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# NOTES ON THE BEHAVIOUR OF HOG DEER IN AN ENCLOSURE

# **Richard Miller\***

## Introduction

The hog deer, *Cervus porcinus*, is one of nine animals now considered by the Thai government to be severely endangered. This species prefers to live in grassland near water and has been in competition with man for these lands. Because of the increase in human population in Thailand, lands near water are at a premium for use in rice farming. For this reason the natural habitat of the hog deer has been reduced at a great rate.

In the dry season when meadows are burned, hog deer are shot with the aid of spotlights at night. In some areas this practice has exterminated local populations.

Because hog deer are becoming rare in Thailand, the Royal Forest Department began an experimental breeding programme aimed at the introducing hog deer into Game Sanctuaries and National Parks. A search through available literature in Bangkok disclosed no papers on hog deer and very little mention of them in articles and books about other wild animals. The author was then asked to study the behaviour of a small herd of hog deer at the Nature Education Centre and Rare Animal Breeding Centre at Khao Khieo Game Sanctuary. This study is intended only to record observations and to assist other researchers in conducting a more thorough study of hog deer behaviour.

# Study Area

Khao Khieo in Chon Buri Province was officially designated as a Game Sanctuary in June of 1974. The Game Sanctuary was to contain a Nature Education Centre and a breeding centre for rare and endangered

<sup>\*</sup> Peace Corps Volunteer, Division of Wildlife Conservation, Royal Forest Department, Bangkok, Thailand.

animals. The Nature Education Centre includes a sixteen-acre enclosure used as an "open zoo", where visitors can view animals from an elevated walkway. This enclosure contains sambar deer (*Cervus unicolor*), barking deer (*Muntiacus muntjac*), a single female eld's deer (*Cervus eldi*), one serow (*Capricornis sumatraensis*), and a herd of eight hog deer (at the beginning of the study, one yearling male, three adult males, and four adult females).

The enclosure contains as varied a habitat as possible. The enclosure contains approximately 40 percent grassy meadow, 40 percent bamboo scrub forest and 20 percent secondary decidious forest in an area which was tropical evergreen forest before being cleared by slash and burn farming. In addition to the natural vegetation, bananas, tubers, and swamp cabbage (phak bung) were provided for animals. A building originally to be used as an office and museum stands within the enclosure. Water was provided in a pond with water piped in from a stream. During the rainy season a small temporary stream ran through the enclosure. At the beginning of the study the enclosure was closed to the public but was later opened. By the end of the study, visitors were creating problems in observation.

#### Study Methods

Behaviour studies: Field notes recorded time, weather data, interactions between individuals, and conspicuous behaviour. The hog deer project was only part of the author's job, and observation time was worked in around other duties at the sanctuary.

Observations began on June 19, 1974, and ended May 8, 1975, totalling 153 recorded hours. In addition, many hours of observed activities were not recorded unless something unusual was seen; times were recorded only when behaviour warranted. Most observations were made in the morning and in the evening. The observations may also have been influenced by the small size of the enclosure, and, toward the end of the study, by interactions with visiting people.

Feeding studies : Samples of plants were gathered by following feeding deer and taking samples of plants that they ate. The plant specimens

were identified at the herbarium of the Department of Agriculture. Use of browse, forbs, and grasses was estimated by counting the number of bites of each taken in a set time period. This was abandoned when it became obvious that supplemental feeding and over-grazing of some parts of the enclosure were influencing the results.

# Observations

Alert and flight: An alarmed hog deer generally stood with its head up, ears and eyes directed at the disturbance. The head might bob up and down and to the side in order to get a better view of the disturbance. The tail is lifted and curled up over the back. Hog deer might stand motionless for two minutes or more while trying to determine if the disturbance was dangerous. A hog deer may also bark or stamp its feet helping to communicate the alarm. (Figure 1).



FIGURE 1.

DOE AND FAWN ON ALERT

The alarm bark was a sharp, "eerp", similar to but higher in pitch than the bark of a sambar deer. The bark might be given while walking or standing still, but it was not given while running. When danger seemed to be approaching rapidly, a hog deer barked only once before running. One doe, however, alarmed by the sound of several jets passing overhead, barked almost continuously for five minutes. This bark generally attracted the attention of all animals in the area.

Alarmed hog deer sometimes stamped their fore or more rarely their hind hooves to produce a hollow thump. This sound was more frequently used than the bark and was often used with the bark. Hog deer could be walking or standing while stamping. This sound could not be heard by a human from more than 20 metres away. In one instance a two month-old fawn was seen ignoring its mother as she stamped while approaching a clump of grass in which a young palm civet was sleeping. The stamping doe attracted a buck hog deer, which came and investigated the grass, stamping once, again without startling the fawn. Possibly something in the behaviour of the adults indicated curiosity instead of alarm. Hog deer were seen to bark and/or stamp at palm civets, leopard cats, and at areas where nothing could be seen. Once a doe with a twelve day-old fawn barked at a low-flying hawk possibly to warn her young. In some of these areas the barking hog deer would be continually sniffing the air, indicating that a scent may have caused the alarm.

When a hog deer took flight, it ran under or through, but usually did not jump over, grass and brush. Only once was a hog deer seen jumping over an obstacle. A running buck carried its head down and its horns laid back along its shoulders. Generally the sound or sight of a running deer put other hog deer to flight.

Alert distance could not be determined because of the tameness of the deer. The hog deer had a tendency to run a short distance, 10 to 30 metres, and then seek cover and hide or slowly sneak away. SCHALLER (1967) describes similar responses for the Chital (Axis Axis).

Mother and young: Four hog deer were born in the course of the study in November, January, February, and March. The fawns were spotted all over and had dark coats at birth. As they grew older their coats became lighter and the spots faded, starting at the fore-quarters and eventually leaving only the two rows of spots down the back which is normal in adults. (Figure 2).



FIGURE 2 HOG DEER FAWN AGED ONE MONTH

WALTHER adapted by LENT (1974), described two types of relationships between ungulate mothers and their young; the "follower" relationship where the young begins following its mother almost immediately after birth and "hiders", which have a period during which they hide for a large part of the day, and begin following their mothers after some time.

Of the four fawns born in the enclosure during these observations one was seen with its mother within two days of birth. The other three were seen with their mothers only at twelve to twenty days after birth, indicating that hog deer fawns had a "hider" relationship with their mothers. Hog deer showed other traits characteristic of hiders in that mothers sought out fawns at their hiding places and fawns sometimes moved in front of their mothers rather than behind.

When a hog deer fawn went to a hiding place, its mother did not accompany it. Fawns sought their own hiding places, and their mothers called with a squeak as they approached the place. Fawns often squeak while seeking their mothers. The squeak was a soft sound, similar to the whine of a male hog deer or the squeak of an excited barking deer. This sound was repeated frequently. No fawn other than a doe's own was seen responding to the doe's squeak. Schaller (1967) reported that he encountered chital does and fawns searching and emitting nasal bleats; this may be comparable to the hog deer's squeak. One doe was

seen to leave her month-old fawn in bamboo as she approached people and then returned, squeaking for it, 15 minutes later. Three times does were followed by the author as they squeaked and, were seen to be joined by their fawns.

Nursing : A hog deer fawn approached the mother from the front, its body at an angle of approximately 45 degrees to the mother. The fawn showed its intent to nurse by approaching its mother with head lowered, nose directed slightly upwards and neck outstretched. If the fawn was large, it had to also stoop with its shoulders. Fawns were seen nursing eight times. The length of time spent in nursing varied from 30 seconds to five minutes (mean 92 seconds). The fawn seen to nurse for five minutes was 10 days old; the nursing was almost continuous. Fawns were seen attempting to nurse and being rejected six times. When a doe did not want her fawn to nurse, she allowed the fawn to duck its head under her body and then lifted the hind foot nearest the fawn and stepped over the fawn's head and neck. The doe would then usually walk a few metres away. A year old fawn was seen trying to nurse after its mother had given birth again, and his mother stepped over his head. The oldest fawn allowed to nurse was 6 months old. Fawns older than 3 months were rarely seen nursing. When a strange fawn moved close to a doe in an attempt to nurse or, in some cases, when a deer came too close to a fawn, the mother nipped at the intruder.

Sniffing and grooming: Hog deer fawns could single out does, and does could distinguish between fawns, by smelling. Four times does were seen sniffing at fawns, three times fawns were seen sniffing at does, and twice does and fawns touched noses. Fawns sometimes tried to smell the wrong doe and got nipped.

A doe with a young fawn would often groom the fawn after smelling it or being smelled by it. The oldest fawn seen to be groomed was 28 days old. The doe licked the fawn's ears, head, sides, legs, and anal area; grooming usually began at the anal area in young fawns (Figure 3). KITCHEN (1974) says that when a Pronghorn doe licks a fawn's anal area, she is consuming urine and feces. This is possibly also true for hog deer, as young fawns were never seen to defecate or urinate.



FIGURE 3 DOE GROOMING FAWN

Grooming of fawns with no licking of the anal area was seen only twice. On these occasions the doe licked the fawn's sides or head and groomed for less than one minute. When grooming a young fawn, a doe spent from one to three minutes at the task.

Fawns sought out their mothers when frightened and often attempted to nurse or smell their mothers when the danger had passed. Sometimes frightened fawns gave all observable signs of alarm without disturbing their mothers. The reverse was also observed, as described above. Possibly this was due to some action which indicated curiosity rather than alarm to the other deer but which the author failed to recognize as such.

**Play**: When fawns played with other fawns or does, play consisted of hopping, kicking, or running back and forth over a short (3 to 10 metres) distance. In a form of play that was seen frequently one fawn would hop and kick near its mother, directing its play activity towards the doe while she fed quietly. Twice fawns were seen rubbing up against and smelling each other. Once a fawn rubbed its head up against its mother after playing.

A fawn and a yearling were once seen in a play "fight". This may have been caused by a serious fight between adult bucks which had just taken place in sight of the yearlings and the fawn. The play "fight"

started with a presentation of heads as if the heads had antlers. The yearling and fawn then butted heads and started jumping and hopping around each other, butting sides and rumps. This lasted for nearly five minutes.

Following responses : Following seemed to largely be a matter of staying close together. If the doe wandered or was frightened off, the fawn followed; if the fawn wandered or was frightened, the doe followed. Does and fawns were often found separated after the fawn's second month, but they ware usually seen together in the late evening. Fawns may have been seeking company, as fawns were often found in groups of two and three or with the yearling buck. The male yearling was still feeding with its mother in the evenings up until six days before the mother gave birth to another fawn. Twice fawns stayed with their mothers even when the mothers were being herded by a male.

Feeding behaviour : Feeding activity in the enclosure varied with weather. Hog deer were seen feeding at all hours between 05:00 and 22:00. The lack of observations between 22:00 and 05:00 may have been due to difficulty in approaching the animals after dark, when they would run or sneak into the brush if approached. Hog deer feeding had no recognizable pattern. One doe was followed feeding from 16:50 until 22:00 while on the same day a buck was bedded from 18:06 until 20:45. Possibly the female required more food, as she had a two-month old fawn; however a male was often seen feeding while a female rested, or one male fed while another male rested. The only recognizable patterns were associated with weather. (See below).

The deer generally began feeding in the bamboo scrub or meadow where they had rested during the night. The cool of the morning was spent grazing in or on the edge of meadows, moving into the brush or forest as the day grew hotter. In the afternoon feeding began in the brush or forest, and the deer moved into the meadows to feed as the air cooled again. Hog deer grazed much more than they browsed. Estimates made of relative use ranged from 50 to 90 percent grass. Counting bites on one occasion gave 75 percent grass. On another occasion

a male was seen to take only two bites of plants other than grass in an hour's feeding. The author's best estimate would be 80 percent grass, and 20 percent forbs and browse.

Hog deer sought feed by smell. A deer typically smelled a leaf before beginning to feed on the plant. Deer were often seen to pass over tubers in plain sight, only to find them later when sniffing for them. Several times deer found tubers by smell which had rolled out of sight under a rock.

Hog deer were never seen breaking down small trees as sambar deer do, though hog deer would feed on trees after sambar had broken them down. Hog deer did, however, straddle tall stalks of hairy grass (Pennisetum purpureum) and push them down to get at young leaves near the top of the stalks. Once a buck was seen eating the bark of Dalbergia discolor after thrashing the sapling until the bark was hanging in strips.

Within two months of introduction the hog deer had created a series of trails through the high grass and brush of the enclosure. These trails were 8 to 10 inches wide at ground level and about 20 inches high.

Drinking was observed during all daylight hours but never after dark. There was a marked tendency to drink during the rest period when it was hot. Deer were frequently seen drinking at about 11:00.

Table 1. Lists of plants fed on by hog deer.

Name of plant

Comments from field notes

1.	Bridelia tomentosa
2.	Imperata cylindrica

heavy use-old grass not preferred

3. Eupatorium odoratum

4. Grewia elatostemoides

5. Streblus asper

6. Pennisetum purpureum

7. Wrightia javanica

8. Mecopus nidulans

9. Desmodium pulchellum

heavy use heavy use heavy use-preferred heavy use

heavy use

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	Name of Plant	Comments from field notes					
10.	Dalbergia discolor	heavy use, leaves and bark taken					
11.	Dalbergia foliacea						
12.	Polyathia craibii						
13.	Indigofera sp.						
14.	Allophylus montanus						
15.	Cassia pumila	moderate to heavy use					
16.	Albizzia lebbekoides	heavy use					
17.	Cyrtococcum accrescens						
18.	Setaria pallidefusca	heavy use					
19.	Brachiaria distachya	moderate use					
20.	Cassia fistula	moderate use					
21.	Glabba sp						

Pennisetum purpureum was the most preferred plant in the enclosure, though Imperata cylindrica was more prevalent and so eaten more than Pennisetum; where the two grasses grew together the Imperata was ignored in favour of Pennisetum. Fertilizer spread on small areas seemed to increase the use of all plants in the area.

# Reaction to weather :

Heat: The temperature partially controlled the feeding and resting activities of hog deer. On hot days feeding activity ended at 08:30 and began again after 16:30. On cool days feeding might continue all day with some animals resting while others fed. When the observer was uncomfortably hot in direct sunlight, the deer generally quit feeding, sometimes rising from their beds later in the day to feed briefly. On cloudy or cool days the feeding period was extended later into the morning and began earlier in the afternoon; on some days during the rainy season and the cold season there was at least one deer feeding at all times during day-light hours.

*Rain*: In a light rain the deer continued feeding or stood quietly under bamboo chewing their cud. Sometimes, especially on cool rainy mornings, adults and fawns played. They jumped at each other or ran back

and forth over a distance of 10 to 20 metres. In a heavy rain hog deer stood with their rumps close to the centre of a clump of bamboo or the trunk of a small tree. They did not face into a storm but faced away or stood broadside to it; some hog deer did lie down when it rained. If the rain continued for over half a day, the deer began to go about feeding normally. Aggression and sexual interactions were observed during long periods of rain.

Wind: Wind seemed to have little effect on hog deer. On windy mornings hog deer grazed for unusually long periods of time, possibly due to cooling effects of the wind.

**Resting**: Hog deer were seen to bed in one place for as long as  $2\frac{1}{2}$  hours. On a hot day two males were seen resting in the shade from 10:00 to 15:00, rising occasionally to change position or feed briefly. They did not always return to the same bed but stayed in the same area. The feeding and stretching periods usually lasted less than 10 minutes. Beds were changed every 5 to 60 minutes during the day and used for up to  $2\frac{1}{2}$  hours at night.

Hog deer generally bedded under bamboo or young trees, often within 30 meters of a meadow. The deer put their backs to an obstacle, such as a clump of grass or bamboo, and faced the trail or opening. While feeding deer sometimes bedded in grass, usually in the shade of high grass or a small tree.

## **Sexual Interaction**

Hog deer in the enclosure at Khao Khieo displayed no distinct breeding season; sexual activity was observed during each month of the study. The author's notes show a peak of sexual activity in January, February, and March of 1975, the same months in which does were giving birth. The increase in sexual activity consisted of an increase in attention paid to does in the first month to six weeks post-partum. According to Schaller (1967) hog deer in India may have a breeding season extending from July through October. U TUN YIN (1967) stated that hog deer give birth in May and June in Burma and that rut takes place in September and October. Schaller (1967) stated that births

generally took place in April and May. Both authors agreed on an eight-month gestation period, which would suggest that the breeding season in the Khao Khieo herd began in March and ended in July. The most frequently seen sexual activity was herding and/or following of a female by a male hog deer. In herding, a male aggressively followed a female, attempting to get close enough to lick or smell her genital area and to mount her if possible. While herding, the deer might walk, trot, or run. At times a male followed a female without making aggressive attempts to get close to her. While herding the male followed within 10 metres of the female. The buck held his head and neck outstretched, nose nearly horizontal, and head at the level of his shoulders or slightly lower. (Figure 4). Extension of the buck's penis and raising of his tail indicated a more intense reaction to the doe.



If the buck caught up with the doe, he may have licked her urogenital area, but the doe would often not allow this. Does in heat or recently post-partum were usually licked. Otherwise, the doe was smelled or prodded under the tail by the buck's nose. Does, whether in heat or not, did not usually allow bucks to approach within one metre and sometimes moved away when a buck came within five metres; the buck was allowed to smell the doe's rump in less that 10 percent of the instances of herding or following.

One doe, which gave birth on November 20, was seen being herded on November 28 by the herd's dominant buck, whose antlers were still in velvet. Once when the deer were alarmed and scattered, the herding

buck ran back and forth squeaking until he found his doe. The buck was seen herding the doe on 12 occasions between November 28 and December 12 and once attemted to mount her. Another doe gave birth on January 20; bucks began herding her on January 24 and continued at least until February 20, possibly longer. On January 24 and February 20, the dominant buck was seen herding the doe, squeaking as they trotted and ran. On February 15 a large fawn, possibly the yearling buck, was seen attempting to copulate with this doe. The bucks herding of the does occurred, almost exclusively, soon after does gave birth. Bucks were seen following does, without aggressive actions of herding, throughout the year.

The squeaking sound made by bucks while herding does resembled the whine or whimper of a dog. The sound was very short and was repeated without pattern. It was heard only four times, the first on December 4 and the last on January 24, each time under similar circumstances: the buck was following a doe which had given birth within the last five weeks, and the buck was highly excited, usually with his penis extended, observed in one buck only.

Attempted or successful mounting of females was seen in June, December (twice), January, February, and April. The buck followed the doe (in one instance for more than one hour), attempted to lick or licked the doe's urogenital area. The buck then tried to place his chin on the doe's rump, lifted a foreleg, and attempted to mount. If the doe then walked out from under the buck but stopped again shortly, the buck attempted to mount again without preliminary movements.

"Flehmen", in hog deer is similar to that described for other ungulates. The buck lifted his head, pointing neck and nose up about 45 degrees from the horizontal, and curled back his lips (Figure 5). The male generally exhibited flehmen when he tasted the urine or licked the vulva of a female. Occasionally a buck exhibited flehmen when he sniffed the ground where a doe had just urinated. Flehmen did not seem to be connected with estrus (heat) in does.



Some behaviour patterns and movement were not seen often enough to be included in a general description of sexual behaviour. Twice males were seen raising their necks and noses high in the air while following a female; they may have been smelling. Once flehmen was seen in a doe. Thrashing and swirling (see page) were seen in a sexual context three and four times respectively. A female was also seen licking a male twice, once on the head and once on the rump.

Seasonal variations: The breeding cycle will be discussed in the section on breeding behaviour. Two annual events are discussed in this section: the change to the summer coat and the antler replacement cycle.

During most of the year the hog deer at the Khao Khieo enclosure had dark brown coats, becoming darker at all four knees. Some males had a more yellowish coloration on the neck and head. All deer had two paralled rows of spots about five centimeters apart running along the backbone to the shoulder. (Figure 6).



FIGURE 6 COOL SEASON COAT

In late March and early April some adult hog deer developed spots in a random pattern over their sides, and the row of spots on the back became more distinct. (Figure 7).



FIGURE 7 SUMMER COAT

The fawn born in November lost its spots and then regained them at the same time as did its mother. Some deer did not develop the spots on the side but in all deer the double row of spots on the back became clearer. The coats became unspotted again in June.

Three adult male hog deer at Khao Khieo shed their antlers within three weeks, beginning October 15. All the bucks then came into hard antler between February 5 and February 13. A new male was received at Khao Khieo in early March with antlers still in velvet. The yearling male, one year old in February, began to show antler pedicles in March and actually started antlers in late April.

## Interrelations with Other Species

Hog deer bucks often challenged and sometimes fought the sambar buck. Serious injury to hog deer bucks occurred on a few occasions when they became caught in brush or against the wire fence and so were unable to flee from the sambar after losing a fight.

One male hog deer frequently followed sambar does, attempting to mount. When the male was bitten by sambar does after attempting to mount, he moved off only one or two metres unless chased.

The Eld's deer doe has twice aborted dead fawns before full term, once after being caged with a hog deer and once when caged with sambar and hog deer bucks, indicating a relatively weak reproductive barrier between hog deer and Eld's deer.

Barking deer were seen to interact with hog deer only once, when a hog deer doe bit a barking deer doe.

Table 2. Behaviour patterns of hog deer during the study.

Months seen	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
Behaviour pattern												
Males following or herding	v	v	v	v		v	v	v	v	v	v	
Temate.	Λ	Λ	Λ	л		Λ	Λ	Λ	A	л	л	
Attempted mounting	x						х	х	x		x	
Male squeaking							х	х	х			
Male smelling female's run	ıp		x	x		x	х	x		x		
Male licking female's run	np						x	x			x	
Mole								160			41.46	
wailing									х	х		x
Births						Х		Х	Х	X		
Serious												
fights	Х	X							Х	Х	Х	
Swirling		Х	Х	Х	х		х	x	х	х	х	
Males												
herding mal	es	X	X		X		X		X	X	X	X

## **Agressive Behaviour**

Agressive behaviour involving bucks was seen through out the year, though there was a reduction in aggressive behaviour immediately after the males lost their antlers. However, herding of other males and threatening behaviour resumed when antlers were about six inches long and in velvet.

When the hog deer were first introduced to the Khao Khieo enclosure, the males became especially aggressive for a period of about two months, until a dominance hierarchy was established. The bucks again became especially aggressive for approximately one month after their antlers became hard. During this period the dominance hierarchy, which had never really collapsed while antlers were in velvet, was reinforced. This second period was not as intensively contested as the first period.

During the study period only eight serious fights were seen, all but two between the first and second bucks in the hierarchy. The third buck had underdeveloped antlers his first year and could not lock antlers for a fight. He was seen several times attempting to fight with other males, but when they could not get a good interlock of their antlers, they always stopped, shifted their head positions slightly, and resumed pushing and thrusting, only to stop again. The third buck's inability to interlock antlers may have lowered his frequency of interaction until he shed his abnormal antlers and regrew normal ones.

A hog deer buck's most serious challenge is a broadside display. In a broadside display, the buck arched his back and neck, holding head above shoulder level, with nose pointed down and antlers held slightly forward of the normal position, and approaches in a stiff, slow, sideways walk. (Figure 8). The broadside display always led to a fight or to the flight of the less dominant buck.

When using this display, a buck might walk directly towards another and change to the sideways walk only when within five metres. A buck might extend his penis and/or flare his preorbital glands, but

these may have been purely individual embellishments, as one of the two bucks which was often seen in broadside display added them, while the other only occasionally flared his preorbital glands and was never seen to extend his penis in broadside display. The full broadside display was very seldom seen. The usual displays could almost be described as preliminary to broadside display movements. If the dominant buck arched his back and neck slightly or stiffened his walk, a little while raising his head to broadside display position, this was usually enough



FIGURE 8 BROADSIDE DISPLAY

to move any deer out of his way or to force the second male up from his bed. Everytime two males gave the broadside display simultaneously, the immediate result was a serious fight.

Twice hog deer fights lasted as long as 30 minutes. The deer fought with horns interlocked, pushing, occasionally separating only to meet again within a few seconds. Twice two males separated and then came

together with a sapling between them. They sparred without touching until they separated again and drifted past the sapling. Hog deer fought with heads held so low that at the end of a fight both males had often rubbed all the hair and hide off the upper surface of their noses. During the long fights the deer sometimes rested for as long as one minute with horns interlocked, noses and antler tips pressed to the ground. (Figure 9).

At the end of a fight the beaten buck fled, with the winning buck following at a fast walk. If the beaten deer fell as he turned to flee, the winning buck jabbed the fallen deer with his antlers. The winner herded



FIGURE 9 RESTING DURING FIGHT

the loser for up to 30 minutes after the fight, not allowing him to stop or graze. In addition when the winner met the loser during the following week or two, he would begin herding him. The herding male held his head up, neck slightly arched, bringing the antlers forward, and walked more stiffly than usual. The buck being herded walked with his head lower than his shoulders and his antlers in normal position (Figure 10). It is believed that this was an attempt by the dominant male to force the subdominant male to leave the area.

Males were often seen to lower heads and push on each other with a minimum of display beforehand. These pushing bouts lasted from thirty seconds to five minutes and seemed to end on mutual consent. Rarely could a dominant or subdominant be determined after a pushing bout. The amount of display before a pushing bout, ranging from none to nearly a full broadside display, seemed to determine the amount of submission required of the loser after a pushing bout. If there was no

preliminary display before a pushing bout, no submission was required. When submission was required, the subdominant buck would lower his head, holding antlers in normal position, and move away from the dominant.



FIGURE 10 MALE HERDING ANOTHER MALE

Bucks often thrashed grass and small trees with their antlers seemingly for display. Though once a deer was seen eating the strips of bark hanging on a tree he had just thrashed. This was a low intensity display which called for little or no reaction on the part of other males. If two bucks began thrashing in the same area, they might have a pushing bout or ignore each other. Thrashing was also used as a prelude to the broadside display. Thrashing was the most often observed aggressive action. One male was twice seen to thrash in tall grass until he had dry grass draped in his antlers and then to begin a nearly full broadside display. The object of these displays was not clear, as no other deer were in sight and the observer was beyond the distance that usually attracted this male's attention.

A head shake was also used as a threat display. This movement was a jab in the air made with a circular motion, with the head about shoulder high. This was mainly used by the dominant male to move other deer from food or their beds. Once a pregnant doe used this movement to threaten the second male in the hierarchy.

A lowered head with antlers presented forward was used as a threat to force subdominants to move when they were feeding. Once a

buck presented his antlers in this lowered position, then arched his back and walked stiffly as in broadside challenge. The lowered head approach on some occasions was not an effective threat as the threatened animal twice did not move and had to be induced to move by prodding.

Biting or threatened biting was the most common aggressive behaviour seen in female hog deer. In the threat position the ears were laid back, neck and head outstretched, and teeth bared. Biting by males was only seen twice while biting by females was seen 22 times. This was the most common type of aggression shown by females. Any type of aggression in does was rare. Usually does bit, when they were in advanced stages of pregnancy or if a strange fawn tried to nurse; only three times were does seen to bite in other circumstances. Once a doe was seen to combine a stiff legged foreleg kick with the threat of a bite.

## **Dominance Hierarchy**

The male hog deer at Khao Khieo formed a definite dominance hierarchy. For the first ten months this hierarchy remained stable, with fighting only occuring immediately after release and after losing the velvet from new antlers. In late April, the dominant male was injured in a fight with the sambar male when he was caught up against the fence and gored. He became second ranked as a result, and after he regained his health, he was never again seen to make a serious attempt to become dominant. Whether this reveals some characteristic trait of hog deer or indicates that the buck's injury had not really healed or other factors is not known.

The two bucks were very different in their relations with humans and other deer while holding the dominant position. Igo, the first dominant buck, was very passive and could usually be approached by all other deer up to a distance of three metres. Igo also allowed does to graze next to him, almost touching him. Igay, the second dominant buck, was very aggressive, threatening all males at a distance of seven to ten metres and not allowing any does near him, except when herding them.

When Igo was dominant, Igay was afraid of his keepers, but after Igay became dominant, he knocked down and tried to gore one of his keepers.

The hierarchy of the does could not be absolutely determined, due to a lack of observed interactions. It was clear that a doe which was in the later stages of pregnancy or had a very young fawn was not frightened of deer which normally dominated her, bucks and does included. The weakest and lowest ranking doe nipped at the yearling buck on two occasions and threatened the second ranking buck with a head toss; these incidents occurred when she was either in very late pregnancy or shortly after she had given birth.

# Unclassified behaviour

Two behaviour patterns, swirling and spraying urine, could not be classified as either sexual or aggressive behaviour. Swirling was seen in connection with both sexual and aggressive behaviour. As for spraying urine, a low number of observations precluded classification. The author feels that these behaviour patterns may prove to be territorial. Territorial behaviour was hard to recognize in the small enclosure at Khao Khieo.

*Swirling*: Bucks were seen with their necks arched back over their bodies, noses pointing straight up into a low hanging branch. Their preorbital glands were flared open as they made a swirling motion, waving their noses and preorbital glands through the leaves. (Figure 11).

This movement apparently spreat a secretion from the bucks' preorbital glands on the leaves. This behaviour was recorded 20 times. The bucks often used the same branches for swirling repeatedly. Three bucks sometimes swirled in the same branches within ten minutes. On most occasions the stimulus that prompted the buck to swirl could not be determined. On three occasions the swirling was connected with sexual activities such as herding a female, and on other, more frequent occasions it was connected with aggressive actions. Swirling was a marking behaviour, and since only males gave any indication of noticing the markings (by using the same branches), the marks were probably intended for other males as part of a threat or territorial pattern. (Figure 11).



FIGURE 11 SWIRLING

*Wailing*: Only the dominant male of the herd was heard to wail. This sound was a cry similar to the prolonged wail of a human baby beginning to cry. While wailing, the buck stretched his head and neck out at an angle of 45 degrees from the horizontal. The wail was always connected with aggressive actions, such as after fights or when thrashing. The wail was only noted eight times; approximately ten more times other workers reported hearing the wail. Igo first wailed on February 20 and was last heard to wail on March 21. By April 12 Igay was replacing Igo as dominant male. On May 8 Igay wailed after threatening the observer. Igay was only heard to wail twice.

SCHALLER (1967) mentioned thrashing, pawing with foreleg, head up display, head down display, and sparring as representing aggressive behaviour for hog deer, but he did not describe these behaviour patterns in detail. It is interesting to note that pawing with the foreleg was never seen in the hog deer at Khao Khieo.

Spraying urine : Spraying urine was only seen three times, each time by the same buck. An official at Khao Khieo said that he had often seen this behaviour but could not give dates. When spraying urine the buck let his penis out of its sheath and urinated a fine stream, while lying down. The pressure of the urine caused the penis to whip around in a circular motion, spraying urine over the buck's body. The buck then turned his head and body back into the spray, his preorbital glands open. This behaviour was seen on May 5, 10, and 15. It seems likely that the substance sprayed was not pure urine but may have included other secretions. The author also believes that this is another form of scent marking, but again the function of the marking was not determined.

#### **Proposals for Conservation of the Species**

Hog deer are able to reproduce and maintain themselves in the enclosure at Khao Khieo. These deer seem to adapt themselves readily to the bamboo-Imperata grass habitat that is left after slash and burn farming in many parts of Thailand, such as in the enclosure of Khao Khieo. Many of the Game Sanctuaries and National Parks have large areas of this type of habitat. The hog deer also use forest areas between grass meadows, indicating that they could spread throughout a system of grasslands if distances between meadows were not too great. Water needs could not be evaluated at the Khao Khieo enclosure due to its small size, but water is thought to be the critical factor for hog deer in some areas. The Royal Forest Department, through its Division of Wildlife Conservation, is planning to build a larger enclosure for the breeding of rare unglates at Khao Khieo. It is proposed that this enclosure include ten rai per hog deer planned at maximum capacity. The figure of ten rai per deer developed from observations made immediately after release of hog deer into the present enclosure, when eight hog deer were then feeding over 35 rai and this proved too heavy usage. It is further suggested that not less than four rai of grassland per hog deer at desired carrying capacity be made available. However, these figures are only estimates.

The new enclosure should be surveyed for plant composition and prevalence of all plant species less than one meter in height before the hog deer are introduced. Once the deer are introduced, a feeding study should be immediately undertaken, including food preference, volume taken, seasonal feeding preferences, and effect of hog deer on the food species at various population levels.

The new enclosure should contain at least two meadows separated from the main meadow by forest. The use of these small meadows could then be monitored to judge if hog deer could spread throughout a system of meadows, forest, and brush for feeding, escape, and resting. Water usage, especially the distance from water that the deer will go to feed in both dry and wet seasons, should be evaluated, along with territoriality. It would also be useful to study the census of hog deer populations by indirect means. Completion of these proposed studies would enable forestry personnel to evaluate the capacity of a release site to support hog deer, to manage hog deer numbers in the wild, and to estimate hog deer population numbers and reproduction in an area. With this information the Royal Forest Department could then release hog deer into new areas and old areas which had been hunted out and be reasonably sure of success; hog deer population as either a huntable resource or as a tourist attraction.

It is suggested that the new enclosure be planned for 80 hog deer, as this would give an annual reproduction rate of approximately 25 young. With no new additions this level should be reached in 2523-24 (1980-81). Additions of newly acquired deer are suggested, as this would increase the size of the gene pool, as suggested by CowAN (1974).

It is suggested that when the population reaches this level, a herd of hog deer of approximately 20 animals should be released into suitable areas of habitat in other Game Sanctuaries each year. The herds possibly should contain all age groups of hog deer and comprise a unit

which normally occupied the same area, if hog deer prove to be territorial. It is possible that young deer will relocate better than old deer (HoLLOWAY, 1973). If this proves to be so, the method of selection of deer for release should be changed. Possibly the best release method would be to transfer the animals to a release area and put them in an enclosure. Once the hog deer have become accustomed to the new area, the gates of the temporary enclosure should be opened with as little fuss as possible and the deer allowed to drift out on their own. This release procedure may reduce the shock and scattering of animals which results from release from crates immediately upon arrival in a new area. Releases should be well publicized to create interest and possibly aid in control of poaching. The first herds released should subsequently be studied to evaluate their success in adaption and reproduction and to improve release methods.

These methods may prove useful for other species but care should be taken before other species are introduced into the same enclosure. A small population of sambar or barking deer in the enclosure would probably help control plant species which hog deer do not eat, but sambar and barking deer populations would require control to keep interspecific competition for food, water, and space to a minimum. If Eld's deer are to be bred, it would probably be best to keep them in an enclosure free of hog deer and sambar deer as one Eld's deer doe has proven partially fertile (two aborted young) with hog deer, and sambar does became very aggressive toward the Eld's deer doe. Due to the rarity of this species in Thailand, great care should be taken to insure maximum fertility and reduce chances of premature death. Visitors to the breeding centre's large enclosures must be limited to viewing from towers outside of the enclosure. This will reduce but not remove the chance of accidental poisoning of deer by visitors (plastic bags, wire, paper, and cloth are eaten), allow research to be conducted under naturalistic conditions, maintain reproduction rates (repeated disturbance is believed to reduce

reproduction) and allow animals to become wild enough to be successfully introduced to the wild. Khao Yai National Park and Khao Soi Dao, Thung Yai, Huai Kha Khaeng, and Phu Khieo Game Sanctuaries could be release sites. Major problems at the Game Sanctuaries will be transporting the deer and poaching. Major advantages are that these areas are generally lightly used by other game species and are under the control of the Division of Wildlife Conservation. The major problems at Khao Yai National Park will be the possible disturbance of the hog deer by the large numbers of visitors to the park and problems in cooperation between divisions of the Forest Department. Major advantages at Khao Yai are relatively good protection from poaching and easy access for transporting animals and follow-up research.

The author feels that the above proposals will produce the best deer possible for release into grassland habitat created by man's activities in protected areas, at the least possible cost.

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