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FORAGE AND FEEDING ECOLOGY OF INDIAN ANTELOPE OR BLACKBUCK (*ANTILOPE CERVICAPRA*. Linn 1780) IN GANJAM DISTRICT, SOUTH ODISHA, EASTERN INIDA

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ABSTRACT

The foraging pattern of blackbuck was studied in research project during the Feb-1998 to March 2005 in Balipadar-Bhetnoi blackbuck reserve, Ganjam district, southern Odisha, India. The seasonal variation in natural vegetation abundance especially in herbs, shrubs and low height scrubs and trees are greatly marked. The topography of the study area is undulated with cultivated croplands, pastures and highland scrubs ranging from 20mts to 100 mts MSL elevations. The district receives rainfall of 1551.6mm in interior to 1148.6mm of rainfall in the coastal area. But the area shows severe dryness and most of the habitat behaves semi-arid conditions during the summer season. The animal did movement in greater area in search of forage and water. Cropping pattern also provide good quality of forage to blackbuck and caused population fluctuation and group sizes. The overall dryness during summer causes in shrinkage of forage grounds. However, the tree vegetation scattered in cropland habitat provide shade and cooling to the animals as well as provides forage in the form of leaf, flower, and fruits. The population in the reserve site in Ghumusur south forest division exceeds 4000 animals. The local people do not harm to the beautiful and harmless animal. They protect blackbuck in a socio- religiously and conserving century ago.

Keywords: foraging, blackbuck, shrinkage in habitat, vegetation, shade, cropping pattern, conservation.

1. INTRODUCTION:

The blackbuck or the Indian antelope (Antilope cervicapra) is a medium sized antelope native to Indian sub- continent. This antelope shows remarkable sexual dimorphism at maturity. Males are on average larger than females, conspicuously colored and having horns. The adult males (sub –species rajputanae) weighs 34 to 45 kg while females weigh 31 to 39 kg (Ranjitsinh 1989). The coats of adult males show striking black or (dark brown) and white under parts, while the coats of females and immature males varies from tan to jet- black. This variation can be seen among the males within a population. Furthermore, even an individual male's coat color may vary according to age structure and climatic factors. This variation can be seen among the males within a population. Furthermore, even an individual male's coat colour may vary seasonally and with his breeding status (Schaller, 1967; Prater, 1971; Mungal, 1978). Unlike Females which are horn less, males bear distinctive long, in rare cases females have also rudimentary horns (Chouhan, 1984), spiral and diverging horns. The conservation status of blackbuck is listed in Red Data Book of IUCN (International Union for Conservation of Nature and Natural resources.) as Vulnerable, under CITES (Convention on International trade for Endangered species of wild flora and fauna) it is categorized in Appendix III. It is classified in Schedule I of Wildlife (Protection) Act 1972.

The overall dryness during summer causes in shrinkage of forage grounds making the animals move to distant area in search of water. The animals are confined to the water bodies like small to medium check dams, stream beds and low-lying area in the cropland habitat. The raising in the additional population in the older areas tends to migrate in search of forage, habitat and new territory. The topography of the study area is undulated with highlands ranging from 20 meters above sea level (MSL) to 100 meters MSL. The undulation in the terrine supports against flooding in monsoon and availability in similar forages helps the animal to live in newer habitat (Das, U.K; Kar, S.K. 2015). I observed these glands in a closure view at Suramani village near Kalamba habitat. The pre-orbital glands when swell within males. It also discharging oily secretions in males and it is in dormant stage in females. In addition, both sexes have a pair of frontal glands: two straight slits on the face between the eyes. It was observed field that the males rub their facial gland on stems of small trees and shrubs and left the oily pheromones over the bark of the tree. Indirectly, they demark the territory by scraping the bark of the trees by rubbing the hard horns. They also defoliate the leaves and

small twinges in hedges and bushes by the help of hard and strong horns. The blackbuck feed around the day time with intervals of rest and other movement activities. They start feeding in early hours of dawn which continues up to 9.00 - 9.30 a.m. This feeding activity slows down during hot hours of the day. After 3.00 p.m. blackbuck grazes uninterruptedly till dusk if not disturbed. This feeding activity varies according to the change of season. During winter, they take rest / sleep for sun up to 8.00-9.00A.M. And then graze till dusk with short period for rests.

2. MATERIALS AND METHODS:

The blackbuck or the Indian antelope (Antilope cervicapra) is a medium sized antelope native to Indian sub- continent. Ellerman and Morisson Scott (1951) recognized 4 subspecies of blackbuck (Antilope cervicapra. Linnaeus) of these on the basis of morphological features of skulls and physical attributes 4 native sub species of blackbuck are recognized Groves (19 80).

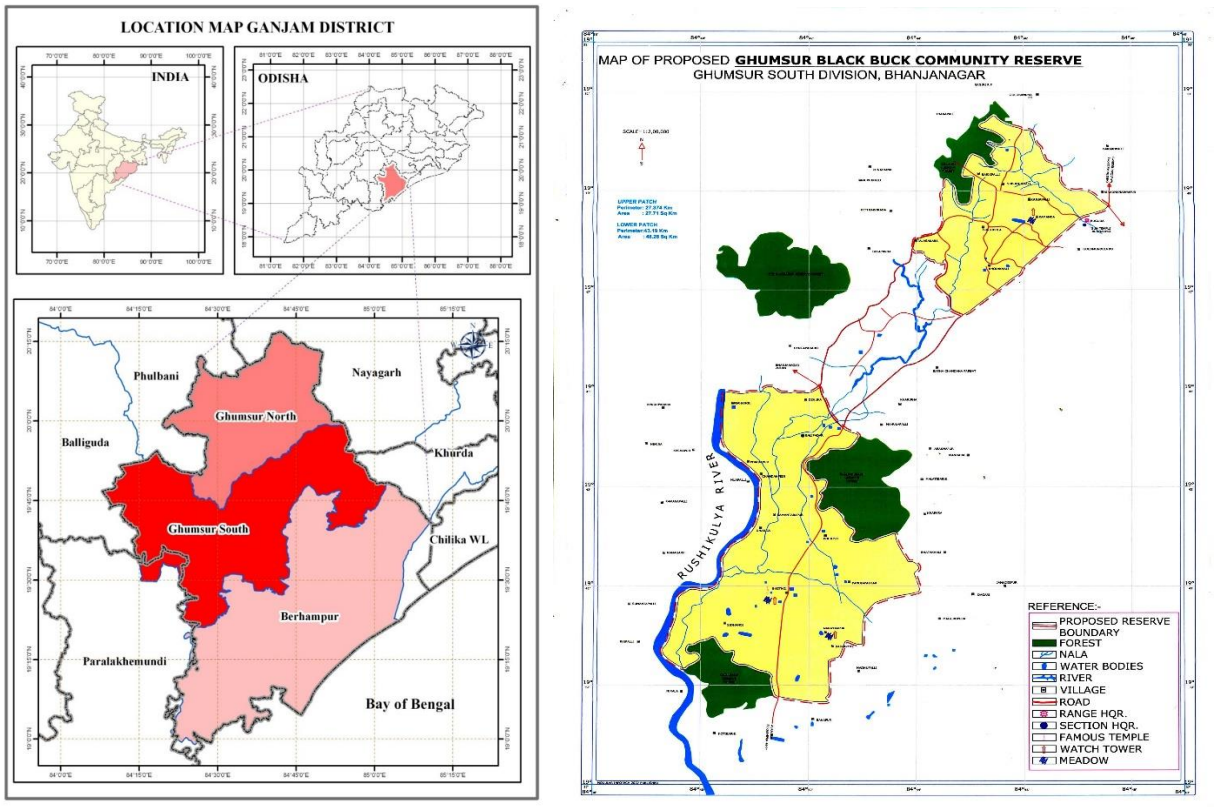
i) Antilope cervicapra centralis (Zukowsky):- Central India ii) Antilope cervicapra rajputanae (Zukowsky):- Rajsthan, Gujrat, Punjab and Hariyana iii) Antilope cervicapra rupicapra (Muller):- Uttar Pradesh iv) Antilope cervicapra cervicapra (Linnaeus):- Southern India

Blackbuck belongs to the tribe Antilopini and their closest extant relatives are the Gazzells (Effron, 1976). Two sub-species of blackbuck are currently recognized: the northwestern A. c. rajputanae and eastern and southern A. c. cervicapra (Groves, 1980; Ranjitsinh, 1989). Body size, horn length and darkness of male coats typically decrease from north to south and from west to east (Dharmakumarsinhji and Gaekwad, 1958; Krishnan, 1972; Ranjitsinh, 1989).

There are three ranges namely Buguda, Polasara and Aska Ranges of Ghumusar South Forest Division and Khallikote of Berhampur Forest Division in Ganjam district is situated between 19°33′ - 19°55'N : 84°35' 85°01'E., covering an area of 300 sq.km. vide Govt. notification No.22755/FFAH dt.19.9.89. Its northern and western boundaries touch the river Badanadi near Kumarsuni Reserve Forest, southern part touches the bank of river Rushikulya and Baghua runs along its eastern boundary. The extremes of the major habitats falls in north most in Betarsingh habitat of Buguda range (Lat N19° 49′ 25″ / Long E 084° 46′ 50.3″) west most in Gahangu habitat of Buguda range (Lat N 19° 41′ 32.0″ / Long E 0 84° 40′ 43″), in eastern most habitat of Chikili under Khallikote range (Lat N 19° 33′ 42.5″ / Long E 085° 0′ 48.6″) and the southern- most continuous habitat of Babanapur beat area under Asika range (Lat N 19° 40′ 29.7″ / Long E 084° 41′ 33.7 ″) The state highway (SH 33)connecting Berhampur to Nayagarh via Buguda and the Khallikote- Bhanjanagar state highway passing through Kodala, Kabisuryanagar, Asika is passes through the major habitat portion the district.(Das & Kar 2011). The habitat extends beyond the boundaries as blackbuck population are also seen in some isolated pockets. The state highway (SH 33) connecting Khurda and Berhampur via Nayagarh passes through the study area and the state highway from Khallikote to Asika cover most of the habitat (Kar, S..K. and Panda, R.M. 1997. Line transect surveys was made to know the habitat use and relative abundance of the sighting of animals and study on herd structures. Maximum care taken during line transect survey during dry seasons. The tree vegetation in different transect sites are varying according to topographic features and soil types. The initial transect sites the starting 400meters is taken for sampling of vegetation and more information is recorded.

Photo-1 A blackbuck herd in Bhetnoi- Jagatipadia Pasture land with paddy cropland habitat in Asika range during late rainy season.

Photo-2 A herd of blackbuck in common grazing ground with sheep and cattles in Bhetnoi- Jagatipadia Pasture land habitat near Asika range in Odisha.



Map 1-2 Location Maps of study area and Management map of Blackbuck community reserve in Ganjam district.

3. RESULTS AND DISCUSSION:

Presently after the 2008 survey periods the animal seem to disperse in similar habitats in Digapahandi rand of Berhampur forest division and Jaggannath prashad range of Ghumusur North division, The major part of the study area for blackbuck was almost covered by the 19 survey transects, and some other isolated pocketed patches of habitat still occupied by blackbucks are only covered during census operations. The Lunidhepa and Kumpapada habitat in Udayapur beat area under Panchubhuti section in the northern fringe of the habitat bordering to Nayagada district is unique and have gentle slope with scrub and casew nut plantations. The blackbuck inhabited in such a habitat that direct sighting to all individuals or herds is not possible. Only one by one counting is applied during movement across forest roads or smaller meadows. The whole area under study consists of Ballipadar - Bhetnoi Blackbuck community reserve and other habitat patches in 50 neighboring villages. The human population in blackbuck habituated villages are 40,000 and the cattle population will be above 15000. The sheep population is round 8,000 and goat population is around 12,000. The blackbucks live in peacefully in the habitats of three forest ranges and they are protected in a socio- religious sentiment of the local people. The study area consisted of 60-65 % cultivated land, 12-15% rocky elevations, 10-15% manmade houses and roads, 5-6% forest cover and 7-8 % tanks / water body (Kar, 2000 and Das, U.K; Kar, S.K. 2015).

Availability of forage in the study area depends upon various physio-graphic conditions, seasonal variation as well as topography of the terrain. Blackbuck live on fresh tender leaves, grass, and crop. Sometimes the leaves of shrubs and trees are also taken. During the study, it has been observed that the blackbuck feed selective food varieties available in the area. Some grass and crops are seen to be taken regularly. A season-wise classification of food items available in the area was documented **(Table-1 & 2).** The degree of preferably to different food plants and the variability of crop pattern throughout the year was made based on daily observations.

The preference and non-preference to food plants at different phenological stages was studied **(Table- 1).**

During the winter, the cropping pattern changes in the study area. Major crops are leguminous (moong, ararha, cow pea, etc.) types and vegetables (tomato, brinjal, potato, cucumber, beans, ladie's finger, spinach etc.). The area gradually becomes dry and it helps Blackbuck to move in scattered groups (small and big) and collect food. During winter month cultivation of pulses was about 30% of the total crops and cereals at their harvesting stage. The varieties of grasses were available abundantly. It has been

observed that pulses like *Phaseolus mungo, Cajanus indicus* (pigeon pea), *Lathyrus sativus* (khesari) were taken by the blackbuck. However, *P. mungo and C. indicus* were more preferred than other available pulses (e.g., *L. sativus*). The Blackbuck regularly eat the moong plants (green gram) and even prefer to rest within field during dry cropping season. If the blackbuck got disturbed and felt unsafe, they choose nearby crop fields adjoining to the habitat. Raid of rabi-crop fields by blackbuck at night also substantiate this fact. However, soft leaves of *L. sativus* is taken when the Blackbuck pass through by these fields. The grasses like *Cynodon dactylon, Cyperus rotundus* and *Celosia argentia* are the favorable food items for this period (Das, U.K. and Kar, S.K.,2011). The *Celosia argentia* is regularly eaten by blackbuck which was only available for this season. In the paddy field, they prefer to eat only soft paddy leaves other than coarse parts of the plant. They prefer to feed entire ragi (*Elusine coracana*) plants including tender pods (pods are most preferred ones than any other food items) . There is no instances of sizable damages to young plants of corn crops (*Zea mays*) and sugarcane (*Sacharum officinarum*) as the crop field looks a thicket and blackbuck does not prefer to enter such crop fields.

The summer was not totally dry, and scarcity of food was not experienced for the first half of the season. The blackbuck also to take soft, tender leaves of *Magnifera indica* and the fruits of *Ficus species*. They also raid summer vegetables like water melon, cucumber, gourd etc. both day and night time which is a loss to farmers. Grasses like *C. dactylon* and *C.rotundus* are taken with much interest during this time also. The crop plants like *Sesamum indicum* (til) and hemp, sugarcane is not preferred to forage by blackbuck. The second half of the summer during mid-April to mid-June, there is acute scarcity of fodder in the area. Blackbuck faces much difficulty for getting required food. They move place to place in search of forage and water. They prefer to stay nearby the stream and river banks, where tender grass is available. During this scarcity of forage, they also move into village fringes in search of food items like (*Prosopis juliflora, Acacia arabica, Terminalia belerica, Zizyphus jujuba etc*) and other vegetable crops. They also move to nearby foot hills for browsing and shelter. During monsoon, in addition to the kharif crops a large variety of grasses and shrubs are available in the cropland habitat. The congregations of blackbuck are seen in such habitats having highly preferable crops. The rice (*Oryza sativa*) and ragi (*Eleusine coracana*) are among the most favored crops and the blackbuck seen continuously feeding these crops. However, the *Cynodon sp*. and *C. rotondus* are preferable among available grasses. Therefore, the study reveals that the *Cynodon sp*. and *C.rotondus* was taken by the blackbuck throughout the year while the other vegetation is seasonally taken. During the rainy season the entire habitat turns to green due to sprouting of new grasses, shrubs and tree species. Paddy cultivation commences, and the higher ground is utilized for minor cereal crops like ragi and maize. Vegetables are cultivated at the village site farmlands. Blackbuck likes tender shoots of paddy, but they are attracted more towards the luxuriant growing crops having with good coloration (greenish). In the peak monsoon period (August - September) when the paddy fields are with full of water of varying depths, Blackbuck avoid entering muds in central portions of the paddy fields. They usually prefer to move over or beside the bunds and feed on grasses over bunds and in pasture lands. To scare and disperse the blackbuck from the paddy sapling grounds and vegetable fields, the farmers put dummies of various shapes, sizes and coloration at strategic locations. Farmers also create driving sounds by beat drums and use wind operated tin drums to scare away the animals from vegetable crop fields. However, blackbuck does not prefer leaves or fruits of a variety of plant species. The leaves of *Anona sp*. , Casew nut *Eupatorium sp, Jatropha sp., Ipomoea sp.* and other plants like *Sesamum indicum* etc. are not taken by the blackbuck. It appears that the smell in addition to the softness and sweetness of food plants are playing a major role for their choice of food.

In the rainy season, except during the heavy rain, their feeding time is same as the summer months. They usually do not take food during heavy torrential rain. Occasionally, they raid crop fields at night also. While grazing the blackbuck move with a slower pace and frequently raise their heads and look around observe the human disturbances. While browsing they keep their forelimbs on the field bunds, raise their heads upwards and pluck leaves and fruits of *Cajanus indicus*. But bipedal feeding was very rarely observed during the study period. Blackbuck can survive without drinking water for a day to week (Schaller, 1967). The blackbuck is better adapted for life in arid and semiarid regions. They feed for a long time, select succulent grasses, and tender shoots of plants which help them to maintain water balance in their bodies. Besides, the pale colour of the body helps them to reduce absorption of radiant heat. They can tolerate direct sun better than any other wild ungulates. Instead of the black colour of the male which absorbs the more heat energy from sun, the males forage more times than the female to meet increased body activity including movement and infighting. During the study period the mode of drinking of blackbuck is observed only on eleven occasions (individual / separately) involving three lone bucks, five territorial males and three females. On several occasions fresh hoof marks of blackbuck were seen near waterholes / water bodies. This indicates that blackbuck probably drink during the evening or night hours. However, the eleven occasional sightings of drinking behavior were observed during mid-day during summer months (Das, U.K. and Kar, S.K.,2011).

Water management:

Two challenges that blackbuck face in the semi-arid habitats they thrive in water limitation and large fluctuation in nutritional levels in their forage. Blackbuck show several physiological and behavioral traits that are probably adaptive responses to these environmental conditions. During the hot summers, they urinate so concentrated that to check more water loss from body. The overall dryness and low water content of the forages force them to quench moderate amount of water once or twice a day. The study area under Ganjam district does not too dried that occurs in central and north-western region of the country. However, there are considerable amount of water available in different waterholes like, reservoirs, village ponds, and along drainages. Blackbuck used these water sources for their water requirements (Das, U.K. and Kar, S.K.,2011).

Photo-3 A pair of blackbuck in rut and display in Bhetnoi-Jagatipadia Pasture land.

Photo-4 A wild female blackbuck clode to farmers camp site in Bhetnoi habitat

Table 1: Sasonal Food Preference of Blackbuck.

Grasses	Name of the plants	Winter	Summer	Monsoon	Parts of the plant taken
	Cynodon dactylon	++	+	+++	Entire plant
	2Cynodon barbri	++	+	+++	Entire plant
	3Cyperus rotundus	++	+	+++	Entire plant
	Celosia argentea	+++	-	++	Entire plant
Crops	*Oryza sativa*	+	-	++	Leaves and fruits
	Eleusine coracana	+++	-	++	Leaves,flowers and pods
Pulses	*Cajanus indicus*	++	_	+++	Leaves,flowers and pods
	Lathyrus sativus	+	_	_	Leaves
	Pisum sativum	+	_	_	Leaves
	Cicer arietinum	+	_	_	Leaves
	Phaseolus rasiatus	+++	_	++	Leaves, flowers and pods
Oilseed	*Arachis hypogea*	+	_	++	Leaves
Others	*Acacia nilotica*	_	+	_	Leaves
	Prosopsis julifera	+	+++	_	Leaves,flowers and fruits
	Terminalia belericea	_	+	_	Fruits
	Phoneix sylvestris	_	+	_	Leaves and fruits
	Tridax procumbens	_	+	_	Leaves
	Abutilon indicum	_	+	_	Flower

Note:- The symbol + and – indicates the degrees of preferences and non-preferendes of the forage species. During scanty of forage, some of the less choised forage species also taken by blackbuck**.**

Table 2: Seasonal Cropping pattern in different months of a year.

Months	**CROPS**							
	Eleusine corocana	*Oryza sativus*	*Cajanus indicus*	*Pisum sativum*	*Arachis hypogaea*	*Raphanus sativus*	*Phaseolus mungo*	*Brassica oleracea*
JAN.	-	-	GH	GF	-	-	G	-
FEB.	-	-	GH	H	-	-	G	-
MARCH	-	-	H	-	-	-	H	-
APRIL	-	-	-	-	-	-	-	-
MAY	-	-	-	-	-	-	-	-
JUNE	S	S	-	-	-	-	S	-
JULY	SG	SG	-	-	S	-	SG	-
AUG.	G	G	S	S	G	S	G	-
SEPT.	G	G	SG	SG	G	SG	G	S
OCT.	GH	G	G	S	GH	GH	GH	G
NOV.	H	H	G	S	H	H	H	GH
DEC.	-	H	GH	G	-	H	S	H

Abbreviation used in the table
G- growing S- sowing H- harvest GF- growing & flowering
GH- growing & harvesting SG - Showing & growing

Table 3: Seasonal forage species including crops in blackbuck habitat of Ganjam.

Season >>> Crops/ vegetation types bellow	***WINTER***	***SUMMER***	***MONSOON***
GRASS	*Cynodon dactylon* *Cynodon barberi* *Cyperus rotundus* *Commelina benghalensis*	*Cynodon dactylon* *Cynodon barberi*	*Cynodon dactylon* *Celosia argentea* *Panicum sps.* *Borreria hispida* *Vernonia cinerea* *Paspalum- scrobiculapum* *Fimbristylis-miliacea* *Kyllinga triceps* *Commelina benghalensis*
CEREALS	*Elusine coracana*	*Zea mays*	*Elusine coracana* *Oryza sativa*
PULSES	*Cajanus cajan* *Cajanus indicus* *Lathyrus sativus* *Pisum sativum* *Phaseolus aureus* *Cicer arietinaum*	*Dolichus lablab*	*Cajanus indicus* *Phaseolus aureus* *Phaseolus mungo* *Var. radiatus*
VEGETABLES	*Lycopercicum esculentum* *Brassica oleracea* *Spenacia oleracea* *Cucumis sativus*	*Cucumis sativus* *Trichosanthes cucumarina*	*Ipomea batata* *Lycopercicum esculentum* *Trichosanthes-dioica* *Trichosanthes cucumarina*
OTHERS	*Arachis hypojea* *Sesamun indicum* *Prosposis juliflora*	*Acacia nilotica* *Terminalia belarica* *Phoenix sylvestris* *Abutilon indicum* *Carrisa koronda*	*Arachis hypogaea* *Sesamun indicum* *Arachis hypojea* *Prosposis juliflora* *Corchorus olitorious* *Canabis sativa*

Table 4: Quantity of crop damage by blackbuck in study area (in percentage).

Sl. No	Crops	Showing season	Harvesting season	Parts of plant eaten	Percentagedamages
1.	Ragi	June-July	October-November	Shoots and pods	25%
2.	Vegetables (Spinach, Brinjal, Cabbage, Tomato, Potato, Cucumber)	Rainy and Winter	Rainy and Winter	Leaves, Tender twigs, Fruits and other soft parts	20%
3.	Green gram	January	March	Fruits and leaves	20%
4.	Paddy	June-July	Nov.-Dec.	Tender shoots and paddy sapling	15%
5.	Black gram	September	December	fruits and shoots	10%
6.	Groundnut	July and October	Sept. and February	Leaves and shoots	5%
7.	Others (Pigeon pea,Cowpea etc.)	Sept.-November	December-February	Leaves and pods	5%

Scarcity of Forage during peak summer season:
When the digestibility of forage is low, blackbuck seem to be relied on body reserves (Jhala 1991). They also feed less reduce their movement activities, perhaps as a way of conserving energy and avoiding the large physiological costs of trying to digest coarse forage (Jhala, 1997; Isvaran and Jhala, 2000). Blackbuck similarly show several physiological and behavioral responses when water is limited, including concentrating their urine and pellets, panting and feeding at times of the day that may allow them to maximize water intake through their forage (Mungall, 1978; Jhala *et al.* , 1992). In the Ganjam habitat during hot summer the scarcity of grass species is compensated with crop raiding of succulent crops like watermelon, cucumber, luffa, and even groundnut leaves in Buguda region (Das, U.K; Kar, S.K. 2015).

Floral (Tree vegetation) composition in survey transects of the study area:
The plant species found in the blackbuck habitats in open countryside and croplands of Ganjam district that surveyed in transects are Amba (*Mangifera indica*), Amla (*Emblica officinalis*), Arjun (*Terminalia arjuna*), Bahada (*Terminalia belerica*), Char (*Buchanaia lanzan*), Dhaura (*Anogeissus latifolia*), Dhoben (*Dalbergia paniculata*), Harida (*Terminalia chebula*), Jamu (*Syzygium cumini*), Kanchan (*Bauhinia variegata*.), Karanj (*Pongamia glabra*), Kendu (*Diospyros melanoxylon*), Khair (*Acacia catechu*), Kochila (*Strychnos nuxvomica*), Kusum (*Schleichera olesa*), Mahalimba (*Ailanthus excelsa*), Mahula (*Madhuca indica*),Tentra (*Albizia procera),* Muktamanji (Ritha) (*Sapindus emarginatus*), Phasi (*Anogeissus acuminata*), Pitamai (*Garuga pinnata*), Rajmohi (*Lannea coromandelica*), Sachua (Chhatian) (*Alstonia scholaris*), Saguan (*Tectona grandis*), Sal (*Shorea robusta*), Salai (*Boswellia serrata*), Semal (*Bombax ceiba*),Sidha (*Lagerstromia parviflora*), Siris (*Albizzia lebbeck*), Sisso (Bali)(*Dalbergia sissoo*),Sissoo (Pahari)(*Dalbergia latifolia*), Sunari (*Cassia fistula*),Tentuli (*Tamarindus indica*), Indian palm (Borasus sp)etc.

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