

PRODUCTION STRATEGY AND ITS EFFECT ON SPOTTED DEER AT NATIONAL ZOO IN BANGLADESH

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ABSTRACT

The production and reproduction profile, feeds and feeding and herd management of spotted deer studied in captive condition at Bangladesh National Zoo in this experiment. For these purposes, fifteen (15) deer's from each group i.e. adult male (Stag or buck), adult female (Doe), juvenile and infant were used during January 15th to December 15th 2018 for a period of eleven months. Available feeds that were supplied to the spotted deer such as maize fodder, Jambu grass and Gourd Spinach (Kolmi grass), cabbages, cucumber, gourd, pumpkin, grain, wheat bran and soybean meal. Amount of CP and metabolic energy was 13.63% and 14.38 MJ ME per day respectively. From the study it was observed that average males and females' birth weights were 2.97 and 2.73 kg, adult males and females weights 78.08 and 60.97 kg, males and females weaning weights were 19.05 and 18.49 kg respectively. It was also observed that average weaning age was 5.19 months, length of estrous was 17.40 days, age at first fawning was 14.48 months and gestation lengths were 232.69 days respectively. It is concluded that recommended rations need to be fed with proper management systems to keep balanced nutritive conditions along with productive and reproductive well-being of the spotted deer at Bangladesh National Zoo.

Key words: *Axis axis*, chital deer, chittra deer, spotted deer, zoo

INTRODUCTION

Spotted Deer is widely distributed in all habitats of the Sundarbans. The natural distribution of spotted deer (*Axis axis*) is limited in to the Indian sub-continent, although successful introductions occurred elsewhere (Geist, 1999; Seidensticker *et al.* 1999). The Spotted Deer ranges between 52600 (Khan 1986) and 83000 (Dey 2007). The relative abundance of Spotted Deer varies from habitat to habitat, a gradual reduction from west to east (Deodatus and Ahmed, 2002) and deer density increases with the habitat ensuring fresh drinking water (Feeroz, 2001). Apart from the Sundarbans, several islands in the Bay of Bengal also support large population of Spotted Deer. The availability of drinking water, trees for shade, grass for forage, and in presence of the high rugged terrain are four factors that influence the spotted deer concentration in certain areas. Deer have been morpho-physiologically classified as ruminants. Their main fodder in the forest are the leaves and fruits of keora, new leaves of passur, gewa, and various grasses, but they met their calcium requirement by chewing fallen deer antler and eating crab, shrimp etc. In Bangladesh National Zoo (BNZ), the number of spotted deer & barking deer are 241 and 11 respectively. To keep them nutritionally sound everyday a balanced ration is supplied containing green fodders (Maize fodder, Jambu grass, and gourd spinach), vegetables (cabbage, cucumber, pumpkin) and concentrate feeds (Grain, Soybean meal, wheat bran, vitamin-mineral and common salt). Deer is highly sensitive, agile and powerful. They are hardly an easy experimental animal to work with. Nevertheless, feeding of captive deer is now greatly simplified by the

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development of a pelleted ration which seemingly provides the essential nutrients for optimum growth and maintenance. In future it could be an expedient to supply complete pelleted ration for free roaming deer that are faced with acute browse shortage and severe environmental pressure. Deer farming is an economically promising industry. To establish deer farming for the production of venison and other by-products, it is essential to understand and develop effective ex-situ management systems of spotted deer in Bangladesh. Conservation of nature and natural resources are now a global concern. Without proper scientific knowledge on conservation management, natural resource utilization is very difficult. Therefore, the present study was undertaken to find the feeding management strategy to explore the production and reproduction profile of deer at Zoo condition.

MATERIALS AND METHODS

Location, environmental condition, animals and study period

The study was conducted with the spotted deer at the Bangladesh National Zoo. The experiment was carried out from January 15th to December 15th, 2018 for a period of eleven months. The production of spotted deer in a Zoo, tourist and their interaction are greatly influenced by the local environmental condition. Therefore, environmental condition of the study area is over-viewed. Maximum and minimum temperatures as observed in May and January ranged between 33°C and 15-20°C. Summer season continued from April to June 25- 30°C and winter lasted from December to February. Rainfall started in May and continued up to September. About 5% of the annual rainfall occurred during the monsoon. The maximum humidity was observed 96% from July to September and the minimum about 45% from January to April (BBS, 2000). The necessary data for this experiment was collected from the following numbers of deer such as adult male, adult female, young (Juvenile) and infants as 15, 15, 15 and 15 respectively at Bangladesh National Zoo.

Parameters studied

The present study covered the following aspects of spotted deer such as feeds and feeding, production and reproduction profile and herd management.

Feeds and feeding

Axis axis consume an extremely wide range of forage items throughout their native range and in introduced locales. They eat over 75 species of plants, as well as the full spectrum of plant parts including leaves, stems, fruits, seeds, flowers and bark. Their diet consists largely of grasses in all seasons, augmented with browse. Green grasses less than 10cm high are preferred.

Chital deer are ruminant herbivores. (Sub order Ruminantia). Deer have a four-chambered stomach. The first chamber, called the rumen, is for storage. The rumen allows for the deer to gather a lot of food at once and then digest it later. The deer bring the food back up into their mouth and chew it again. This process is called chewing their cud. It is also called ruminating, named after the rumen. Animals that can do this are called ruminants. The reticulum is the second stomach chamber. This is where the microorganisms live. The microorganisms attack the chewed food that the deer has eaten. This process is called fermentation. This helps to break the cellulose down into simpler substances that can be absorbed by the deer and the microorganisms. Fermentation produces a gas (methane), which the deer must discharge very regularly. When deer chew their cud again, mixed in with the digested food are microorganisms. The deer chew the microorganisms and a lot of deer's nutrition comes from them. There are plenty of microorganisms left in the reticulum. This time when it goes back down, the chewed food goes to the third chamber the omasum. This is where water is absorbed. Finally, the resulting cud enters the last chamber, (the abomasum), where gastric juices continue digestion. Gastric juices are liquids, like the acids in your stomach that help digest food. Last, it moves on to the intestines. This is where the food is absorbed by the animal's body. This is where the animal receives the nutrients for his body. The deer's intestines are 28 feet long. When the animal has absorbed everything it can use, everything that isn't digested is passed off as waste droppings.

Deer seek out the highly palatable feed in preference to feed of medium or low palatability. Their feed utilization is influenced considerably by the season. Highest feed intake occurs during the spring when

plants contain highest protein and medium intake occurs during the winter when feed is scarce. During the rut, males ingest little or no feed was reported by Vos (1982). Deer have been morpho-physiologically classified as ruminants, which readily browse shrubs, forbs and grasses (Jean *et al.*, 1995). Deer can eat and digest any kind of feedstuffs used for more traditional domestic ruminants. In digestibility trials deer have been found to digest poor quality roughage diets less completely but high quality concentrate diets more than sheep. This part covered for feed sources, chemical composition of feed, water sources, supplemental feeding and seasonal effect on feed intake. Chemical composition of the supplied feed were analyzed according to AOAC (2005).

Production profile

This part covered mainly for the birth weight of male and female, adult weight to female, weaning weight of male, weaning weight of female, weaning age, length of estrous, age at first fawning, gestation length and sex ratio.

Housing Requirements

The position of the enclosure is irrelevant as long as the deer have shade from large trees and have a sheltered area for poor weather conditions.

The enclosure needs to have a sheltered area for the deer to retreat to in poor weather. There are no size requirements but will need to protect the total number of deer's within the exhibit. There are no temperature requirements. Deer prefer warmer environments with cool areas and this can be provided with trees as it wood replicates the forest. Preferred substrate materials: mulch and pine chips, dolerite other suitable materials: Grass Materials to avoid: Cement (as the harshness to hoofs and joints). Straw and saw dust are the preferred materials for bedding. Which should be completely changed at least once a week? Heat lamps offered in bedding area in the cooler months will provide deer with extra warm, especially when fawn are in the herd. Bedding areas should be under shelter to avoid wet materials. Suitable furnishings would include large tall trees. Mud wallows and scratching poles would offer enrichment to the chital deer. Large logs and nature items.

General Husbandry

Hygiene and Cleaning

Daily cleaning tasks: Spot cleaning feces, cleaning drinking water, removing old browse and left over foods; Weekly cleaning tasks: Complete change of bedding material; Monthly cleaning tasks: Scrub any cement areas; Half yearly: New substrate – mulching; Cleaning agents suitable: Animal house bleach 4% - cleaning holding and cement areas.

Pest control boxes should be placed in areas in and around enclosure and checked weekly and are refilled and any pest removed. Disposing of pests-follow intuitions procedures. Taranga's – all dead animals are to be taken to VQC for post mortem.

Record Keeping

All animals should be individually identifiable, with the use of colored or numbered ear tags. Each animal should have its own file which contains identification numbers or tags of animals, ARKS number, Health problems, Veterinary examinations, Veterinary treatments, Behavioral data, Reproductive stages, condition and behaviors, Gene pool information, Parents, Birth dates, Changes in diet, Movements within and between institutions, Body mass and measurements, History of animal, Enrichment behaviors and reactions, Transfer details, individual characteristics etc.

Routine Data Collection

Most information is on deer farming. Some of this information does work for deer in captive intuition but most is for the production of venison. There have been many studies on wild deer and many on farming deer's. Information that may be acquired for long term studies includes Weights/growth–development charts, Contraception/genes/parenting behaviors, Blood biochemistry

Reproduction and selection

The mating system of these deer is not known. However, in other, related deer, the most common mating system is polygyny. Males compete with one another for access to estrous females. Competition often involves sparring and vocalizing. Successful males are typically older and larger, and able to drive away younger, smaller males. These successful males are the ones who mate with the females. It

is likely that Visayan spotted deer have a similar mating system. In the wild, *Axis axis* bucks are found throughout the year with hardened antlers and in rutting condition. The reproductive cycle of each individual is not synchronized with that of other males in the herd. Concurrently, throughout the year, some bucks are coming into rut, while others are going out of rut, or are in a non-breeding condition. Females also experience non-synchronized estrous cycles, with each cycle lasting about 3 weeks. Bucks do not retain harems of does, but instead mate with does in each herd as they become receptive. One fawn is typically produced per pregnancy and gestation lasts 210-238 days. Following parturition, females again mate during the subsequent breeding period. Adult females tend to produce one fawn each year. The current reproduction system may be defined as a controlled, single-sire and natural mating:

Restraint Systems

Mechanical, manual and chemical restraint systems were followed for control and handling the animals.

Weighing Animals

The systems available are electronic or mechanical and are suspended or platform. All of the restraints can be mounted on either system. Using the restraint as a weight crate means the animals can be weighed each time they are in the restraint. It also means they have to enter the restraint each time they are weighed. The alternative is to put a separate weigh crate in the tunnel, most easily with platform scales, with the facility to draft the animals after the weigh scales and before the restraint. This is most easily achieved with a long tunnel.

Health Management

One key component of herd management is disease control. It is the responsibility of each farmer to manage his animals in such a manner that they are healthy and in good condition because it makes the animals more resistant to infections and disease. Prevention of disease is better than any possible cure. It is important to establish a good working relationship with a veterinarian. Together, the farmer and the veterinarian can work out a program tailored for any individual farm to control disease and to maximize the health and productivity of the animals. The causes of diseases can be categorized as Intrinsic flaws: Nutritive deficiencies; Exogenous poisons: Trauma, Tumours (neoplasms) and Parasitic or other living organisms (i.e. parasites, bacteria, fungi, viruses, mycoplasma and rickettsia).

Deer at low population densities on natural range are generally not affected by disease to any significant extent. Deer in their first 12-15 months of life are more susceptible to disease than adults. Treatment of sick deer is analogous with that of domestic animals. Prevention of diseases by nutritional management, testing, vaccination, drenching and dipping, is more important than treatment. The deer's in Bangladesh National zoo, veterinary facility is provided periodically or when necessary. A vaccine is given which contains BQ, HS, and FMD within 3-4 days of newly born deer. After the birth of a baby deer, the workers put a tag on the body of the spotted deer within 2-3 days of birth.

Statistical analysis of data

Data recorded for different parameters were compiled and tabulated in proper way for statistical analysis. Analysis of mean, standard error of mean, standard deviation and variance was done with the help of SPSS (Version 20.0).

RESULTS AND DISCUSSION

The results of following parameters such as feeds and feeding, production and reproduction profile and herd. management have been presented.

Feeds and feeding

The chemical composition of the feeds supplied to the deer are showed in the (Table-1). From the table 2, it was observed that the total amount of feed intake was 8.12 kg as fresh basis and 2.079 kg as DM basis. During the experimental period maize fodder (*Zea mays*) and gourd spinach (*Impomoea aquatica*) as leafy vegetable, pumkin (*Cucurbita moschata*) and cucumber (*Cucumis Sativus*) as

Table 1. Chemical composition of feed consumed by experimental spotted deer at Bangladesh National Zoo (AOAC, 2005)

Name of feed		% DM	% CP	ME (Kcal/kg)
Local name	Botanical name			
Maize fodder/Jambu grass	<i>Zea mays/Sesbania bispinosa</i>	18	7.91	230
Gourd spinach	<i>Impomoea aquatica</i>	15	8.1	131
Cabbage	<i>Brassica oleracea</i>	10	1.3	260
Pumkin	<i>Cucurbita moschata</i>	14	2.1	430
Gourd	<i>Lagenaria siceraria</i>	14	1.9	420
Cucumber	<i>Cucumis sativus</i>	14.1	1.8	410
Grain	<i>Cicer arietinum</i>	12.51	19.68	720
Soybean meal	-	88	45	2500
Wheat bran	-	88	14	1600
Common salt	-	90	-	-
Vit-min premix	-	-	-	-

vegetable, grain (*Cicer Arietinum*) and as concentrate soybean and wheat bran were supplied to the deer at BN Zoo. The percentage of crude protein (CP) and amount of metabolisable energy of the supplied ration for an adult deer were 13.63% and 14.38 MJ per day (Table 2).

Spotted deer that are free browsers intake a various types to grasses, creepers, shrubs, tree leaves, vegetables etc. But deer at Bangladesh National Zoo, that are confined can not take any feed other than supplied. A little amount of grasses was browse there. This amount is very negligible. From the data of BN zoo authority it was observed that green fodder, leafy vegetables and succulent vegetable were changed in the various seasons and depends on availability in the market. Khira (*Cucumis sativas*), Sasa (*Saha senanensis*), Misty Cumra (*Cucurbita moschata*), Cabbage (*Brassica oleracea*) were supplied in the various seasons of the year.

Table 2. Feed with nutrient intakes by the spotted deer at Bangladesh National Zoo

Name of feed		Amount supply (kg)/deer	DMI (kg)/deer	% CP intake/deer	ME (kcal/kg)/deer
Local name	Botanical name				
Maize fodder /Jambu grass	<i>Zea mays Sesbania bispinosa</i>	3.0	0.54	2.07	690
Gourd spinach grass	<i>Impomoea aquatica</i>	2.0	0.3	1.15	262
Cabbage	<i>Brassica oleracea</i>	0.5	0.05	0.033	130
Pumkin	<i>Cucurbita moschata</i>	0.6	0.084	0.086	258
Gourd	<i>Lagenaria siceraria</i>	0.5	0.07	0.063	210
Cucumber	<i>Cucumis sativus</i>	0.4	0.056	0.048	164
Grain	<i>Cicer arietinum.</i>	0.2	0.177	1.68	144
Soybean meal		0.26	0.229	4.95	650
Wheat bran		0.6	0.528	3.55	960
Common salt		0.05	0.045		-
Vit-min premix	-	0.01			
Total		8.12	2.079	13.63	14.38 MJ

The crude protein is far below than the requirement to the findings of Moon et al. (2000) but metabolisable energy is more or less near to the requirement. They investigated that DMI is around 2.0% in winter increasing to 2.3% in summer for adult spotted deer. DM is around 2.7% to 3.8% for fallow deer (Wilson,1979). Adam (1994) stated that in autumn, winter, spring and summer DMI is 1.7,

2.0, 2.3, 3.0 kg/d/hinds where as 1.4, 1.3, 2.0, 2.2 kg/d/growing calves. Fennessy (1981) stated that an adult spotted deer required for maintenance energy was 16-18 MJ where as a protein diet in the 13-16% range is required for the successful growth, antler development and reproduction (Verme and Ullrey, 1972).

Table 3. Nutrient balances for the spotted deer

Characteristics	CP %	ME (MJ)
Requirement	14.5	16.
Supplied	13.63	14.38
Balance	-0.87	-1.62

A high level of crude protein (approximately 16%) is advantageous for fallow fawns to achieve their target live weights (Malley et al., 2001). Adam (1994) stated that in calves, hinds and stags for the season of autumn, winter, spring and summer CP is required as 17, 10, 12-17; 10, 14, 17 and 10, 12% respectively. Female fawns (white-tailed deer) required 13% crude protein for maximum growth (Ullrey et al., 1967). Denholm (1984) stated that estimates of dietary crude protein requirements for optimum growth vary within the range of 13 to 15%. French et al. (1956) concluded that young male fawns (white-tailed deer) required 13% to 16% crude protein.

The energy concentration for empty body weight is 17.5 MJ/kg and 21.7 MJ/kg and protein content is 150 g/kg and 146 g/kg (ARC, 1980). From Adam (1994) standard of nutritional requirement of spotted deer, it was observed that crude protein deficiency was 4.5% and the ME deficiency was 1.66 MJ per day that are supplied to the deer (Table 3).

There is an imbalance of crude protein and energy supply to the deer of BN zoo. Proper growth and development both in productive and reproductive may not be perform due to insufficient protein supply and in balance of CP and ME. Recommended ration for deer is shown in Table 4.

Table 4. Recommended rations for spotted deer

Name of feed		Amount supply (kg/deer)	DMI (kg) deer	% CP intake / deer	ME (kcal/kg) / deer	
Local	Botanical					
Maize fodder	Jambu grass	<i>Zea mays</i>	3.00	0.54	2.07	690
Gourd	spinach	<i>Impomoea aquatica</i>	2.00	0.30	1.15	262
Cabbage		<i>Brassica oleracea</i>	0.5	0.05	0.033	130
Pumkin		<i>Cucurbita moschata</i>	0.6	0.084	0.086	258
Gourd		<i>Lagenaria siceraria</i>	0.6	0.08	0.066	252
Cucumber		<i>Cucumis sativus</i>	0.5	0.060	0.058	164
Grain		<i>Cicer arietinum.</i>	0.3	0.187	1.78	216
Soybean meal			0.3	0.239	0.500	750
Wheat bran			0.7	0.548	3.65	1120
Common salt			0.05	0.045		-
Vit-min premix		-	0.001	-	-	-
Total			8.5	2.088	13.893	15.82 MJ

Production and reproduction profile

Body weight of spotted deer at BN Zoo is presented in table 5. The average birth weight of males and females spotted deer fawn were 2.97±0.17 kg and 2.73±0.17 kg. The highest and lowest birth weights of them were 4.10 kg to 1.80 kg and 3.90 kg to 1.70 kg respectively. The average birth weight of males and females fawn of spotted deer were more or less similar to the findings of Mulley (1984). He

reported that the mean birth weight of male and female spotted deer fawn was 4.5 kg and 4.2 kg respectively. Ables, (1977) reported that the average birth weight of males and females spotted deer fawn were 3.5 kg and 3.0 kg respectively. Fawn birth weight is generally 10% of their mother's weight reported by Kay and Staines (1981); Mulley *et al.* (1990).

In the present study, the adult males and females' weights were 78.08 ± 2.17 kg and 60.97 ± 1.77 kg respectively. The highest and lowest adult males and females weights were 88.90 kg to 62.20 kg and 74.50 kg to 51.30 kg respectively.

Table 5. Body weight of spotted deer at Bangladesh National Zoo

Traits	No. of animal	Mean	Standard error mean	Standard deviation	Maximum	Minimum
Male birth wt. (kg)	15	2.97	0.17	0.67	4.10	1.8
Female birth wt. (kg)	15	2.73	0.17	0.65	3.90	1.70
Adult male wt. (kg)	15	78.08	2.17	8.39	88.90	62.20
Adult female wt. (kg)	15	60.97	1.77	6.87	74.50	51.30
Male weaning wt. (kg)	15	19.05	0.76	2.96	24.30	15.30
Female weaning wt. (kg)	15	18.49	0.58	2.24	22.30	15.20

The average adult males and females weights were more or less similar to the findings of Ables (1977). He concluded that the average adult males and females weights must be attained within 85.00 kg and 70.00 kg. There is strong relationship between body weight and reproduction. Sharman (1978) stated that young hinds weighing less than 60.00 kg at rutting did not produce calves. Kelly and Moore (1978) showed that the percentage of red deer calves dropped by yearling hinds less than 65 kg in liveweight was only 50%, while above 65kg it could be about 90%. Mitchell and Brown (1974) suggested that a liveweight of 75 kg for hinds should give 80% of calving percentages.

Table 5 showed that the average males and females weaning weights were 19.05 ± 0.76 kg and 18.49 ± 0.58 kg respectively. The highest and lowest weights of them were 24.30kg to 15.30 kg and 22.30kg to 15.20 kg respectively. The average males and females weaning weights in this study were more or less similar to the findings of Mulley (1984) who stated that the mean males and females weaning weights were 19.4 kg and 18.5 kg. Weaning generally takes place at an average weight of 18.00 to 21.00 kg reported by Mulley *et al.* (1990).

Table 6. Reproductive performance of spotted deer at Bangladesh National Zoo

Traits	No. of animal	Mean	Standard error mean	Standard deviation	Maximum	Minimum
Length of estrus (Days)	15	17.40	0.54	2.10	21.10	14.50
Age at 1 st estrus (Months)	15	14.48	0.43	1.65	18.30	11.50
Gestation period (Days)	15	232.69	1.48	5.73	241.10	223.70
Age at 1 st fawning (Months)	15	14.58	0.43	1.68	18.20	12.00
Weaning age (Months)	15	5.19	0.18	0.68	6.20	4.00

In the present study, the average length of estrous cycle was 17.40 ± 0.54 day. The highest and lowest lengths of estrous cycle were 21.10 day and 14.50 day respectively. The mean length of estrous cycle was more or less similar to the findings of Chappelle *et al.* (2003). They reported that mean duration of estrous cycle of chital hinds was 19.30 ± 1.30 day with a range of 17-21 days. Vos (1982) showed that the mean length of estrous cycle in spotted deer was 18.20 days. The mean length of estrous cycle was 18 ± 0.7 days with a range of 12-23 days concluded by Mylrea *et al.* (2004).

From the table-6 showed that the average duration of gestation length was 232.69±1.48 days. The highest and lowest lengths of gestation period were 241.10days and 223.70 days. The average length of gestation period in this study were almost similar to the findings of The mean duration of gestation period was 234.5±3.0 days at chital hinds reported by Chapple *et al.* (2003), that is more or less similar to the present study. Ables (1977) showed that only one fawn is produced per pregnancy after a gestation period of 210-238 days. Vos (1982) reported that only one fawn and rarely twin is produced per pregnancy after a gestation period of 226-233 days.

From the table-6 was observed that the average age at first fawning was 14.58±0.43 months. The highest and lowest age at first fawning was 18.20 months and 12.00 months respectively. In the present study the average age at first fawning were almost similar to the findings of Ables (1977) who reported that does may first bred at an age of 14-17 months. Vos (1982) showed that does may be first bred within 1.5-2 years.

From the table 6 it has been also observed that the average weaning age was 5.19±0.18 months. The highest and lowest weaning age was 6.20 months and 4.0 months respectively. This is an agreement with the findings of Mulley *et al.* (1990). They reported that weaning generally takes place between 14-21 weeks. Flesch *et al.* (1999) showed that weaning age ranged between 12-20 weeks. Mulley and Flesch (2001) cited that deer must be weaned within 16 weeks of its age.

Health Status of Experimental Animals

Deer Disease:

Yersiniosis and malignant catarrhal fever have not been recorded in fallow deer farmed in BN Zoo. Deer develop severe clinical illness very quickly in these serious diseases, which can rapidly progress to decumbency and death. The progress of these diseases is exacerbated by their nervous temperament, making these diseases potentially very dangerous.

During the examination period, no deer was sick in the Bangladesh National Zoo. The deer we identified did not see any disease in the year (table-9). But we tried very well to observe it clearly. Here we have learned from past history that due to the absence bacteria, viruses, parasites and nutrition there usually diseases. However, during the examination, we did not use any medicines in deer. Management of good deer does not cause in disease. So, the deer is a great gain animal.

Table 7. Common parasites reported in deer

Internal parasites reported in deer	
Lungworm Nematodes	Large Intestine/Cecum
Dictyocaulus	Chabertia
Elaphostrongylus	Oesophagostomum
Protostrongylus	Trichuri
Gastroenteric Nematodes Abomasum	Other Nematodes
Haemonchus	Elaeophora (circulatory system-arterial worm)
OstertagiaRinadia	Parelaphostrongylus (nervous systemmeningeal worm)
Skrjabinagia	Trematodes (liver flukes)
Spiculopteragia	FasciolaFascioloides
Trichostrongylus	Paramphistomum
Small Intestine	Dicrocoelium
Bunostomum	
CapillariaCooperia	
Nematodirus	
Strongyloides	
Trichostrongylus	

Table 8. Common Deer Diseases

Diseases reported in deer	
Bluetongue Brucellosis Clostridial infections: ▪blackleg, ▪Malignant Edema, ▪Enterotoximia Facial Eczema Louping ill Pneumonia	Foot Disorders: ▪foot scald ▪foot abscess ▪foot rot Kerato conjunctivitis Leptospirosis Ryegrass staggers Salmonellosis Tuberculosis

Table 9. Experimental Deer Diseases

Identify of Experimental Animals	Name of diseases														
	Deer 1	Deer 2	Deer 3	Deer 4	Deer 5	Deer 6	Deer 7	Deer 8	Deer 9	Deer 10	Deer 11	Deer 12	Deer 13	Deer 14	Deer 15
Calves (Fawn)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Buck or Stags	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Doe or Hinds	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Pregnant Deer	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Weaning Animals	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×

Herd management

Deer rapidly adapts to the presence of man and machinery when they are enticed with palatable feeds. When deer are confined, they should not be over-crowded, so that a handler can move amongst them and carry out drenching, ear tagging, vaccination and pour-on dipping. Normally a supervisor of deer section maintains the following activities:

Table 10. Schedule of day-to-day operations on spotted deer premises

Approx. time (hrs)	Farm operations
7.00-9.00 A.M	<ul style="list-style-type: none"> ❖Check all fences surrounded by deer premises ❖Count the total numbers of deer and adjust previous numbers ❖Find out or observe if any mortality occurred ❖Inspection within the area if any hazard happened at sight ❖Clean out the dumping wastage material such as cons, bottle or any plastic product which was thrown by visitors ❖Cleaning all the equipment's such as feeder, waterer ❖Cleaning the entire feed supply zone ❖Arrange the necessary vehicle to transport feed or other's ❖Cleaning farm premises
9.00-12.00 A.M	<ul style="list-style-type: none"> ❖Feeding of concentrate feed to deer herd ❖Feeding of dry/green fodder ❖Isolation of sick deer ❖Treating sick deer
12.00-3.00 P.M	<ul style="list-style-type: none"> ❖Lunch cum rest period for labors
3.00-4.00 P.M	<ul style="list-style-type: none"> ❖Miscellaneous jobs of deer premises such as, periodical vaccinations, Repair of farm fences, Fittings and repair of equipment, weekly scrubbing and white washing of drinking water tank, attending to sale of deer and their transportation, periodical spraying of deer premises with suitable pesticides
4.00 P.M-7.00 A.M	<ul style="list-style-type: none"> ❖A Night watchman on duty.

For the determination of group size and composition, only visual observation techniques were used in this study. Data on group composition were recorded to age-sex classes, which were previously categorized.

CONCLUSION

At Bangladesh National Zoo, the total amount of feed potted deer was 8.12 kg on fresh basis and 2.079 kg on DM. The percentage of crude protein and amount of met-abolishable energy in supplied feed were 13.63% and 14.38 MJ per day. There was variation of supplied green fodder, leafy vegetables and succulent vegetables with availability in the market and seasons. From the results it could be concluded that to keep balanced nutritive conditions along with productive wellbeing of the spotted deer in the zoo, recommended rations need to be fed with effective management systems to be build up permanently. Then it will largely contribute to the different zoos of Bangladesh.

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