

<https://doi.org/10.33472/AFJBS.4.1.2022.139-144>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

"A Study on Morphological Variability and Evolutionary Patterns in the Blackbuck (*Antilope Cervicapra*)"

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Article Info

Volume 4, Issue 1, February 2022

Received: 01 December 2021

Accepted: 10 January 2022

Published: 07 February 2022

[doi: 10.33472/AFJBS.4.1.2022.139-144](https://doi.org/10.33472/AFJBS.4.1.2022.139-144)

ABSTRACT

The blackbuck (*Antilope cervicapra*) stands as a testament to nature's artistry, adorned with a striking contrast of ebony and ivory fur, and crowned with elegant, spiraled horns. Residing primarily in the vast grasslands and open plains of the Indian subcontinent, the blackbuck commands attention not only for its aesthetic beauty but also for its ecological significance and cultural prominence. The Blackbuck is endemic to Pakistan, Nepal, India, and Bangladesh; however, its population has now been reduced to a few isolated areas. Various threats, including hunting, stress, habitat loss, diseases, poaching, road accidents, habitat fragmentation, interspecific competition, and predation pressure, have diminished the population size of the Blackbuck to a threatened level. Male blackbucks are characterized by their distinctive spiral horns, which can reach lengths of up to 70 centimeters. These horns are utilized as weapons in intraspecific conflicts and as displays of strength during courtship rituals. Conversely, females lack horns and typically exhibit a lighter coloration compared to males.

Keyword: Blackbuck, Phylogeny, Taxonomy, Ecological Behaviour, Morphology.

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1. Introduction

The Blackbuck (*Antilope cervicapra*) (Linnaeus, 1758) is native to Pakistan, India, Nepal, and Bangladesh, with some individuals present in the UAE, Argentina, USA, and Texas (Wright and Glaze, 1988; Mallon and Kingswood, 2001; Long, 2003). The Blackbuck (*Antilope cervicapra*) is a threatened species and is the sole extant member of the genus *Antilope* (Ranjitsinh, 1989). Fossils of the species have been discovered in the Siwalik Hills of Pakistan (Lydekker, 1878; Pilgrim, 1937; Pilgrim, 1939; Khan et al., 2006; Chauhan, 2008). The Blackbuck is a diurnal ungulate exhibiting marked sexual dimorphism and notable beauty (Van der Geer, 2008; Mahato et al., 2010; Saluja et al., 2012; Sheikh and Molur, 2004). Males possess spiral horns that can reach up to 79 cm in length, which are absent in females. The coloration of males darkens with age, ranging from tawny to deep brown or black. Females and juveniles are yellowish at the front and rear. Both sexes have white chins, undersides of legs, and chests, with eyes encircled by a white ring (Sheikh and Molur, 2004). The body length of the species ranges from 100 to 150 cm, with tail lengths between 10 and 17 cm. Males weigh between 20 and 57 kg, while females weigh between 19 and 33 kg (Roberts, 1997b; Sheikh and Molur, 2004).

Taxonomy

The Blackbuck (*Antilope cervicapra*), the only surviving member of the genus *Antilope*, belongs to the family Bovidae within the order Artiodactyla in the class Mammalia. The binomial nomenclature for the species was assigned by Carl Linnaeus in 1758 (Meena et al., 2017).

2. Material And Method

Study Area

The study was conducted in the Jodhpur region of Rajasthan, India. This area was chosen due to its significant population of blackbucks (*Antilope cervicapra*) and its diverse habitat types, which include both arid and semi-arid environments.

Data Collection:

- **Photographic Documentation:** Digital photographs were taken of each blackbuck from multiple angles to assist in detailed morphological analysis and to document physical features.
- **Age and Sex Determination:** Age was estimated based on horn development and secondary sexual characteristics, while sex was determined by examining reproductive organs and secondary characteristics.

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Evolutionary Patterns:

Although focused on the Jodhpur region, evolutionary patterns were inferred by comparing findings with existing and published data.

Observations:

Observations were taken on an hourly basis and observational hours were evenly distributed among two shifts {(6:00 am to 8:00 am) and (6:00 pm to 8:00 pm)}. Both male and female blackbucks were repeatedly sampled at varying times of the day using the focal animal sampling technique.

3. Results and discussions

Palaentology

The Siwaliks, a southern Himalayan mountain range, span from southwestern Kashmir through India into southeastern Nepal. Fossils of various species within the genus Antilope have been discovered in these mountains, dating back to different geological periods. In Pakistan, fossilized species of the genus Antilope include :

- A. subtorta from the Pliocene epoch in the Upper Siwaliks,
- A. planicornis and A. intermedius from the Middle Siwaliks,
- A. cervicapra from the Siwaliks in the Pleistocene,
- Kobus porrecticornis from the Upper Siwaliks

(Khan et al., 2006; Chauhan, 2008). Research suggests that A. intermedia is closely related to A. cervicapra (Khan and Akhtar, 2014). Additionally, the genus Antilope has been recorded at the Tatrot and Pinjor sites in the Upper Siwaliks, within the Omo group in Africa, and in Gerakarou, Greece, dating to the late Pliocene (Kostopoulos and Koufos, 2006).

The blackbuck (*Antilope cervicapra*) is a species with a rich paleontological background that provides insights into its evolutionary history. Fossil evidence suggests that blackbucks have a long lineage, with their ancestors appearing in the Pleistocene epoch. Studies of fossilized remains indicate that the blackbuck's lineage has undergone significant morphological changes over millions of years, reflecting providing crucial information about their evolutionary adaptations and ecological niches. These fossils adaptations to varying environmental conditions (Jenkins & Smith, 1980).

The oldest known fossils of blackbucks have been dated to approximately 1.5 million years ago, reveal that early blackbucks were similar in many respects to modern forms, but with some distinct differences in horn structure and body size, suggesting an evolutionary response to climatic and environmental changes over time (Kumar et al., 1992).

Furthermore, comparative studies of blackbuck fossils with those of other antelope species have shed light on the evolutionary relationships within the Bovidae family. These studies have highlighted the blackbuck's close evolutionary ties to other antelopes in the region and have helped elucidate the broader patterns of antelope evolution in the Indian subcontinent (Singh & Gupta, 2004).

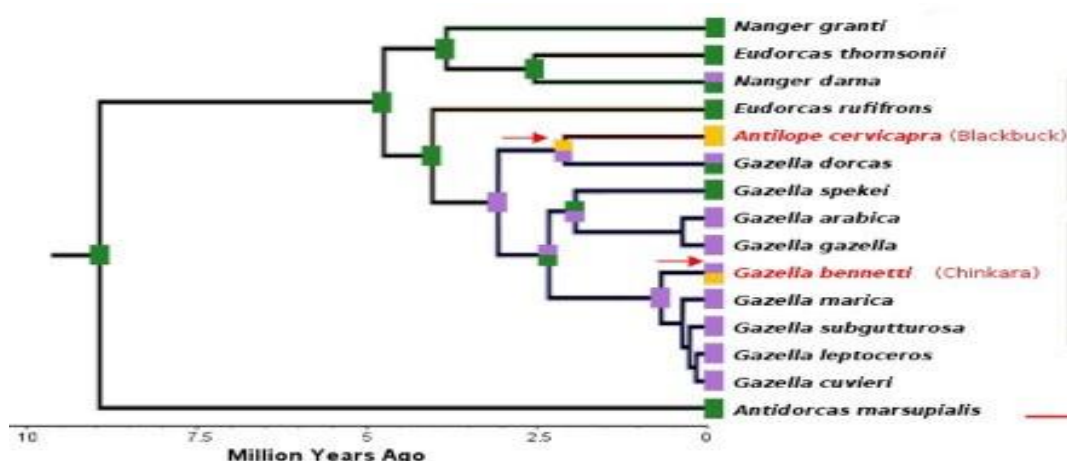


Fig. 1. Biogeography and Divergence time estimation of Antelopes

Morphological Description of the Species:

During the observations, the blackbuck (*Antilope cervicapra*) emerged as a medium-sized antelope, distinguished by its notable morphological features, which reflected its ecological adaptations and pronounced sexual dimorphism. It was found that adult blackbucks typically

exhibited a shoulder height ranging from about 2 to 3 feet and an overall body length of 3 to 4 feet.

The coloration of the blackbuck was particularly striking in males. They sported a rich, dark brown to near-black pelage on their dorsal side and legs, contrasted by a pristine white underbelly, throat, and inner limbs. This dark pigmentation intensified with age, especially during the breeding season, where it played a crucial role in sexual selection.



Fig. 2. Adult Male (dark coloration with spiraled horns)

Conversely, females were adorned with a more muted brown to fawn coloration, with a white underbelly and inner limbs, lacking the intense dark hues observed in males.

It was observed that male blackbucks were distinguished by their impressive, spiraled horns, which measured to reach lengths of approximately 70 cm. These corkscrew-shaped horns were not only a prominent feature of sexual display but also served as instruments in territorial conflicts.

In contrast, female blackbucks had shorter, less elaborate horns, which were typically straight or only slightly curved, rarely exceeding 15 cm.



Fig. 3. Adult Female (Tawny coloration)

The limbs of the blackbuck were slender yet robust, optimized for swift locomotion and agility across diverse habitats. The forelimbs were marginally longer than the hind limbs, facilitating their characteristic leaping stride. Their cloven hooves (specific type of hoof characterized by being divided into two distinct parts) were perfectly adapted for maintaining stability and traction on various terrains.

Facial features included a proportionately small head with large, expressive eyes that provided an extensive field of vision. The moderately large and highly mobile ears enhanced auditory capabilities, crucial for detecting potential threats.

In terms of age and sex-related morphological variations, it was observed that juveniles presented a lighter coat and less developed horns compared to adults. Males matured to display a deep, glossy coloration and substantial spiraled horns, whereas females retained a more subdued. Adult males were marked by their striking dark pelage and formidable horns, while adult females were characterized by their lighter coat and subtler horn structure.

4. Conclusion

This study on the morphological variability and evolutionary patterns of the blackbuck (*Antilope cervicapra*) has illuminated key aspects of its physical adaptations and evolutionary processes. The observed sexual dimorphism, with males exhibiting darker pigmentation and more elaborate horns compared to the lighter-colored and less horned females, highlights the impact of sexual selection and environmental pressures on morphological traits. Additionally, the variation in traits among different age classes reflects the species' adaptive strategies across diverse habitats. These findings enhance our understanding of blackbuck evolution and underscore the need for further research into the genetic and ecological factors driving these adaptations, which are crucial for informing effective conservation strategies.

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