

# REPRODUCTIVE BEHAVIOUR OF TIMOR DEER (*Rusa timorensis*)

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## ABSTRACT

Timor deer (*Rusa timorensis*) is a newly domesticated animal in Indonesia and other countries in the world. It is a potential source of meat and livelihood. Low birth rate is a problem of deer farming in Indonesia. It happens because of low concern for key aspects of behaviors including reproductive behavior. The aim of this review is to give information about reproductive behavior of Timor deer in natural habitat and captivity breeding. Libido and estrous behaviors of Timor deer in captivity breeding were similar with natural habitat. However, male Timor deer in captivity breeding took longer time to approach the females before mating, compared with those in their natural habitat. Aggressive behavior commonly leads mating. Parturition and maternal behavior of hinds are affected by limitation of space, therefore dividing the area of cage which depends on age and physiological status is needed to improve reproductive management.

**Key words:** Reproductive behavior, captivity, Timor deer

## ABSTRAK

### TINGKAH LAKU REPRODUKSI RUSA TIMOR (*Rusa timorensis*)

Rusa Timor adalah hewan yang mulai didomestikasi di Indonesia dan negara lain di dunia. Rusa Timor adalah hewan yang berpotensi sebagai sumber daging dan mata pencaharian. Rendahnya peningkatan populasi adalah masalah penangkaran rusa Timor di Indonesia. Masalah ini muncul karena rendahnya perhatian terhadap tingkah laku dasar rusa Timor. Tujuan dari *review* ini adalah memberikan informasi tentang tingkah laku reproduksi rusa Timor di habitat alami dan penangkaran. Tingkah laku libido dan berahi rusa Timor di penangkaran menyerupai rusa Timor di habitat alami. Namun, pejantan rusa Timor di penangkaran membutuhkan waktu yang lebih lama untuk mendekati betina sebelum perkawinan dibandingkan rusa Timor di habitat alami. Tingkah laku pertarungan sering mengawali perkawinan. Tingkah laku melahirkan dan keindukan rusa Timor betina dipengaruhi oleh keterbatasan kandang. Oleh karena itu, pembagian kandang berdasarkan umur dan status fisiologi dibutuhkan untuk meningkatkan manajemen reproduksi.

**Kata kunci:** Tingkah laku reproduksi, penangkaran, rusa Timor

## INTRODUCTION

Indonesia is a rich country in biodiversity. In Sunda land alone (Kalimantan, Sumatera and Java), as a distinct of biogeographic region, around 15.000 endemic plants and 701 endemic vertebrate species can be found. However, Indonesia's forest cover is rapidly decreasing. Between 1985 and 1987, it was the largest absolute loss among Indonesia's major islands. This means that annual deforestation rate in Kalimantan was 2,1% for this period, approximately three times greater than the reported in South East Asia as a whole (FULLER *et al.*, 2004). Illegal logging was the biggest contributor for this decrease. This condition depresses the wildlife population because of loss of habitat and food source. Illegal hunting, trading, burning, disaster and infectious disease further depress the condition of wildlife population.

The Timor deer (*Rusa timorensis*) is a medium-sized cervid with 40 to 120 kg mature body weight. Timor deer is one of wildlife animals that is endemic in Indonesia. The total native population of Timor deer was estimated to be fewer than 10,000 mature individuals, and it is expected to continue to decline by at least 10% within three generations (estimated to be at three minimum of 15 years) as a result of habitat loss, habitat degradation, and poaching. Conservation is one of the ways to solve this problem. There are two kinds of conservation: *in-situ* and *ex-situ* conservation. *In-situ* conservation is not a viable option in this case because of degrading natural environment condition. The benefit of *ex-situ* conservation can be maximized when supported by extensive knowledge of animal reproductive behavior.

Now, Timor deer is currently being reared in animal farms in many countries including Brazil,

Malaysia, Thailand, New Caledonia, Australia, and Mauritius. This domesticated deer is prolific and noted for its good quality meat, antler and skin. Timor deer has good quality meat with low fat in venison (0.33%) and high protein (24.5%) and has special taste. Blood deer powder, velvet powder and some clothing materials from skin deer are the other products from Timor deer (SEMIADI and NUGRAHA, 2004).

In Indonesia, the productivity of deer farming 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. These results suggest that deer farming in captivity should be improved on some key aspects at management such as feeding, mating, the aggressive male behavior, maternal care and nervousness tendency. ASHER *et al.* (1996) claimed that intensive deer farming system with poor management practices may result to some maladaptation of the animal, including some components of cervid reproduction. The report of MOBERG (1991) stated that behavioral stress has adverse effect on reproduction of both males and females.

Changing environment from natural habitat to the ranging condition resulted to the decrease in reproductive performance of Timor deer. Social stress is the reason for the decrease in reproductive performance. Social stress will elevate cortisol level. The concentration of cortisol in blood is widely used as an indicator of stress, although caution is advised, since an increase does not occur with every type of stressor (MOSTL and PALME, 2002). Cortisol fluctuation affected to seasonal fluctuations in body weight, morphometry, antler growth, testicular size and voluntary food intake (MONFORT *et al.*, 1993). Therefore, it is necessary to study reproductive behavior of Timor deer raised in natural habitat compared with those raised under captivity. Furthermore, knowledge of the normal reproductive behavior and the physical or biological requirements of Timor deer on natural habitat can be used to improve the reproductive management under farm condition.

## REPRODUCTIVE BEHAVIOR OF TIMOR DEER

### Libido behavior

Libido behavior refers to reproductive behavior in male that show male desire of mating. SAMSUDEWA and SUSANTI (2009) observed that stag's libido of Timor deer in natural habitat was expressed by seeking for a female, followed by kissing and kicking, mounting, intercourse and refractory. MESSANG-NALLEY (2006) stated that stag's libido of Timor deer in captivity was rutting, attraction to hinds, fighting and

urinary spray. The study of SAMSUDEWA *et al.* (2010) on reproductive behavior showed that male Timor deer in captivity have various signs of libido behavior. The common signs were roaring and holding of harem. A male Timor deer began to approach the females by rounding the group. After finding a female in heat, it roared 3 – 5 times and then got the female out of the group. SEMIADI and NUGRAHA (2004) stated that the libido behavior in male deer is manifested by roaring, wallowing, following female and pheromone odor.

### Estrous behavior

Estrous behavior is the sexual receptiveness of female Timor deer during the approach of the male Timor deer and during mating. SAMSUDEWA and SUSANTI (2009) observed that the estrous in female Timor deer in natural habitat in Karimunjawa Island is expressed through behavior changes, manifested by kissing, mounting and vaginal anatomical changes. Estrous cycle in female Timor deer was  $20.3 \pm 2.2$  days and the length of estrous was  $24.8 \pm 3.2$  hours. The research of GARCIA *et al.* (2002) in female Iberian red deer showed that daylight length affects the female estrous. Timor deer like other deer is a short day breeder. The estrous behavior in female Timor deer was the sign for male Timor deer to start approaching. In another study of SAMSUDEWA *et al.*, (2010) on Timor deer raised in captivity, the common signs of estrous were standing tail, shouting for 2-6 times and nervousness. The other signs of dominant female Timor deer is mounting the other female around 2 times and kissing male deer once. The last sign was standing heat when the male mounted. These signs of female Timor deer estrous behavior in captivity breeding were not different with those in their natural habitat.

The work of SAMSUDEWA *et al.* (2010) revealed the absence of courtship behavior in the female deer when she was urinating frequently as the male is approaching. On other hand, infrequent urination would be followed by copulation. GASSETT *et al.* (1998) in their study of female white-tailed deer (*Odocoileus virginianus*) indicated that variation in urination and the subsequent effect on the urination-flehmen sequence may facilitate vomeronasal and/or olfactory communication between non receptive female and male conspecific. Furthermore, non-estrous females urinate more frequently than estrous females.

### Aggressive behavior

Aggressive behavior happened when more than one male approach a female, and it would be the start for fighting between males. (Figure 1) under this

condition, male show aggressive behavior. Aggressive behaviors in Timor deer can be divided into 3 basic sequences (head down, present threat and actual fighting). The aggressive behavior study of SAMSUDEWA (2010) showed that male Timor deer in captivity has an average duration for head down, present threat and actual fighting of  $3.27 \pm 1.02$  s;  $4.64 \pm 1.16$  s and  $36.78 \pm 6.51$  s, respectively. The complete sequence of aggressive behavior included head down, present threat, push, fighting and flee. Aggressive behavior in Timor deer mainly happened during day time (6 am – 6 pm) and never showed during night time. During night time, Timor deer will be in groups with 2 – 3 male deer and 12 – 16 female deer and a fawn per group. One form of aggressive behavior of Timor deer showed in Figure 1.

Research by *et al.* (2000) in male Timor deer showed that aggressive behavior was not affected by the size of the cage, feed quality and body weight, but was significantly influenced antler stage. Furthermore, DRAJAT *et al.* (2000) stated that aggressive behavior was incidental in the formation of dominance hierarchy in Timor deer. MAUGET *et al.* (2007) reported that testosterone may promote dominance hierarchy and social rank in Chinese Water Deer (*Hydropotes inermis*). BLOTTNER *et al.* (1996) reported that testosterone and other reproductive hormone on Roe deer (*Capreolus capreolus*) rose during rut season. Testosterone level of adult male Muntjacs fluctuated throughout the year in correlation with their annual antler replacement cycle. This pattern which is very similar to other deer species studies clearly shows that the quantity of circulating testicular androgens in Muntjacs also plays a key role in regulating phase shifts in their antler cycle (PEI *et al.*, 2009). BUBENIK *et*

*al.* (1991) also reported that antler cycles in male Axis deer (*Axis axis*) affected by testosterone level. Moreover, the study of SAMSUDEWA *et al.* (2010) on male Timor deer in captivity showed that deer with cornification antler would dominate in mating and disturb the other male when the other male start to mate. The duration of fighting was  $469.37 \pm 138.92$  second. BLANCHARD *et al.* (2002) reported that fighting may reflect the mate selection strategies of the females. Timor deer during the hard stages of antler cycle why more aggressive.

### Mating behavior

Mating behavior is reproductive behavior that starts with libido and estrous behavior and will end at copulation. Copulation happens when the male continue the approach and the female shows receptiveness for mating. The mating behavioral sequences of Timor deer include the approach, actual mating and refractory period. SAMSUDEWA and SUSANTI (2009) stated that the duration time of every pre-mating stage, kissing and kicking in natural habitat, was  $408.00 \pm 42.00$  seconds. Mounting lasted for  $204.00 \pm 18.00$  seconds and actual mating (mounting and intercourse) was  $534.00 \pm 54.00$  seconds. Male Timor deer needs 2 – 3 times mounting before intercourse (Figure 2). Refractory conditions of Timor deer was  $8784 \pm 60.20$  seconds. On other hand, SAMSUDEWA *et al.* (2010) indicated that male libido under captivity is expressed by seeking for a female, followed by sniffing, kissing, flehmen, mounting, intercourse and refractoriness. The duration time of seeking, sniffing, kissing and flehmen, were  $1691.11 \pm$



**Figure 1.** Aggressive behavior of Timor deer in captivity



**Figure 2.** Mounting of Timor deer in captivity

329.12;  $134.99 \pm 77.16$ ;  $45.90 \pm 18.32$ ;  $8.31 \pm 3.03$  seconds, respectively. Mounting lasted for  $56.40 \pm 17.90$  seconds and intercourse was for  $18.90 \pm 4.81$  seconds. Male Timor deer needs to mount for 2 – 3 times before intercourse.

After intercourse, female undergoes refractoriness by cleaning vagina. Cleaning vagina after intercourse of Timor deer was  $80.38 \pm 29.77$  seconds. The work of SAMSUDEWA (2010) on Timor deer in one captivity breeding in Bicol, Philippines showed that average duration for the approach, actual mating and refractory mating was  $942.71 \pm 26.00$  seconds;  $81.69 \pm 12.13$  seconds and  $14.65 \pm 1.62$  seconds, respectively. Sequence of mating behavior included the following, sniffing, licking, mounting, intercourse, flee and cleaning the vagina. The result of research in natural habitat and captivity showed that male Timor deer in captivity breeding needs a longer time to make approach than those in natural habitat. This difference is caused by the inability female deer to exhibit estrous. ASHER (1996) stated that in wild population of Red deer, the stags become reproductively active in advance of the hinds. In addition, MESSANG-NALLEY (2006) stated that male libido of Timor deer (*Cervus timorensis*) in captivity was shown by flehmen reaction (19.33 times/day), licking the hinds genital region (32.78 times/day), erection and copulation ( $\geq 20$  times/day).

In the same study of Timor deer under captivity in Bicol, Philippines Samsudewa (2010) reported that Timor deer does not exhibit mating from 12 to 6 am. This behavior was affected by temperature during that time. Data showed that during 12 to 6 am, temperature was lower than  $20^{\circ}\text{C}$ . The present observation showed that Timor deer needs to be within the comfort zone of

temperature to start mating. Approach of the mate will start at temperature range of  $21 - 23^{\circ}\text{C}$ . Even during the rain, Timor deer continued mating. But, when rain became heavier and the temperature dramatically dropped  $19^{\circ}\text{C}$ , the deer stopped mating and looked for shelter.

Initially, the female Timor deer was not receptive to a male approaching. After that, the female deer became more tolerant to the male's presence, often just avoiding his approaches and urinating. This behavior encouraged persistent pursuit by the male, who paused only to perform flehmen at her urination sites. A similar tolerant behavior of male by female was also observed 24 hours before copulation in white-tailed deer (GASSETT *et al.*, 1998). In contrast, a male approached an estrous female quickly and licked her tarsal glands and vaginal area. After several approaches, an estrous female stopped and allowed male to mount. The most consistent factor in courtship behavior seemed to be the lordotic stature of an estrous female.

### Parturition behavior

The common behavior on deer in wild populations during parturition is seeking isolation from conspecifics, the hind and fawn returning to the herd after a period of 1 – 2 weeks (ASHER *et al.*, 1996). Paddock size, stock densities and synchronous fawning may mean that parturient hinds are prevented from attaining isolation on some farms. Some modification can be done by changing the fawning or cage. Modification of fawning can be done by synchronization. A consequence of such a modification in behavior is that

hinds can do fawning together. This will also decrease disturbance among other females. Modification of cage can be done by separating the hinds that will deliver fawn.

SAMSUDEWA (2010) showed that parturition behavior of Timor deer after include cleaning of the fawn and eating the placenta. After parturition, the hinds start cleaning the fawn through licking from the head to the back area. Duration of licking is around 10 minutes. Furthermore placenta of fawn will be eaten by hinds and hinds will help fawn to suckle.

### Maternal behavior

The common expressions of maternal behavior of Timor deer include nourishing, milking and preventing other individual from disturbing the fawns. Nourishing behavior demonstrated by fawn shouting and hind calling. Average fawn shouting in Timor deer farm was 6 times and 3 times for hind calling. Milking duration was around 58 seconds (SAMSUDEWA *et al.*, 2010). In the study of SAMSUDEWA (2010) of deer in captivity in Bicol region, Philippines, nourishing behavior expressed was by hind calling and fawn shouting with an average of 3 and 2 times, respectively. The behavior also include following after the fawn, looking for fawns that were trapped or lost their way and licking of wounds caused by entrapment. On the average, 43.25 seconds was duration time of milking. The shorter duration of milking happened because of more population (> 200 heads) placed in one cage. This condition resulted to more disturbances during milking such as attack from a male that wants to mate the female. This case increased when the fawn age more than 1 month.

Preventive behavior is also observed when the hind protect the fawn from the attack of a male and separate them from group during feeding to reduce the attack of the male. Therefore, there is a need to segregate cages based on age and physiological status. Body condition score (BCS) of hinds was important factor in reproductive performance and maternal behavior. BCS was significantly associated with conception rate, conception date, dystocia, weight of weaned offspring, and ability of the hind to rear a calf to weaning (AUDIGE *et al.*, 1998). Therefore, maintenance and improvement of hinds' BCS will increase productivity of fawn.

### RELATIONSHIP BETWEEN AGGRESSIVE AND MATING BEHAVIOR

Reproductive behavior research of SAMSUDEWA (2010) on Timor deer in captivity showed that the frequency of mating in January may still be low.

Frequency mating may get higher in the later months of summer (March – May). Aggressive behavior among mature male was quite apparent during January and will increase during March-May. Aggressive behavior was not pronounced when one male found an estrous female being followed by other males. The first male will try to get hold of the female and would drive the female out from the group. When the other male still follows them, the first male will start to head down and present threat to the other male and will start the fight. Fight will happen when the second male also exhibits threat. This fighting will be concluded when one of the males will flee. The winner male will start mate the estrous female.

### CONCLUSION

In captive breeding, one of the important aspects that need to be considered is reproductive behavior. Aggressive behavior commonly leads to mating. Therefore, more than one male in one cage is important to increase reproductive success. Timor deer in captivity breeding showed the same signs of libido, estrous and mating behavior with those in natural habitat. However, male Timor deer in captivity breeding took longer time to approach the female than those in natural habitat. Study of testosterone and estrogen levels of Timor deer in *ex situ* and *in situ* conservation is needed to generate information and give better recommendation on reproduction management of Timor deer. Segregation of the cage based on the age and physiological status is needed to support success reproductive management and reduce mortality.

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