

## **Residential Population Structure and Abundance of Nilgai, *Boselaphus tragocamelus*, (Pallas) in Bihar, India**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author SP designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DKS and SKC managed the analysed of the study. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Nilgai (*Boselaphus tragocamelus*) is one of the most discussed animals after cow in agrarian society of India. However, conflict between farmers and Nilgai due to its habitat loss and the increased damage to the crops by this wild species in the agricultural lands. Present paper deals with the study conducted on the population structure, size group and abundance of Nilgai inhabiting Shahabad region in Dumraon (Buxar) Bihar, India from January, 2014 to December, 2015. Survey was performed in the morning to evening time on the specific days by motorcycle and walking, where, there was no local footpath due to difficult, undulated study area. The direct methods utilized sighting of animals carefully from a close distance and behavior of the animal were observed. During the course of study 07 herds with total 407 numbers of Nilgai were counted through direct sighting with from closed distance. The density of Nilgai was found under 431.10 acre are as covered in Haryana Cattle Breeding Farm (HCBF) and its surrounding in Dumraon. The sex ratio of Nilgai with age group structure of the population was represented in percentage. Female biased

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adult male, ratio was found 1:3. While overall sex ratio was found 14.25% male, 38.57% female, 9.58% semi adult male, 20.15% semi adult female, and 18.46% calves respectively. Female Nilgai has been observed social like behavior and grazing with juveniles in a group but males were found in scattered form. Nilgai migrate for food towards agricultural land during dusk and return to HCBF with less human activity during dawn. This shows mark migration behavior during summer and rainy season. Some Nilgai migrations were observed for searching food and water during summer from south upward plain region of Dumraon to low-lying north plain area near Bhagar oxbow lake Simri, Chakki and Brahampur.

**Keywords:** Antelope; blue bull; size group; population; Nilgai; Shahabad; Buxar.

## 1. INTRODUCTION

Population parameters are necessary in order to understand the health of any wild animals to determine appropriate management measures [1]. In present time Nilgai (*Boselaphus tragocamelus*) is one of the most discussed animal after cow in agrarian society of India [2]. Nilgai is one of the largest antelope which is found in Indian subcontinent [3]. It is member of the family Bovidae and only species of *Boselaphus* [4]. India encompassed about 400 mammalian species [5]. There are 31 species of ungulates found in India and 3 antelope species are present outside the protected areas in Dumraon, Buxar, Bihar [6]. Hunting was completely prohibited for the wild animals after introduction of wild life protection Act, 1972 and the population of some species which were present outside the protected areas were increased rapidly [7]. It is fact, some species have become pest due to their over abundance in some areas [8]. The reason is absence of the natural predator in these areas [2]. Nilgai is one such species which is over abundant in some states of India and it may be regarded as pest [2, 7,9]. The encroachments into grasslands by farmers and government policies which consider the grassland and fallow land as the wasteland is another reason of habitat loss and over abundance of these animals [8]. In the present time, Dumraon, Buxar has no natural forest. Haryana Cattle Breeding Farm (HCBF) located at south east part of Dumraon town and spreading 431.10 acre of land covered by sandy loam soil. HCBF, un-used open undulated area small Island, which is covered by different types of herbs, shrubs and small trees [10]. HCBF, have residential home of many wild mammals including Nilgai, however, presently they are losing conservational support with rapid increase in there pest like activities [6]. The Dumraon, Buxar, area is also characterized by extreme hot and heavy rain. Many investigations have been

conducted on status, population and ecology of Nilgai (blue bull) in different part of our country [3,11,12,13,14]. However, north Bihar has received very little attention of the biologist due to severe hot climate, in accessible habitat and lack of local expertise. The status and population structure of Nilgai of this region specially of Dumraon, Buxar has not been documented.

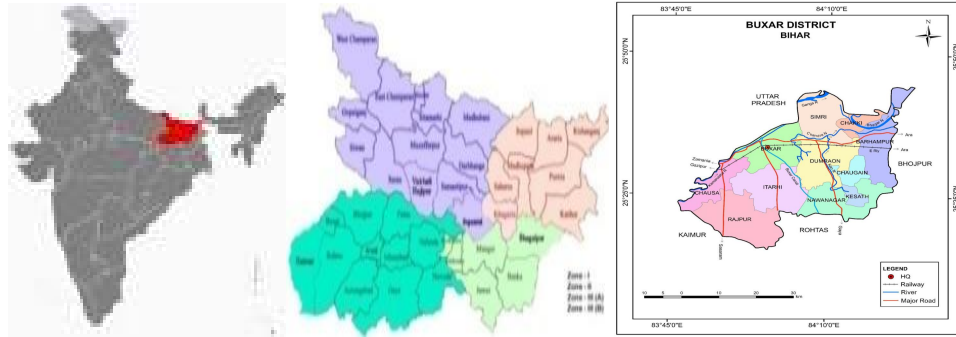
In this background, we have assessed for the first time, an effort have been done to study the residential population, abundance and size composition of Nilgai who successfully adapted in such type of extreme climate.

## 2. METHODOLOGY

Animals were monitored using a combination of direct sighting by scan sampling methods [12, 15]. Survey was performed in the morning to evening time on the specific days by motorcycle and walking, where, there was no local footpath due to difficult, undulated study area. The direct methods utilized sighting of animals carefully from a close distance and behavior of the animal were observed. The total numbers of Nilgai were recorded along with the age, sex with habitat activity and its migratory behavior also observed during the course of study period. All Nilgai groups encountered were classified as (a) an adult male (b) adult female (c) sub-adult male (d) sub-adult female and (f) calves. Some photographs were taken and some necessary information's were also collected through the past history and attitudes of the people towards the Nilgai from the villagers those living near in the fringe area of Dumraon.

### 2.1 Study Area

Dumraon is one of the oldest municipalities of Bihar and one of India's oldest princely states. It



**Fig. 1. Map of study area in District Buxar, Bihar, India [16]**

is a sub-division of district Buxar and lies between 25.55°N Latitude and 84.15°E Longitude at the average elevation of 61 meters (200 feet). It is located 1.5 km South of National High way (NH-44; Ara-Buxar Highway) and human population was 53,618 census of 2011 [16] Fig. 1. The ambient temperature rises up to 45°C, winter starts towards the middle of October and during January-February, temperature drop down to 4°C. The average annual rainfall is to 21 mm reported by [15]. Haryana Cattle Breeding Farm (HCBF) unused open areas were covered with sandy soil and undulated/surrounded by Canals, Kao River and human habitations making it a short forest island (Fig. 2 [a, b, c, d]). The topography is full of contrasts and diverse in nature. It has ditches and small forest with irregular depressions while the tilas or hillocks lie between dressings. Nilgai prefer areas with short bushes and scattered trees and grassy plains.

In Dumraon, HCBF, has considerable wild mammalian population. The present investigation was carried out on population structure and abundance of Nilgai in HCBF, Dumraon from January 2014 to December 2015.

## 2.2 Brief History of HCBF

HCBF, come in existence on 17<sup>th</sup> December 1952, was established with the aim to rear bulls of hybrid and supply them among farmers to raise the quality of milk producing cattle on the spreading 431.10 acres of land in East-Southern part of Dumraon town. This farm was famous for its Sahiwal cows and Murrah buffaloes have the capacity of keeping 450 cattleheads at a time. According to farmer Sri Raj Narayan Yadev (65 years old), from village Banjhu-Dera, before the existence of HCBF, that area covered by the dense forest and had considerable resident population/habitat of gray langur, Rhesus

Macaques, Nilgai, Deer, wild Boar, Jackal, Indian porcupines, Indian flying fox, Squirrels, Rats, Snakes and different types of birds etc. In present study some areas of HCBF were found covered with small bushes and some trees. According to Bharat Prasad, one of the farm employees in the year 1984, the farm had 1,000 cattle heads and around 1000 liters of milk was produced per day. Now during course of study period the HCBF, stuttering with only 35 cattle heads only.

## 2.3 Study Animal

Nilgai is a horse like creature and shows clear sexual dimorphism. Adult male looks in blue-grey colour but females and all adolescents are light in shading. Male possess a pair of horns on head about 20-22 cm long; circular, smooth and triangular at the base with pointed towards the tips [17]. The Indian name 'Nilgai' can be translated to mean blue (nil) bull (gai), gai is female gender, but the used by Indian either sex of the species as one of a variety of cattle. The scientific name of the Nilgai is *Boselaphus tragocamelus*. The binomical combination was first used by English Zoologist Philip Sclater in 1883 [18].

## 2.4 Data Analysis

Using Microsoft Excel software, the group structure of Nilgai (*B. tragocamelus*) and individual detail like age, sex and number of individual were recorded. The collected data was presented in simple tubular form and percentage ratio analysis was done.

## 3. RESULTS AND DISCUSSION

*Nilgai* is an endemic wild mammalian found in Bihar. Vertebrate pest like monkeys and blue bulls or Nilgai also pose major threats to crop

production in fringe areas of Bihar specially Shahabad. The ambient temperature rises up to 45°C, winter starts towards the middle of October and during January-February, temperature drop down to 4°C. The average annual rainfall is to 21 mm reported by [16]. HCBF unused open areas were covered with sandy soil and undulated/surrounded by Canals, Kao River and human habitations making it a short forest island (Fig. 2, a b c & d). The topography is full of contrasts and diverse in nature. It has ditches and small forest with irregular depressions while the tilas or hillocks lie between dressings. Nilgai prefer areas with short bushes and scattered trees and grassy plains. The greater part of the areas lies above flood level and only a small plane level area immediately to the East of Dumraon town where kharif and rabi crops are mainly cultivated. [19] Reported that Nilgai occurred near human habitations and crop field outside protected areas. They are found in a variety of habitats, from level ground to

undulating hills, in thin bush with scattered trees to cultivated plains, but not in dense forest and steep hills [6,20,21]. The present study is in correlated with some earlier studied on wild mammals reported from differe [3,7,8,11,13]. They reported regarding ecology and status of wild animals *Macaca mulatta*, *Presbytis entellus*, antelopes etc. They were also documented many plants like *Prosopis juliflora*, *Acacia catechu*, *Prosopis. Cineraria*, *Prosopis. Spicigera*, *Meliaazedarach*, *Azadirachta indica*. [10]. Documented the diversity abundance and composition of non human primate's *P. entellus* and *M. mulatta*. [6] Reported mammalian diversity like deer (Black bucks, barasingha), Nilgai (blue bull), wild boar, Indian porcupine and chiropteran (flaying fox) etc in Dumraon. They also documented many plants and vegetation are covering is in small patches consist mainly *Ziziphus*, *Acacia*, *Madhuca*, *Syzygium*, *Ficus*, *Mangifera*, *Boassum*, *Bambusa*, *Azadirachta*, *Adina*, *Albizia*, *Dalbergia* etc. in HCBF [19].



a. Male Nilgai in HCBF, Dumraon



b. Male scattered in HCBF, Dumraon



c. Female in group with juveniles



d. Nilgai piles (lavatory)

Fig. 2. Nilgai (*Boselephus tragocamelus*) different activity in HCBF, Dumraon

Nilgai was found associated with common langur (*Presbytis entellus*) in feeding area in HCBF, gleaning food dropped by them. A social change is an usual phenomenon in mammals and it is a natural process of maintaining a specific character like group size and structure in relation to their environment. At times, even female Nilgai have been observed standing on hind legs and feeding on *Zizyphus mauritiana* leaves and fruits. Female Nilgai have been observed in social and grazing with juveniles in groups but males were scattered form Fig. 2a, b, & c. According to Buxar district survey report [16], district had variety of wild animals and game birds when the forest was dense. Now with the increase in irrigation facilities the area under cultivation has grown consequently diminishing the forest. During the course of study the estimated population of Nilgai by the villagers was about 550 individuals in HCBF. In the present study a total seven numbers of herds groups were found and comprising total of 407 individuals were recorded. The maximum numbers of individuals were recorded in herd group 7 (90), while the minimum was found in herd group 01 (37). 58 adult males, 157 adult female Nilgai were recorded in the total herds; whereas small adult male 30 and semi-adult female 82 and calf 67 were recorded during investigation period the detail presented in Table 1 and Fig. 3. [7] Reported the estimated populations of Nilgai in Naha area of Haryana were over 500 in number. Whereas, [14] reported mean group size of Nilgai (including group of one) as 2.2 with high seasonal variability in group sizes in Gir. [17] reported overall 108 groups in Aligarh district in which 1845 individuals were recorded. These comprise of 249 adult males, 212 sub adult male, 466 adult females, 343 sub adult females, 213 yearling and 356 calves. Table 2 showed the percentage data of overall sex ratio, the adult

males and adult females' was 14.25:38.53, whereas semi adult males and semi adult females' sex ratio were found 9.58: 20.15 while the adult male and calf ratio was 14.25:16.46. According to [22] Nilgai occurred in groups ranging from 1to 10 individuals and the mean group size observed in Karnali-Bardia in Nepal. In the present study Nilgai were found year-around in HCBF and its surrounding areas but observed accumulate more in numbers in the entire rainy / winter month, because during rainy season most of the plain area of Dumraon, submerged by water and covered with seasonal paddy crops. During the course of study the animals were found seeing no other place for shelter other than HCBF Dumraon. In comparison to other plain area of Dumraon, HCBF has a high and may be recognized to presence of sandy loam soils and number of wild herbs and shrubs plants which acts as perfect shelters, habitats throughout the rainy season. Hence the mean group size was higher than other studies. High rates of mortality are common for males in particular, before age 3 year [23], but vary depending on population density and status of particular populations, either on native or introduced range [8,24]. Reported in summer the herds of 35 to 40 individuals were continuously seen in Atrauli, Pala, Sallu and Adla in Aligarh district of Uttar Pradesh. Groups are generally small with ten or fewer individuals, through groups of 20 to 70 individuals can occur at time [25]. The first author encountered many times Nilgai and spotted deer (Black bucks) near the Bhagar oxbow lake areas in Simri, Chakki Gaihat and Brahampur, Dumraon during the survey period of research project during the summer season; these area were found harbor of wild animals' species like Nilgai, deer, barahsingha, wild boars etc.

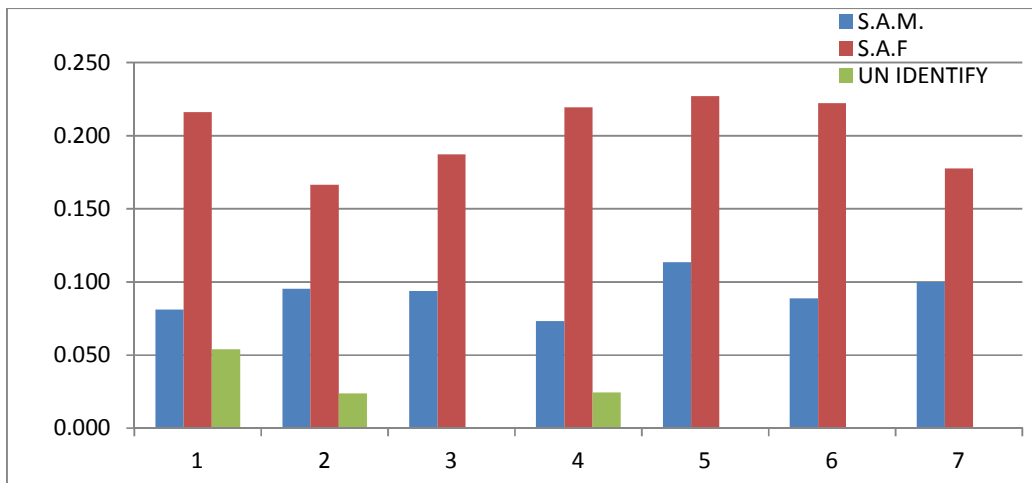
**Table 1. Population structure of Nilgai (*Boselaphus tragocamelus*) in HCBF, Dumraon**

Number of Herd	Group composition						Total
	AM	AF	SAM	SAF	Calves	Unidentified	
1	4	12	3	8	8	2	37
2	7	18	4	7	5	1	42
3	9	27	6	12	10	0	64
4	5	15	3	9	8	1	41
5	12	30	10	20	16	0	88
6	6	17	4	10	8	0	45
7	15	38	9	16	12	0	90
<b>Grand Total</b>	<b>58</b>	<b>157</b>	<b>30</b>	<b>82</b>	<b>67</b>	<b>4</b>	<b>407</b>
<b>Estimated population</b>							<b>550</b>



**Table 2. Sex ratio (%) of Nilgai (*Boselaphus tragocamelus*) in HCBF, Dumraon, Buxar**

Number of Herd	AM	AF	SAM	SAF	Calves	Unidentified
1	10.81	32.43	8.10	0.21	21.62	5.40
2	16.67	42.85	9.52	21.62	11.90	2.38
3	14.06	42.18	9.37	16.66	15.62	0.00
4	12.20	36.58	7.31	18.75	19.51	2.43
5	13.64	34.09	11.36	21.95	18.18	0.00
6	13.33	37.77	8.88	22.72	17.77	0.00
7	16.67	42.22	10.00	22.22	13.33	0.00
Total	14.25	38.57	9.58	20.15	16.46	0.98



**Fig. 3. Graphic diagram of semi-adult males, semi-adult females and calves of Nilgai**  
(AM: Adult Male, AF: Adult Female, SAM: Semi Adult Male, SAF: Semi Adult Female)

[26] Reported regarding Nilgai (blue bulls) is non migratory although individuals and groups are capable of considerable movement if ambient conditions (e.g. drought) dictate. More or less similar observation reported about, blackbucks in summer may be migrated to long distance in search of water and food [27,28]. HCBF is a harbor and treasure house of wild mammals like deer, blue bull, langurs, porcupine, wild boars etc. and they suffered in the process and their number (especially Blackbuck & hanuman) has gone down very considerably [6,10]. Basically Nilgai described as diurnal animal [29], but some degree of nocturnal activity has also been reported [26]. It has been reported that Nilgai migrate for food towards agricultural lands during dusk and return to places with less human activities during dawn [2]. It has been observed that females' Nilgai, with juveniles do not interact appreciably with males, except during the mating season Fig. 2 (a, b, c, d). Nilgai have a characteristic habit of defecating repeatedly in the same location, resulting in the formation of large fecal piles or lavatory sites of nearly a

meter in diameter, more or less similar observation reported by [30]. In the present study observed that during summer most of the water resources around HCBF and surrounding dry up, since they (Nilgai) may be migrated from high-lying southern plain area of Dumraon to the low-lying Northern plain areas like Simri Chakki and Brahampur block near Bhagar, oxbow lake in search of water and food. It is also observed that during rainy season most of the low-lying area of Dumraon, submerged by water and covered with seasonal paddy crops then they back upward area. Considering its limited area for this population is very high and large numbers of animals are successfully sequestered. This isolated small patch fragile area a safe refuge for most of the big and small wild mammals and other fauna of the surrounding area.

#### 4. CONCLUSION

The Nilgai has some unique and ecological function they may be beneficial in many ways, only need to explore their use for better well

being. This study brought to light the residential population, group size and abundance of Nilgai in Dumraon, Buxar Bihar, providing imperative information and a primary data for the future research like behavioral aspects, domestication and captive breeding etc. The number of Nilgai in this area (HCBF) is estimated to about 550 and total Nilgai reported 407. overall sex ratio was found 14.25% male, 38.57% female, 9.58% semi adult male, 20.15% semi adult female, and 18.46% calves. From this study it is concluded that during favorable condition at Dumraon the sex ratio of Nilgai was 1:3 as Male: Female ratio. During unfavorable condition Nilgai showed migratory behavior searching food and water.

### ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s).

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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