UNIVERSITI PUTRA MALAYSIA

A COMPARATIVE BEHAVIOUR STUDY OF THREE DEER SPECIES UNDER FARM MANAGEMENT SYSTEMS IN MALAYSIA

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BY

ZAITON AHMAD

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"MAY ALLAH BLESS US ALL IN OUR FUTURE ENDEAVOUR"

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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July 1997

Chairman : Assoc. Prof. Dr. Dahlan Ismail

Faculty : Veterinary Medicine and Animal Science

The objectives of this study were: 1) to compare the grazing behaviour of three deer species viz. *Cervus timorensis*, *Dama dama* and *Axis axis* farmed under similar conditions - on the Right-Of-Way (ROW) of Petronas Gas Sdn. Bhd. (PGSB) - a strip of land measuring 40 meters wide carrying the gas pipeline; 2) to determine the stocking rate for each deer species; 3) to determine the most suitable species to be farmed in Malaysia in general and specifically on ROW; 4) to determine a suitable management system relating to the animal behaviour, pasture use and stocking rate. Data collection for this study were conducted from July 1993 until August 1995 and were carried out at PGSB, Parit Baru and Ceremin Kiri Deer Farms and Dewan Bandaraya Kuala Lumpur (DBKL) Deer Park. All three deer species showed similar grazing behaviour represented by a bi-modal pattern with two major peaks. They were observed to graze predominantly at night (*A. axis* - 30.8%, *C. timorensis* - 41.7%, *D. dama* - 16.7%) indicating their nocturnal nature. *D. dama,* being a temperate species also exhibited modification of grazing behaviour due to high

temperature conditions (mean daily maximum temperature - 34.5^{o}C) on ROW. Overt heat stress was exhibited by *D. dama*. Deviation from natural patterns due to supplementation was also noted in all three deer species. Experiments on intake of different sub-groups (matured males and females, and juveniles) of *C. timorensis* revealed that juveniles showed the highest intake (1.34% of live body weight), followed by matured males (1.19%) and the least by matured females (1.10%). However, these rates were very much lower than those obtained from other studies that did not include supplementation. Stocking rate was found to be highest when using *Panicum maximum* with 26.73 heads per hectare for *A. axis*, 19.09 heads for *C. timorensis*, and 24.30 heads for *D. dama*. The least number was recorded for native pasture. *C. timorensis* was concluded to be the most suitable species to be farmed commercially in Malaysia followed by *D. dama* and the least was *A. axis*. The management system which was found to be suitable on ROW would be that which provides ample shade preferably vegetative in nature, especially when *D. dama* was being used. Improved pasture using *Panicum maximum* would ensure optimum production since stocking rate was found to be highest when compared with other grass types. The possibility to habituate *D. dama* was seen at DBKL Deer Park, while at the other three farms 'adoption' phenomenon was observed in *C. timorensis*. These factors could be exploited to optimise production.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia, sebagai memenuhi keperluan untuk mendapat Ijazah Master Sains.

KAJIAN PERBANDINGAN KELAKUAN ANTARA TIGA SPESIES RUSA DI BAWAH SISTEM PENGURUSAN PERLADANGAN DI MALAYSIA

Oleh

ZAITON AHMAD

Julai 1997

Pengerusi : Prof. Madya Dr. Dahlan Ismail

Fakulti : Kedoktoran Veterinar dan Sains Peternakan

Tujuan kajian ini ialah untuk 1) membandingkan kelakuan peragutan antara tiga spesies iaitu *Cervus timorensis*, *Dama dama* and *Axis axis* yang diternakkan dalam keadaan yang serupa iaitu di atas Right-Of-Way (ROW) milik PETRONAS Gas Sdn. Bhd. (PGSB) - sejalur tanah berukuran 40 meter lebar yang menempatkan paip saluran gas; 2) untuk menentukan kadar penyimpanan untuk tiap-tiap spesies rusa tersebut; 3) untuk menentukan spesies yang paling sesuai untuk diternakkan di Malaysia secara amnya dan di atas ROW khususnya; 4) untuk menentukan satu sistem pengurusan yang mengaitkan kelakuan haiwan, penggunaan padang rumput dan kadar penyimpanan Data untuk kajian ini telah dikumpulkan antara Julai 1993 hingga Ogos 1995 Ladang-ladang Ternakan Rusa PGSB, Parit Baru dan Ceremin Kiri dan juga di Taman Rusa Dewan Bandaraya Kuala Lumpur (DBKL).Ketiga-tiga spesies rusa telah menunjukkan kelakuan peragutan yang serupa yang digambarkan oleh corak bi-modal dengan dua puncak dan satu penurunan diantaranya. Ketiga-tiga spesies juga diperhatikan lebih banyak melakukan peragutan diwaktu malam (*A. axis* 30.8%, *C. timorensis* - 41.7%, *D. dama* -16.7%) menunjukkan tabiat malaman

mereka. *D. dama* yang merupakan spesies temperat telah mempamerkan ubah-suaian ke atas kelakuan peragutan akibat suhu harian yang tinggi (min suhu harian maksimum - 34.5^{o}C) di atas ROW. Ketegangan haba yang nyata telah juga dipamerkan oleh *D. dama.* Penyimpangan dari corak semulajadi akibat penambahan makanan telah juga diperhatikan dalam ketiga-tiga spesies rusa. Ujikaji keatas pengambilan makanan yang dijalankan ke atas kumpulan bawahan (jantan matang, betina matang dan juvenil) telah dijalankan ke atas *C. timorensis* telah menunjukkan bahawa kumpulan juvenil mempamerkan kadar pengambilan makanan yang tertinggi (1.34% dari berat badan hidup), diikuti oleh kumpulan jantan matang (1.19%) dan paling kurang ialah kumpulan betina matang (1.10%). Walaubagaimanapun, kadar ini adalah sangat rendah berbanding dengan kadar yang diperolehi dalam kajian-kajian di mana pemakanan tambahan tidak disediakan. Kadar penyimpanan yang tertinggi diperolehi apabila *Panicum maxicum* digunakan dengan 26.73 ekor sehektar untuk *A. axis*, 19.09 ekor sehektar untuk *C. timorensis* dan 24.30 ekor sehektar untuk *D. dama.* Rumputan asli telah mencatitkan kadar penyimpanan yang terendah. *C. timorensis* telah disimpulkan sebagai spesies yang paling sesuai dan berpotensi untuk diternakkan secara komersil di Malaysia. diikuti dengan *D. dama* dan yang paling tidak sesuai ialah *A. axis*. Sistem pengurusan yang didapati sesuai untuk keadaan di ROW adalah yang memberi banyak teduhan sebaik-baiknya dari tumbuhan terutamanya apabila *D. dama* diternakkan. Perumputan membaikkan yang menggunakan *P. maxicum* akan menjaminkan penghasilan optimum kerana kadar penyimpanan adalah yang tertinggi berbanding dengan jenis-jenis rumput lain.

Kemungkinan untuk menjinakkan *D. dama* telah diperhatikan di Taman Rusa DBKL sementara fenomenon 'anak angkat' telah diperhatikan di ketiga-tiga ladang yang lain. Faktor-faktor ini boleh digunakan untuk kebaikan dalam mendapatkan penghasilan optimum.

CHAPTER I

INTRODUCTION

In Malaysia, deer farming is fast gaining popularity (Vidyadaran *et al.*, 1993), thereby presenting an alternative to diversification in the livestock production industry. Currently, Malaysia has about thirty-five deer farms holding more than 5000 heads of deer from eight different species (Dahlan *et al.*, 1995), the favourite species being those of intermediate sizes for economic reasons. Some examples of the species are *Cervus elaphus* (Red deer), *Cervus timorensis* (Timorensis or Rusa deer), *Dama dama* (Fallow deer) and *Axis axis* (Axis or Chital deer).

In other parts of the world, these species besides being farmed for the production of venison and other deer products, are also being capitalized for recreational purposes as in game hunting and as attraction in the tourist industry - in zoos and deer parks. Nara, a unique township in Japan has been successful in breeding tamed deer that comfortably roam the park and town (Miura, 1975).

For the purpose of this study, a definition for farming management system which was based on a definition given by Giles and Stansfield (1980) was adopted. It is defined as a system that is comprised of a comprehensive activity that involves a combination and co-ordination of resources which includes human, animals, financial as well as other physical structures that are available resulting in a successful and viable project. In this case, the PGSB Deer Farm had to be managed into a viable and environmentally sustainable project through optimum exploitation of the various resources. This study concentrated on the management of two of its resources which were the deer and its environment which includes pasture and other physical structures.

Interaction of behaviour patterns of an animal and its habitat bears an influence on its productivity. Specifically, ingestive or grazing behaviour has been known to be one of the major limiting factors in animal production as implied by Forbes (1986).Thus, it is essential that the biology and management of specific animals under local production conditions be fully understood. This was found to be necessary since much research on deer species had been carried out in temperate and other tropical countries but to date relatively very few of such studies have been conducted specifically in Malaysia.

The objectives of this research are:

- to study the grazing behaviour patterns of three deer species viz. *Axis*

axis, *Cervus timorensis* and *Dama dama* and how these behaviour traits were modified by environmental and husbandry practices

- to identify the behaviour traits which could be exploited for more successful farming of these animals
- to evaluate the optimum stocking rate on various types of pasture on ROW of Petronas gas pipeline.

CHAPTER II

LITERATURE REVIEW

Grazing

One of the main maintenance activities of an animal is feeding - as grazing in grazer and browsing as in browser. Thomas (1947) defined a grazing animal or grazer as one which obtains either the whole or major part of its diet, usually grass, in a field on which the diet has been produced. Later, Arnold and Dudzinski (1978) defined grazing as a physical activity involving the selection of herbage, its prehension, mastication and swallowing. While El Aich *et al.* (1989) defined grazing as a general activity of head down or moving between feeding stations which according to Novellie's (1978) definition is the area in which ungulate feed without moving both front legs. These definitions were thus adopted for the purpose of the field observations.

Efficient animal production depends on adequate levels of voluntary intake (Forbes, 1986). This implies that one of the limiting factors in animal production is

their ingestive behaviour which comprises of three separate components: grazing time, intake per bite, and prehension or biting rate. Intake per bite and prehension or biting rate can be defined as rate of intake. These three components, with other grazing behaviour traits form a part of the grazing behaviour pattern of a grazer.

Environmental factors, physiological attributes and state of the animal (whether wild, feral, domesticated or under management) also contribute to variation in grazing behaviour patterns. Sensitivity to environmental variables such as air temperature, wind velocity and barometric pressure especially during winter grazing was shown by Malachek and Smith (1976) while Adams *et al.* (1986) hypothesized that forage intake fluctuates with temperature changes. Thus knowledge of the complex interactions between environmental, plant, animal and managerial influences is vital to develop an understanding of how plants and animals respond to various grazing management schemes (Stuth *et al.*, 1987).

Two bodies of theory have been used to explain animal foraging behaviour, i.e. optimal foraging theory (OFT) (Belovsky, 1984 and Pyke, 1984) and learning psychology (Staddon, 1983). Similar to the later theory by Staddon (1983), Penning *et al.* (1993) suggested that animals use behavioural cues to modify grazing time while Bailey (1988) and El Aich *et. al.* (1989) suggested a hypothesis that animals are using memory-based mechanisms to make spatial decisions. Similarly, El Aich and Rittenhouse (1988) rejected the null hypothesis that animals are using their

habitat in a random fashion and that response can be explained by mechanism that animals regulate their rate of walking and grazing based on the level of reinforcement provided by food supplies alone. Crawley (1983), though, had suggested that food, being the only factor determining herbivore spatial distribution, would influence the animals to congregate in the best patches of habitat, assuming that there is little direct or interference competition for food within groups of grazing herbivore (Wittenberger, 1981). Similarly, Senft *et al.* (1985) also suggested that foraging of free-grazing animals operates at different levels, e.g. habitat, plants and plant parts, while Staddon (1983) showed that many animals exhibited a matching response to food supply .

A number of grazing systems had been suggested. Of these, the two most common are:

1) continuous grazing which allows unrestricted selective grazing of available plant communities and species throughout the growing season, often leading to a frequency and intensity of defoliation which eventually reduces the vigour and productivity of preferred species (Kothmann, 1980)

2) rotational grazing, which is a grazing method in which a pasture is intermittently grazed to improve managerial control of the frequency and intensity of defoliation (Hodgson, 1979; Kothmann, 1980 and Stuth *et al.*, 1985). Different responses in animal performance and vegetative composition may result from the unique way each grazing system manipulates grazing behaviour and forage

consumption. In other words, animal movement is not controlled under continuous grazing, while timing and location of grazing is controlled by management in rotational systems.

Diurnal Grazing Pattern

Nielsen (1958) had suggested that one of the basic factors considered when dealing with grazing behaviour patterns is when does a group of or an animal concentrate mainly on grazing activity only. Animals, except for nocturnal ones, are generally more active during the daylight hours than at night.

Diurnal rhythm or patterns developed due to physiological reasons when animals adjusted their daily activities to environmental conditions. Usually animals concentrated on feeding activities when temperature is low to avoid heat stress. This resulted in a bimodal pattern with peaks during the early morning hours and late evenings as has been observed by Arnold and Dudzinski (1978). They had also defined major grazing periods, as periods when all the animals in a flock or herd will be grazing. In contrast, secondary or minor periods occur between major grazing peaks (periods) during which only part of the herd will still be grazing lightly.

Studies conducted in the Northern hemispheres by Hughes and Reid (1952) and in the Southern Hemisphere by Arnold (1962) had revealed similar findings.

Infact, they had also found that as the days get shorter, the breaks between grazing periods decrease until midwinter, where in latitudes 35^{o} or more, grazing is almost continuous during the day.

In tropical climates, Payne *et al.* (1951) in their study with cattle showed that grazing occurred predominantly at night. This, however, is not always the case as shown by Harker *et al.* (1954, 1961), Smith (1959), Mugerwa *et al.* (1973), Ruckebush and Bueno (1978), and Alhassan and Kabuga (1988). They had observed two major grazing peaks which occurred during the day and a minor one at around midnight. Arnold and Dudzinski (1978) concluded that temperature and humidity regulate the times that grazing periods begin and end. This explained why grazing was intensified when cloud cover was high.

Basically, a grazing animal forages by grazing, browsing and/or feeding on supplements when under management. Variation to natural daily diurnal patterns can be expected from populations under management. Holder (1962) showed that feeding supplements to grazing animals reduces their grazing time, particularly when a concentrated ration is used. Since the studied population was managed on concentrate rations as well as cut and carry grass when pasture was low, it is hypothesized that the amount of both the concentrate rations and cut and carry grass, as well as the time the animals were given the rations will affect the diurnal pattern.

Activity Budget

Animals were found to have a tendency to perform certain activities more than the others. This could be due to adaptations to physiological and also environmental conditions which regulate their daily behaviour. Miura (1981) divided the behaviour acts of animals which were carried out constantly throughout the day and night into four categories:

- resting (lying on the ground),
- feeding (grazing and/or browsing),
- moving (locomotion),
- other acts due to low occurrence to merit a distinct category (grooming, suckling, drinking, elliminative, sexual and other social acts etc.).

However, variations occurred within the groups itself due to preference caused by adaptations to environmental and physiological conditions.

Free grazing animals spend more time eating and foraging for food than the confined or stall-fed animals. This resulted in extra muscular activity which will have considerable impact on the animals' maintenance energy requirement (Osuji, 1974). It has been estimated that grazing animal requires 40-70% more dietary energy as compared to confined ones (Graham, 1964; Young &Corbett, 1972 and Havstad & Malachek, 1982). Osuji (1974) suggested that the increase in the animal's maintenance requirement is probably due to the energy costs associated with eating,

walking and the work of digestion done by the gut in handling bulky pasture materials.

Animals maximize the benefit of energy expanded. This will result in giving priority to more important basic functions for maintainence such as feeding or grazing in normal conditions, more so in lactating and expecting females but reverse in rutting males (Denholm, 1984). Activity budget also varies with changes in environmental conditions which serves as strategies in minimizing negative effects such as physiological stress to the animals.

From activity budgets, preferences for variations within activities could be determined since every activity carried out by animals will have variations within them and animals will show preference for certain variations over the others. These preferences may be due to physiological or environmental factors as stated by Alhassan and Kabuga (1988). Observations were carried out for variations in grazing, resting and locomotion (postures).

Grazing Behaviour

Jiang and Hudson (1993) have suggested that foraging postures influenced the size of feeding stations - following Novellie's (1978) definition of feeding station. Adopting postures that cover large feeding stations is one way of improving foraging