Range Management and Agroforestry 46 (2) : 190-196, 2025
ISSN 0971-2070 (Print); 2249-5231 (Online)
https://doi.org/10.59515/rma.2025.v46.i2.02

Research article

Assessment of grass diversity and habitat suitability for herbivores in Kawal Tiger Reserve, India

Mhaiskar Priya Rajendra[1], Milkuri Chiranjeeva Reddy[1*], Ragula Anil[1], Prabhat Tiwari[2], Bheemreddyvalla Venkateshwar Reddy[1], Rohith Ravula[1], Yerrawada Naveen[1], Katikala Anish[1] and Sachin Kumar[1]

[1]Forest College and Research Institute, Mulugu-502279, India
[2]Rani Lakshmi Bai Central Agricultural University, Jhansi-284003, India
[*]Corresponding author email: chiranjeevamilkuri@gmail.com

Received: 06th October, 2025 Accepted: 30th November, 2025

Abstract

Grasslands form a crucial ecological component of tropical dry deciduous forests, providing forage for herbivores and indirectly sustaining apex predators like tigers. This study assessed grass diversity, habitat distribution, palatability, and conservation implications in the Kawal tiger reserve (KTR), Telangana, India, through systematic field surveys conducted between 2020 and 2023. Using transects and quadrats across 16 ranges, 74 grass species belonging to 44 genera were documented, representing approximately 4.84% of India's grass flora. Taxonomic analysis revealed dominance of subfamily Panicoideae (66.21%), reflecting its C4 photosynthetic efficiency and ecological adaptability. Species were distributed across five habitat types, with open grasslands (48.68%) and open moist areas (22.97%) serving as primary reservoirs of diversity and forage. Palatability analysis indicated that 21.62% of species were exceptionally good (Grade A), 50% good (Grade B), and 28.37% medium quality (Grade C), suggesting limited availability of highly nutritious forage, potentially constraining herbivore carrying capacity. Awn analysis showed a near balance between awnless (54.05%) and awned (45.95%) species, highlighting trade-offs between herbivore preference and long-term ecological resilience. While all species are currently listed as Not Evaluated by the IUCN, localized threats-livestock grazing, invasive species (*Lantana camara*, *Parthenium hysterophorus*), and habitat degradation-pose risks to grassland integrity. Comparisons with regional studies confirm that KTR is moderately rich in grass diversity within the central Indian tiger landscape.

Keywords: Grass diversity, Habitat distribution, Palatability, Panicoideae, Tiger conservation

Introduction

Grasslands, defined as ecosystems dominated by herbaceous vegetation with less than 10% tree and shrub cover (Pye, 1985), cover approximately 40.5% of the world's terrestrial area, excluding Greenland and Antarctica (Gibson, 2009). They are among the most productive landscapes, playing a vital role in carbon cycling, water regulation, and soil stabilization while sustaining diverse faunal communities (Shinde and Mahanta, 2020). In India, grasslands account for over 10% of the land surface and provide critical forage for herbivores, which in turn support apex predators such as tigers and leopards (Pemadasa, 1990). Grasses, as monocotyledonous plants, produce substantial biomass within short life cycles, supplying food, shelter, and cover for a wide variety of species. They not only sustain herbivore populations like chital (*Axis axis*), sambar (*Rusa unicolor*), and nilgai (*Boselaphus tragocamelus*) but also influence predator-prey dynamics by determining prey abundance and distribution (Askins *et al*., 2007). Despite their ecological significance, grasslands in India have historically been undervalued, often regarded as degraded stages of deciduous forests (Champion and Seth, 1968). This perception has led to their widespread conversion for agriculture, infrastructure, and industrial use, causing habitat fragmentation and loss of forage quality (Roy *et al*., 2019; Moretto and Distel, 1997).

The ecological value of grasslands has been highlighted by studies showing that their degradation directly impacts herbivore carrying capacity and predator populations. In Nepal's Bardia National Park, cutting and controlled burning were shown to improve forage quality, enhance grass diversity, and sustain herbivore nutrition (Lamichhane *et al.,* 2024). Similarly, research in Telangana emphasized that conserving grass species is crucial for ecosystem resilience, soil stability, and sustaining local cultural traditions (Swamy *et al.*, 2024). Grassland diversity thus emerges as a key ecological indicator for wildlife management and biodiversity conservation. However, grasslands across India face increasing anthropogenic pressures. Studies in Ranthambhore Tiger Reserve revealed that over 45 years, dense forest cover declined by 13.8%, shrubland by 42.8%, and water bodies by 63.5%, while built-up land expanded more than 70-fold, leading to fragmentation and heightened human-wildlife conflicts (Singh *et al.*, 2025). These findings underline the vulnerability of semi-arid and dry deciduous landscapes to land-use change and the consequent challenges of balancing conservation with human needs.

Herbivore habitat selection further illustrates the importance of grass diversity. Research on four-horned antelope (*Tetracerus quadricornis*) in Central India found that their distribution was strongly associated with areas of high plant species richness, highlighting that diverse grassland and forests provide year-round forage and refuge (Sharma *et al.*, 2013). Such patterns suggest that conserving grass diversity is central to sustaining prey populations and, by extension, predator viability.

Based on the above-mentioned importance, the study was conducted at Kawal Tiger Reserve (KTR), located in Mancherial district, Telangana, which represents a critical conservation landscape in southern India. Declared a tiger reserve in 2012, KTR spans 2,015.44 km², including a core zone of 893 km². Its tropical dry deciduous forests are interspersed with grasslands and riparian habitats along the Godavari and Kadam rivers. These ecosystems support diverse fauna, including tigers, leopards, sambar, nilgai, and chital. However, like many reserves in India, KTR faces challenges such as livestock grazing, encroachment, invasive species, and forest fires, which threaten habitat quality and ecological balance. The captioned study assessed habitat suitability for herbivores and evaluated the impacts of anthropogenic pressures on grassland health. By linking grass composition with herbivore support, the findings are expected to inform conservation strategies that enhance prey base availability, strengthen predator populations, and ensure sustainable habitat management under increasing anthropogenic and climatic pressures.

Materials and Methods

***Study area*:** The present study was conducted in Kawal Tiger Reserve, an important part of the protected area network of Telangana state, which is located in Jannaram Mandal of Mancherial District (Old Adilabad district). The Government of India declared this a tiger reserve in 2012. It is well known for its abundant flora and fauna. This sanctuary is a catchment area for the rivers Godavari and Kadam, which flow south of the sanctuary. The reserve is the oldest sanctuary in the northern Telangana region of the state and forms the southernmost tip of the central Indian Tiger landscape in the world. A total of 16 KTR ranges were selected for conducting the research.

Line transects method: The study was carried out from 2020 to 2023 in the Kawal Tiger Reserve. Habitat mapping was initially undertaken by classifying the landscape into major habitat types, including wetlands, grasslands, open forests, and dense forests. Existing transects established by the Forest Department were used for data collection, and additional transects were laid in areas lacking prior baseline coverage. Transect lengths varied from 0.5 to 6 km, depending on terrain and accessibility. Grass diversity was assessed by laying 1m × 1m quadrats at 100 m intervals along each transect. Within each quadrat, the presence, abundance, and relative proportion of grass species were visually estimated. This approach facilitated a comprehensive assessment of grass species composition and the identification of key forage species preferred by herbivores. The study established robustness of the findings, employing a methodological framework combining quadrat-based field sampling (Singh *et al.*, 2023), transect-based habitat assessment, and GIS-supported habitat mapping.

Results and Discussion

***Grass species diversity and taxonomic richness*:** The field surveys in Kawal Tiger Reserve (KTR) documented 74 grass species across 45 genera (Table 1-2), representing approximately 4.84% of India's total grass diversity. This reflects KTR's importance as a floristic diversity repository within the Central Indian Tiger Landscape. Of the 74 recorded species, 46 are annuals and 28 are perennials, indicating a balanced composition of short-lived and long-lived grasses within the reserve, strengthening both seasonal availability and year-round stability of herbivore forage resources (Arora and Kataria, 2023). Key genera, including Chloris (*e.g.*, *Chloris barbata*, *C. bournei*, *C. gayana*, *C. radiatus*, *C. virgata*), Digitaria (*e.g.*, *D. abludens*, *D. bicornis*, *D. ciliaris*, *D. longiflora*, *D. tomentosa*), Eragrostis, and Setaria, exhibit adaptability to diverse microhabitats ranging from open grasslands to shaded and moist areas. The flora comprises both annual species (*e.g.*, *Digitaria ciliaris*, *Eragrostis tenella*, *Setaria verticillata*) and perennial species (*e.g.*, *Cynodon dactylon*, *Dichanthium caricosum*, *Chloris gayana*), enhancing structural complexity.

Taxonomically, the 74 species are distributed across 6 tribes and 3 subfamilies (Table 1-2). Panicoideae dominates with 49 species (34 genera, tribes Andropogoneae: 28, Paniceae: 20, Isachneae: 1), led by Digitaria (5 species).

Table 1. Annual grasses documented in Kawal Tiger Reserve

S. No.	Name of grass	Sub-family	Tribe	Palatability grade	Awn characteristic (P/A)
1	*Alloteropsis cimicina* (L.) Stapf	Panicoideae	Paniceae	B	P
2	*Andropogon pumilus* Roxb.	Panicoideae	Andropogoneae	A	P
3	*Apluda mutica* L.	Panicoideae	Andropogoneae	B	P
4	*Aristida adscensionis* L.	Arundioideae	Aristideae	C	P
5	*Aristida redacta* Stapf	Arundioideae	Aristideae	C	P
6	*Arthraxon lancifolius* (Trin.) Hochst.	Panicoideae	Andropogoneae	B	P
7	*Brachiaria distachya* (L.) Stapf	Panicoideae	Paniceae	C	A
8	*Brachiaria ramosa* (L.) Stapf	Panicoideae	Panicoideae	B	A
9	*Brachiaria reptans* (L.) C.A.Gardner and C.E.Hubb.	Panicoideae	Paniceae	B	A
10	*Cenchrus ciliaris* L.	Panicoideae	Paniceae	A	A
11	*Chloris barbata* Sw.	Chloridoideae	Cynodonteae	C	P
12	*Chloris virgata* Sw.	Chloridoideae	Cynodonteae	B	P
13	*Dactyloctenium aegyptium* (L.) Willd.	Chloridoideae	Eragrostideae	C	A
14	*Dichanthium annulatum* (Forssk.) Stapf	Panicoideae	Andropogoneae	A	P
15	*Digitaria abludens* (Roem. and Schult.) Veldk.	Panicoideae	Paniceae	A	A
16	*Digitaria bicornis* (Lam.) Roem. and Schult.	Panicoideae	Paniceae	C	A
17	*Digitaria ciliaris* (Retz.) Koeler	Panicoideae	Paniceae	B	A
18	*Digitaria longiflora* (Retz.) Pers.	Panicoideae	Paniceae	A	A
19	*Digitaria tomentosa* (J.Koenig ex Rottler) Henrard	Panicoideae	Paniceae	A	P
20	*Dimeria orissae* Bor	Panicoideae	Andropogoneae	C	P
21	*Dimeria ornithopoda* Trin.	Panicoideae	Andropogoneae	C	P
22	*Eragrostis amabilis* (L.) Wight and Arn.	Chloridoideae	Eragrostideae	B	A
23	*Eragrostis riparia* (Willd.) Nees	Chloridoideae	Eragrostideae	B	A
24	*Eragrostis tenella* (L.) P. Beauv. ex Roem. and Schult.	Chloridoideae	Eragrostideae	B	A
25	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Chloridoideae	Eragrostideae	B	A
26	*Eragrostis viscosa* (Retz.) Trin.	Chloridoideae	Eragrostideae	A	A
27	*Eriochloa procera* (Retz.) C.E.Hubb	Panicoideae	Paniceae	C	A
28	*Hackelochloa granularis* (L.) Kuntze	Panicoideae	Andropogoneae	B	A
29	*Ischaemum rugosum* Salisb.	Panicoideae	Andropogoneae	B	P
30	*Isachne pulchella* Roth	Panicoideae	Isachneae	B	A
31	*Iseilema hackelii* U.B. Shrestha & Gandhi	Panicoideae	Andropogoneae	B	P
32	*Melanocenchris jacquemontii Jaub. and Spach*	Chloridoideae	Cynodonteae	C	P
33	*Oplismenus burmanni* (Retz.) P.Beauv.	Panicoideae	Paniceae	B	A
34	*Paspalidium flavidum* (Retz.) A. Camus	Panicoideae	Paniceae	B	A
35	*Pennisetum pedicellatum* Trin.	Panicoideae	Paniceae	A	A
36	*Perotis indica* (L.) Kuntze	Chloridoideae	Cynodonteae	B	A
37	*Pseudosorghum fasciculare* (Roxb.) A. Camus	Panicoideae	Andropogoneae	C	P

38	*Rottboellia cochinchinensis* (Lour.) Clayton	Panicoideae	Andropogoneae	B	A
39	*Sacciolepis indica* (L.) Chase	Panicoideae	Paniceae	B	A
40	*Schizachyrium brevifolium* (Sw.) Nees ex Buse	Panicoideae	Andropogoneae	C	P
41	*Setaria intermedia* Roem. and Schult.	Panicoideae	Paniceae	A	A
42	*Setaria pumila* (Poir.) Roem. and Schult.	Panicoideae	Paniceae	B	A
43	*Setaria verticillata* (L.) P. Beauv.	Panicoideae	Paniceae	C	A
44	*Sorghum bicolor* (L.) Moench	Panicoideae	Andropogoneae	B	A
45	*Spodiopogon rhizophorus* (Steud.) Pilger	Panicoideae	Andropogoneae	B	P
46	*Themeda quadrivalvis* (L.) Kuntze	Panicoideae	Andropogoneae	C	P

*A: Absent; P: Present

Table 2. Perennial grasses documented in Kawal Tiger Reserve

S. No.	Name of grass	Sub-family	Tribe	Palatability grade	Awn characteristic (P/A)
1	*Arthraxon hispidus* (Thunb.) Makino	Panicoideae	Andropogoneae	B	P
2	*Bothriochloa bladhii* (Retz.) S. T. Blake	Panicoideae	Andropogoneae	B	P
3	*Bothriochloa pertusa* (L.) A. Camus	Panicoideae	Andropogoneae	B	P
4	*Capillipedium assimile* (Steud.) A. Camus	Panicoideae	Andropogoneae	C	P
5	*Chionachne koenigii* (Spreng.) Thwaites	Panicoideae	Andropogoneae	B	A
6	*Chloris bournei* Rang. and Tadul.	Chloridoideae	Cynodonteae	C	P
7	*Chloris gayana* Kunth	Chloridoideae	Cynodonteae	A	P
8	*Chloris radiatus* Roth. ex Roem. and Schult.	Chloridoideae	Cynodonteae	A	P
9	*Chrysopogon fulvus* (Spreng.) Chiov.	Panicoideae	Andropogoneae	C	P
10	*Cynodon dactylon* (L.) Pers.	Chloridoideae	Cynodonteae	A	A
11	*Cynodon radiatus* Roth. ex Roem. and Schult.	Chloridoideae	Cynodonteae	B	A
12	*Dichanthium caricosum (L.) A. Camus*	Panicoideae	Andropogoneae	A	P
13	*Eleusine indica* (L.) Gaertn.	Chloridoideae	Eragrostideae	B	A
14	*Enteropogon dolichostachyus* (Lag.) Keng	Chloridoideae	Eragrostideae	C	P
15	*Eragrostiella bifaria* (Vahl) Bor	Chloridoideae	Eragrostideae	C	A
16	*Eragrostiella brachyphylla* (Stapf) Bor	Chloridoideae	Eragrostideae	C	A
17	*Eragrostis atrovirens* (Desf.) Trin. ex Steud.	Chloridoideae	Eragrostideae	B	A
18	*Eragrostis nutans* (Retz.) Nees ex Steud.	Chloridoideae	Eragrostideae	B	A
19	*Eremopogon foveolatus* (Delile) Stapf	Panicoideae	Andropogoneae	B	P
20	*Heteropogon contortus* (L.) P. Beauv. ex Roem. and Schult.	Panicoideae	Andropogoneae	C	P
21	*Ischaemum ciliare* Retz.	Panicoideae	Andropogoneae	B	P
22	*Iseilema laxum* Hack.	Panicoideae	Andropogoneae	A	P
23	*Oplismenus compositus* (L.) P. Beauv.	Panicoideae	Paniceae	B	A
24	*Panicum sparsicomum* Nees ex Steud.	Panicoideae	Paniceae	B	A
25	Paspalum scrobiculatum *L.*	Panicoideae	Paniceae	B	A
26	*Sporobolus diandrus (Retz.) P.Beauv.*	Chloridoideae	Eragrostideae	B	A
27	*Sporobolus indicus* (L.) R. Br.	Chloridoideae	Cynodonteae	A	A
28	*Sehima nervosum* (Rottler) Stapf	Panicoideae	Andropogoneae	A	P

*A: Absent; P: Present

Chloridoideae contribute 23 species (10 genera, tribes Cynodonteae: 10, Eragrostideae: 13), dominated by Eragrostis (7 species). Arundinoideae comprises 2 species (1 genus, tribe Aristideae, genus Aristida), forming the smallest subfamily component in the study area.

This taxonomic richness is comparable to that of other Indian tropical deciduous ecosystems. Abhijit and Krishnamurthy (2020) reported 78 species in Kundadri Hills, while Katiyar *et al.*, (2022) documented 65 species in Kishanpur Wildlife Sanctuary. KTR's diversity, however, is lower than Saharanpur Forest Division (142 species, Vijai, 2015) and Barak Valley (98 species, Barbhuiya *et al.*, 2013). These variations reflect ecological and climatic differences, survey intensity, and transitional zones that often harbor greater diversity. The dominance of *Panicoideae* (66.21%) aligns with patterns observed in Indian grasslands, attributed to their C4 photosynthetic pathway that provides adaptive advantages in hot and high-temperature conditions (Clayton *et al.*, 2006; Vijai, 2015).

Habitat distribution of grass species: Grass species in KTR exhibited habitat-specific distributions across five categories: open grasslands, open moist areas, partial shady and wet areas, shady areas, and marshy areas. Open Grasslands (48.68%) exhibit the most species-rich habitat with 36 species. Species such as *Cenchrus ciliaris, Dichanthium annulatum,* and *Setaria intermedia* thrive here, making these habitats crucial for herbivores like deer and antelope. The dominance of open grasslands aligns with Hiremath and Sundaram's (2005) findings that open habitats are key for maintaining native grass diversity but also vulnerable to invasive species like *Lantana camara* and *Parthenium hysterophorus*. In Open Moist Areas (22.97%), 17 species were documented, including *Paspalidium flavidum* and *Sacciolepis indica*, adapted to higher soil moisture and seasonal flooding. These habitats provide critical forage during dry seasons. Seven species documented from partially shady and wet areas (9.45%), such as *Arthraxon hispidus* and *Isachne pulchella*, thrive in transitional zones with moderate shade and moisture. Six species of shady areas (8.10%), including *Oplismenus burmannii* and *O. compositus*, are adapted to low-light environments under forest canopies, contributing limited but specialized forage. Only *Chionachne koenigii* was recorded in marshy areas (1.35%), reflecting highly specialized conditions. The concentration of species in open grasslands and moist areas (71.65% combined) highlights their role as biodiversity reservoirs. These habitats require urgent conservation due to pressures from invasives and anthropogenic activities.

Palatability analysis for herbivores: The 74-grass species recorded in KTR-comprising 46 annuals and 28 perennials, were classified into three palatability grades, with Grade A containing 9 annuals and 7 perennials, Grade B containing 26 annuals and 11 perennials, and Grade C containing 11 annuals and 10 perennials. Sixteen species of Grade A (21.62%), including *Cynodon dactylon, Dichanthium annulatum, Digitaria longiflora,* and *Sehima nervosum*, were rated exceptionally good fodder. Their high nutritional value makes them critical for sustaining herbivores and indirectly supporting apex predators like tigers (Singh *et al.*, 2023; Pradhan *et al.*, 2022; Karanth *et al.*, 2004). Thirty-seven species grouped as Grade B (50%), including *Alloteropsis cimicina, Brachiaria ramosa,* and *Eragrostis amabilis*, provide reliable forage across habitats. Their abundance suggests resilience, but also potential habitat disturbances favoring intermediate palatability species (Kumar *et al.*, 2024). Twenty-one species in Grade C (28.37%), including *Aristida adscensionis, Capillipedium assimile,* and *Heteropogon contortus*, are less nutritious and often associated with degraded or overgrazed habitats (Belsky, 1992). The relatively low proportion of Grade A species may constrain herbivore carrying capacity, indicating the need for management interventions to restore high-quality forage.

Analysis revealed 40 awnless species (54.05%) and 34 awned species (45.95%). Among the awnless grasses, 27 were annuals (67.50%) and 13 were perennials (32.50%), while among the awned grasses, 19 were annuals (55.88%) and 15 were perennials (44.12%), as detailed in Tables 1 and 2. Awnless species (*e.g.*, *Cynodon dactylon*, *Digitaria ciliaris*, *Pennisetum pedicellatum*) are typically softer, more palatable, and therefore heavily grazed by herbivores (Gorade and Datar, 2014). The absence of awns reduces leaf and seed surface roughness, enhancing bite efficiency, chewing ease, and digestibility-factors well recognized in forage science as determinants of herbivore preference (Vallentine, 2000). These species also exhibit higher leaf-to-stem ratios, finer tillers and higher moisture content, which further elevate their nutritional value (Shaffer, 2019). Ecologically, awnless grasses play an important role in biodiversity maintenance and regeneration of grassland systems. Species such as *Cynodon dactylon* and *Digitaria ciliaris* regenerate rapidly after grazing owing to their stoloniferous spread and vigorous tillering, characteristics that allow them to recover biomass quickly and maintain continuous ground cover (Mahgoub, 2023). Persistent cover provided by these grasses stabilizes soil, reduces erosion, and conserves moisture, thereby improving microsite conditions for the recruitment of forbs and other grass species (Dagar and Gupta, 2021). The dense mats formed by many awnless grasses also moderate soil temperature, reduce evapotranspiration, and enhance germination niches-processes known to support early successional species and overall habitat heterogeneity (Sala *et al.*, 1988). Such microhabitat creation supports diverse faunal groups, including insects, small mammals, and ground-nesting birds, thereby strengthening ecological complexity. Overall, the dominance and resilience of palatable awnless grasses not only make them key forage resources for herbivores but also promote long-term ecosystem stability, successional turnover, and biodiversity in savanna–dry deciduous landscapes such as KTR.

Awned species (*e.g., Andropogon pumilus*, *Chloris gayana*, *Themeda quadrivalvis*) are generally less palatable because their bristly awns reduce bite efficiency and increase chewing difficulty for herbivores (Roodt, 2015). Recent studies confirm that awned spikelets increase structural defenses and lower intake rates in grazers (Masudi, 2021). However, these grasses become notably more palatable during the early vegetative to pre-flowering stage, when tissues are softer, fibre content is lower, and awns are not fully developed, making them attractive to herbivores for a short seasonal window (Pradhan *et al.,* 2022; Gandhi *et al.,* 2011). Despite reduced palatability at maturity, awned grasses contribute significantly to grassland ecology. Their awns enhance seed dispersal and soil penetration, improving germination success through hygroscopic movements that assist self-drilling of diaspores (Peart, 1984; Elbaum *et al.,* 2007). Many awned species, including members of *Themeda*, are well adapted to nutrient-poor and fire-prone environments, enabling rapid post-disturbance recovery and promoting long-term ecosystem resilience (Bond and Keeley, 2005). This near-even split reflects an ecological balance: awnless species support immediate herbivore needs, while awned species enhance long-term resilience through seed dispersal and persistence.

Conservation status: All 74 species are classified as not evaluated (NE) by the IUCN Red List, reflecting a lack of global assessments. While no species are currently threatened, local pressures such as livestock grazing, tourism infrastructure, settlement encroachments, and invasive species warrant regional monitoring. The absence of assessed species highlights a conservation gap that requires targeted evaluation.

Ecological and conservation implications: The results underscore KTR's ecological importance as both a biodiversity hotspot and a critical tiger corridor connecting Tadoba Andhari and Indravati Tiger Reserves. Herbivore populations in KTR depend heavily on the quality and distribution of grasses, which in turn influence predator densities (Karanth *et al.,* 2004). The dominance of moderately palatable species (Grade B) and presence of disturbance indicators (Grade C) suggest that current forage quality could be improved through management actions such as control of invasive species (*Lantana camara, Parthenium hysterophorus*) to preserve open grasslands and moist habitats (Hiremath and Sundaram, 2005), regulation of livestock grazing to prevent further shifts toward unpalatable or grazing-tolerant species (Belsky, 1992; Moretto and Distel, 1997) and restoration of Grade A species to enhance forage quality and carrying capacity for herbivores. The balance between awned and awnless species, coupled with habitat-specific diversity, reflects ecological resilience. However, targeted monitoring, conservation action, and integration of grassland management into broader tiger conservation strategies are necessary to maintain KTR's role in the central Indian landscape.

Conclusion

Kawal Tiger Reserve (KTR) represents 4.84% of India's grass flora. Species were distributed across habitats, serving as key forage reservoirs for herbivores that sustain apex predators. Even though awned and awnless species were nearly balanced, a detailed palatability analysis is still needed to determine their forage value and its implications for herbivore carrying capacity. Comparisons with regional studies suggest moderately high diversity, constrained by ecological and anthropogenic factors. Major threats include habitat degradation, grazing, and invasive species such as *Lantana camara* and *Parthenium hysterophorus*. Conservation priorities should include restoring grasslands, enhancing Grade A species, mitigating human pressures, and conducting regular floristic monitoring to ensure KTR's ecological resilience and role as a key central Indian tiger landscape corridor.

Acknowledgment

The authors gratefully acknowledge the Biodiversity Society of Telangana for funding that enabled this study. We also thank the Telangana Forest Department and the Field Director Project Tiger, Kawal Tiger Reserve, for their field support. Additionally, we extend our sincere appreciation to the Dean, Forest College and Research Institute, for institutional support that facilitated this research.

References

Abhijit, H. U. and Y. L. Krishnamurthy. 2020. Grasses of Kundadri hills in the western Ghats of Karnataka, India. *Journal of Threatened Taxa* 12: 15619-15630.

Arora, K. and P. Kataria. 2023. Role of traditional feeding practices in solving forage inadequacy issue in sub-mountainous Punjab, India. *Range Management and Agroforestry* 44: 370-377.

Askins, R. A., F. Chávez-Ramírez, B. C. Dale, C. A. Haas, J. R. Herkert, F. L. Knopf and P. D. Vickery. 2007. Conservation of grassland birds in north America: understanding ecological processes in different regions. *Ornithological Monographs* 64: 1-46.

Barbhuiya, H. A., B. K. Dutta, A. K. Das and A.K. Baishya. 2013. An annotated checklist of the grasses (Poaceae) of southern Assam. *Check List* 9: 980-986.

Belsky, A. J. 1992. Effects of grazing, competition, disturbance and fire on species composition and diversity in grassland communities. *Journal of Vegetation Science* 3: 187-200.

Bond, W. J. and J. E. Keeley. 2005. Fire as a global 'herbivore': the ecology and evolution of flammable ecosystems. *Trends in Ecology and Evolution* 20: 387-394.

Champion, H. G. and S.K. Seth. 1968. *A Revised Survey of the Forest Types of India.* Manager of Publications, Government of India, New Delhi.

Clayton, W. D., K.T. Harman and H. Williamson. 2006. *Grass Base: The Online World Grass Flora.* The Board of Trustees of the Royal Botanic Gardens, Kew.

Dagar, J. C. and S.R. Gupta. 2021. Silvopasture options for enhanced biological productivity of degraded pasture and grazing lands: an overview. *Agroforestry for Degraded Landscapes: Recent Advances and Emerging Challenges* 2: 163-227.

Elbaum, R., L. Zaltzman, I. Burgert and P. Fratzl. 2007. The role of wheat awns in the seed dispersal unit. *Science* 316: 884-886.

Gandhi, D. J., S. Albert, N.R. Pandya and K. R. Panchal. 2011. Socioeconomic study of grasses and legumes in Baria and Godhra forest division, Gujarat. *Notulae Scientia Biologicae* 3: 53-61.

Gibson, D. J. 2009. *Grasses and Grassland Ecology.* Oxford University Press, Oxford.

Gorade, P. D. and M. N. Datar. 2014. Checklist of palatable grass species from peninsular India. *Notulae Scientia Biologicae* 6: 441-447.

Hiremath, A. J. and B. Sundaram. 2005. The fire-Lantana cycle hypothesis in Indian forests. *Conservation and Society* 3: 26-42.

Karanth, K. U., J. D. Nichols, N. Samba Kumar, W. A. Link and J. E. Hines. 2004. Tigers and their prey: Predicting carnivore densities from prey abundance. *Proceedings of the National Academy of Sciences USA* 101: 4854-4858.

Katiyar, P., P. Agnihotri, A. K. Paliwal and T. Husain. 2022. A checklist of grasses from Kishanpur wildlife sanctuary, Uttar Pradesh, India. *Flora and Fauna* 28: 49-57.

Kumar, C. V., V. Kumara, H. U. Abhijit and G. N. Kumar. 2024. Overgrazing effects on seasonal variations in availability of palatable grasses in the foraging grounds of black bucks Antilope cervicapra. *Ecological Frontiers* 44: 595-604.

Lamichhane, B., J. B. Karki, S. K. Thapa, A. Bhandari and B. Basyal. 2024. Effect of cutting and burning on grassland habitat in Bardia national park, Nepal. *Ecosphere* 15: e70004.

Mahgoub, A. M. 2023. Ecological importance and sociological characters of fourteen widespread weeds and their contribution to observed similarity and dissimilarity between weed communities. *Heliyon* 9: e14710.

Masudi, S. P. 2021. Effect of domestic and wild herbivores on vegetation quality, cover, species turnover and diversity response to fire in an east African savanna. Ph.D. Thesis, University of Nairobi, Kenya.

Moretto, A. S. and R. A. Distel. 1997. Competitive interactions between palatable and unpalatable grasses. *Plant Ecology* 130: 155-161.

Peart, M. H. 1984. The effects of morphology, orientation and position of grass diaspores on seedling survival. *Oecologia* 62: 141-149.

Pemadasa, M. A. 1990. Tropical grasslands of Sri Lanka and India. *Journal of Biogeography* 17: 395-400.

Pradhan, A., N. Dikshit, A. Dixit and A. Mahanta. 2022. Inventory of forage grass species from southern Chhattisgarh, India: A case study. *Range Management and Agroforestry* 43: 192-200.

Pye, N. 1985. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa (F. White). *Geographical Journal* 151: 132-134.

Roodt, V. 2015. *Grasses and Grazers of Botswana and the Surrounding savanna.* Penguin Random House, South Africa.

Roy, A. K., D. R. Malaviya and P. Kaushal. 2019. Genetic improvement of dominant tropical Indian range grasses. *Range Management and Agroforestry* 40(1): 1-25.

Sala, O. E., W. J. Parton, L. A. Joyce and W. K. Lauenroth. 1988. Primary production of the central grassland region of the United States. *Ecology* 69: 40-45.

Shaffer, M. 2019. Ecology of grazing lawns on tall grass prairie. Ph.D. Thesis. Kansas State University, USA.

Sharma, K., R. S. Chundawat, J. Van Gruisen and A. R. Rahmani. 2013. Understanding the patchy distribution of four-horned antelope *Tetracerus quadricornis* in a tropical dry deciduous forest in central India. *Journal of Tropical Ecology* 29: 521-529.

Shinde, A. K. and S. K. Mahanta. 2020. Nutrition of small ruminants on grazing lands in dry zones of India. *Range Management and Agroforestry* 41(1): 1-14.

Singh, B. V. R., A. K. Batar, V. Agarwal, A. Sen and K. Kulhari. 2025. Forest fragmentation and human-wildlife conflict: assessing the impact of land use and land cover change in Ranthambhore tiger reserve, India. *Environmental Research Communications* 7: 061006.

Singh, S., S. Ahmad, S. S. Bhat, T. Singh and N. H. Mir. 2023. Yield and nutritive value of local races of grasses and legumes to rejuvenate pastures for sustaining livestock productivity in sub-Himalayan region of India. *Range Management and Agroforestry* 44: 353-362.

Swamy, J., A. Appaiah and V. Jalander. 2024. Grass species diversity and conservation in Shivaram wildlife sanctuary, Telangana, India. *Indian Journal of Pure and Applied Biosciences* 12: 26-33.

Vallentine, J. F. 2000. *Grazing Management.* Elsevier, USA.

Vijai, M. 2015. A checklist of grasses (Poaceae) of Saharanpur forest division. *Indian Journal of Fundamental and Applied Life Sciences* 5: 74-80.