RESEARCH REPORT

Structure of Herd in Giraffe: Developmental Changes of Social Relationship in Calves

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ABSTRACT

In the present study, I aim to clarify social structure and differences of social interaction among different aged giraffe's (*Giraffa Camelopardelis*) in Katavi National Park, Tanzania. I recorded giraffe's sex, herd size and individual identify by pattern of marking on their necks. I estimated age on the basis of body size. The study about social structure was conducted around HQ and IKUU. As a result, I observed more calves around HQ than IKUU. A previous study revealed that predation pressure around IKUU is higher than HQ, which may produce the difference of the number of calf. Mother giraffe that had a calf tended to form a herd with other mothers that had calves. This was probably because the mother giraffes may form a herd to keep their offspring from predation. Perhaps they may share responsibilities with other mothers. I also conducted focal animal sampling of calves and juveniles, I recorded social interaction and distance between focal animal and other individuals. The result shows mean distance between calves was shorter than that between calves and mothers. The calves tended to make longer distance with adult males than that with females, while juvenile giraffes tended to be closer not only to peers but also to adult males or females. This is probably because of developmental behavioral change, which means that calve tend to spend most of the time for resting or playing, but not spend same time to feed like adult. In addition they tend to gather each other for resting to beware predator, which might made calves have preference to physically close to other calves. Juveniles move in larger

area than calves and spend more time to feed and ruminate. Therefore juveniles have more chances to encounter other giraffes than calves. While they feed and ruminate, they tend to come closer to other adult ones to avoid predator. The bush may make the juveniles and calves difficult to detect predator. This may be because social relationships change as result of changes of home range and developmental behavioral pattern.

INTRODUCTION

Tanzania has 15 national parks and Katavi national park(Katavi NP) is one of them. It located western Tanzania and has the third largest area in Tanzanian national parks. This NP differs from northern NPs in the location and the number of tourist. This NP is far from big cities or airports, which makes much fewer visitors. In Katavi NP has an advantage to observe wild animals because they are not familiar to humans.. However, there are few research projects in Katavi NP and most of them are about animal transect (Vesey-Fitzgerald,1954,1964,1965. Vesey-Fitzgerald & Beesley,1960. Caro, 1999), botany (Nathan,2004) and only one research about large mammals associations(Hansen,1996). Because there are still few researches that focus on specific species, it is necessary to research specific species and to clarify the ecosystem of Katavi NP for the perspective of conservation.

In Tanzania, studies about giraffe were conducted in many NPs (e.g. Serengeti NP: David M. Pratt and V. H. Anderson, 1985, Pellew 1983, Lake Manyara NP: Henk P/ van der Jeugd,2000, Arusha NP: David M. Pratt,198 ,Tarangire NP : David M. Pratt,1982, but there is no study in Katavi NP. Therefore it is benefical to conduct ecological researches about giraffes in Katavi to compare their ecology to other NPs.

Giraffe are classified into 12 subspecies, but only Masai giraffes (*G.c.tippelskirchi*) is distributed in Tanzania. Patterns of marking are not only different between subspecies but also different between each individual in each species which makes enable to identify them. In general, society of giraffe is termed as a fission/fusion society. The herd is composed of about 2~32 individuals. In the wild, calves reside in a crèche (Cynthia, 1975; Pratt, 1982) at a month old. The crèche consists of a cow and offspring. At a 6 month old, calf move long distance with their mother and comprise a herd and a number of giraffe is roughly 2-10. When young bull become about 3-4 years old, they become independent and come in a herd which consists of young bulls. At 7 years old, bull conducts solitary to find a herd which consists of mature cows (Bercovitch *et al*, 2009a; Cynthia, 1975, van der Jeugd. *et al*, 2000).

There are several reports about giraffe's activity budget (Pellow,2005),

seasonal movements (Le Pendu,1998) and about reproductive strategy(Bercovitch, *et a*l, 2009b). The researches on foraging behavior revealed that male and female giraffes can live sympatric by taking food of a different height (Ginnett, *et al,* 1997; Young, *et al*, 1991). The research about social structure of giraffes' herd in captivity, revealed that social behavior frequently occured between mother and offspring giraffes, or between young and much elder giraffes (Bercovitch, *et al*, 2006). There were few reports about social relationships in the wild between 1985 and 2000. In addition most of studies about social behavior were focusing on sexual behavior, sparring among males, and mother-infant behavior. Because there are still developmental studies, I conducted a research about social structure in giraffes and developmental change of social relationship in Katavi National Park, Tanzania.

MATERIAL AND METHODS

Study area

The present study was conducted in Katavi National Park (Katavi NP; latitude 6° 45' to 7° 05' S, longitude 30° 45' to 31° 25' E) at the north end of the Rukwa Valley in Rukwa Region, western Tanzania. As a flora, there is open woodland, shrublands, grasslands and 226 different tree species are recorded. It is dry season between May and October and it is rainy season between November and April. In the rainy season, we can find seasonal two lakes, Lake Chada and Lake Katavi in Katavi NP. The study about social structure, I was conducted around HQ, and around IKUU. The study about social relationship was conducted in 10 km^2 area with a central focus on HQ (Fig. 1).

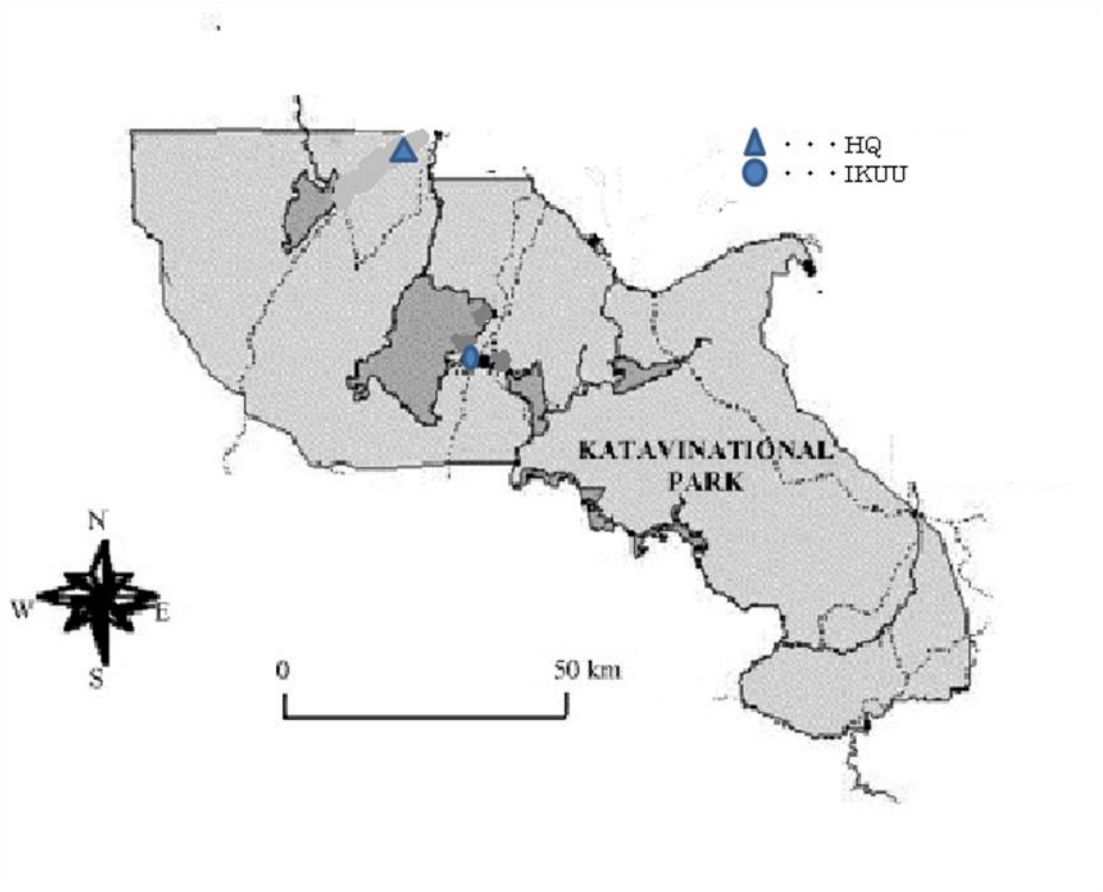


Fig1. A map of Katavi National Park and Study Area; HQ and IKUU

Methods for studying social group structure

Between 9/July/2010 and 20/October/2010, I conducted a widespread area research about social structure around IKUU from a car once per week. And five days per week, I did it around HQ on foot. I distinguished data of HQ and IKUU while analyzing. When I encountered giraffe, I recorded the points by GPS where I found it. And then I recorded the number of bull (a male giraffe except juvenile and calf), cow (a female giraffe except juvenile and calf), juvenile (the height is 2.5~3m) and calf (the height is shorter than 2m and accompany with mother). Individuals within 100m of each other were defined as belonging to 1 group. And I recorded marking pattern on the both sides of neck which allows the easy identification of individuals. And when I encounter lion (*Panthera leo*) and spotted hyena (*Crocuta crocuta*), I recorded their number of heads.

Methods for studying social behavior

I observed social behavior in giraffes in five days per week from 14/July/2010 to 20/October/2010(8:00~12:30, 15:30~18:00). I collected data by direct observation usually at close range on foot. After collecting data about social structure, I decided focal animal and followed it. The focal animals were mainly calf or juvenile but I followed bull or cow when I couldn't find them after 2 hours from start to walk. Social behaviors were scored as necking, head rub, suckling, glooming, urine testing and anogential exam by all-occurrences recording. When social behavior happened between focal animal and other giraffe, the age/sex class of other giraffe and category of social behavior were recorded. Furthermore, the duration of next (when focal animal huddle together with other one) and proximity (when the other giraffe is within two neck lengths of focal animal) were recorded. I recorded individual's age/sex class which was contact or proximity to focal animal.

Table 1. Categories and details about each social behavior

Category	Behavior
Anogenital exam	Animal sniffs or licks the anogenital area of other's
Glooming	Animal rubs or rubs another
Head rub	Animal touches other's head or body with their head
Necking	Swing their heads and necks against each other
Suckling	Animal suckles maternal milk
Urine Testing	Animal licks the urine of other's

RESULTS

Group structure

Around HQ, one hundred sixty three bulls, 256 cows, 135 juveniles and 109 calves were found. Around IKUU, ninety two bulls, 222 cows, 28 juveniles, 4 calves were found. Herd size was compared between HQ and IKUU (Fig. 2). Observation of the former, site-showed the rate of solitary individual out of all the number of observed herds is 17% (n=25), but that is 36% (n=44) in the latter site, which was more than double of the rate in HQ.

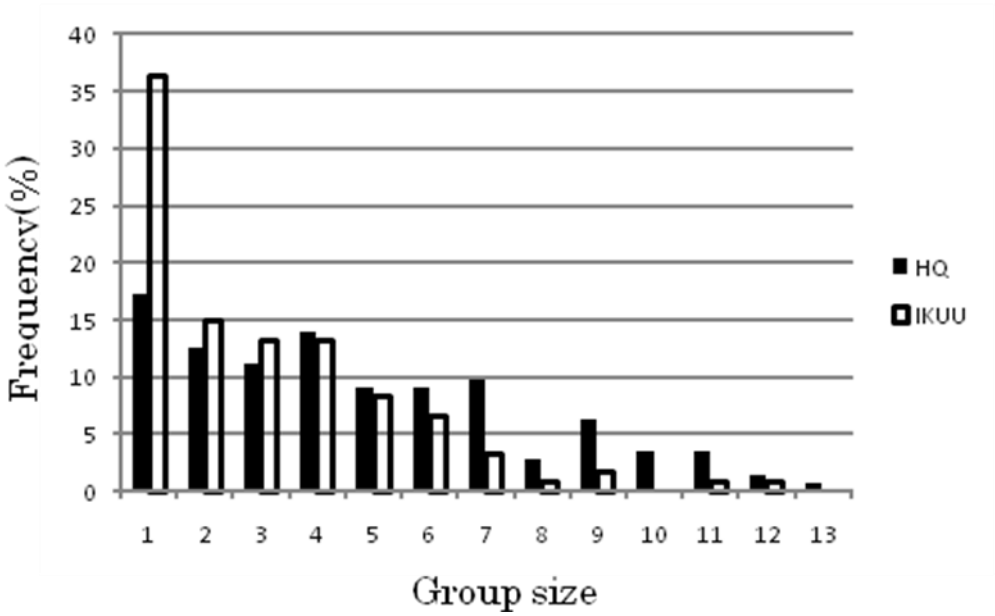


Fig2; Frequency distribution of herd size between HQ and IKUU

Group structure

I recorded group structure based on age/sex class. The number of solitary bull and cow per all the number of herds around HQ are 9% and 12% (n=13, n=17) and around IKUU, a number of that are 30% and 31% (n=34. n=35). As a result, around HQ, there is many herds which were consisted of many sex and age class, but around IKUU, conversely, many herds were consisted of one sex and age class (Fig. 3). And also the observation times of calf is 1.5 /day around HQ and 0.2/day around IKUU.

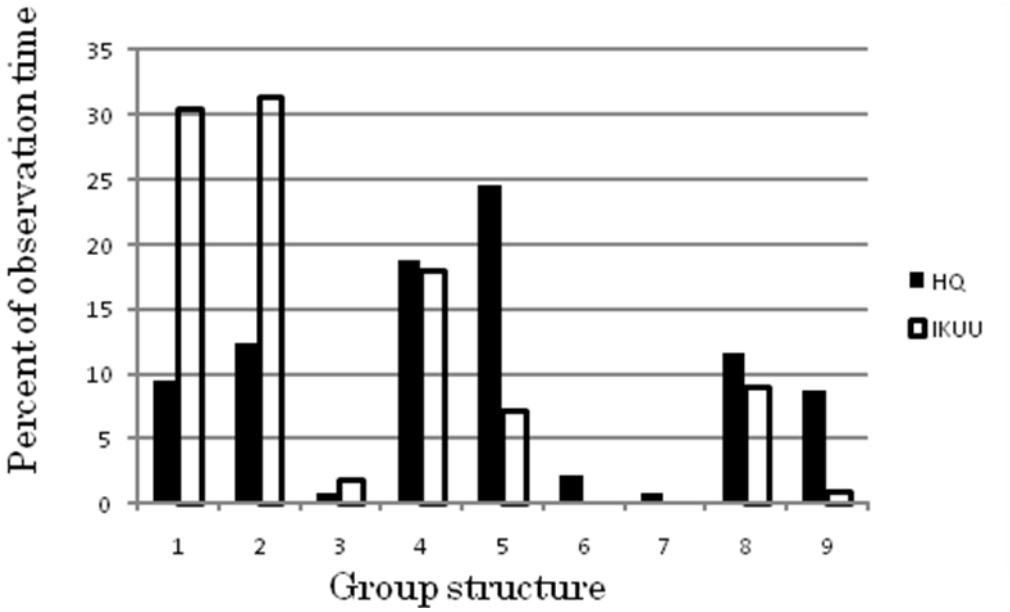


Fig.3 Giraffe’s group composition and percent of observation time

1; Bull only 2; Cow only 3; Juvenile only 4; 1Bull and other age/sex class

5; Bull≧2 and other age/sex class 6; Bull and juvenile 7; Bull and calf

8; Cow and juvenile 9; Cow and calf 10; Cow and juvenile and calf

Herd of cow-calf

The percentage of herd which was consisted of the same number of cows and calves is 78% out of all the observation times. Among them, the percentage of herd which was consisted of 1cow and 1calf is 28%.

Table2. The frequency to observe herd of cow-calf

The number of cow and calf	Frequency of ovservation
cow:1,calf:1	4

cow:2,calf:2	4
cow:3,calf:3	2
cow:6,calf:6	1
cow:1,calf:2	2
cow:3,calf:2	1

Social interaction

In total, 59 individuals were identified: 16bulls, 22 cows, 15 juveniles and 6 calves. Total observation time is 7109min: 411min for bulls, 435 min for cows, 2768 min for juveniles, and 3494 min for calves.

Table 3 shows the number of social behavior occurrence. About glooming, juvenile and calf tends to do it more than adult one and about head rub, juvenile did it to all age/sex class and especially to calf.

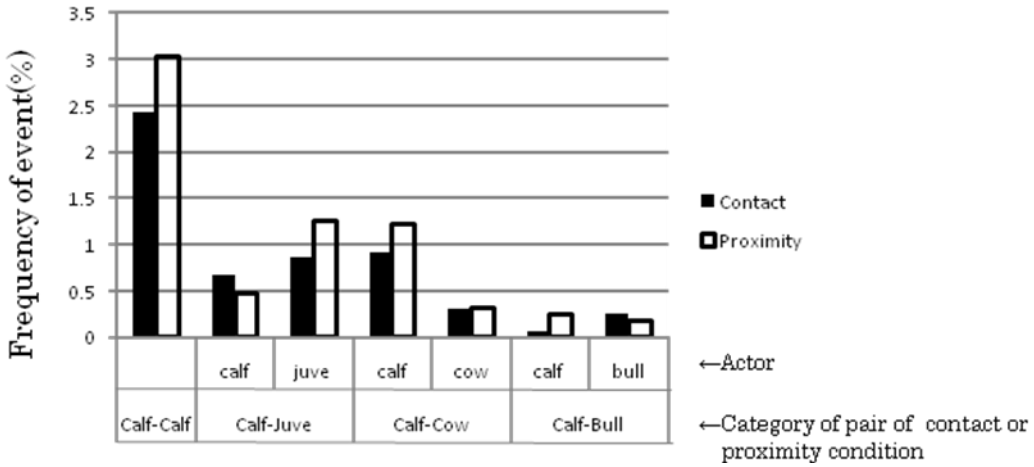
Table3; The number of social behavior occurrence

Receiver

Actor	Anogential exam				Necking			
	Bull	Cow	Juvenile	Calf	Bull	Cow	Juvenile	Calf
Bull	1	23	6		Bull 3			
Cow		3		1	Cow			
Juvenile	3	2	2	5	Juvenile 1		1	
Calf					Calf			
	Glooming				Suckling			
	Bull	Cow	Juvenile	Calf	Bull	Cow	Juvenile	Calf
Bull					Bull			
Cow					Cow			
Juvenile		3		1	Juvenile	12		
Calf			2	5	Calf	37		
	Head rub				Urine testing			
	Bull	Cow	Juvenile	Calf	Bull	Cow	Juvenile	Calf
Bull	2		1	4	Bull	5	1	
Cow			8	32	Cow			
Juvenile	4	12	6	26	Juvenile			
Calf			3	21	Calf			

Figure 3 shows the frequency of the number of events when the calf contacted or in proximity with the other individual. (The number of times which contact or proximity was occurred/the herd observation times which includes focal animal and the other side). As a result, the frequency of contact and proximity among calves is the highest category. About calf-juvenile, it can be said that juvenile tends to come close to calf and about category of calf-bull, it marks the lowest frequency when to compare with other categories.

Fig3. Frequency of event between calf and the other



The figure 4 shows the frequency of contact or proximity between focal juvenile and the other. The bond between juveniles is tight, like calves. On the other hands, juvenile tends to come close to different age/sex classes. This tendency can not be recognized in calf. It means that the frequency to stay with different age/sex class individual is increasing with growth.

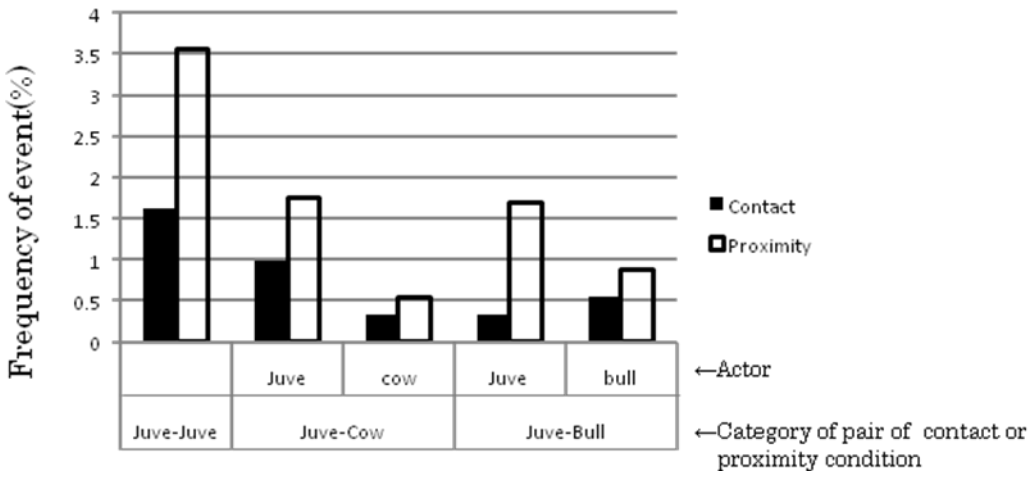


Fig4. Frequency of event between juvenile and the other

DISCUSSION

Group size

A previous research which conducted in Niger revealed that in rainy season, the number of individual of giraffe herd is approximately 3 to 18 and in dry season it changes to approximately 2 to 10 (Pendu et al. 2000). I conducted my research in dry season in Katavi NP and obtained the results of group size that were the same as the previous research. These result suggest no difference in group size difference in giraffes between Niger and Katavi NP in dry season.

Social structure

Most of herds are consisted of different age/sex group and group size around HQ, but most of herds are consisted of one age/sex class around IKUU. Group size is smaller around IKUU than around HQ. This difference is partly because the number of predator and the number of calves. The observation times of calves around IKUU are fewer than those around HQ. As the predator of calves, loins, panthers (*Panthera parades*), cheeters (*Acinonyx jubatus*), crocodiles (*Crocodilus niloticus*) and spotted hyenas are reported and the predation pressure of lion is the highest (Pratt *et al.* 1979). In some region, giraffe represent 43% of the diet of lions (du Toit, 2001) and Foster and

Dagg (1972; Kingdon) estimated a 73% mortality amongst giraffes in Nairobi Park during the first year of life and 50% of Serengeti calves are lost in the first three months of life (Moss, 1976; Kingdon). It is reported that there is 0.12kg/km^2 lions and 0.29kg/km^2 spotted hyenas are living in the eastern part of Katavi NP which included IKUU. On the other hands, there is 0kg/km^2 lion and 0.08kg/km^2 spotted hyena are living in the southern part of HQ (Caro, 1999). I also recorded the number of lions and spotted hyenas when I encountered them. The number of lion is 0.48individual/day and spotted hyena is 0.04individual/day around IKUU. But no lion and spotted hyena were observed around HQ. To compare the number of predator between HQ and IKUU, it is more around IKUU than around HQ. These results suggest that the predation pressure may infect the number of calves. The researches about elk (*Cervus elaphus*) revealed that females with newborn calves must remain vigilant for predators in both high and low wolf encounter regions because ubiquitous coyotes and bears are also important predators of calves and females increase vigilance with decreasing herd size (Lung, 2006). Even if elks were replaced by giraffe, of course cows with calves must vigilant around themselves. And if cows with calves gather and make large group, cows cost relatively less effort to vigilant and they can use that time for feeding or resting. A previous study about elks, actually, revealed that sharing responsibilities of raising calves may increase feeding time of individual cows and reduce risk of predation (Paquet and Brook, 2004). In sum, the difference of predation pressure around HQ and IKUU may infect the number of calves. Around HQ where there are many calves, cows with calves tends to consist of large herd to protect their children and to do feeding or resting effectively.

Herd of cow-calf

Most of the herds of cow-calf were consisted of many pairs of cows and calves. This mean that protection of calves is main purpose to make that large herds. Giraffe depends on eyesight to detect predator (Cameron *et al.* 2005), but calves can not see well because the bush disturb their sight. If there is many adults in the herd, they can cover large area and enable them to detect predators early. This is probably why cows with calf tend to gather each other.

Social interaction

A previous report which conducted in Arusha NP, shows that 12 of 15 calves spent a higher proportion of their time with other calves than with their mothers (Pratt,1982). The present results supported the previous report. Why does calf tend to

gather with same age class? This is partly because of calf`s behavior pattern. It is revealed that a comparison of the percentage of diurnal time spent by calf; 79% for lying, 19% for browsing and 2% for suckling (Langman,1976). Langman shows that there are two ways of calf lying; group ling out (lying with more than one calf), single lying out (lying only one calf). In this research term, I observed more herds which are consisted of more than one calf, than herd which comprised with only one calf and the other age/sex class, and calf is lying most of the day time, so the time of group lying out is increased. The occurrence of glooming and running calves is higher than other age classes (Pratt, 1979). Also the results of social behavior shows that calf is prefer to do glooming and head rub with the same age class. I think these reasons produce the result that the duration of contact or proximity among calves is longer than between calf and other age/sex classes. It also means that the bond between calves is tighter than between calf and mother. Most of social behaviors between calves and juveniles are induced by the juvenile to calf. Because of aggressive social behavior were occurred by juvenile to calf, the occurrence of next or proximity is increased. It seems that juvenile has some interest to calf.

Juveniles tend to come close to cows or bulls. This tendency was not found in calves. The change of tendency in social behavior seems to attributed to the one reason. Pratt (1982) revealed that the frequency of social behavior, like nosing, rubbing and sniffing between calves declined steadily from a mean of 0.65/hour in the first week of life to 0.08 after one year. The results show the same tendency. When calf did social behavior to the other, most of social behaviors are induced to calf. When the actor is juvenile, however, social behavior induced to many age/sex classes. Langman (1976) estimated the home range of calf is 0.1~0.2 km^2, and that of juvenile is 0.1~0.5km^2 { Fennessy (2009) estimated the home range of juvenile is 14.5km^2 }. The enlargement of home range enable individual to encounter more other giraffe. The frequency of contact or proximity in the pair of juvenile-cow or juvenile-bull is more than that of calf to cow or bull. This may be partly because of the duration of ruminating. A previous report revealed a comparison of the percentage of diurnal time spent by juvenile, 80% for browsing, 19% for lying and 1% for suckling (Langman,1976). And also the duration to ruminate will be increasing accompanied by increment of browsing duration. The rumination, in general, starts 3~4 months after birth (Landman,1976). In this research, I classified individual within 60 days after birth as calf and individual within 61 days~1.5 year after birth as juvenile. It means, in this study, calf does not reach the age when giraffe enable to ruminate but juvenile is enough age. During rumination, giraffes

are just standing or lying, not moving frequently. To stay a certain place for a long time, like this case, it is more safety to be with adult one than to be with juveniles. Because the body size of juvenile is still undeveloped, bushes disturb them to detect predator easily. That is why juvenile has tendency to come close to bull or cow.

I will analyze in details regarding giraffe's behavior and social interactions later on.

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