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Conservation Threats of Re-introduced Blackbuck (Antilope Cervicapra) in Hirapurphanta of Shuklaphanta National Park, Kanchanpur, Nepal

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Abstract - The study of Blackbucks at Hirapurphanta was carried out through bi-seasonal vegetation analysis (pre-monsoon and post-monsoon), parasitological analysis, direct observation, questionnaire survey and secondary data collection. The field work was completed from December of 2017 to December of 2018. Sedimentation and centrifuging methods were applied for parasitological examinations. The study reported that the Relative Cover (RC) value for *Imperata cylindrica*, highest, as 24.17% in average, followed by *Cynodon dactylon* 12.96%, *Digitaria setigera* as 10.06% and so on. The ecological (realized) population density was 2.78 individuals/ha though the crude population density was found to be 1.65 individuals/ha. Parasites reported from the blackbuck were *Eimeria spp*. (both with micropyle and without micropyle), *Strongyloides spp*., and *Strongyle spp.* while that from livestock were *Eimeria spp., Strongyle spp*., and *Oxyuris spp.* The result obtained showed that there are common parasites between Blackbuck and Livestock. This implies that there is the chance of parasite transference from the livestock to the blackbuck which seems challenging in its conservation. The index of similarity between the parasites of blackbuck and that of livestock was found to be 0.67 and the calculated male to female sex ratio for adult is calculated to 1:0.86 and for sub-adults is 1:1.

Therefore, the study recommend in the eradication of the invasive species that altering the suitable habitat of blackbucks, making emergency health-post near the captivity and the bucks should be safeguarded from the possible attack of different harmful animals and strongly recommends in giving higher concern in its conservation from the government.

Keywords - Blackbuck, Conservation, Fecal samples, Livestock, Parasites, Threats.

I. INTRODUCTION

1.1 BACKGROUND

Himalayan country of Nepal is rich in biodiversity. Biodiversity is the diversity of living and non-living things. The vulnerability of biodiversity is increasing in context of Nepal. Biodiversity needs to be conserved. Various anthropological activities such as deforestation, cultivation, cattle grazing and burning, habitat encroachment, hunting, poaching etc., are the major threats that need immediate conservation concern [9]. Habitat degradation is the process by which habitat quality for a given species is diminished.

Currently, human-wildlife conflict is one of the major threats to the survival of many wildlife species [22]. The human-wildlife conflict is one of the main factors for the loss of biodiversity. The human-wildlife conflict is particularly due to the conversion of forest into large scale monoculture plantations, shifting cultivation, overgrazing, forest cutting and encroachment in the home range which reduce the availability of natural food to the wild animals ([1], [22]). As the natural habitat gets fragmented, the interface between human and wildlife increases while the animal populations become compressed. Consequently, it leads to greater contact and conflict with human as wild animals seek to fulfill their nutritional, ecological and behavioral needs ([35], [22]).

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Therefore, understanding and predicting wildlife-habitat relationship and identifying and protecting suitable ecological areas and landscapes to ensure the viability of wild populations is a foundation of wildlife management [22].

The conservation and management of wildlife species is highly reliant on the geographic location of potential habitat ([25], [22]) that, in turn, relies on research which clarifies the habitat preferences of the species [22]. To know and understand the interactions of endangered animals with other animals is also important for carrying out a successful conservation program.

Photo © Mr. Suraj Prasad Joshi
Picture 1: Jumping blackbuck captured @Hirapurphanta

Conservation threat means the threats that are seen in conservation practices. Wildlife threat is an issue with off-putting role in our effort to conserve and sustainably utilize the biological capitals [26]. However, the wildlife biodiversity and conservation practices are still at low attention. The present study is aimed to know the vegetation composition of the study area, the problems that are being faced by blackbuck in Hirapurphanta of SuNP, to identify the parasites residing in the fecal matter of blackbucks and to recommend some conservation strategies to follow for its betterment.

Blackbuck, *Antilope cervicapra*, is commonly known by the name *Krishnasaar* in Nepali. It is taxonomically classified for the first time by Linnaeus 1758 as,

Animalia

Chordata

Mammalia

Artiodactyla

Bovidae

Antilope

A. cervicapra

Blackbuck is native to parts of Nepal, India, and Pakistan, and endemic to the south Asian subcontinent and are the sole extent member of the genus *Antilope* [23]. Based on the coat color, shape and length of the horn, four blackbuck sub-species are recognized ([11], [7]). They are *Antilope cervicapra centralis* in Central India, *Antilope cervicapra rajputanae* in Western India, *Antilope cervicapra rupicapra* in South India and *Antilope cervicapra cervicapra* in North India and Nepal ([21], [4], [23]).

1.2 IMPORTANCE OF BLACKBUCK

Blackbuck has important ecological roles in grassland ecosystem. It has genetic, medicinal (horns and skin to cure liver and heart diseases), scientific, aesthetic and re-creational value [22]. Besides biological, genetic, ecological and economical importance, the Blackbuck has cultural value in Hinduism and Buddhism [16]. Due to its high concern in conservation, Nepal Rastra Bank has tagged Blackbuck in ten rupees note.

It is a symbol of purity, prosperity and peace and regarded as a vehicle of Moon (Chandrama in Nepali). Its skin is used during the worship and in the time of taking secret thread (Bratabanda in Nepali) in Hindu culture. Its horns are also regarded as sacred objects. A pair of buck symbolizes Buddha when he turned to the Sarnath India [16].

1.3 CONSERVATION STATUS

The Blackbuck species is now listed in appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and classed as “near threatened” in the International Union for the Conservation of Nature (IUCN) Red List and Protected under the National Park and Wildlife Conservation Act 1973 in Nepal [40]. Now the species is assessed as Critically Endangered (CR) in Nepal [40].

1.4 RE-INTRODUCTION HISTORY OF BLACKBUCK IN HIRAPURPHANTA

The blackbucks were reintroduced to the Hirapurphanta of SuNP in 2012. Initially 28 blackbucks (22 from Nepalgunj mini zoo in two shifts and 6 from central zoo, Lalitpur) were introduced to the Hirapurphanta (Table 1) under the joint collaborative effort of the Department of National Parks and Wildlife Conservation (DNPWC) and the National Trust for Nature Conservation (NTNC) through the USAID funded Hariyo Ban Program [37]. Additional 14 wild individuals from Blackbuck Conservation Area, Khairapur were translocated to Hirapurphanta in June 2015 [28].

Source	Date of Re-introduction	Male		Female		Yearling	Total
		Adult	Sub-adult	Adult	Sub-adult		
Nepalgunj mini zoo	2012-09-18	2	1	4	1	-	8
Nepalgunj mini zoo	2012-09-20	-	3	8	3	-	14
Central zoo, Lalitpur	2012-10-01	3	-	2	-	1	6
Total		**5**	**4**	**14**	**4**	**1**	**28**

Table 1: Date, source, age and sex composition of Reintroduced blackbucks in Hirapurphanta of SuNP [40]

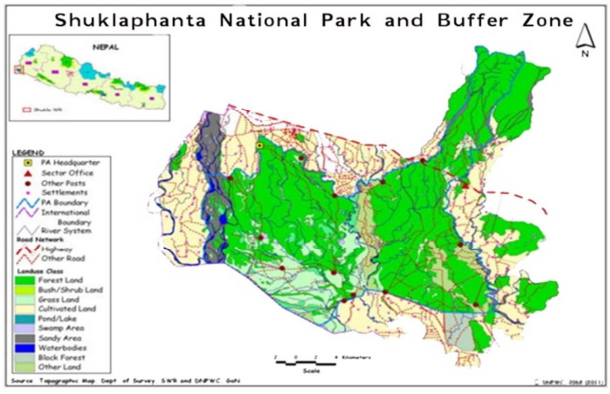
II. Methods And Materials

2.1 STUDY AREA

The study area i.e. Hirapurphanta lies North-East to Shuklaphanta National Park. It's an enclosure having area of 54 ha.

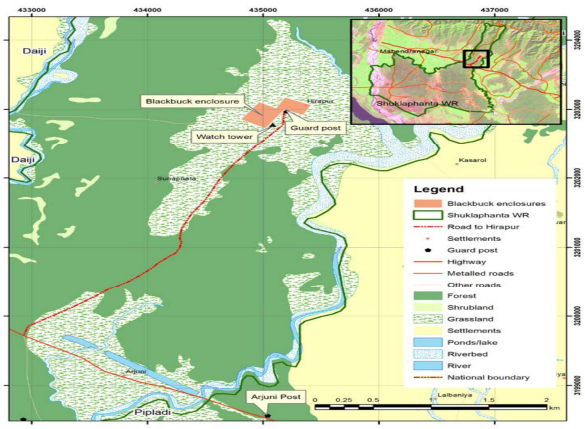
2.1.1 Shuklaphanta National Park (SuNP)

SuNP lies in the far-western region of Nepal (now in Province no. 7). The total area of SuNP is 305 sq. km. It lies between longitude 80^0 06' 04" and 80^0 21' 40" E and 28^0 45' 16" and 28^0 57' 23"N latitude. The altitude of SuNP ranges from 90 to 270 m. The SuNP extends up to the Syali River in the east and to the Siwalik in northeast corners. The southern boundary runs along the Nepal- India border for 15Km. The Western is separated by the Mahakali River [28].



Map 1: Map showing Shuklaphanta National Park (SuNP) [39]

2.1.2 Hirapurphanta



Map 2: Map showing reintroduced blackbuck site in Hirapurphanta, SuNP [40]

Hirapurphanta is an area within SuNP covering an area of 150 ha. Though the Hirapurphanta comprises about 150 ha area, only 54 ha area is delimited for the blackbucks, in which blackbuck are reared and some area within this captivity is used to cultivate different crops favoured by Blackbuck. The geographical location of this area is 28º 56' 58.06" N 80º 20' 26.59"E; and lies North-East to SuNP. Altitude of this area ranges up to 220 m.

2.2 Methods of Data Collection

The methodology of study involved sufficient field visit to study area and relevant literatures, questionnaire survey & lab work.

2.2.1 Population Status

2.2.1.1 Population Census: A direct count of animals was done in the enclosure with the help of binocular to estimate the total population [2].

2.2.1.2 Population Density

Population density is defined as total number of animal per unit area they occupy. The generalized formula to obtain the crude density is;

$$\text{Crude Density (D)} = \frac{\text{Total Number of Individual in an Area(N)}}{\text{Total Area}}$$

Ecological density is the total number of individuals present in the actual area of habitat available to the species;

$$\text{Ecological Density (E.D)} = \frac{\text{Total Number of Individual (N)}}{\text{Area of the Actual Habitat}}$$

2.3 Vegetation Analysis

Six plots were considered initially, each containing nine different quadrates having size of 1m×1m was prepared for grasses and herbs [20]. In each quadrate, the number of species was counted and the percentage cover for grasses and herbs was

recorded. Then, the density (D) and relative density was calculated by using the formula developed by [38]. The cover value was calculated by using the formula of [10].

$$\text{Cover } \% = \frac{\text{Approximate area covered by an individual}}{\text{Total no.of plots sampled}} \times 100$$

$$\text{Relative cover } \% = \frac{\text{Cover of individual species}}{\text{Totalcover of all species}} \times 100$$

$$\text{Density of a species} = \frac{\text{Total number of individuals of a species}}{\text{Total no.of quadrates sampled} \times \text{size of quadrate}}$$

$$\text{Relative density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

The frequency was calculated using the formula [38].

$$\text{Frequency} = \frac{\text{Total number of quadrates in which a particular species occurs}}{\text{Total no.of quadrates sampled}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{sum of frequency valus for all species}} \times 100$$

2.3.1 Identification of Vegetation

Herbarium identified with the help of standard literature sources and/or by comparing them with the specimens preserved at Tribhuvan University Siddhanath science campus, Nepal.

2.4 Threat identification:

The existing threats introduced in conservation were identified and then prioritized with risk assessment.

2.5 Gastro-intestinal parasite Analysis

2.5.1 Materials Required

1. Fecal sample (of both livestock & blackbuck)
2. Small plastic bottles to collect fecal matter
3. Test tube
4. Test tube strand
5. Beaker
6. Brush
7. Slides and cover slips
8. Compound microscope
9. Centrifuging machine
10. Tea strainer
11. Mortar and pestle
12. Digital camera

2.5.2 Chemicals Required

1. NaCl
2. Methylene Blue
3. Formalin
4. Washing soda

2.6 Collection of fecal samples

For the prevalence of gastro intestinal parasites in the blackbuck and domestic livestock grazed in the Hirapurphanta, the fresh fecal samples were collected from the ground after defecation at the morning of the day and processed for further examinations in the laboratory of the Department of Zoology, Siddhanath Science Campus, Kanchanpur. The eggs of different parasites were identified using sedimentation and floatation techniques as described by [34] and index of similarity was calculated using formula given by [18] as below:

$$\text{Index of Similarity} = \frac{2Z}{X+Y}$$

X=No of parasite species in livestock
Y=No. of parasite species in Blackbuck
Z=No. of common parasite species in livestock and blackbuck

2.7 Laboratory Methods

For both the methods (Sedimentation & Floatation), fecal samples (of both 60 sample of blackbuck and 60 samples of livestock) were collected from the study area. Samples were preserved in 10% Formalin. These preserved samples were carried to the laboratory of Zoology at Siddhanath Science Campus, Mahendra Nagar and were further processed by two different methods to find out the parasites present in that fecal matter.

For floatation process,

- The fecal matter was first of all washed gently to remove the alcohol used for its preservation.
- Then grinded (by adding water) with mortar and pestle in a watch glass.
- Then filtered in a beaker with a tea stainer.
- The filtrate was poured in a test tube and put in a test tube strand.
- Four test tubes at once put in a centrifusing machine and centrifused at a rate of 2000 rpm.
- After five minute, the centrifusing work was stopped and test tubes taken off of machine and water were replaced by saturated NaCl solution.
- Again the test tubes were placed for centrifusing and after five minute, the saturated NaCl solution and Methylene blue (as a stainer) were filled in test tubes till over and covered with cover slips.
- After three minutes, the cover slips were put in a slide and observed in a microscope.

For sedimentation process,

- Little drops were taken from the test tubes in a slide and covered with a cover slip.
- Then processed for microscopic observation.

2.8 Interview with key persons

Key person interviews were conducted exclusively with the persons of Hirapurphanta who do take care of black bucks using questionnaire method.

2.9 Secondary data collection

The secondary data were collected through different literatures and journals, reports and dissertation works. The data were collected through different relevant institutions like NTNC, DNPWC, SuNP etc.

2.10 Data analysis

The collected data obtained from the field was analyzed through Microsoft Excel Spread Sheet and also through a computer package, namely "Statistical Package for Social Sciences (SPSS)", (SPSS, Version 16) program. The data was presented in descriptive form as well as in suitable table, pie-chart and tabular form. For Gastrointestinal parasite, 'F' Test was performed.

III. RESULTS

3.1 Population Status (recent) of Blackbuck in Hirapurphanta of SuNP

The initial reintroduced population of blackbuck i.e. 28 is now increased to 89 (from 2012 to 2019), which is as below (Table 2).

Location	Fiscal Year	Male		Female		Fawn	Total
		Adult	Sub-adult	Adult	Sub-adult		
Hirapurphanta captivity	2075/76	25	8	29	8	19	89

Table 2: Current population status of blackbuck in Hirapurphanta of SuNP for fiscal year 2075/75.

(*Source:* Direct field observation)

3.2 Population Trend since its Establishment in SuNP

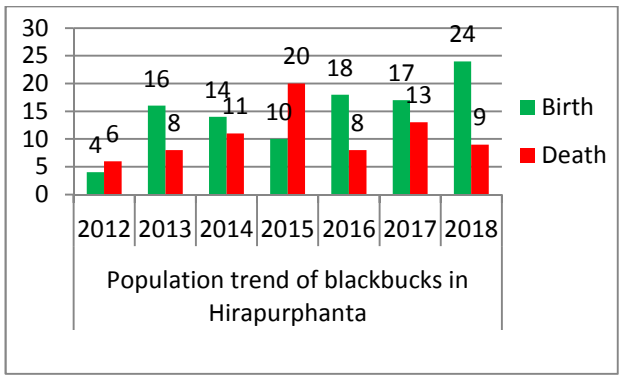


Table 3: Population increasing/decreasing trend of blackbuck in Hirapurphanta since its establishment .

(*Source:* NTNC)

The table 3 shows that there were highest deaths in the year 2015 and the death rate is low in the year 2012 and the highest birth is in the year 2018 followed by 2016. As we see the table deeply it shows that the birth rate is followed by the death rate and somewhere has crossed the birth rate such as in the year 2012 and 2015.

3.3 Population Density and age-sex composition

The total population of blackbucks at Hirapurphanta for the fiscal year 2075/76 B.S. is 89 and which is regarded as a great achievement that with in very short period of time (6 years) the bucks were increased more than three times of these were translocated initially. The area of the Hirapurphanta captivity was 54 ha and it is now projected to increase about 7 ha immediately which then good news is for bucks there in Hirapurphanta.

The crude population density would be 1.65 individuals/ha. Though the total area is 54ha, the actual area used by bucks to live is around 32 ha. Therefore the ecological population density would be 2.78 individuals/ha. And the male to female sex ratio for adult is calculated to 1:0.86 and for sub-adults is 1:1.

3.4 Vegetation Analysis

3.4.1 Food Preference and Relative Cover

Food preference is the choice of blackbuck to eat. Blackbucks largely feed on grasses. Those grasses that it prefers are the grasses in preference. Food preference was observed through binocular from a distant in to the captivity. After they left that plot and goes to another, the previous plot in which they are grazing was checked and plants eaten were observed. The result showed that 8 species of plants were highly preferred, 9 species were preferred secondarily and other species were found less preferred as food by Blackbuck (Annex 1). The plant species include grasses, herbs, trees and shrubs. It was found that, the Blackbuck was rarely feed on the bushes but it prefers the young leaves of the trees.

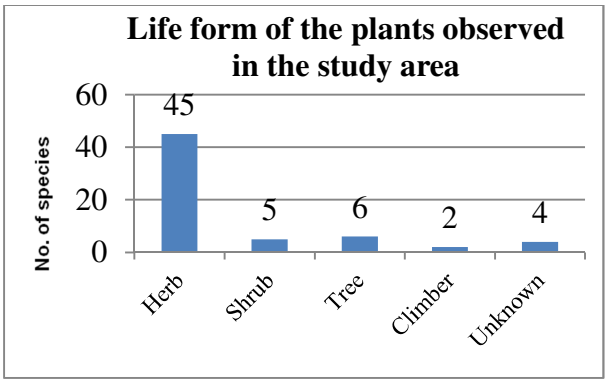


Table 4: Life form of plants

3.4.2 Vegetation Composition of the Study Area

The result showed that vegetation composition altogether 45 species of herbs, 5 species of shrubs, 6 species of trees, 2 species of climbers and 4 (unknown life form) were recorded from six different plots within the study area.. Among these, dominant grass was *Imperata cylindrica* had the highest value of relative cover 24.17% followed by *Cynodon dactylon* (12.96%), *Digitaria setigera* (10.06%) and others. During season, the Maize, Wheat, Pea, Mustard etc were used to cultivate.

IV. Survival Threats Of Blackbuck

4.1 Health Hazards

The threat of gastro intestinal parasites and other disease was noticed in the Hirapurphanta of SuNP. Two different methods: Sedimentation and Floatation were used to identify different parasites present in the fecal matter of blackbucks and also in the nearby captivity grazing livestock. The parasites observation in 60/60 samples were done respectively in livestock and blackbuck.

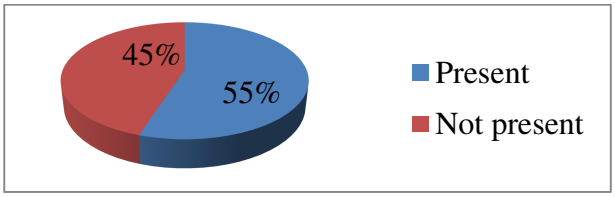


Figure 1: Blackbuck fecal sample containing parasites

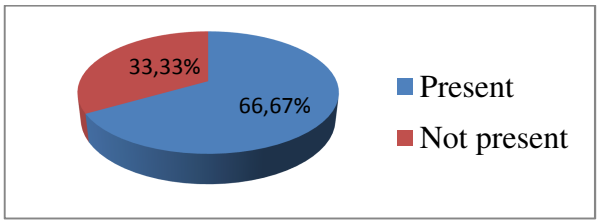


Figure 2: Livestock fecal sample containing parasites

Among 60/60 fecal samples of livestock and blackbuck, 55% of the blackbuck fecal samples were found to contain parasites while, on the other hand, 66.67% of the livestock fecal sample were found containing parasites. The summary of the parasites is given in the table 5.

S.N.	Parasites found in Blackbuck	Remarks	
1.	*Eimeria* with micropyle	Common in both	Annex-2
	Eimeria without micropyle		
2.	*Strongyle spp.*	Common in both	
3.	*Strongyloides spp.*		
S.N.	**Parasites found in Livestock**		
1.	*Eimeria spp.*		
2.	*Strongyle spp.*		
3.	*Oxyuris spp.*		

Table 5: Parasites found in blackbuck and livestock respectively

4.2 Index of Similarity of Parasite

According to [18],

Index of similarity (I_S) = $\frac{2Z}{X+Y}$

Where,

X=No of parasite species in livestock

Y=No. of parasite species in Blackbuck

Z=No. of common parasite species in livestock and blackbuck

Therefore, $I_S = \frac{2 \times 2}{3+3} = 0.67$.

Index of similarity (I_S) is found to be 0.67. This means that there is a 67% chance of transmission of the parasites between livestock and blackbuck.

4.3 F-Test for the difference between the parasites

Hypothesis: Is there any significance difference between the parasites found in blackbuck and that found in livestock?

For F-test,

H_0= there is significance difference between the parasites of both the species.

H_1= there is no any significance between the parasites found in both the species.

Calculation:

Count	mean	Variance
60	0.55	0.251695
60	0.666667	0.225989
F-stat	1.11375	
DF blackbuck	59	
DF livestock	59	
F-crit.	1.53	

Table 6: F-ratio calculation

Since, $F_{stat} < F_{crit}$. Therefore, the H_0 is accepted. This means that there is significance difference between the parasites found in blackbuck and that found in livestock.

4.4 Threats to Blackbuck

4.4.1 Overgrazing

The illegal livestock grazing made serious problem in the habitat management of blackbuck. Conservation practices of Blackbuck at Hirapurphanta were deemed over the survival threat. The main threat observed was the illegal grazing of livestocks in Hirapurphanta in SuNP for Blackbuck conservation. This area is overgrazed. Livestock rearing was found to be one of the common occupations of local people. During the survey, livestock grazing (cattle, Buffalo, and goats) were counted within four days. Average number of livestock grazed in Hirapurphanta was found to be 318 per day. The night grazing practice of buffalo and cattle was also reported but could not be assessed. Beside this, unproductive cattle abandoned by local people were also found grazing in the Park area. During the study, the Buffalo and Cow were found to present in greater extent and is being followed by the Bull, Goats, pigs and other wild animals. Cows and Buffalos mostly found there were of unproductive nature. The whole day they graze there. Other wild animal includes different animals from the Shuklaphanta National Park, such as- deer, jackal, etc. But

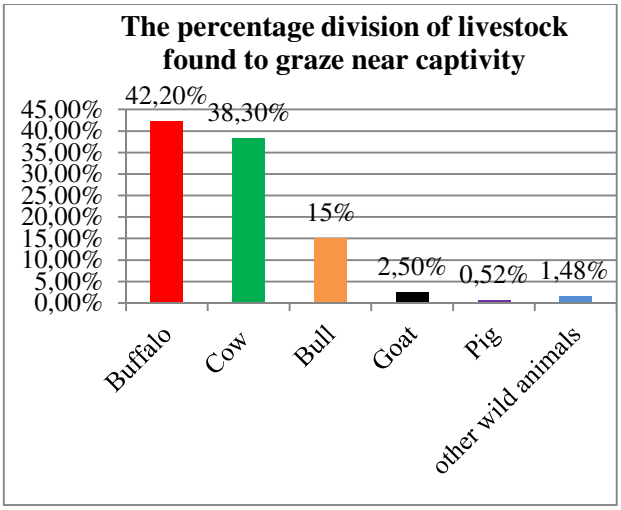


Table 7: Percentage of livestock grazing outside of the captivity in Hirapurphanta

they are reported less frequently than the buffalo, cow, bull etc. These cows, buffalos etc., were mostly leaved by the residents nearby the captivity. They were found to rear them till they are productive. Once they become unproductive, they were leaved in this way to the Park area and interesting thing is that they again get them back whenever they turn productive. This type of nature shown by the public is also responsible for the survival of the blackbucks because it increases the chances of transferring diseases from livestock to the blackbuck.

4.4.2 Threat from different Aves, herpatofauna and arboreal mammals

Different aves, such as Hawk possesses harm to the blackbuck fawns. Similarly, different mammals such as Monkey entered to the captivity from the national park causes disturb to the blackbucks by various means. Likewise different snakes, lizards were also found in the captivity. These may also possess harm to the survival of Blackbucks.

Picture 2: Respectively *Martes spp.* and *Python spp.* seen inside the captivity.

4.4.3 Threat due to flooding

Blackbuck prefers the dry grassy land to graze. It never likes the land which is wet. During flooding in terai the water is filled in to the enclosure also which possess harm to its survival. During flooding the chances of transmission of parasites is also high which causes different diseases in bucks.

4.4.4 Overcrowding

The present population of Blackbuck in Hirapurphanta of SuNP is 66. Because of having limited area of 54 ha it is insufficient for 66 jumping, running bucks. The ecological (realized) density was 2.06 individuals/ha. This seems crowding occurs there for the jumping, running bucks and due to the reason of overcrowding many of the bucks were died. The male buck fights for mating with herd of female bucks (doe). During fight, the fawns and the injured ones are in more risk than the adult ones.

4.4.5 Isolated Population

The blackbuck population in Hirapurphanta is small and it may crash at any time due to stochastic events. Therefore strong efforts should be taken to maintain and increase its population in Hirapurphanta.

4.5 Management Practices

There are different management practices observed in the Hirapurphanta with the involvement of government and non-governmental organizations and the local people. The

government of Nepal endorsed the Site Specific Conservation Action plan for Blackbuck in Suklaphanta Wildlife Reserve, Nepal (2016-2020). At first, the making of captivity in Hirapurphanta of SuNP is the keystone in the management practices of the Blackbuck habitat. Some efforts were made in the core area of blackbuck in Hirapurphanta of SuNP, in order to increase their population and long term survival. Some of them are discussed below:

4.5.1 Fencing

The all boundary of Hirapurphanta is fenced with the three tired metallic net. The outermost layer of the net contains electric current to protect any external predator of blackbuck to enter the captivity. Electric current is being maintained from the solar system. Even though the different Bird species are causing harm to the species in many aspects. Monkeys, Snakes and the *Martes spp*. are also noticed inside the captivity.

4.5.2 Water hole construction

The problem of water is becoming the reason for its survival threat. During dry periods, the captivity is facing water problems. Therefore the actions for the improvement of water facility should be taken more efficiently.

4.5.3 Ploughing and Seedling Growth

27.5 ha area out of 54 ha of the total enclosed area was found ploughed. They used to plough the land twice a year with tractor. The seasonal crops are sown in the ploughed field. The lentil, pea, black gram, bean, wheat seed, mustard, maize, etc., were sown to provide supplement diet of the Blackbuck and to prevent growing out of the habitat (Table. 1).

S. N.	Blocks in Hirapurphanta	Ploughed area (Hector)
1	A	0.5
2	B	6
3	C	4.5
4	D	9
5	E	2.5
6	F	5

Table 8: The area of Ploughing and Seedling Growth

4.5.4 Food for Black Buck

The artificial food which comprises a mixture Gram, Soyabean, is not so easily available therefore the readymade food available in market (Chokar, Pasuhar, and Chana) is also fed. Though the expenditure for its feeding is provided by Government of Nepal (GoN), there is very much difficulty in finding artificial food for it as replied by the technicians of the Hirapurphanta. They insisted on facing difficulty in buying the artificial food for the blackbuck. It is not available to buy so easily.

4.5.5 Health Care of Blackbuck

The technicians are hired in taking care of it by NTNC. They do take care of the blackbuck in the captivity. They do visit of the field so many times within a day and also they take the photos daily and analyze for any ups and downs. The bucks were fed with Metronidazole, Albendazole etc., at regular interval of time to protect the bucks from the chances of transmission of parasites. But this is not enough for its conservation. There is lack of emergency ward near the captivity for any accidents due to fights or to give first aid to any diseases. They were brought to Dhangadhi, Nepalgunj or Kathmandu to treat in case they were suffered from any sickness or diseases. They may die within the interval at any time.

4.5.6 Habitat Management

Total 54 ha area was protected by enclosed fenced, to raise the population of Blackbuck but only 32 ha area is in use. Of this, the grassland cover about 21.5 ha, cultivated (6 ha) and Plantation (4.5 ha).

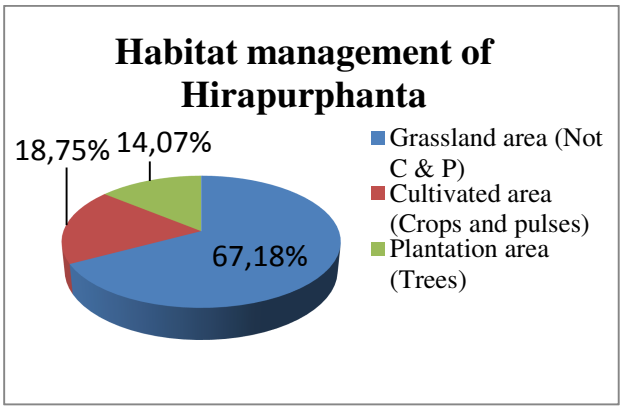


Figure 3: Chart showing percentage of area Cultivation (C), plantation (P) and grassland in Hirapurphanta of SuNP

4.5.7 Non-Palatable species Removal

The species like Pire Jhar (*Persicaria hydropiper*), Aakh (*Calotropis gigantean*), Akhtaruwa (*Equisetum ramosissimum*), Balu jhar (*Sida acuta*) Bhang (*Cannabis sativa*) Gandhe jhar (*Ageratum conyzoides*) etc., are the non-palatable species of the plants for blackbuck in Hirapurphanta. These species were occupying the greater area and multiplying its size in the field area. Removal of these species is necessary for the survival of the blackbuck as these may cause food poison to it.

4.5.8 Involvement of local people, NGOs and INGOs

The local people, different NGOs, INGOs and the GoN, including NTNC, DNPWC, and Shuklaphanta National Park are engaged in its conservation practices. NTNC has governed a team near the captivity to take care of the blackbuck. Shuklaphanta National Park is the prior agency to protect the animal there. DNPWC is providing different grants for research work in study area. The support of the local people in its conservation seems weak.

4.6 Perception of Key Persons towards Government

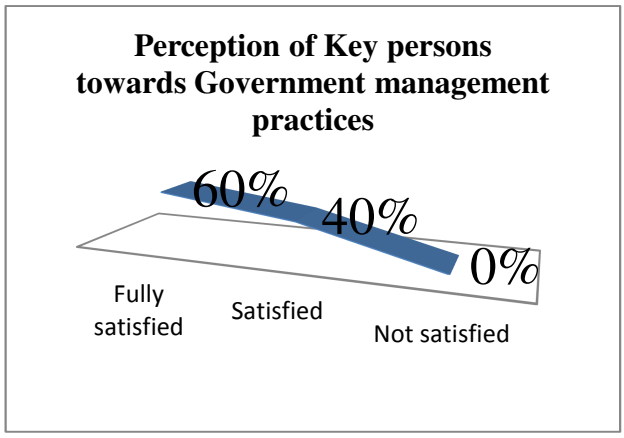


Figure 4: Perception of Key persons towards Government management practices

This data shows that the key persons are satisfied with the government and its policy to conserve blackbuck in Hirapurphanta. All of them are satisfied with the governments. Among them, 60% were fully satisfied and 40 %were just satisfied (Figure 4).

V. Discussion

From a bird's eye view, there are observed highest deaths in the year 2015 and the highest birth in the year 2016 (Table 3). As we see the table deeply it shows that the birth rate is followed by the death rate and somewhere has crossed the birth rate such as in the year 2012 and 2015. This natality and mortality trend shows that the ratio of birth and death is nearly in the same ratio. Little bit birth rate is high but is followed by the death rate. If this trend goes in the same way it becomes hard to achieve the future vision and difficulty will be faced in increasing its number. This death rate should be minimized with the smart projects that directly address it. Another point is that if the death rate is going in this ratio, blackbuck can't be made wild in future days. Our target to make it wild will fail. Therefore effective programs should be launched by government to save more and more species of blackbuck, to reduce the mortality rate and to make the area best fit for the blackbucks.

5.1 Habitat: As this study refers the blackbuck prefers open grassland with full of its highly preferred grass species, also supported by [40].

5.2 Food Preference: Blackbuck is a diurnal feeder. It feeds on grasses. It prefers Dubo, *Cynodon dactylon*, also supported by ([40], [6]) and it also prefers *Evolvulus nummularius* (Badam pate), *Fimbristilys bisumbella* (Chhata mothe), *Hemarthria compressa* (Ghode dubo), *Cyperus niveus* (Mothe-I), *Morus alba* (Kimu), Makai (*Zea mays)* and *Cynodon spp.* (Pani dubo) followed by *Imperata cylindrica* (Siru), *Chrysopogan aciculatus* (Kuro), *Cyperus rotundus* (Mothe-II), *Phyllanthus virgatus* (Amala jhar), *Euphorbia hirta* (dudhe jhar), Kamale ghas, *Cyanotis cristata* (Kane jhar), *Oxalis corniculata* (chari amilo), and *Digitaria setigera* (Bansho) and others is also preferred by blackbuck, when there is lack of highly preferred grass species.

On the other hand, blackbucks feed on cultivated grass species also such as; cereals (maize, wheat etc), vegetables (pea, peanut, mustard, gram, soyabean, lentil etc), soft grasses, leaves of shrubs or trees. This is supported in his study by [14]. It does not require water regularly though water consumption becomes essential occasionally when moisture content of the forage is very low ([32], [30], [40]). On their study, [7] reported that the blackbuck nibble the young shoots of various cereals and pulse crops.

[40] reported the blackbuck preferred plant species were eight species of grasses, herbs or forbs, six species of agricultural crops and four species of trees but the present study reported all total of 62 plant species. Among them, seven species were highly preferred by the blackbuck, other nine species as the second preferred plant species, sixteen species of plants as low preferred plant species and remaining others as negatively preferred plant species. These negatively preferred plant species, non-palatable species of the plants which the blackbuck does not eat and the invasive species are also found to cover the large area in the blackbuck enclosure. This may harm to the survival of the blackbuck there in Hirapurphanta.

5.3 On Parasites: The study noticed different parasites from both livestock and blackbuck. *Eimeria* with micropyle, *Eimeria* without micropyle, *Strongyle spp.*, *Strongyloides spp.* were found in the fecal matter of livestock and the *Eimeria spp.*, *Oxyuris spp.* and Strongyle *spp.* were found in blackbuck fecal sample. This means that the two parasites were common among them. They are: *Eimeria* and *Strongyle*. [18] concluded that the five common species of parasites from livestock: *Coccidia*,

Ascaris, *Paramphistomum*, *Strongyles* and *Fasciola.* The pellets samples of Blackbuck population showed that 93.33% of the tested samples had at least one of the protozoan or helminthes parasites. The common parasites of livestock and blackbuck were *Paramphistomum, Strongyle, Ascaris and Coccidia*.

The index of similarity or homogeneity is found to be 0.67, showing a high degree ($2/3^{rd}$) of chances of transmission of parasites between the livestock and the blackbuck while the similarity index of gastro-intestinal parasite communities in livestock and blackbuck was computed to be 0.89 [18]. They also concluded that there is high degree of similarity in parasitic occurrence in the herbivores sharing the same grazing fallow.

VI. CONCLUSIONS

After all, following points can be concluded,

- There were 89 blackbucks at present (but are not viable to live out of the captivity). There is increase in the blackbuck number. The ecological (realized) population density at Hirapurphanta is found to 2.78 individuals/ha even though the crude population density is 1.65 individuals/ha.
- The vegetation composition of the study area is satisfactory for now but this never means that the vegetation of the Hirapurphanta is best fit for the blackbuck. After the eradication of the non-palatable and invasive species of plants from the study area, it would be best fit for its survival. Therefore, there needs to be done researches at regular interval of time to check and balance any ups and downs.
- There is 67% of transmission of parasites between livestock and blackbuck. Therefore, the safe replacement program for the livestock grazing near the captivity should be organized by government through effective policies or there needs to make another boundary outside the present boundary to prevent the contact of the blackbuck and the livestock. This reduces the chances of transmission of parasites from livestock to the blackbuck and help to increase its population. This help to reduce the loss of blackbucks due to parasites.
- The effective conservation policies and the livestock management policies should be organized by the government.
- The government should take it more seriously to help increase its number and also should follow the best scientific practices done in other countries applied to make it wild in coming days.
- The Injured Blackbuck Treatment Centre (IBTC) should be established near the captivity to control the rapid loss in number.
- The area should be increased with increase in blackbuck number at regular interval of time. This reduces crowd & helps to make homogenous distribution of the blackbuck within that area and protects them from dying off due to crowding.
- Daily observation on blackbuck should also be initiated because many of the bucks may die due to fight among them but due to lack of observation it cannot get treated in time.
- Awareness programs to the locals should be organized to control the rapid cutting of grasses preferred by blackbuck during the course of sanitation program.

VII. RECOMMENDATIONS

The following recommendations are suggested,

- ❖ Invasive plant species should be checked and removed at regular interval of time.
- ❖ Area should be increased with the number rise of blackbuck species.
- ❖ Snakes, Hawk, Monkeys may possess harm to the blackbuck. Any cut in the metallic net should be checked and the holes of the net should be maintained in such a way that snakes cannot enter it.
- ❖ Scientific policies and programs should be made that help to conserve this species more precisely.
- ❖ Regular monitoring of the parasitic attack should be organized and the species should be treated if suffered from any diseases in time.
- ❖ Awareness programs about the conservation of blackbuck to the local peoples should be organized to control the cheating while sanitation program such as cutting of grass species that was most preferred by blackbucks.
- ❖ The regular use of medicines such as Albendazole, Mebendazole, and Piperazine should be reduced. Indirectly these medicines possess harm to the health of blackbuck.
- ❖ Lack of well equipped laboratory near to the captivity is another reason aiding its declination. Therefore, government also should take its concern on it.
- ❖ An outer boundary should also be maintained to cut off the contact line of blackbuck with the grazing livestock.
- ❖ Injured Blackbuck Treatment Centre (IBTC) should be made available near the captivity.

- A water canal should be made outside of the enclosure to prevent the inflow of run-a-way water during the rainy season.
- The invasive species and the non-palatable species of the plants should be eradicated for the better life of the blackbuck there in Hirapurphanta.

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ANNEX 1: Food Preference and Relative Cover (aggregated)

S.N.	Common Name	Scientific Name	Intake	RC%(*)	RC%(#)
1.	Aakh	*Calotropis gigantean*	-	0.54	0.5
2.	Akhtaruwa	*Equisetum ramosissimum*	-	0.15	0.05
3.	**Amala jhar**	***Phyllanthus virgatus***	**++**	**5.07**	**4.29**
4.	Asare	*Murraya koenigii*	+	1.50	-
5.	**Badam pate**	***Evolvulus nummularius***	**+++**	**5.96**	**14.23**
6.	Bale bot		+	0.86	2.51
7.	Balu jhar	*Sida acuta*	-	3.38	2.27
8.	Ban tarul	*Dioscorea bulbifera*	+	1.20	-
9.	**Bansho**	***Digitaria setigera***	**++**	**10.06**	**6.11**
10.	Bayer	*Ziziphus mauritiana*	+	2.55	2.65
11.	Bel	*Aegle marmelos*	+	1.12	1.87
12.	Bhang	*Cannabis sativa*	-	2.11	1.56
13.	Bhelar	*Trewia nudiflora*	-	1.06	4.47
14.	Charchare kuro	*Parthenocissus semicordata*	-	2.85	0.19
15.	**Chari amilo**	***Oxalis corniculata***	**++**	**6.35**	**3.21**
16.	Chhata mothe	*Fimbristilys bisumbella*	+++	2.43	3.78
17.	**Dubo**	***Cynodon dactylon***	**+++**	**12.96**	**15.24**
18.	Dudhe jhar	*Euphorbia hirta*	++	4.10	3.94
19.	Gandhe jhar	*Ageratum conyzoides*	-	0.14	-
20.	**Ghode dubo**	***Hemarthria compressa***	**+++**	**4.30**	**5.16**
21.	Ghodtapre	*Hydrocotyle asiatica*	-	1.42	0.64
22.	Gineri		-	0.45	-
23.	Githa	*Dioscorea spp.*	+	-	0.89
24.	Gol kakree	*Solena heterophylla*	+	1.45	-
25.	Kamale ghas		++	2.49	2.45
26.	Kane jhar	*Cyanotis cristata*	++	0.65	2.20
27.	Kash	*Saccharum spontaneum*	-	1.89	0.70
28.	Khair	*Acacia catechu*	-	1.13	-
29.	Kimu	*Morus alba*	+++	0.05	-
30.	Kuiya/Khursani jhar	*Persicaria barbata*	+	2.94	1.15
31.	Kuro	*Chrysopogan aciculatus*	++	3.29	4.10
32.	Kush	*Desmostachys bipinnata*	-	0.98	-
33.	Makai	*Zea mays*	+++	-	5.02
34.	Mothe-I	*Cyperus niveus*	+++	2.49	2.50

35.	Mothe-II	*Cyperus rotundus*	++	2.81	1.67
36.	Mula pate		-	2.51	1.12
37.	Narkat	*Phargamitas karka*	-	0.12	0.12
38.	Pani dubo	*Cynodon spp.*	+++	4.57	5.70
39.	Peepal	*Ficus religiosa*	+	0.34	1.30
40.	Pidalu	*Colocasia esculentum*	-	1.75	0.95
41.	Pipla	*Piper longum*	+	0.73	-
42.	Pire jhar	*Persicaria hydropiper*	-	2.01	0.46
43.	Sano ghodtapre	*Hydrocotyle sibthorpioides*	+	1.08	1.03
44.	Simal	*Bombax ceiba*	-	0.85	0.14
45.	**Siru**	***Imperata cylindrical***	**++**	**24.17**	**13.34**
46.	Sulsule	*Eragrostis tenella*	-	-	0.82
47.	Thakail	*Argemon mexicana Linn.*	-	0.77	0.28
48.	Thuke jhar	*Caesulia axillaris*	+	1.49	1.56
49.	Toriya	*Luffa acutangula*	+	3.17	-
50.	Uniu	*Pteris spp.*	+	2.02	1.50
51.	Unknown-1		-	3.03	1.48
52.	Unknown-2		+	0.89	1.74
53.	Unknown-3		-	0.60	0.25
54.	Unknown-4		-	1.92	2.23
55.	Unknown-5		+	0.97	1.55
56.	Unknown-6		-	1.72	-
57.	Unknown-7		-	0.57	-
58.	Unknown-8		-	1.12	-
59.	Unknown-9		+	1.01	-
60.	Unknown-10		-	2.51	-
61.	Unknown-11		-	0.66	-
62.	Vix jhar		-	0.07	-

(*Source:* Field observation)

Where,

High preference = + + + Medium preference = + + Low preference = +

Negative preference = - Pre-monsoon= * Post-monsoon= #

ANNEX 2: PHOTO PLATES

Board at Hirapur!

Running Buck!

Blackbuck herd!

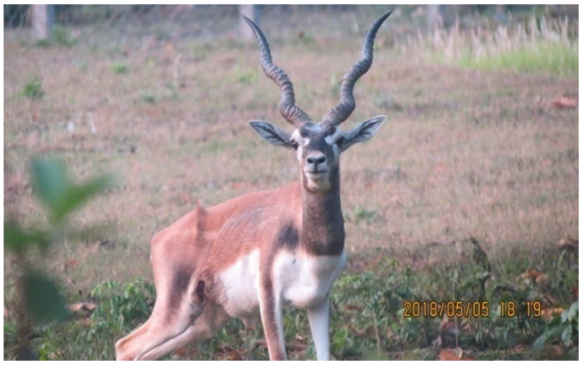
Blackbuck feeding!

Female Blackbuck (doe) and Fawn

Sanitation program inside captivity @Hirapur


During Quadrate sampling inside the captivity!


Focus Group Discussion!



Parasite attack in Blackbuck!

Injured Blackbuck!

Boring water under construction inside captivity @ Hirapurphanta


Pellet collection & using preservative!


Data collection!

Water facility for Blackbucks!

Male buck chasing female for mating!









Herd of Livestock near the captivity!Laborat mpts!

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