at 6 months are quite independent of their mothers and will graze and rest with others of a similar age about 25-50 yards from the herd. The young ♀♀ as they approach puberty were observed to leave this group and rejoin their mothers. The mother-daughter association may then continue throughout life resulting in persistent groups of a mother, her grown and half grown daughters, and both the mother's and daughters' calves.

Other regressive tendencies have also been noted in ungulates. Lent (1974) noted wide spread occurrence of regression to infantile behavior patterns by adults under stress. This is similar to the tendency of many ungulate young to seek their mothers and attempt to suckle when disturbed (Lent 1974). Adler, Linn, and Moore (1958) noted this in goats and humans and Schenkel (1966) observed that in impala, when a slightly disturbed herd runs off and stops, most of the lambs join their mothers and start suckling. The nipple as a pacifier for anxious infant primates has been commonly noted (Horwich 1974b).

The pulsating phenomenon in behavioral development seems to be a universal pattern in mammals. It was noted in 14 species of old world monkeys, 1 species of new world monkey, 3 prosimians, 1 ape, human infants, 1 rodent and 2 carnivore species (Horwich 1974c). Since the publication of the afore mentioned study, additional unpublished data have been collected showing the regressive growth pattern in the following animals in a captive situation: a chimpanzee, a gorilla, 3 orangutans, a siamang, 2 lesser spot nosed guenons, an okapi, a giraffe, and the Siberian ibex infants observed in this study.

The probable universality of such a phenomenon seems to imply that this pulsating mother-infant contact is in some way at the roots of mammalian social structure and group formation. In the ibex, which are both very social and seasonal animals, Figs. 1 and 2 show the phenomenon of regressive growth periods more dramatically than any other species studied to date. We have thus decided to investigate how mother-infant contact proceeds in older infants and how it fits into adult society and seasonal fluctuations of behaviors in the ibex. Very early investigations on individuals in the Brookfield Zoo herd of ibex with known parentage are already showing close mother-"infant" ties with yearlings and even with adult ♀♀ indicating the formation of herd structure around matriarchal lines. Fig. 6 shows the number of minute intervals at which yearlings were noted to be within 15 feet of their mothers. These yearlings spent between 30 and 55 minutes per hour near their mothers. When Fig. 6 is compared to the distance of "Tramp" to his mother (Fig. 1) we see that the amount of time is comparable and that the yearlings were in another regressive growth phase prior to and extending into the birth season. With the birth of a younger sibling there was an immediate drop in mother-infant contact due to aggressive responses by the mother to her yearling during and following

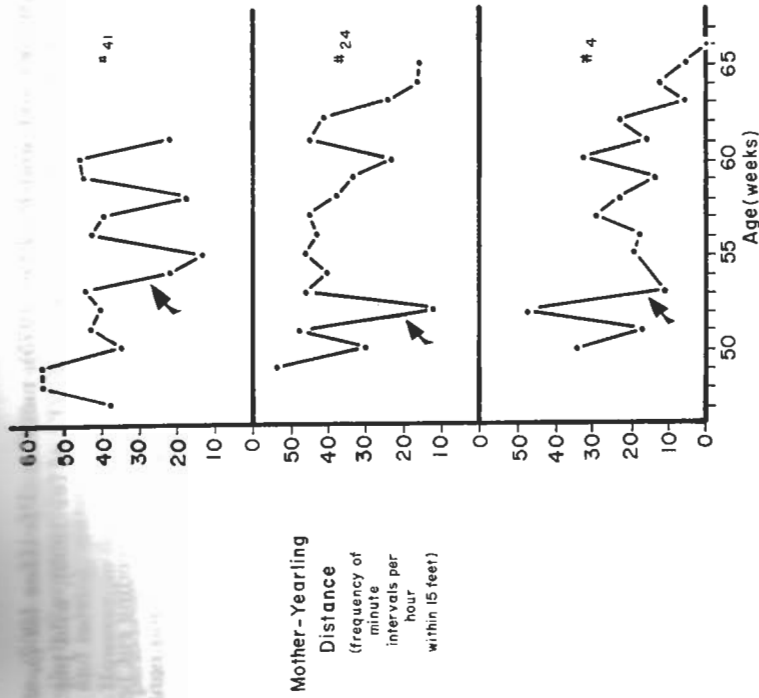


Fig. 6. The average number of minute intervals per hour in which 3 yearlings were within 15 feet of their respective mothers as a function of age in weeks. (→ represents the birth of a sibling)

the birth. In 2 of the 3 cases the yearlings were quickly able to resume contact with the mother. With the third infant, the mother retained her aggression toward her yearling (4) and the yearling stayed beyond 15 feet although it did show strong signs of interest in being with its mother.

Data which have been collected on other ungulates exhibiting varying degrees of sociality all show certain consistent trends. Despite the fact that weaning takes place much earlier, infants maintain extended contact with their mothers (Lent 1974), usually through the first year and in some species into the third year. According to information of Jarman (1974), the length of time spent with the mother may increase in species that exhibit a greater affinity for herd formation. Despite the strong, extended mother-infant contact in ungulates, the contact may be radically reduced for a short while preceding and following the birth of the new calf. This was clearly seen in the yearling ibex (Fig. 6). Extended mother-infant contact occurs in elk (Altmann 1956), European red deer (Burkhardt 1958; Darling 1937), Columbian black tailed deer (Dassmann and Taber 1956), reindeer (Espmark 1966), mule deer (Hanson 1958), white tail deer (Palmer 1951), roe deer (Eisenberg 1971), moose (Denniston 1956; Altmann 1960), Coke's hartebeest (Gosling 1969), waterbuck (Kiley-Worthington 1965; Herbert 1974), reedbuck (Jungius 1970), blesbok (Plessis 1972), impala (Schenkel 1966) wildebeest (Talbot 1963), American bison (McHugh 1958), prong-

horn antelope (Autenrieth and Fichter 1976), mouflon (Pfeiffer 1967), soay sheep (Grubb and Jewell 1966), rocky mountain goats (Lentfer 1955), wild pigs (Eisenberg 1966), and African elephants (Buss 1961).

At the time of the next calving and sometimes during the preceding rut period, calves may go through periods when they are prevented from maintaining contact with their mothers either due to her aggressive actions during calving or due to harassment from ♂♂ during rut. Despite these crisis periods, the calves stay within a close range of their mothers and may actually show similar activity patterns to her even though they are at a distance from her. In many species it seems to be the ♀♀ calves that maintain contact for longer periods. The ♂♂ calves are driven away at rut by ♂♂ who view them as competitors, and later are displaced by their own mothers at calving, and thus leave their mothers and don't maintain the bond. Instead, they may attach themselves to an older ♂ and maintain a bond with him.

In mammals in general, it is the mother-family which is universally the basic social unit (Eisenberg 1966; Harper 1970). This stems from the unique mammalian infant feeding on breast milk. Even relatively solitary species maintain the mother family grouping initially (Eisenberg 1966).

The ungulates then additionally utilize the following response to promote the mother-family grouping which is the most cohesive unit in artiodactyls (Eisenberg 1966). The natural and logical extension of this grouping probably results in the prolonged association of the mothers with their ♀ offspring, creating a permanent herd (Estes 1974). Estes, however, does not feel the evidence supports this continuance of such an association except in the more socially advanced bovids. However, evidence cited above, at least shows the tendency of many varied ungulates with varied social systems to prolong the infant contact far beyond the time when the infant needs direct nurturing for its survival. Additionally, evidence from these varied systems shows the tendency is greater in the ♀ progeny and seems to be terminated for the young ♂♂ by older ♂♂ during rut rather than the young ♂♂ leaving by their own volition.

Beyond this tendency, however, certain species have definite matriarchal social units and with additional studies on marked animals we feel that more and more research will show that much of the natural groupings are based on the mother-infant grouping and extensions of it. Specific matriarchal groups include red deer (Darling 1937), African elephants (Buss 1961), possibly bison (McHugh 1958) and impala (Schenkel 1966).

Summary

A mother-infant pair of Siberian ibex was observed for 30 weeks in order to collect information about distance they kept from one another, nursing frequency and duration, unsuccessful nursing attempts, and mobility of the mother and infant. 10 other mother-infant pairs were observed hourly for inter-animal distance. It was found that the infant stayed close to the mother with a peak at 7 weeks. This peak was followed by the infant staying farther from the mother. Then, from weeks 14-26, closeness to the mother was resumed. A similar fluctuation was seen in the other infants. Nursing was most frequent during the early weeks and recurred again during weeks 14-16 after which it was not seen again. Unsuccessful nursing attempts peaked at 7-10 weeks and 15-17 weeks. Nursing was 100% successful during the early weeks and again during week 14 (early regression period). During weeks 15-17 nursing success dropped to zero percent. The infant's mobility paralleled that of the mother during the first 6 weeks and during the whole regressive period. However, from 7-13 weeks and after week 26 the infant was much more mobile and was rarely within 15 feet of the mother. A literature survey revealed an indication of regressive behavior in ungulates and a

general tendency for many species with varied social systems to maintain the mother-infant bond (particularly ♀ progeny) beyond the first year and often into the third year. Two crisis periods, rut and calving, make it difficult to maintain this bond due to aggression by ♂♂ or the mother. However, in ibex, regressive periods on the part of the infant prior to and during these crisis periods seem to serve to maintain the matriarchal social structure yet allow for seasonal variation in herd sociality.

Zusammenfassung

Ein Mutter-Kind-Paar von Sibirischen Steinböcken wurde 30 Wochen beobachtet, um Informationen über die Entfernung zwischen der Mutter und dem Kind, die Säugehäufigkeit und Dauer erfolgloser Säugversuche und Beweglichkeit von Mutter und Kind zu sammeln. 10 andere Mutter-Kind-Paare wurden stündlich hinsichtlich der Entfernung untereinander beobachtet. Man stellte fest, daß das Kind ständig in der Nähe der Mutter blieb. Den Höhepunkt erreichte dieses Nahesein mit 7 Wochen. Danach folgte eine Zeit, in der der Anschluß an die Mutter lockerer wurde, von der 14.-20. Woche wiederholte sich die enge Bindung an die Mutter. Die gleiche Situation fand man bei den anderen Paaren. Das häufigste Stillein fand sich in den frühen Wochen und in der 14.-16. Woche statt, danach wurde es nicht mehr beobachtet. Der Höhepunkt der erfolglosen Säugversuche wurde in der 7.-10. und der 15.-17. Woche erreicht. Das Säugen war 100% erfolgreich in den frühen Wochen, und das wiederholte sich in der 14. Woche (frühe Rückkehr-Periode, Regressionsperiode). Das Säugen war in der 15.-17. Woche völlig erfolglos. Während der ersten 6 Wochen und der ganzen Rückkehrperiode war die Beweglichkeit des Kindes und der Mutter gleich. Jedoch von der 7.-13. Woche lief das Kind viel mehr umher und war selten weniger als 15 Fuß von der Mutter entfernt. Bei Durchsicht der Fachliteratur kommt man zu dem Ergebnis, daß bei häufigerer Neigung zu regressivem Verhalten besteht und daß bei vielen Arten mit unterschiedlicher sozialer Ordnung allgemein die Tendenz besteht, das enge Mutter-Kind-Verhältnis über das erste Jahr hinaus, oft sogar bis in das dritte Jahr zu erhalten. Zwei Krisenperioden, Brunst und Geburt, machen es schwierig, diese Verbundenheit während dieser Zeit aufrecht zu erhalten, und zwar wegen der Aggressivität sowohl der männlichen wie der weiblichen Tiere. Bei Steinböcken scheinen jedoch die Regressionsperioden vor und während der Krisenzeiten zur Erhaltung der matriarchalischen Sozialordnung beizutragen und trotzdem eine saisonbegrenzte Variante des geselligen Verhaltens innerhalb der Herde zu gestalten.

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