

Foraging Behaviour of Nilgai, *Boselaphus tragocamelus* (Pallas, 1766) in Agro-Ecosystem of Washim District

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Abstract: The Nilgai (*Boselaphus tragocamelus*) is a widely distributed ungulate species in the Indian subcontinent, known to inhabit agricultural landscapes and cause significant crop damage. This study aimed to investigate the foraging behaviour of the Nilgai in agro-ecosystems, with a focus on its herd size and foraging behaviour. We conducted a comprehensive field study in the agricultural landscapes of Washim district, using an observational method. Our results show that the Nilgai is a browser, with a diet consisting mainly of crops, including wheat, jowar, maize, pigeon pea, green gram, black gram, groundnuts and soybean. The species exhibits a strong preference for certain crop species, particularly those with high nutritional value. We also found that the Nilgai is a crepuscular and nocturnal forager, with peak activity periods during dawn and dusk. The species uses a variety of habitats, including agricultural fields, grasslands, and forest edges, with a strong preference for areas with dense vegetation and access to water.

Keywords: Blue bull, foraging behaviour, agro-ecosystem, vigilance, herd dynamics

1. Introduction

The Nilgai (*Boselaphus tragocamelus* Pallas, 1766), also called as blue bull in common and *Nilgai* or *Rohi* in Marathi. It is the largest antelope native to the Indian subcontinent with a wide distribution across India, Nepal, and Pakistan. The Nilgai belongs to family Bovidae and order Artiodactyla (Corbet & Hill 1992; Ramesh *et al.*, 2019) and have cover of protection under the Schedule III of Wildlife Protection Act, 1972. The species is endemic to the Indian subcontinent, major populations occurring in India, Nepal and Pakistan. They are only found in the Indian peninsula from the base of the Himalayas to Mysore (Prater, 1971). Blue bulls or Nilgai are found in the northern plains of India, stretching on from base of the Himalayas in the north, to the state of Karnataka in the South. Their range also covers the area from the Gir forest, all along the entire eastern length of Pakistan, across the border of Rajasthan in the West to the states of Assam and West Bengal in the East. The species is known to inhabit agricultural landscapes and cause significant crop damage, resulting in economic losses for farmers. Despite its widespread distribution, the Nilgai is considered a species of least concern by the IUCN, due to its adaptability to different habitats and its ability to thrive in human-dominated landscapes. However, the species is facing several threats, including habitat loss and fragmentation, poaching, and human-wildlife conflict. They are found in a variety of habitats from level ground to hillsides, in thin brush with scattered trees to cultivated plains, but not in thick forests. It lives in close proximity to human settlements (Mallon, 2008). It avoids densely wooded areas and inhabits undulating plains with grass and patches of scrub (Prater, 1971), and is often encountered in agricultural fields raiding crops (Chauhan and Singh, 1990). It is both a grazer and browser, but grasses constitute bulk of its diet (Prater, 1971; Mirza & Khan, 1975; Sankar & Vijayan, 1992; Prasad *et al.*, 2021).

The nilgai has a rich cultural history in India. It is mentioned in ancient Hindu texts and is considered a sacred animal. The nilgai is often associated with fertility and abundance. Its horns are used in religious ceremonies. Hindus revere the nilgai as sacred and associate it with the cow, the mother animal in Hinduism. The nilgai is rarely consumed by Hindus due to its religious significance.

Research on food habits of sympatric ungulates has not progressed in India as it has in Africa (Talbot & Talbot, 1962, Gwyne & Bell, 1968; Leuthold, 1970; Bell, 1971; Jarman & Sinclair, 1979). In India, Schaller (1967) has listed the food plants of wild ungulates in Kanha. Berwick (1976) made cafeteria and field feeding trials on wild ungulates and cattle in Gir. Green (1985) has studied ungulate food habits in Kedarnath by faecal analysis. Haque (1990) studied wild ungulate food habits by direct observations on animals feeding and pellet analysis. Johnsingh & Sankar (1991) studied the food plants of wild ungulates and cattle in Mundanthurai based on direct field observations. Sankar (1994) studied the food habits of wild ungulates in Sariska by direct field observations. Bhat *et al.* (2012) studied the food habits of nilgai in Van Vihar National Park, Bhopal and their diet in included 123 plant species of which 37 trees, 34 herbs, 25 types of grass, 14 shrubs, and 13 creepers. They eat grasses as a major part of their diet, followed by fallen leaves, flowers, fruit, herbs, shrubs etc. Foraging behaviour is a critical aspect of an animal's ecology, as it determines the species' energy intake, nutrient acquisition, and overall fitness. The Nilgai is a browser, with a diet consisting mainly of plants, including crops, grasses, and leaves. However, the species' foraging behaviour in agro-ecosystems is not well understood, with limited information available on its feeding habits, habitat use, and activity patterns. This study aimed to investigate the foraging behaviour of the Nilgai in agro-ecosystems, with a focus on its herd size and foraging behaviour.

2. Material and Methods

2.1 Study Area

Washim district is the one of the districts of Maharashtra located in central eastern part of the State and lies between 19° 51' to 20° 45' N latitudes and 76° 36' to 77° 41' E longitudes covering an area of about 5155 sq. km. The forest cover of the district is 333.814 sq. km out of which 302.960 sq. km. is under reserved forest, only 2.864 sq.km. is under protected while 27.990 sq. km. is under unclassified category. The district has been subdivided into 3 sub-divisions of forest viz Washim, Mangrulpir and Karanja. Part of Katepurna Wildlife Sanctuary and Sohul Karanja Wildlife Sanctuary are located in the district. The main crop seasons are kharip and rabbi. Net sown area is 27,990 ha while 38 ha is the area sown more than once in a year with 109.8 % cropping intensity. According to provisional data for 2023-24 in Washim district, the total area under crop cultivation is 549003 ha with soybean as a main crop, of which 1,603 ha are under jowar crop and 38,137 ha under wheat. Cereals are 41977 ha, pulses 141618 ha and sorghum, cotton and soybean are the main crops grown in dry land. Among the remaining rabbi crops, wheat and gram are the main crops (DSER, 2024).

2.2 Methodology

Exploration surveys were carried out from July 2023 to June 24. This study was carried out by observational method and interviewing the local farmers. Their knowledge on Nilgai & its history were recorded. For the observation of feeding habits and behaviour a binocular Olympus 10X50 DPSI was used and recorded food plants eaten. Then from the radius of 5 m around the freshly eaten plant, the number of plant species eaten were recorded. Data on herd size, foraging patterns, and vigilance behaviour were recorded through direct observation and camera.

3. Result and Discussion

3.1.1 Herd Dynamics

In the present investigation the bachelor herd size ranged from 3 to 7 males while mixed herd size ranged from minimum two to maximum 9 per sighting. Most of the times the male found moving solitarily while female found in herd with their calves. Blue bulls exhibited a tendency to forage in smaller groups or as solitary individuals in agricultural lands. Minimum of one to maximum of 11 individuals per sighting were recorded in an around Beer-Sonty reserve forest of Haryana (Chopra & Rai, 2009). Herd size studied across the forest and agricultural land during the monsoon and post-monsoon seasons, and the results showed that herd size was greater in the forest than in agricultural lands (Bayani & Watve 2016). Their population size does not suggest any alarming situation because of devoid of large predators. This seems to be a major factor for population increase in Nilgai and imbalance in the Agri-ecosystem. Similar observation is recorded by Kumar & Kumar (2018). It's worth noting that nilgai are social animals and are often found in small groups, typically consisting of females and their young, while males will often wander on their own or

form small bachelor groups. The herd size of *Boselaphus tragocamelus*, can vary depending on several factors, including the location and the time of year. Herd sizes in agricultural lands were smaller and less compact compared to forested areas.



Figure 1: A solitary male grazing the farm



Figure 2: A female feeding her calf



Figure 3: A herd of female moving across the farm



Figure 4: A bachelors male herd standing on bandh



Figure 5: Pile of faces of *Boselaphus tragocamelus*

3.1.2 Foraging behaviour

The diet of Nilgai in the agro-ecosystem of Washim District is depicted in *Table 1*. Our results show that the Nilgai in an agro-ecosystem is a browser, with a diet consisting mainly of crops, including cereals and legumes. The species exhibits a strong preference for certain crop species, particularly those with high nutritional value, such as wheat, maize and pigeon peas in the months of November, December and January, and soybean, green gram, black gram in August and September. In hot dry months like April, May and June the species use agricultural fields when natural food sources are scarce. In this hot dry season, the crop remaining, shrubs and trees on the bandh of farm are browsed by Nilgai. We also found that the blue bulls use a variety of habitats, including agricultural fields, grasslands, and forest edges, with a strong preference for areas with dense vegetation and access to water. It is observed that they also hold their meetings in the orange fields. They do not eat the fruits or leaves of oranges, but often mating fights occur in male roaches. It destroys the

fruits of the orange tree and destroys the garden. Nilgai are crepuscular, meaning they are most active at dawn and dusk, but they also forage at night, especially during the hot summer months. Nilgai prefer areas with dense crop cover, tree cover and fallow lands, which provides them with food, shade and shelter. Nilgai need access to water sources, such as rivers, lakes, or ponds, for drinking and thermoregulation. Nilgai were reported to feed on all the major crops grown in Kaushambi district of Uttar Pradesh. Rice, maize, wheat, mustard and lentils were recorded to be eaten at all stages (Upadhyay, 2023).

The findings suggest that nilgai have adapted their foraging behaviour to the challenges posed by agro-ecosystems with a strong preference for crop species with high nutritional value. The species' crepuscular and nocturnal activity patterns are likely an adaptation to avoid predators and human disturbance.

Table 1: The diet of Nilgai in the agro-ecosystem of Washim District

Group	Common name	Scientific name
Grasses	Bermuda grass	<i>Cynodon dactylon</i>
	Marvell grass	<i>Dichanthium annulatum</i>
	Anjan grass	<i>Cenchrus ciliaris</i>
	Cogongrass	<i>Imperata cylindrical</i>
	Kans grass	<i>Saccharum spontaneum</i>
Leaves (Trees And shrubs)	Babul	<i>Acacia nilotica</i>
	Babul	<i>Acacia jacquemontii</i>
	Indian plum (ber)	<i>Ziziphus mauritiana</i>
	Velvet bean	<i>Mucuna pruriens</i>
	Bael,	<i>Aegle marmelos</i>
	Shatavari	<i>Asparagus recemosus</i>
	Jamun	<i>Syzygium cumini</i>
	Vilayati Shami	<i>Prosopis sp.</i>
	Stylo	<i>Stylosanthes guianensis</i>
Khair	<i>Senegalia catechu</i>	
Crops	Soybean	<i>Glycine max</i>
	Pigeon pea (toor)	<i>Cajanus cajan</i>
	Chick pea (Chana)	<i>Cicer arietinum</i>
	Jowar	<i>Sorghum bicolor</i>
	Wheat	<i>Triticum aestivum</i>
	Groundnut	<i>Arachis hypogaea</i>
	Green gram/Mung/ Green bean	<i>Vigna radiate</i>
	Black gram/Udad	<i>Vigna mungo</i>

Vigilant foraging is a behaviour exhibited by Nilgai (*Boselaphus tragocamelus*) where they are constantly on the lookout for potential threats while foraging for food. This behaviour is essential for their survival, as they need to balance their need for food with the risk of predation. Blue bulls displayed increased alertness and scanning behaviour in response to human activities and potential threats from farmers. Nilgai maintain an alert posture while foraging, with their ears perked up and their eyes scanning the surroundings. Nilgai may reduce their foraging time to minimize their exposure to potential threats. Nilgai are more vigilant during peak predation hours, such as dawn and dusk, when predators are most active. Nilgai may use cover such as trees, bushes, or rocky outcrops to conceal themselves while foraging. Vigilant foraging provides several benefits to Nilgai, including, reduced predation risk, increased foraging efficiency and improved survival rates on the other hand vigilant foraging also incurs costs for Nilgai, including, reduced foraging time, increased energy expenditure and stress and anxiety. The higher vigilance frequency and smaller herd sizes in agricultural lands indicate a response to the increased risk of human encounters.

Non-vigilant foraging refers to the behaviour of Nilgai (*Boselaphus tragocamelus*) where they forage for food without being constantly alert and vigilant for potential threats. Nilgai reduce their scanning of the surroundings while foraging, focusing more on finding and consuming food. Nilgai maintain a relaxed posture while foraging, with their ears and eyes focused on the food source rather than scanning the surroundings. Nilgai may spend more time foraging when they are not vigilant, as they are not constantly interrupting their foraging to scan for threats. Non-vigilant foraging provides several benefits to Nilgai, including, increased foraging efficiency, improved nutrition and reduced energy expenditure.

Nilgai is grazer but it became browser in the scarcity of grasses during winter and summer. During monsoon the Nilgai preferred green grasses and herbs very much while browsed only on leaves and young twigs of *Prosopis cineraria*, *Ziziphus nummularia* and *Acacia senegal* (Jaipal, 2020). Prasad & Prabhakar observed the co-grazing of Nilgai with the cattle very adjacent to the human locality but in present investigation no such behaviour was observed. During feeding, one of the herd's dominant females inspects (Gehlot & Jakher 2015) the location and enters the crop fields, while the male stands behind and the calves occupy the mid position. It examines its surroundings and carefully observes the crop after eating a bite. It constantly feeds on crops at various locations rather than from a single location (Gautam & Bissa, 2014). When it detects a danger, it runs very fast and looks behind after covering a distance of 400-500 m.

4. Conclusion

The foraging behaviour of Nilgai in the agro-ecosystem of Washim District is influenced by various factors, including crop availability, water availability, predator avoidance, and human disturbance. Understanding the foraging behaviour of Nilgai is essential for managing and conserving this species, as well as for developing effective conservation strategies

that balance the needs of humans and wildlife. The foraging behaviour of Nilgai in the agro-ecosystem of Washim District can lead to conflicts with humans, particularly farmers, who may view them as pests. The conflicts arise from crop damage particularly during periods of crop maturity.

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