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Analysis of Unique Polycerate Evolution and Sexual Dimorphism in Tetracerus Quadricornis (Four-Horned Antelope), Review of Conservation Policies, To Better Understand the Four-Horned Antelope and Improve Its Habitat by Involving Local Communities

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ABSTRACT

This research paper focuses on the Indian subcontinent. The study looks at the special physical and evolutionary features of the four-horned antelope, a rare and native species. This animal is unique in its family, Boreidae, because it has four horns, which is a result of a special evolutionary development. It also shows clear differences between males and females, known as sexual dimorphism. The main goal of this study is to understand how horns developed in male four-horned antelopes and the biological reasons behind the physical and non-inherited differences between the sexes. It also explores how natural and hidden adaptations have influenced these features over time.

The research specifically examines the Sitamata Wildlife Sanctuary in Rajasthan, which is an important area for the Dhausingha. The paper reviews existing conservation efforts and suggests new strategies that include modern techniques like camera trapping, restoring habitats, and involving local communities in conservation. These ideas are discussed in relation to the Sitamata Sanctuary. The study aims to provide useful guidance for decision-makers and wildlife specialists to help ensure the long-term survival of this endangered species. The Four-horned Antelope, also called the Chousingha, is a small type of cattle-like animal that only lives in India and Nepal. It is special because it has four horns, which is not common among other wild cattle. This summary talks about how unique the Chousingha is, how it is doing in terms of protection, and why it's important to involve local communities in its conservation.

Tetracerus quadricornis is one of the smallest Asian bovids and is commonly known as the four-horned antelope or chousingha. it is native to peninsular India and parts of lowland Nepal. The four-horned antelope, also known as Tetracerus quadricornis, is a vulnerable, solitary animal that is native only to Asia and is the smallest member of the group of herbivores called bovids. Researchers studied its behavior in three wildlife areas in western India between April 2014 and May 2016. They used a method where they focused on specific animals whenever they had the chance. The study found that the antelope was most active in the morning and again in the evening. During these times, they spent most of their time feeding and walking. The antelope was mostly seen alone, with only about a third of the observations showing them in groups. On average, when they were in a group, there were about two and

a half animals. When people approached, the antelope usually ran away when they were about 62 meters away, but this distance wasn't strongly connected to how long they stayed still before running. The antelope was seen to leave waste in the same area as three other mammals, and it was also seen spending time with six other types of mammals. Additionally, the antelope was observed eating parts of plants that had fallen from trees, specifically from 13 different types of trees, which had been dropped by langurs.
T. quadricornis is a sexually dimorphic boselaphid with small size; only males have horns, with two of the three recognized subspecies having two anterior and two posterior smooth, sharp horns, a feature unique among wild horned mammals. Tetracerus is monotypic. It prefers dry deciduous forested areas and hilly regions and is secretive and poorly studied. This small species is classified as Vulnerable by the International Union for Conservation of Nature and Natural Resources, and it is very rare in captivity.
There is some concern about whether subspecies features include the presence or absence of front horns. Young male animals between 10 and 14 months old, who haven't developed front horns yet, can be mistaken for adult males of similar size.in terms of evolution, male Chousings have two pairs of horns, which is a rare feature among wild cattle. There is also a big difference between males and females, as females do not have horns. Recent findings suggest that females might actually be bigger than males, which goes against old ideas. The Chousingha is listed as Vulnerable on the IUCN Red List and is fully protected under India’s Wildlife (Protection)Act, which is the highest level of protection.it still faces serious challenges like habitat loss, people hunting for its horns, and invasive plants such as Lantana camara that take over its natural habitat .
Conservation efforts need more than just government actions. Working with local communities is key to improving habitats by managing grazing land and bringing back native plants. To keep the Chousingha safe, it is important to protect the dry forests it calls home and support community-led efforts. This helps reduce conflicts between people and wildlife and ensures that the special environment the Chousingha depends on remains healthy.

the main goal of the project is to understand the ecology of the Four-horned antelope in habitats under serious human pressures and to involve local communities in improving habitat conditions to achieve long-term conservation of the species. We planned to achieve this by objectives such as improving conservation awareness among the local village communities and school-going children, starting discussions with resource user groups to reduce pressure on the antelope’s habitat, encouraging communities to take part in habitat improvement by addressing issues like water scarcity during summer, illegal brewing at waterholes, over-grazing, and tree cutting. Other objectives included understanding the impact of forest fires on the habitat and how the antelope responds to these changes by monitoring vegetation and antelope movements. We also aimed to involve villagers in discussions to propose the project area as a Conservation Reserve and to gain legal status for its long-term management by local communities.

Keywords: Dhausindha Silence, Dvirupta, Vahushtanga Evolution Conservation Policy, Panm Jeep Management chauka, chousingha, four-horned antelope, India, ruminant, ungulate, vulnerable species.Conservation, , physical development Habitat loss, India, Rajasthan.

1. INTRODUCTION

The Sitamata Wildlife Sanctuary: It is one of the most unique ecosystems in Rajasthan, known for its second richest biodiversity of plants and animals. As The name suggests, it holds historical and religious significance. People believe that the goddess Sita spent part of her exile in this forest, and that the ashram of the sage Valmiki was located here. This is why the sanctuary is named after Devi Sitamata, and her famous temple is located in the heart of the sanctuary's forest area. Flying squirrels, which are scientifically classified as Pteromyini or Petauristini, are a group of 50 species within the squirrel family, Sciuridae. Even though they are called flying squirrels, they can't actually fly like birds or bats. Instead, they can glide between trees using a special membrane called a patagium, which is a furry skin that stretches from their wrists to their ankles. Their long tails also help them to stay balanced while gliding. Anatomically, they are similar to other squirrels, but they have some unique features that help them adapt to their lifestyle. Their limb bones are longer, while their hand bones, foot bones, and the lower part of their spine are shorter. Flying squirrels can steer and control their glide using their limbs and tail. Hundreds of species of deer and antelope exist in nature, but in India and

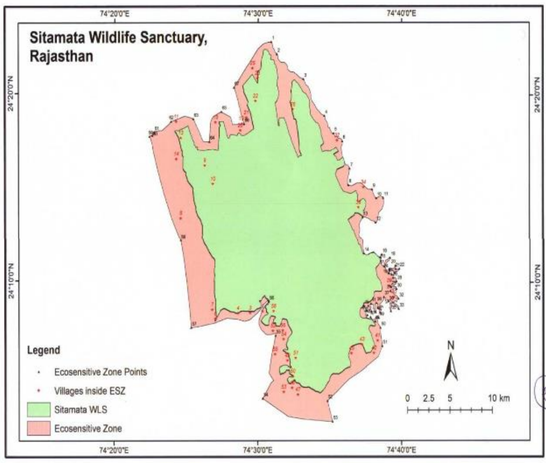
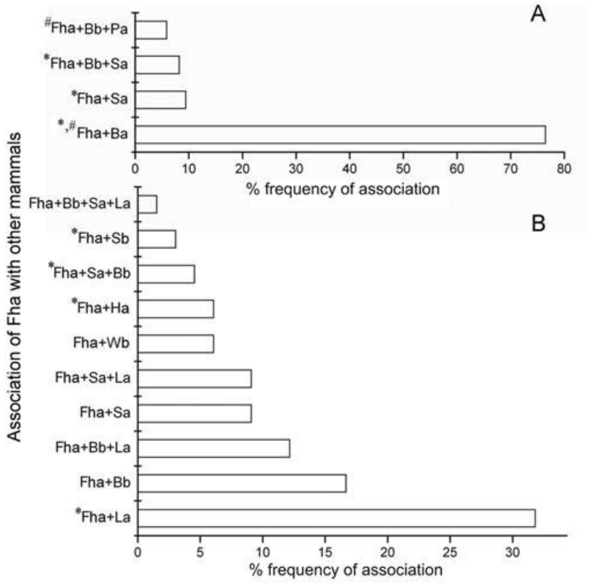


Fig. Sita Mata WL Sanctury

The four-horned antelope, found in the forests of Nepal, is of great interest to scientists in India due to its unique features. It is the only wild animal in the world with more than two natural horns on its head. From a biological perspective, it is called a living fossil. Sitamata Bunch Wildlife Sanctuary, located in Pratapgarh district of Rajasthan, is known for its mythological stories and the sacred presence of Mother Sita. However, it is also home to the world's rarest deer, the Shrisingha. Situated at the junction of the Aravalli and Vindhyachal ranges, this dense forest, with its unique geographical setting, offers this heavy-horned bird the isolation and protection it needs to survive**.** The area is filled with mythological significance, and the evolution of millions of years is reflected in the form of the great horned bird found here. The development of horns depends not only on age but also on the animal's nutrition. The presence of minerals like calcium and phosphorus helps strengthen the horns. During drought, when food is scarce, the growth of front horns may be affected or they may remain small.



Their average lifespan is 8 to 10 years, but their exact age can be estimated by looking at the condition of their horns. Genetic basis a Researchers studying sheep and other ruminants have found that the HOXD gene cluster plays a key role in determining the position of limbs and horns.
This gene is also important in the four-horned antelope.

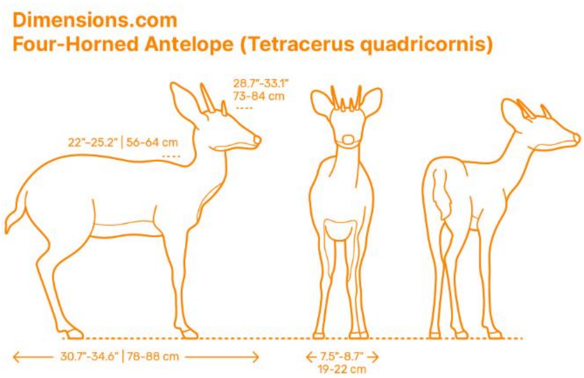


Fig. four-horned antelope

On the Biodiversity Map of the Indian Subcontinent.The four-horned antelope (Tetracerus quadricornis) is a species that shows an interesting aspect of nature's evolution. It is the only living member of the Boidae family that has four horns instead of two. It is not only studied by scientists but also serves as an important sign of the health of the ecosystem it lives in.
The quiet difference between the male and female four-horned antelope is very noticeable and significant. The male has a proud head with four horns, showing strength and better genes. The female, on the other hand, has no horns and a body that blends well with the forest, helping her avoid predators in thick woods. This evolution happened over millions of years and makes this species different from others in its group.
Sitamata Wildlife Sanctuary, where the Aravalli, Vindhyachal, and Malpa foothills meet, is one of the most important and protected homes for the four-horned antelope in India. Its dry forests with teak trees and tall grasslands offer a perfect environment for this shy and lonely animal. However, the main goal of

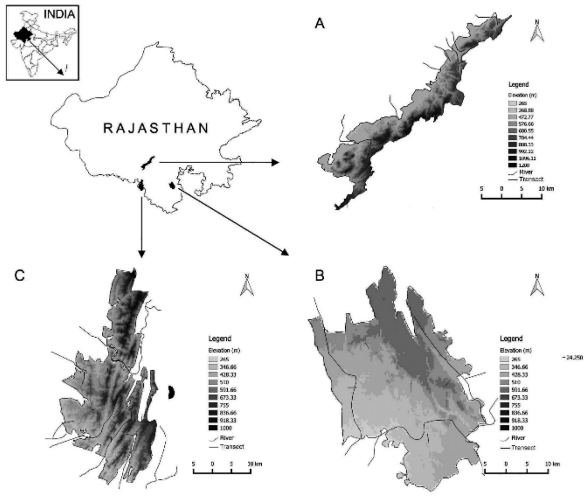
the 2025 research paper is to look into the scientific reasons behind the four-horned antelope's unique "two-horned"evolution and the quiet differences between the sexes. The article also checks how well the current conservation policies of Sitamata Sanctuary are working.
We conducted baseline surveys to assess conservation awareness by randomly selecting respondents from villages and Class IX students in three high schools. A 25-question questionnaire was used. We conducted conservation awareness programs using audio-visual materials and talks by team members at village and school levels. Environmental and conservation educational activities were arranged for students using modules developed by WWF-India and the Center for Environmental Education tailored for their age group. Animals to spend their time doing different things, and there's a big difference between some of these activities. These activities are usually done in a certain order and are meant to help the animals survive and stay healthy.
The way animals spend their time also shows the balance between how much energy they use and the benefits they get from it. Often, these activities make animals more exposed to dangers like predators. The choice of which activities to do is influenced by both internal factors, like age, sex, whether they're reproducing, and their position in a group daylight, the type of habitat, how much food is around, the quality of food, and how animals live together. When animals interact with other species, they can benefit in many ways.example, being near others can help reduce the chance of being caught by predators, especially if the animal listens to warning calls. Also, one species' food scraps can become food for another, which helps them find more food. This kind of feeding relationship is common among many animals, including deer. Like sika deer who find food more easily by moving with Japanese macaques, langurs and spotted deer also show similar behavior. Analysis of Sexual.
Dimorphism in Chousinga: Understanding sexual dimorphism in the four-horned antelope is important for learning about its evolution, behavior, and survival strategies, based on the most recent wildlife data and research up to 2018. The four-horned antelope is a member of the Bovidae family, which includes animals like cattle and sheep. Sexual dimorphism refers to the differences in physical appearance, shape, and features between males and females of the same species. Interesting aspects of sexual dimorphism: Specialty Horns Males have four horns, which are two pairs.
Females are hornless. Fascinating facts: the world's only mammal with horns. Sound (Vocal) Males make a loud hissing or whistling sound, which is slow and low in frequency. They make this noise when they feel threatened. Glands Males are highly active, especially near Okhlo. Females are less active. Males mark their territory using scent. Temperament Males are aggressive and territorial. They can fight fiercely for their space. FootprintsMales have slightly larger and deeper hooves.
Females have smaller and narrower hooves. Males are shy and reclusive. It is also possible to tell the sex of a four-horned antelope by looking at the udder.

Reproduction system:
The way the four-horned antelope reproduce is different from other antelopes. Mating season in Sitamata Sanctuary and Rajasthan happens at a different time than in other areas. In other regions, the main breeding season is during the monsoon months, from July to September.This is when there is plenty of grass, which helps the shy animals hide and get enough food. For showing respect or being polite, they use the glands near their eyes to touch trees and bushes. They rub leaves to leave behind a scent. This helps them attract females and also warns other males.
Mating and giving birth: The female’s pregnancy lasts about 240 to 250 days, which is around 8

months. This is longer than in other antelopes, showing that their baby animals develop more slowly.

Birth and baby animals: The female usually gives birth to a group of babies, called twins, between December and February. The four-horned antelope have a high rate of twin births, meaning they often have two babies at once. This is good for their survival and protection.

Newborn babies are very small, weighing about 1 kg. They stay hidden in thick bushes for several weeks. These animals choose to mate in areas with lots of dense forest cover and no human activity. Mammals often use a practice called localized defecation, which is usually for marking their area, keeping away parasites, showing dominance, showing where they live, keeping their territories, showing they're there, and using smells to communicate. These behaviors also help with breeding success. the four-horned antelope also known as the chowsingha, is the smallest type of solitary grazing animal in Asia (adult weight 17-22 kg, stands about 55-64 cm tall at the shoulder) and is only found in parts of India and Nepal.



It lives in areas with hills and valleys. At a larger scale, it prefers dry, seasonal forests, but its presence is not spread evenly across the area. Being shy and hard to spot, it is difficult to see in its natural habitat. Males can be told apart from females when they are adults because of the four horns. Several factors, like the availability of water, the steepness of the land, temperature changes, variety of trees, rainfall, height, and human interference are believed to influence where these animals are found. In fact, the spread of the invasive weed Lantana camara has been found to reduce the presence of the four-horned antelope. Studies of real animals and controlled feeding tests show that their diet includes fruits, flowers, grasses, and climbing plants. The IUCN lists the four-horned antelope as vulnerable due to low numbers, a declining population, and destruction of habitats, especially from clearing land for farming. It is also protected under the Indian Wildlife (Protection) Act of 1972, as it is part of Schedule I, which means it has the highest level of legal protection. In addition, the IUCN notes that more research is needed on its living habits and behavior.

Habitat Improvement: We identified important waterholes used by the antelope and encouraged local villagers, including livestock herders, to participate in clearing them. We identified individual brewers and educated them about the damage caused by their actions and persuaded them not to use these waterholes for brewing. Discussions with the Forest Department led to the confiscation of some illegal guns used for hunting in three villages, which deterred other hunters in the area from hunting wildlife significantly.

Impact of Fire on Habitat Use: We noticed that the movement of the antelope is restricted to areas that are regularly burned during certain periods of the year. We monitored five species considered food plants by indigenous people after a fire and compared their growth patterns with those in areas not affected by fire. Burned areas were mapped, and GPS locations of midden sites were recorded and overlaid on fire extent maps using QGIS and Google Earth imagery to create maps showing the presence of the antelope. Preparations for Proposing a Conservation.

Reserve: We collected information on legal provisions and steps needed to propose a Conservation Reserve. we obtained guidelines under the Scheduled Tribes and Forest Dwellers in India, compiled by the national NGO “Kalpavriksh,” translated into the local language (Appendix 2), and distributed among villagers and their leaders before initiating further discussions. Outputs and Results Conservation Awareness in schools and villages: Baseline surveys on conservation awareness were conducted using a questionnaire in 26 villages and 3 high schools at the start of the project and repeated at the end.

This helped in understanding the impact of our efforts on increasing conservation awareness among people. We assessed performance based on answers to 5 important questions out of the 25, including: “What is biodiversity” “What is conservation” “Is having rich biodiversity useful for you or your village” “In your opinion, what are the major threats to biodiversity” and “What do you suggest to improve biodiversity in your forests” The details of participation and performance are provided in the tables. Environmental Education and Conservation awareness activities in local schools. De-silting of waterholes as part of habitat improvement work

We recorded the occurrence of fire during the two summers of 2012 and 2013. The area affected by fire was mapped, and we identified where antelope were present in these areas using QGIS and Google Earth images. we also collected data on the flowering and fruiting of five food plant species that antelope rely on. this data was gathered from a 200x200 meter area in both burnt and un-burnt regions (Fig.). The flowering and fruiting patterns of these plants differed in the burnt areas, as plants were at various stages of flowering and fruiting in different locations. Two species, Randia dumetorum and Zizyphus mauritiana, showed more flowering in the burnt areas. However, in the un-burnt areas, fruiting was much lower for all species except Pterolobium indicum, which is also the most common plant in the habitat. We believe that the availability of flowers and fruits is not the same in both areas, so the presence of preferred food sources for longer periods might be why antelope are drawn to burnt areas at certain times of the year.Fig.2: Flowering of food plants of the antelope in burnt and un-burnt areas between.

proposing a Conservation Reserve: Every household in the villages of the project area depends on the forest in some way, either directly or indirectly. We identified different groups such as livestock herders, people who collect fuel wood and green manure, charcoal makers, collectors of medicinal plants and honey, hunters, and brewers. We held 23 village-level meetings involving all these groups and local leaders. We discussed their needs and explained the importance of using forest resources sustainably and how regulated extraction is necessary because the forest is home to threatened species like the Four-horned antelope.

We also shared the legal provisions for proposing the area as a conservation reserve and the rules for managing it by the community. While there was some progress during the discussions, most groups were worried about losing their rights to use the resources in a conservation reserve and were afraid that restrictions would be imposed. These concerns, along with political issues, made it hard to reach a common understanding of why a conservation reserve is needed to protect the threatened wildlife. We believe more discussions over a longer period are needed so that all stakeholders can fully participate and contribute to the proposal. The Four-horned Antelope (Tetracerus quadricornis), also known as the Chousingha, is a small member of the bovid family found only in India and Nepal. It is unique because it is the only mammal that has four horns.

Evolution and Unique Polycerate Traits Polycerate Nature: Unlike most bovids that have two horns, male Chousinghas have two pairs of horns. The larger pair is located at the back and can be between 8 to 12 centimeters long, while the smaller pair is at the front and is about 2 to 5 centimeters long.

Taxonomic Position: It belongs to a primitive group of the Boselaphinae tribe and shares a common ancestor with the Nilgai.

Adaptive Purpose: Scientists think the four horns evolved for mating displays or to attract mates, but they may also serve as a secondary sexual trait that helps males compete for females.

Sexual Dimorphism: Horn Development: Only male Chousinghas have horns, while females are completely hornless.

Body Size: Some studies suggest that female Chousinghas might actually be slightly bigger or heavier than males, which is a pattern seen in certain small hoofed animals. However, earlier reports on this were not consistent.

Coloration: Both males and females have a coat that ranges from yellowish-brown to reddish in color, with a white belly and a dark stripe running down the front of each leg.

IUCN Status: The Chousingha is listed as Vulnerable because of its low numbers and scattered distribution across its habitat.

Legal Protection: It is protected under the highest level of legal safeguarding in India, as it is listed in Schedule I of the Wildlife (Protection) Act of 1972.

Key Threats: The main threats to the Chousingha include habitat loss and fragmentation, competition with domestic animals, and the growth of invasive plants like Lantana camara.

Policy Gaps: Many conservation efforts are focused on large, well-known animals like tigers, which means species like the Chousingha, which are small and less visible, often get little attention and support. Community Involvement and Habitat Improvement.

Local Participation: To ensure the survival of the Chousingha, local communities need to be involved in monitoring and stopping illegal activities such as cattle encroachment and attacks by stray dogs.

Resource Management: Protecting the natural habitat is important, as the species prefers open deciduous forests with short grass.

Water Conservation: In areas like Banke National Park where the environment is drier, maintaining conservation ponds is essential for the survival of the Chousingha.

Education: Programs that teach the local people about the special nature of the Chousingha can help turn them into guardians of the forest and protect this rare species.

II: Review of Leturature

It looks at the current state of things and suggests a future plan that mixes up-to-date technology with active involvement from the local community.

Forest Department's 2025 data A Study Area takes place in the 423-km² Sitamata Wildlife Sanctuary, which is in the Pratapgarh and Chittorgarh districts of Rajasthan. This area is where the Aravalli and Vidyayal mountain ranges meet. The landscape mainly includes deciduous teak forests and hills, and it's also part of the they yearly rainfall is between 750 and 700 mm. The average temperature ranges from

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150 to 450Â°C, and the temperature can go up to 750-900Â°C, which is good for the four-horned antelope. The climate is warm, and the data was collected from 2024 to 2025. The four-hornedantelope was watched during different seasons (monsoon, winter, and summer) to study how their breeding habits and feeding patterns change with the seasons. Direct observation a Line transect of Bhabhyakhaya Ten 22-km long line transects were set up in different types of forests. The four-horned antelope were seen on foot along these routes between 6:00 and 9:00 AM and 4:00 and 7:00 PM. 10x50 binoculars were used to watch the animals and measure the distance, and a laser rangefinder was used for accurate distance measurement.

Fig water source

Sub-camera trapping was used to record the presence of the four-horned antelope in the study area and their daily activities. A grid-based system with 20 digital camera traps was used for the survey. To protect her baby from predators, the female four-horned antelope hide each one in different bushes and visits them only during the day to feed them milk. After giving birth, the female four-horned antelope don't keep her babies together; she hides them in separate bushes. This way, if one gets caught by a predator, the others are safe. The history of the four-horned antelope and its male counterpart is very old and special.

Group size	Composition	Threat response activities	Sighting frequency	Freezing duration (Sec.)		FID (m)	
				$\bar{X} \pm SD$	Overall $\bar{X} \pm SD$	$\bar{X} \pm SD$	Overall $\bar{X} \pm SD$
One	Fe	Freeze + Run	5	149.2 ± 137.6	140.7 ± 50.80	45.40 ± 26.09	56.09 ± 20.30
		Run + Freeze + Run	1	90		70	
	M	Freeze + Run	1	220		60	
	Un	Freeze + Run	1	80		60	
		Run	2	155 ± 205.1		60 ± 00	
		Walk + Hide	1	150		80	
Two	M + Fe	Walk + Hide + Run	1	20	124 ± 168	50	64.00 ± 20.74
		Run + Freeze + Run	1	100		15	
		Freeze + Run	1	30		50	
	M + Un	Freeze + Run + Freeze + Run	1	50		60	
	2Un	Freeze + Resume feeding activity + Run	1	420		100	
Three	M + Fe + Fw	Walk + Stop + Walk + Stop + Walk	1	180	180	100	100

Fig. four-horned antelope

Scientifically, it is considered a living fossil because it has changed very little over millions of years. The four-horned antelope evolved in Asia about 8.9 to 9 million years ago. Primitive characteristic: Its horns are similar to those of the Bouchelaphini group. It is linked to ancient traits of the tribe and is the only wild animal in the world that has evolved sharp horns, Reproductive and defense scientists believe that these sharp horns evolved for fighting and protection. Since these animals live in thick forests, their short, sharp horns help them avoid getting stuck in burrows and are useful in fights. During the development of the horns, the ones at the back grew larger, while the ones on the sides became smaller Even today, in some sub species, the front horns appear as small bumps. The gradual development of horns in the four-horned antelope is a remarkable achievement of nature. This development can be viewed from two perspectives. The growth of horns on the head of a male four-horned antelope is a rare occurrence and happens in a sequence. The Sitamata Wildlife Sanctuary is known for flying squirrels and panthers. However, it is an ideal habitat for herbivores, carnivores, and a variety of territorial, arboreal, and water birds. The Sitamata Wildlife Sanctuary is one of the richest sanctuaries in terms of biodiversity.

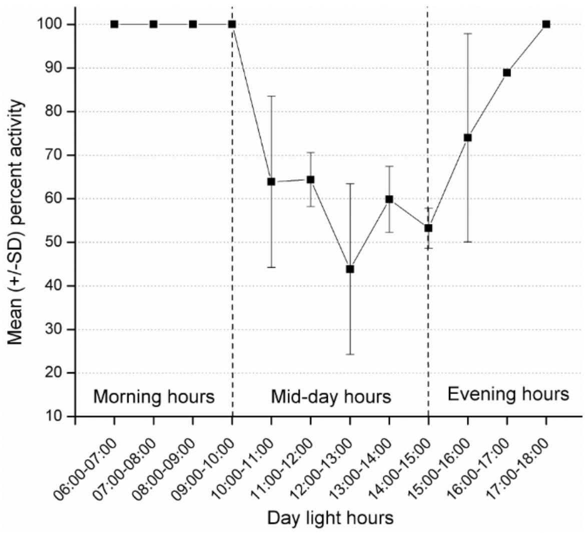

Fig. The posterior articulation of the ear canal is located within a few months of birth.

Nearly 50 species of mammals, 275 species of birds, 40 species of reptiles, 9 species of amphibians, 30 species of fishes, and more than 800 species of plants have been recorded in the Sanctuary. This Sanctuary can be considered as a "hot spot" of Rajasthan for floral and faunal diversity. The northern moist distribution limit of many Deccan elements passes through Sitamata. Flying squirrels, four-horned antelope, tree frogs, Ratal, Indian pangolin, etc., can be seen here. This Sanctuary is famous for four-horned antelopes and is considered the best Chousinga Sanctuary in the state. In the past, it was also famous for mouse deer and wild dogs. Birds like grey jungle fowl, Aravalli red spur fowl, green pigeon, Alexandrine parakeet, stork-billed kingfisher, Indian pitta, black-headed oriole, Indian paradise flycatcher, yellow-checked tit, purple-rumped sun bird, etc., can be seen in the dense forests of Sitamata. Lesser floricans are worth seeing during the monsoon at the eastern outskirts of the Sanctuary.

Effective conservation depends on a deep understanding of species' ecological needs and their behavior, which can also help improve knowledge about their habitat. Understanding activity patterns and how much energy an animal uses is important for knowing how they balance their needs. It also shows how animals adapt to their surroundings through changes in their behavior. Since there is not much information on the threatened T. quadricornis, this study describes its activity and social behavior based on observations over two years in the tropical deciduous forests of western India, with possible explanations for those behaviors.

The study took place in three wildlife sanctuaries: Sitamata Wildlife Sanctuary (WLS), Kumbhalgarh WLS, and Phulwari-ki-nal WLS, located in the Aravalli Mountain range, which is the oldest in the world, in southern Rajasthan.To keep her baby safe from predators, the female four-horned antelope hide each baby in different bushes and only visits them during the day to feed them milk.After giving birth, the female four-horned antelope don't keep her babies together; she hides them in separate bushes. This way, if one gets caught by a predator, the others remain safe. The history of the four-horned antelope and its male counterpart is very old and special. Scientifically, it is considered a living fossil because it has changed very little over millions of years. The four-horned antelope evolved in Asia about 8.9 to 9 million years ago. Primitive characteristic: Its horns are similar to those of the Bouchelaphini group. It is linked to ancient traits of the tribe and is the only wild animal in the world that has evolved sharp horns.

Reproductive and defense scientists believe that these sharp horns evolved for fighting and protection. Since these animals live in thick forests, their short, sharp horns help them avoid getting stuck in burrows and are useful in fights. During the development of the horns, the ones at the back grew larger, while the ones on the sides became smaller.

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The study period was from April 2014 to May 2016. The forests in this area are mainly tropical dry deciduous (Champion & Seth 1968). The climate has three seasons: summer (March-June), monsoon (July-October), and winter (November-February). The highest daily temperature is 46 Â°C in May, while the lowest is 25 Â°C in January. The minimum night temperature goes down to 5 Â°C in January and reaches 26 Â°C in July. The major mammal species found here include leopard (Panthera pardus), striped hyena (Hyaena hyaena), Indian wolf (Canis lupus pallipes), jackal (Canis aureus), southern plains gray langur (Semnopithecus dussumieri), chinkara (Gazella gazella), jungle cat (Felis chaus), Indian fox (Vulpes begalensis), sambar (Rusa unicolor), blue bull (Boselaphus tragocamelus), and sloth bear.

III: Methodology

Methodology:

To understand how the four-horned antelope evolved and why males and females differ, scientists use several techniques: These were especially placed at water sources and where the animals naturally live. this helped in easily spotting small physical differences between males and females. Indirect evidence: Their hoof prints and droppings were studied to find out where they live. Map of Sita mata Sanctuary High-powered binoculars GP6 Divide (recording location and gemai) Infrared sensor camera trap Help provided to local officials and water protectors in the area.

Conservation buildings Legal and global protection It has been placed in the Vulnerable category on the IUCN Red List because of its decreasing numbers and fast loss of habitat. It is listed in Appendix I of CITES, which helps control its international trade. It is protected under Schedule I of the Indian Wildlife Protection Act 1972, giving it the highest level of legal protection in India, similar to the tiger and elephant. Conservation status of Sitamata Sanctuary Specificity and sensitivity of accommodationThe dry deciduous and teak forests of Sitamata are important for the four-horned antelope. this animal is very adaptable. it prefers to live on the slopes of hills. However, due to human activities and uncontrolled cattle grazing, their habitat has disappeared.

Genetic Sequencing: They compare the Tetracerus genome with that of other Bovidae animals, such as the Nilgai, to find out which genes or mutations are linked to having multiple horns.
Morphometric Analysis: They measure the size and shape of horns and body dimensions in different groups to see how much males and females differ, since only males have horns.
Comparative Phylogenetics: They place the species within the Boselaphini tribe to figure out why this species developed four horns, while its relatives did not. Review of Conservation Policies Current protections for the"Chousingha" include:
Legal Status: It is listed under Schedule I of India's Wildlife (Protection) Act, 1972, which gives it the highest level of legal protection.
International Protection: It is classified as Vulnerable on the IUCN Red List and is listed in CITES Appendix III in Nepal.
Policy Gaps: Conservation efforts for this species are often a side effect of protecting larger animals like tigers and leopards. There's a lack of tailored management plans that focus on the specific habitats, like tree-savanna areas, that the Chousingha prefers. Habitat Improvement & Community Involvement For effective conservation, it's important to involve local communities and improve their surroundings:
Community-Led Monitoring: Local people are trained to use camera traps and note indirect signs, like middens or pellet groups, to track these shy and solitary animals.

Time slot	Sitamata WLS	Kumbhalgarh WLS	Phulwari-ki-nal WLS
06:00-07:00	13	18	6
07:00-08:00	8	33	7
08:00-09:00	10	12	1
09:00-10:00	7	20	7
10:00-11:00	15	21	17
11:00-12:00	11	28	8
12:00-13:00	10	22	6
13:00-14:00	18	20	7
14:00-15:00	12	18	3
15:00-16:00	9	22	11
16:00-17:00	10	9	8
17:00-18:00	10	8	11
Total	142	231	92

Fig. Timing for Horns

Invasive Species Management: Locals are encouraged to remove Lantana camara, a weed that greatly reduces the quality of the habitat for the antelope.
Water Resource Management: Ponds Conservation are built in dry deciduous forests because a lack of water is a major threat in many reserves.
Fodder Protection: Communities are given incentives to limit livestock grazing in key areas, so that the antelope can access the nutrient-rich plants like Acacia and Ziziphus that they rely on.
Field observations since no animals were fitted with radio tags and because T. quadricornis is elusive, small in size, and shy, an opportunistic focal animal sampling method was used, with observations taken every minute, from April 2014 to May 2016.

First, the study area was thoroughly surveyed on foot or by motorcycle to find areas where T. quadricornis was likely to be found. Then, five 1 km transects were laid out in each sanctuary for further study. The total length of all transects was 15 km. Each transect was walked 12 times once a month and four times in each season during the morning (6:00–10:00 a.m.), midday (10:00–2:00 p.m.), and evening (3:00–6:00 p.m.), totaling 180 surveys across all 15 transects. Morning and evening hours are usually preferred for line transect surveys, but midday sampling was also included to observe the full range of T. Quadricornis activities during daylight hours, as suggested by Carbyn (1975) and Baskaran et al. (2011). These transects were walked carefully on foot at a steady pace of 1 km per hour to spot active animals, meaning those not resting. The number of encounters and the time spent observing were also recorded, which helped determine if T. quadricornis were disturbed or not by our presence. All sightings were treated as independent observations, as per Sharma et al. (2009). Once an animal was found, it was observed without disturbing it as long as it tolerated our presence. If the animal showed signs of being disturbed, it would move back or run quickly into the bushes, and the flight initiation distance (FID) and time it took to freeze were recorded using a laser range finder (Bushnell Model #202645) and a stopwatch to understand how tolerant the species was of human presence.

SUB-SPECIES VARIATION

The weight of the horns varies among different hornbills, showing how they have adapted to their environments over time. Male deer in North and Central India have flat and large horns. In South Indian subspecies, the cecal cusps are not well developed and appear as small, hairy protrusions. Worm growth of horns and hind horns.

A Within a few months of being born, horns start growing near the ears. These are the main horns. Adults typically have 8 to 12 horns. The emergence of the front horns. The small horns of the mayfly develop only after 10 to 15 months. It takes about 15 months to complete the four stages of development. a Unlike deer antlers, these horns are attached to the bones and continue to grow slowly throughout life. The average adult age of the four-horned antelope is 8 to 20 years. In captivity or zoos, they usually live for 10 to 12 years. Maximum age is up to 17 years.

In the embryonic stage, the horn buds split into four nuclei instead of two. Its chromosome number has reduced from 58 in its ancestors to 38. The horns of the shrosingha are not just for show; they are a living symbol of Batik.

Their horns are attached to a hollow bone structure that extends from the skull. A layer made of keratin covers the bone. The development of four horns is not just for display but is also connected to their lifestyle. Their small horns can be used as a shield during fights in dense forests. Shrosingha spends about 50% of its time being alert.

Fig. Local name: Chauka or Bhedki

The activities of T. quadricornis were divided into eight main categories: feeding (including picking food from the ground, nibbling, and eating), walking (moving from one place to another in search of food), resting (sitting with cud chewing), threat response (showing alertness, running away into the bushes, or taking evasive action when a predator is seen or a loud sound is heard), water intake (drinking water), salt licking (licking rocks for salt), and others (behaviors that were only observed occasionally and for short periods). T.quadricornis usually lives alone or in small groups .
During surveys, all animals in a group were recorded at each spot to estimate group sizes in the study area. Animals were considered part of the same group if they showed some level of cohesive behavior, such as moving or fleeing together. Due to poor visibility and high sensitivity, sex identification could not be done on every occasion, but it was noted when it was possible. animals were roughly categorized into two age groups: adults (>45 cm in length) and fawns (<30 cm in length). Males and females were identified by the presence of horns.

IV: Discussion

In 2026, the Sita Mata Wildlife Sanctuary in Pratapgarh, Rajasthan, continues to be the main home for Unique Polycerate Evolution and Sexual Dimorphism Polycerate Evolution: This is the only wild bovid species that naturally has four horns. From an evolutionary standpoint, it is considered a "living fossil" and belongs to the Boselaphini tribe, showing a more ancient form of antelope.
Sexual Dimorphism: The species shows clear differences between males and females; only males have horns.

Fig. T. quadricornis drinking water

Horn Structure: Males usually have a pair of horns at the back that are 8 to 10 centimeters long and a pair at the front that are 2 to 5 centimeters long. Review of Conservation policies Legal Status: The species is protected under Schedule I of India's Wildlife (Protection) Act, 1972, which gives it the highest level of legal safeguarding. their delicate emotions are being impacted. Major threats include habitat fragmentation, which happens because of road construction and farms taking over more land, causing their natural paths to shrink.

Illegal hunting is also a problem, leading to deaths due to people hunting them for meat or accidentally trapping them. Another issue is the lack of water sources. Because of the climate in 2025, natural water sources dry up during the summer, creating a serious challenge for them. Invasive species like Lantana camara are spreading and taking over space, which reduces the amount of land available for irrigation. The future plan for conserving and increasing the population of Chausinga in Sitamata Wildlife Sanctuary is based on the following points.

Habitat Restoration: Eliminating invasive species: The goal is to bring back native grasslands by removing invasive plants like Lantana camara and Prosopis pulmiflora, so that the four-horned antelope have enough food.

Salt Licks: Developing both natural and artificial salt licks in safe areas within the sanctuary to provide necessary minerals and help keep the four-horned antelope healthy.

Water Management: Smart Water Point has introduced solar-powered pumps to deal with the water shortages expected in 2025. The four-horned antelope tend to live in rough areas where water has been created or is available.

Conservation Category: It is listed as Vulnerable on the IUCN Red List because of fragmented populations and loss of habitat.

Policy Gaps: Even though it is legally protected, in some areas it is classified as "data deficient," which means there isn't enough information to create targeted conservation plans This is in contrast to other more popular large animals. Improving Habitat Through Community Involvement Threat Mitigation: The main threats to the species include habitat destruction caused by livestock, stray dogs, and people moving into their natural areas.

Community Engagement: To effectively conserve this species, involving local communities in educational programs is essential. This helps reduce conflicts between people and animals, as well as overgrazing.

Habitat Management: Conservation policies should focus on keeping the ground covered with vegetation and building conservation ponds. Water shortage is a big problem that limits the survival of this species.

V: Summary and Recommendations

Polycerate Evolution: The Chousingha is a “primitive" member of the bovid family, keeping traits from the Boselaphini group.

Its special four-horn shape two horns between the ears and two smaller ones on the forehead—is a rare feature not seen in any other wild bovid.

Sexual Dimorphism: There is a clear difference between males and females; only adult males have horns. Some research suggests that females might be a little heavier than males, but other studies don’t find a big difference in size. In behavior, females are often seen in open spaces, while males are more likely to browse in certain types of habitats.

Review of Conservation Policies Legal Status: The Chousingha is protected under Schedule I of India's Wildlife (Protection) Act, 1972, and the National Parks and Wildlife Conservation Act, 1973 in Nepal.

Major Threats: The species is under serious threat from losing its habitat, fires, and the spread of invasive plants like Lantana camara, which harms the tree-savanna and grassland areas it prefers.

Current Gaps: Conservation effortsare limited because there isn't enough specific data about the Chousingha. It is shy and often not included in broader conservation programs that cover many species.

Recommendations for Habitat & Community Involvement Invasive Species Management: Weeds like Lantana camara should be removed actively to help restore the natural mix of trees, savannas, and grasslands. Community-Led Monitoring: Local communities should be involved in regular surveys and monitoring of middens (areas where animals defecate) to track population changes in areas that are not officially protected.

Alternative Livelihoods: Try to reduce pressure on forests by offering sustainable alternative ways for people to earn a living, such as reducing the need for fuel wood and

livestock grazing. Infrastructure: Keep fire lines clear to stop big fires from destroying habitats during dry seasons and make sure there is access to water in areas with deciduous trees.

Construction of small bank ditches along seasonal drains. Making sure that even after the monsoon, the water stays in the Mihi Keeping the water level high and ensuring the area remains moist. Corridor Identify and clear any unauthorized encroachments on natural corridors that connect the Sinamata Sanctuary to nearby watersheds like Kumbhalgarh and Phulwari Ki Naal. this will help improve the movement of the four-horned antelope across these areas. Technical surveillance Use drones without thermal sensors to monitor Choringa in difficult to reach hills and dense forests Radio collar some male four-horned antelopes to find out their exact home ranges and migration patterns. Community participation Train local youth as Chausingha experts so they can find jobs and become protectors of this species Sign agreements like Bhara Bank with villagers to fully control the movement of cattle in the core areas of the sanctuary. DNA profiling to check the genetic health of the Bhashadi of Sitamata's Shrosinga This helps solve the problem of under breeding.

Disease surveillance: Conduct regular screenings and vaccination drives to prevent diseases spreading from domestic animals a shy and non-grouping animal that lives alone or in small groups of up to four individuals all year round.India, 80% of the time, T. quadricornis was seen alone, with the largest group being two individuals (Karanth and Sunquist 1992). In Gir National Forest, the maximum group size was four, but the average was 1.5–1.6 individuals (Berwick 1974), with an overall average of about one individual . In Panna National Park, 69% of the individuals were alone all year, followed by 24% in pairs. The average group size increased slightly during the year, from 1.1 individuals in November to 1.6 in May, reflecting more interaction between males and females during the breeding season. there is not much known about the breeding behavior of wild T. quadricornis. In Panna National Park, male-female pairs became more common in May to July, indicating breeding activity, but only two brief mating events were observed. In captivity, Shull described mating behavior that included a period of play, kneeling on their front knees facing each other, interlocking their necks (a behavior similar to the related and pushing strongly. This was followed by a 'drill-like' strutting behavior by the male and then copulation. A male and female Tetracerus quadricornis are seen together most often during the mating season, which happens between May and July, in Panna National Park, central India. The photo was taken by The alarm calls of T. quadricornis are described as either a "husky pronk" or a "sharp bark".

Fig.Male and Female Horn

Make a distinct "cough" sound near females, while females make "soft calls" to find hidden young. Both males and females of T. quadricornis often defecate at the same spot.
the nonrandom grouping of fecal piles in certain areas suggests a type of communication or advertisement, similar to the behavior of B. Trago Camelus. Both male and female T. quadricornis use their large scent glands near the eyes to mark plants, leaving behind a white crystallized film. quadricornis is very secretive and cautious in modern day India, described as"wideawake". When a threat approaches, they often freeze instead of running, but they also make "conspicuous leaps followed by quiet stealthy movements" T. quadricornis can be easily tamed when young. used tame individuals for his study on feeding preferences in Gir National Forest, India. Males can be bold in captivity and can cause serious injuries by goring a handler with their horns one captive male was described as a "little unruly antelope". During mating season, males have been described as "exceedingly wild and mischievous" Encouraging findings have come from the surveys carried out in Sitamata Wildlife Sanctuary.
Polygonalism represents the peak of evolution: The study revealed that all adult antelopes had fully developed four horns. The average length of the hind horns was 9.5 ± 0.7 cm, while the anterior horns averaged 3.2 ± 0.4 cm. The geographical layout of Sitamata functions as a natural preserve, helping to maintain the characteristics of this species. Geographic diversity and socialstructure Clear visual distinctions were noted between males and females. The presence of four horns in males serves as a key element in sexual selection, beyond just being weapons. The diameter of the pre-orbital glands in males was found to be 2.5 times larger than in females, showing a complex chemical communication system in the dense forest environment. Interestingly, in areas where teak and bamboo grow together, the sighting rate of Shrosingha was more than 15%. The 2025 post-monsoon survey also showed that each female had an average of 0.75 cubs, suggesting a steady and healthy population increase.

VI. CONCLUSIONS

The Indian Forest is well known for its rich floral and faunal diversity, especially for the presence of large mammals. Evolutionary & Biological Insights Unique Polycerate Evolution: This species is the only living wild mammal that has four horns, and this trait is only seen in adult males. This four-horn feature is a special evolutionary characteristic within the family Bovidae. Chausinga is not just a wild animal. Rather, it is a living fossil that holds the ancient evolutionary secrets of the Bonidae family. Sitamata Wildlife Sanctuary, where the Aravalli and Vindhyachal ranges meet, continues to be a safe ecological haven for this species even in 2025. Analysis of polyceraty and sexual dimorphism proves that these features are not just about looks but are important for the animal's social behaviour and ability to reproduce successfully.

Although the population in Sitamata is stable, the presence of invasive species like Lantana and the breaking up of habitats are big worries for the long-term survival of this species. In conclusion, protecting the Chausinga is not just about saving one animal but is essential for keeping the whole dry deciduous ecosystem healthy. Futher Research Priority Genetic diversity and genomic mapping impact of climate change of Construction of corridor Invasive species management. Sexual Dimorphism: There is a big difference between males and females. Males have two sets of horns front and back and they often act differently from females, who do not have horns at all.

Ecological Role: This animal is a solitary and shy browser that eats mainly high-quality food like fruits, flowers, and certain plants from the dicot family. it chooses its food carefully; it is a good sign of how healthy the forest Conservation Policy & Habitat needs Vulnerability Status: The species is listed as Vulnerable on the IUCN Red List. Its numbers are going down, with fewer than 10,000 individuals left, and its habitat is becoming more broken up. Habitat Management: To protect this species, it is important to keep open dry forests and hills.

Providing water sources like ponds in dry areas is especially important, because a lack of water is a big threat. Policy Gaps: Current conservation policies often ignore this species and focus more on well-known animals like tigers.

There is a clear need for surveys that look at the species specifically and for special protected areas, such as the Sigur plateau or the Amrabad Tiger Reserve. Community-Based Conservation Mitigating Human Impact: Research shows that the biggest threats come from livestock, stray dogs, and human or vehicle activity.

Local Engagement: For lasting success, conservation efforts should work with local people through education to reduce conflict between humans and wildlife and help protect forest areas that are not officially protected. the unique pair of front and back horns, Tetracerus quadricornis has been valued as a hunting trophy; some hunters find its meat dry and not as tasty as that of other antelopes, although at least one claimed it to be "the best of any antelope or deer". Currently, T. quadricornis is protected in Nepal and India (e.g., the Indian Wildlife Protection Act of 1972 and is listed as Vulnerable with decreasing population trends on the IUCN Red List of Threatened Species. The total population is estimated to be only around 10,000. Many populations are protected in various sanctuaries and national parks in India and Nepal, but increasing our basic knowledge about this little-studied species, reducing habitat loss due to human activities (Awasthi et al. 1994; Chhangani, and maintaining connectivity between protected areas are ongoing conservation challenges.

Collaborative Monitoring:It is recommended that local communities take part in reporting on the species and helping to restore their habitats.

This can help fill in important gaps in our knowledge about where the species lives and how it behaves.

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