



Comparative Reproductive Behavior of α -Male, β -Male and Subordinate Male Timor Deer (*Cervus timorensis* Blainville) Raised under Captivity

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Abstract Timor deer were used in an experiment to study the comparative behavior of α -male, β -males and subordinate male raised in captivity. Twelve males (4.25 years old) and 24 females (3 to 4 years old) were randomly assigned into three separate cages following the ratio of 4 males: 8 females. Kruskal-Wallis H test of non-parametric analyses were done for aggressive, libido and mating behaviors. The α -male was the dominant male in terms of aggressive, libido and mating behaviors. Subordinate male showed the highest frequency of wallowing to reduce stress, and running around for expressing libido. Successful mating was mostly exhibited by α -male, Subordinate2 (S2)-male did not show actual mating. The establishment of dominance hierarchy resulted to the manifestation of differences reproductive behaviors.

Keywords reproductive behavior, male Timor deer, captivity

INTRODUCTION

The Timor deer (*Cervus timorensis* Blainville) is a medium-sized cervid with 60 kg mature body weight and 1.00-1.10 m shoulder height (Jacoeb and Wiryosuhanto, 1994). It is currently being reared in farms in many countries including New Zealand, Australia, Indonesia, Mauritius, New Caledonia, China, Korea and Russia (Semiadi and Nugraha, 2004).

The productivity of deer farming in Indonesia is still low. The study of Daningsih (2005) showed that annual population growth of deer was only 0.169 at Kelompok Pemangkuan Hutan (KPH) Bunder, 0.25 at Kulon Progo and 0.17 at KPH Jonggol. The low of the annual population growth suggests that the productivity of deer farming in captivity can be improved if some key aspects of management such as feeding, mating, aggressive male behavior, maternal care and nervousness tendency are addressed. Asher et al., (1996) claimed that intensive deer farming with poor management practices, such as low of the feed quality and high social stress, may lead to poor cervid reproduction health. This is corroborated by Moberg (1991) who stated that behavioral stress has adverse effects on the reproduction system of both males and females. Reproductive success is one of the parameters to monitor stress. Animals that suffer from stress often fail to reproduce successfully.

Timor deer's develop a linear dominance hierarchy consisting of α -males, β -males and subordinate males through aggressive behavior. Social stress including those caused by conflicts related to dominance hierarchy has relatively consistent effects on reproductive behavior. This is manifested by changes in male sexual behavior (Blanchard et al., 2002).

OBJECTIVES

Therefore, in order to develop better management practices to maximize reproductive capacity of deer farms, it is necessary to study reproductive behavior of α -male, β -male and subordinate male Timor deer raised under captivity.

METHODOLOGY

The study was conducted at H. Yusuf Wartono Timor deer captive breeding, Gondosari, Gebog, Kudus, Central Java. The reproductive behavior observation was carried out for 43 days starting August 1, 2011 until September 12, 2011. Twelve (12) males (51 ± 6 months old; 68.29 ± 8.41 kg body weight and in same antler stages), and twenty-four (24) females (3-4 years old 40-60 kg body weight with normal estrus) were used. Other materials include 3 communal cages (23.5 x 21.5 m) and ethogram table.

Observation for reproductive behavior was done with behavior sampling (Martin and Bateson, 1993). The observation was done by manual recording using a record book and an ethogram table. Time, frequency, interval, duration and sequence of every behavior were recorded. The data was supported by audiovisual recorder. Data gathering of reproductive behavior was focused on a number of aspects including libido behavior, aggression and mating behavior.

Kruskal-Wallis H test of non-parametric analysis was done for comparing α , β and subordinate male Timor deer in terms of libido, aggressive and mating behavior.

RESULTS AND DISCUSSIONS

Aggressive behavior: Aggressive behavior of male Timor deer was expressed by wallowing, walking with head up, shouting, rubbing antler, expression of threat, pushing, actual fighting, fleeing and climbing. Aggressive behaviors are commonly expressed when more than one male start to approach an estrus female, α -males are the ones commonly displaying these behaviors, especially when β -males or subordinate males are approaching. From the time of actual fighting and incidence of fleeing, dominance hierarchy was established.

Average values of each aggressive behavior of α , β and subordinate male Timor deer's are shown in Table 1. The result of Kruskal-Wallis H test showed significant differences for all aggressive behaviors among the different hierarchy of male Timor deer. The α -male as the dominant male had mostly shown dominancy in all of the behavior parameters except in frequency and interval of wallowing and fleeing. The highest frequency and interval of wallowing were exhibited by S2-male, which could be an attempt of the animal to reduce stress. S2 male had the highest frequency and longer interval of wallowing, but shorter duration because he was disturbed by more dominant males when started. On the other hand, β -male exhibited the highest frequency of fleeing because of he was the opponent of α -male. The β -male also exhibited the longest interval of fleeing because in addition to fighting with α -male, in between also fight with S1 or S2-male and exhibited winning.

Indeed, shouting bouts (shouting in between two periods of shouting) were only done by α -males as a sign of dominance. Wallowing is commonly followed by rubbing antler or expression of threat. In these behavior α -male still shown the most dominant male except for interval of expression threat. In terms of pushing and actual fighting, α -male also shown dominancy in frequency, duration and interval. Actual fighting was longer time between α and β -male compare with other male. Climbing as one sign of dominancy, α -male was shown the most frequent male exhibited this behavior with longest duration and interval. The α -male exhibited climbing everyday

and the males usually disturbing other males when they exhibited this behavior.

Table 1 Average values of each aggressive behavior (43 days observations) of male Timor deer

Behavior	α -male	β -male	S1-male	S2-male	χ^2
Wallowing					
- Duration, seconds	69.56	67.50	63.97	56.26	183.94*
- Frequency, counts	1.18	1.06	1.28	1.93	72.02*
- Interval, minutes	43.15	26.60	30.58	134.72	114.10*
Walking with Head Up					
- Duration, seconds	13.70	11.65	5.61	0.00	374.69*
- Frequency, counts	3.50	1.42	0.63	0.00	404.36*
- Interval, minutes	173.36	127.09	36.81	0.00	241.47*
Shouting Bouts					
- Duration, seconds	33.49	0.00	0.00	0.00	
- Frequency, counts	4.08	0.00	0.00	0.00	
- Interval, minutes	151.69	0.00	0.00	0.00	
Rubbing Antler					
- Duration, seconds	39.06	16.27	4.68	0.17	374.44*
- Frequency, counts	5.26	0.60	0.15	0.01	400.83*
- Interval, minutes	148.56	28.55	1.64	0.00	407.85*
Expression of Threat					
- Duration, seconds	5.76	4.66	2.33	0.29	353.30*
- Frequency, counts	4.22	1.57	0.64	0.07	415.32*
- Interval, minutes	159.31	170.47	35.65	0.00	250.80*
Pushing					
- Duration, seconds	6.14	4.95	2.57	0.47	348.38*
- Frequency, counts	3.92	1.61	0.68	0.11	402.98*
- Interval, minutes	162.15	156.53	40.78	0.37	247.04*
Actual Fighting					
- Duration, seconds	229.72	247.01	204.09	107.36	261.66*
- Frequency, counts	3.55	1.96	1.39	0.68	342.14*
- Interval, minutes	163.64	206.17	88.69	38.41	156.82*
Fleeing					
- Frequency, times	0.00	1.82	1.32	0.69	341.99*
- Interval, minutes	0.00	204.08	71.29	41.14	189.89*
Climbing					
- Duration, seconds	13.61	11.31	6.02	1.50	317.80*
- Frequency, counts	3.00	1.33	0.64	0.13	365.55*
- Interval, minutes	143.27	75.06	26.41	0.00	231.32*

Legend: α -male (The most dominant male); β -male (The second dominant male); S1-male (Subordinate 1 male); S2-male (Subordinate 2 male)

Libido behavior: Libido behavior of male Timor deer was expressed by wallowing, roaring, seeking female, crowning, flehmen, spraying of urine, rutting, climbing and running around. Libido behavior was shown by male as expression of mating desire. In this present study, duration, frequency and interval of each libido behavior was measured. The most behavior exhibited by male Timor deer was seeking female (6.55 counts/day) followed by flehmen, spraying urine rutting and climbing (6.40, 6.32, 4.88 and 4.31 counts/day, respectively). Average values of each libido behavior of α , β and subordinate male Timor deer's are shown in Table 2.

The result of Kruskal-Wallis H test showed significant differences ($P < 0.05$) for all libido behavior among the different hierarchy of male Timor deer. The α -male as the dominant male had mostly shown dominancy in all the libido behavior parameters except running around. The highest frequency and longest duration and also interval of running around was exhibited by S2-male, which might be an attempt to express libido.

The α -male has shown dominancy for wallowing and spraying urine (most frequent and also longest duration and interval). Spraying urine and wallowing could be related to release of odors and attract the estrus female, that activity will be repeated when the estrus female shown non-receptive behavior prior to mating. Libido behavior of α -males was found to be related with scent marking (urinary spray and rutting), which was more common compared with other males. Roaring was commonly done by α -males to display their dominancy. Blanchard et al., (2002) reported that dominant male sugar gliders (*Petaurus breviceps*) display frequent scent marking behavior as part of their libido behavior. The α -male also showed dominancy on crowning behavior, which could be

included as a sign of dominance and an act of attracting female. Flehmen is one of the interesting libido behaviors of Timor deer's. It is an important sign signaling the start of a mating behavior. Flehmen is done to facilitate exposure of the vomeronasal gland for a scent or pheromone (Messang-Nallley, 2006). Climbing was also mostly done by α -male. When other males exhibited this behavior, α -male would disturb them. This is the reason for shorter duration and interval of climbing in other males.

Table 2 Average values of each libido behavior (43 days observations) of male Timor Deer

Behavior	α -male	β - male	S1- male	S2- male	χ^2
Wallowing					
- Duration, seconds	252.40	225.78	139.98	37.64	345.92*
- Frequency, counts	3.24	1.40	0.73	0.20	359.41*
- Interval, minutes	146.21	110.65	21.58	0.00	233.78*
Roaring Bouts					
- Duration, seconds	38.87	0.00	0.00	0.00	
- Frequency, counts	4.41	0.00	0.00	0.00	
- Interval, minutes	155.73	0.00	0.00	0.00	
Seeking Female					
- Duration, seconds	228.82	194.01	102.93	17.71	335.81*
- Frequency, counts	4.06	1.59	0.79	0.11	384.72*
- Interval, minutes	151.57	154.56	86.39	3.37	170.91*
Crowning					
- Duration, seconds	61.51	16.76	6.08	0.00	366.77*
- Frequency, counts	2.81	0.43	0.16	0.00	388.85*
- Interval, minutes	170.96	23.82	7.44	0.00	365.40*
Flehmen					
- Duration, seconds	8.06	6.38	3.02	0.21	348.34*
- Frequency, counts	4.13	1.53	0.69	0.05	399.34*
- Interval, minutes	156.66	149.81	72.96	3.37	184.10*
Spraying Urine					
- Duration, seconds	11.98	10.14	5.07	0.96	317.07*
- Frequency, counts	4.04	1.50	0.68	0.10	388.25*
- Interval, minutes	151.21	143.78	64.14	0.00	195.76*
Rutting					
- Duration, seconds	41.13	13.48	2.68	0.00	393.76*
- Frequency, counts	4.19	0.57	0.12	0.00	404.09*
- Interval, minutes	156.90	27.13	2.74	0.00	403.62*
Climbing					
- Duration, seconds	11.86	5.70	2.66	0.51	294.60*
- Frequency, counts	3.33	0.63	0.29	0.06	329.22*
- Interval, minutes	145.53	25.82	12.58	4.10	307.65*
Running Around					
- Duration, seconds	0.00	0.00	45.95	129.90	331.10*
- Frequency, counts	0.00	0.00	0.41	1.58	373.43*
- Interval, minutes	0.00	0.00	24.18	145.31	195.57*

Legend: α -male (The most dominant male); β -male (The second dominant male); S1-male (Subordinate 1 male); S2-male (Subordinate 2 male)

Mating behavior: In the present study, mating behavior of male Timor deer was expressed by following, sniffing, kissing, flehmen, kicking, nudging, mounting, erection, intercourse, ejaculation, refractory and bisexual. The highest frequency of mating behavior of male Timor deer was manifested in following (6.91 counts/day) followed by sniffing and kissing (6.18 and 5.84 counts/day, respectively). Average values of each mating behavior of α , β and subordinate male Timor deer's for duration, frequency and interval are shown in Table 3.

The result of Kruskal-Wallis H test showed significant differences for all mating behaviors among the different hierarchy of male Timor deer. The α -male as the dominant male had mostly shown dominancy in all of the mating behavior parameter except bisexual. Bisexual only observed in the subordinate male. S2-males showed the highest frequency (0.71 counts/day), longest duration (3.16 seconds) and longest interval (37.41 minutes) of bisexual behavior among the male deer's. The Subordinate male Timor deer exhibited bisexual behavior when they cannot mate with female deer's due to intimidation of α -male. Mating behavior was observed to be more frequent in α -males than other males. Subordinate males had the lowest frequency of mating behavior. Indeed, S2 males only exhibited following, sniffing, kissing and bisexual behavior (0.08, 0.03, 0.02 and 0.71 counts/day). Blanchard et al., (2002) also reported that subordinate males of albino mice

(*Rattus norvegicus*), deer mice (*Peromyscus maniculatus*) and lesser mouse lemurs (*Microcebus murinus*) have the least frequent of the mating behavior.

Table 3 Average values of each mating behavior (43 days observations) of male Timor deer

Behavior	α -male	β -male	S1-male	S2-male	χ^2
Following					
- Duration, seconds	229.68	95.72	49.63	4.88	326.96*
- Frequency, counts	5.11	1.22	0.50	0.08	351.55*
- Interval, minutes	111.57	72.80	36.43	3.23	217.04*
Sniffing					
- Duration, seconds	9.96	3.64	1.68	0.13	353.15*
- Frequency, counts	4.87	0.92	0.39	0.03	281.83*
- Interval, minutes	113.75	67.01	26.78	3.23	243.24*
Kissing					
- Duration, seconds	13.55	4.80	2.14	0.10	365.10*
- Frequency, counts	4.65	0.84	0.33	0.02	372.71*
- Interval, minutes	118.15	62.10	20.92	0.00	267.72*
Flehmen					
- Duration, seconds	6.82	2.00	0.90	0.00	383.80*
- Frequency, counts	4.51	0.69	0.27	0.00	327.54*
- Interval, minutes	116.16	39.97	16.83	0.00	298.17*
Kicking					
- Duration, seconds	5.61	1.59	0.70	0.00	379.90*
- Frequency, counts	4.49	0.63	0.24	0.00	281.66*
- Interval, minutes	117.68	33.74	13.40	0.00	313.31*
Nudging					
- Duration, seconds	17.69	4.86	2.11	0.00	382.44*
- Frequency, counts	4.47	0.55	0.21	0.00	386.38*
- Interval, minutes	114.64	21.44	10.41	0.00	355.73*
Mounting					
- Duration Inter, seconds	20.28	5.84	1.64	0.00	331.45*
- Frequency Inter, counts	4.20	0.43	0.09	0.00	403.67*
- Interval Inter, minutes	114.12	7.58	3.11	0.00	416.05*
Erection					
- Duration, seconds	37.99	7.64	2.42	0.00	422.22*
- Frequency, times	4.20	0.24	0.09	0.00	422.33*
- Interval, seconds	112.14	1.27	3.11	0.00	446.74*
Intromisian & Ejaculation					
- Duration, seconds	4.67	0.88	0.28	0.00	393.19*
- Frequency, times	4.20	0.22	0.08	0.00	425.15*
- Interval, seconds	112.28	1.27	0.26	0.00	454.14*
Refractory					
- Duration, seconds	212.50	39.41	13.11	0.00	407.73*
- Frequency, times	4.19	0.22	0.08	0.00	425.16*
- Interval, seconds	112.49	1.27	0.26	0.00	454.14*
Bisexual					
- Duration, seconds	0.00	0.05	1.56	3.16	153.41*
- Frequency, times	0.00	0.01	0.33	0.71	156.46*
- Interval, seconds	0.00	0.00	18.44	37.41	41.09*

Legend: α -male (The most dominant male); β -male (The second dominant male); S1-male (Subordinate 1 male); S2-male (Subordinate 2 male)

Mating behavior of Timor deer was observed to occur mostly between 5 am and 8 pm. Timor deers stopped mating activity when the temperature fell down below 21 °C, which commonly occurred after 8 pm. These findings were confirmed by Ismail (2008) in Ranca Upas, Indonesia who reported the same observation. Timor deer still continue to mate under rain condition but will look for shelter when temperature dramatically drops. But, in Ranca Upas this condition would happen when temperature dramatically drops until around 16 °C. It was observed that Timor deer started to rest from 8 pm. Almost all of them would stay and lay in canopy, only a small number would ruminate outside of the canopy. Mating behavior of Timor deer is different compared with Sambar deer (*Rusa unicolor*) in India. Savanth et al., (2011) reported that Sambar deer are nocturnal, therefore during day time mounting and intercourse could not be observed more than once, but other activities related to breeding like chasing females, sniffing and flehmen were observed many times. Territorial behavior, holding the head up high, fighting, spraying urine on its own body and face were also observed a few times.

CONCLUSIONS

The most aggressive males were α -males. The common sequence of aggressive behaviors was expression of threat, followed by pushing, actual fighting and fleeing when one of the males lose the fight. Libido behavior of male Timor deer was expressed by wallowing, roaring, seeking female, crowning, flehmen spraying of urine, rutting, climbing and running around; α -male was the most active in libido behavior. Subordinate male expressed libido through running around. Farm management practices should be given emphasis as an important key for reproductive success. This may include the provision of mud bath in the cage to support expression of normal behavior. Further study on the grouping of the males in relation to the number of males in each cage must be conducted. The possible influence of dominance hierarchy on the subsequent sex ratio of fawns from captive breeding of Timor deer should also be studied.

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