

# Control of red deer (*Cervus elaphus*) stag domination in rut season by estrus synchronization

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## Key words:

red deer, estrus synchronization, refuge park, inbreeding, CIDR.

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## Abstract:

**BACKGROUND:** Inbreeding is one of the major problems of small size herds of red deer in refuge wildlife parks. **OBJECTIVES:** The aim of the present study was to use estrus synchronization technique in red deer (*Cervus elaphus*) based on natural mating to control the dominancy and social rank of stags and inbreeding. **METHODS:** In this study, hinds (n=6) were captured and caged at breeding season (early October) in Semeskande Wild Life Refuge Park. The captured hinds were treated with intravaginal progesterone devices (CIDR) for 12 days, followed by injection of 250 IU PMSG at the time of CIDR withdrawal. After 48 hours, all 6 hinds were released from cages. **RESULTS:** In estrus phase, the chase sequences started and the old dominant stag could not control all of the hinds in his territory so the two other young stags successfully mated with the other hinds. Four out of six hinds became pregnant and the calves were born in early June. **CONCLUSIONS:** The results of this study showed that the estrus synchronization technique in Refuge Wildlife Park which is based on natural mating, can be used successfully to control inbreeding easily and give young stags the opportunity to copulate.

## Introduction

Reproductive success in male red deer (*Cervus elaphus*) depends on fighting with other males for access to mates (Brennan, 2010). In red deer where only the female performs parental care different strategies to improve the reproductive success are evolved. The reproductive success of the female is influenced by breeding experience, age, body condition and dominance status over conspecifics (Côté and Festa-Bianchet, 2001a; Holand et al., 2004). Social dominance over competing conspecifics is for ungulates correlated with features such as antler size (Wolff, 1998), body size (Holand et al., 2004; Vervaecke et al., 2005) and age (Côté and

Festa-Bianchet, 2001b). Females are motivated to join harems to avoid harassment by sub-dominant males, predator safety, and resources availability (Carbone and Taborsky, 1996; Clutton-Brock et al., 1996), even though even though they may suffer the negative effects of crowding in large harems (Wade, 1995) and consequently lead to inbreeding and polymorphism disorders in low population sites. The ability of males to defend a harem is a sign of their quality (Wolff, 1998).

Introduction of an individual into a captive population can increase the survival of the herd. Natural introduction of a single immigrant gray wolf (*Canis lupus*) into a geographically isolated Scandinavian population increased heterozygosity and

rapidly increased population growth (Vilà et al., 2003). The introduction of male adders (*Vipera berus*) into a highly inbred isolated adder population increased male recruitment and decreased stillborns (Madsen et al., 1996).

Reproductive technology has been applied to conserve and manage natural populations of red deer (Garde et al., 2006). Artificial insemination, multiple ovulation, embryo transfer and in vitro embryo production for genetic management of red deer were performed (Aller et al., 2009; Morrow et al., 2009). Genetic weakening occurs with deer raised in a captive environment and because of existence of the dominant stag over a period of several years, similar mating and the same gene transfer happen. The mentioned reproductive technologies are useful but providing opportunity to young stags in breeding season to copulate is a more desirable protocol.

We hypothesized that if all hinds showed their reproductive behavior in a defined time, the territory domination and power of harem defense among the red deer herd in small population of captive refuges could lead to the mating ability of young stags. Therefore, we planned to synchronize the hind by a standard protocol and simultaneously release old and young dominant stags to observe the males ability to conserve their hinds in harem in estrus phase.

## Materials and Methods

The study was carried out at the Semeskande Wild Life Refuge (latitude of 36° 34' N and longitude 53° 5' E, 26 m above sea level), Mazandaran province, in the north of Iran between late September and mid-October, 2010. Three stags aged eight, five, and three years old kept in the refuge park, of which the older one was dominant. Six cycling hinds aged between four to seven years old weighing between 100 to 120 kg were used for synchronization program. During the experiment, hinds were confined in separate pens before rut season and maintained intensively on hay (green grass corn). Concentrate supplement (0.5 kg/day) was given and water was provided ad libitum. The animals were individually identified by means of plastic ear tags. Reproductive status of hinds was checked by rectal probe using a real-time B-mode ultrasound scanner equipped with a 7.5 MHz linear-array transducer (BCF, England). They had not

become pregnant since proper recording of their estrous cycle activities.

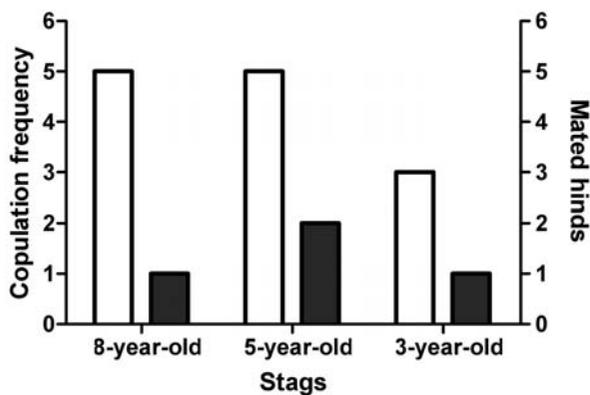
All the hinds were synchronized using a regime of 12 days intravaginal controlled internal drug releasing device (CIDR, 300 mg progesterone, InterAg, Hamilton, New Zealand). Pregnant mare serum gonadotropin (PMSG, Folligon, Intervet, Canada; 250 IU, IM injection) was given at the time of CIDR withdrawal. After 48 h, all hinds were released from cages to the park environment. They were monitored for behavior of estrus manifestation by circuited cameras and were observed visually from time to time from approximately between (8 am and 8 pm) daily for 3 days. The signs of estrus beginning were recorded. Heterosexual signs were observed such as stags roaring; chase sequencing, guarding the hinds, and rapid stags moving toward the hinds. Frequency of copulation and ear tag number of couples were recorded.

## Results

The heterosexual behavior between the six hinds and three stags began exactly eight hours post release (56 h after CIDR removal). Roaring was just done by the old dominant stag of the park. The two young stags just turned round the harem and territory of the old stag. This behavior continued until the estrus signs of the hinds intensified, which caused the dominant stag to be matched to the first heat hind. This allowed young stags to enter the harem of the dominant stag. The first copulation behavior was done by the younger stag unexpectedly but the hind did not allow actual mounting. The first successful copulation by the two younger stags began around mid-day on behalf of the old stag of the park and was repeated five and three times successfully until early morning. (Graph 1).

Two hinds did not show the estrus signs and were not mated. Old dominant stag copulated five times during 24 h just by a single female. However, at the same time in refuge there were three other estrus females ready to mount, but the old stag's attraction was concentrated individually on only one female.

Our study was carried out in early October and the calves were born in early June. One of the calves of the old stag was maternally affected by carpal flexion disorder and died because it was not able to stand and



Graph 1. Copulation frequency and number of *Cervus elaphus* hinds (n=5) mated by stags after estrus synchronization.

□ Copulation frequency    ■ Mated hinds

suckle. Nevertheless, the calves of the young stags were very alert after birth and stood up and started searching the teats of their mothers for milk in less than 40 minutes.

## Discussion

Introduction of two young stags into the population may increase the survival of the herd. Natural introduction of a single immigrant gray wolf (*Canis lupus*) into a geographically isolated Scandinavian population increased heterozygosity and rapidly increased population growth (Vilà et al., 2003). The introduction of male adders (*Vipera berus*) into a highly inbred isolated adder population increased male recruitment and decreased stillbirths (Madsen et al., 1996).

There was not much effort and competition among the stags in the refuge and all were chasing the females individually for copulation. Population sex ratio may be predicted to have an effect on the level of male - male competition (Mysterud et al., 2005). Usually the dominant stag in herds that can copulate has strong body size, older age and more copulation experience. Younger males nevertheless take an active part during the rut, but typically have a much lower reproductive success (Preston et al., 2001; Yoccoz et al., 2002). High population density often leads to female-biased adult sex ratios in red deer, which decrease competition among males during rut (Clutton-Brock et al., 1997). Yearling reindeer reduced reproductive effort when many prime-aged

males were present (Mysterud et al., 2003).

Effect of estrus pheromones in synchronized hinds might cause the stags targeted directly to mate without fighting and the number of females in standing phase accelerates this event. Some findings suggest that males do not trade survival for reproductive effort and male red deer therefore probably reduce reproductive effort at high population density due to associated increased risk of mortality (Evans, 1990).

Our observations showed that the three-year-old stag mated with one hind three times during a 24 hour period and his mounting rate was less than that of dominant stag. Male mating plans consist of roaming widely in search of individual estrous females with males spending up to 24 h 'tending' each receptive female (Hirth, 1977). This behavior was just observed in the old stag and not the two other young males. The lack of experience or the stress of mating competition might cause this behavior.

The novelty of the presented article is the method of control of inbreeding in red deer using assisted reproduction technique (synchronization by CIDR insertion in wild red deer) and reduction of stag dominancy at mating. This method can be advised in endangered species in which mating dominancy of males increases the risk of inbreeding, especially in groups kept in limited refugee parks or small numbers.

In conclusion, the present study showed that estrus synchronization might be useful in control of rut season behavior in *Cervus elaphus* stags which were kept in small population and decreased the risk of injuries, mortality and inbreeding in refuges.

Conflict of interest: The authors found no conflicts of interest to be reported.

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To the best of our knowledge, this is the first report of study on estrus synchronization and natural mating followed by territory break out in rut season done via collaboration of the Department of Environment in Mazandaran province and the Semeskande Wild Life Refuge.

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## کنترل غالبیت گوزن قرمز نر (*Cervus elaphus*) در فصل جفت گیری توسط روش همزمان سازی فحلی

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### چکیده

**زمینه مطالعه:** جفت گیری درون جمعیتی یکی از مشکلات اساسی جمعیت های کوچک گوزن قرمز در پناهگاه های حیات وحش می باشد. **هدف:** هدف از مطالعه حاضر استفاده از یکی از روش های همزمان سازی فحلی در گوزن قرمز (*Cervus elaphus*) با استفاده از جفت گیری طبیعی جهت کنترل غالبیت و رتبه اجتماعی گوزن قرمز نر و کنترل جفت گیری درون جمعیتی بوده است. **روش کار:** گوزن های ماده (تعداد = ۶ راس) بعد از به اسارت گرفتن در فصل تولید مثلی (اواایل پاییز) در پناهگاه حیات وحش سمسکنده (در حومه ساری) داخل قفس های مخصوص قرار داده شدند. متعاقب آن، همه گوزن های ماده برای مدت ۱۲ روز سیدر دریافت کردند و در روز برداشت سیدر به همه آنها ۲۵۰ واحد PMSG تزریق گردید. گوزن های ماده چهل و هشت ساعت بعد (روز ۱۴)، از قفس ها آزاد و وارد طبیعت شدند. **نتایج:** رفتارهای تعقیب و فحل یابی توسط هر ۳ راس گوزن نر شروع شد و گوزن نر غالب گله بدلیل فحلی همزمان در ۴ راس گوزن ماده قادر به کنترل آنها در قلمرو خود نبود، لذا ۲ راس گوزن نر جوان فرصت یافتند با گوزن های ماده جفت گیری کنند. چهار راس از مجموع ۶ راس گوزن های ماده آبستن شدند و گوساله های آنها در اوایل تابستان سال بعد متولد شدند. **نتیجه گیری نهایی:** نتایج حاصل از این مطالعه نشان داد که این روش همزمانی فحلی با استفاده از جفت گیری طبیعی پناهگاه حیات وحش در کنترل جفت گیری درون جمعیتی موفق بوده است.

واژه های کلیدی: گوزن قرمز، همزمان سازی فحلی، پناهگاه حیات وحش، جفت گیری درون جمعیتی، سیدر.

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