Report for Climate-Disturbance Experiment in Grassland of Tadoba Andhari Tiger Reserve

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July, 2026

Project Background

Tropical grasslands and savannas occupy nearly 20% of the terrestrial land surface (Ramankutty and Foley 1999). They are ancient ecosystems that support unique biodiversity with high levels of endemism, high biomass of both native and domestic ungulates, and provide critical ecosystem services to nearly one fifth of the world's human population (Scholes and Archer 1997). Yet, despite their recognized importance for human welfare and economy, they are under intense pressure from human-induced environmental change (Bond and Parr 2010; Veldman, Overbeck, et al. 2015a). They are predicted to be amongst the most sensitive biomes to future climate change (Sala et al. 2000), and are additionally threatened by anthropogenic activities such as conversion for agriculture and tree planting for fuel wood and carbon sequestration programs (Veldman, Overbeck, et al. 2015a, 2015b; Veldman, Buisson, et al. 2015).

Grasslands have been particularly ignored and misunderstood in the Indian context, often being misclassified as 'wastelands' and mismanaged as a result (Sankaran and Ratnam 2013; Ratnam et al. 2016). Given the intense pressures that these ecosystems face in India, both from anthropogenic activities and climate change, there is an urgent need to understand how fundamental drivers like climate, fire and herbivores interactively structure these ecosystems and regulate their functioning, and how these ecosystems are likely to respond to future climate changes.

Grasslands cover about 4% of the area of TATR with potentially more area under savannas interspersed with the mixed-bamboo forests (Paliwal and Mathur 2014). TATR also hosts several species of large herbivores including Chital, Sambar, Nilgai and Gaur. Here, we propose to examine how grasslands in the Tadoba-Andhari Tiger Reserve (TATR) are structured by the action of fire and herbivores, and how future changes in climatic conditions and resource availability are likely to affect their structure and functioning. We proposed to perform a series of nested experiments to tease apart the independent and interactive effects of fire, large herbivores, warming, drought and nutrient enrichment on grassland vegetation structure and fundamental belowground processes such as carbon sequestration and nutrient cycling.

Objectives

• To assess how fire and herbivores independently and jointly influence grassland vegetation and soil nutrient transformations.

• To assess how future changes in climatic conditions due to increased air temperatures and drought occurrence will affect grassland vegetation, soil carbon sequestration and nutrient cycling.

• To assess how nutrient enrichment and grazing by herbivores mediate the effects of climatic changes on grassland structure and function.

Progress till July 2026

Reconnaissance survey

We conducted a reconnaissance survey of the major grasslands in TATR from 16th to 18th February, 2026. We recorded the site characters and species present in these grasslands. We visited the following grasslands:


Palasgaon, Moharli Range


Jamni, Kolara Range


Jamunbodi, Kolara Range


Kolsa, Kolsa Range


Navegaon, Kolara Range

A map of the sites surveyed for the experiment is shown in Fig.1. Based on the site characters such as observed species diversity, edaphic characters, area of the grassland and how old the grassland is, Navegaon grassland was the best candidate for setting up the experimental treatments. Navegaon has the largest expanse of all the grasslands we visited, has significantly high diversity and heterogeneity in species occurrence, has characteristic savanna tree species such as *Vachellia leucophloea, Ziziphus sp.,* interspersed with the grasses which adds to the heterogeneity in vegetation structure.

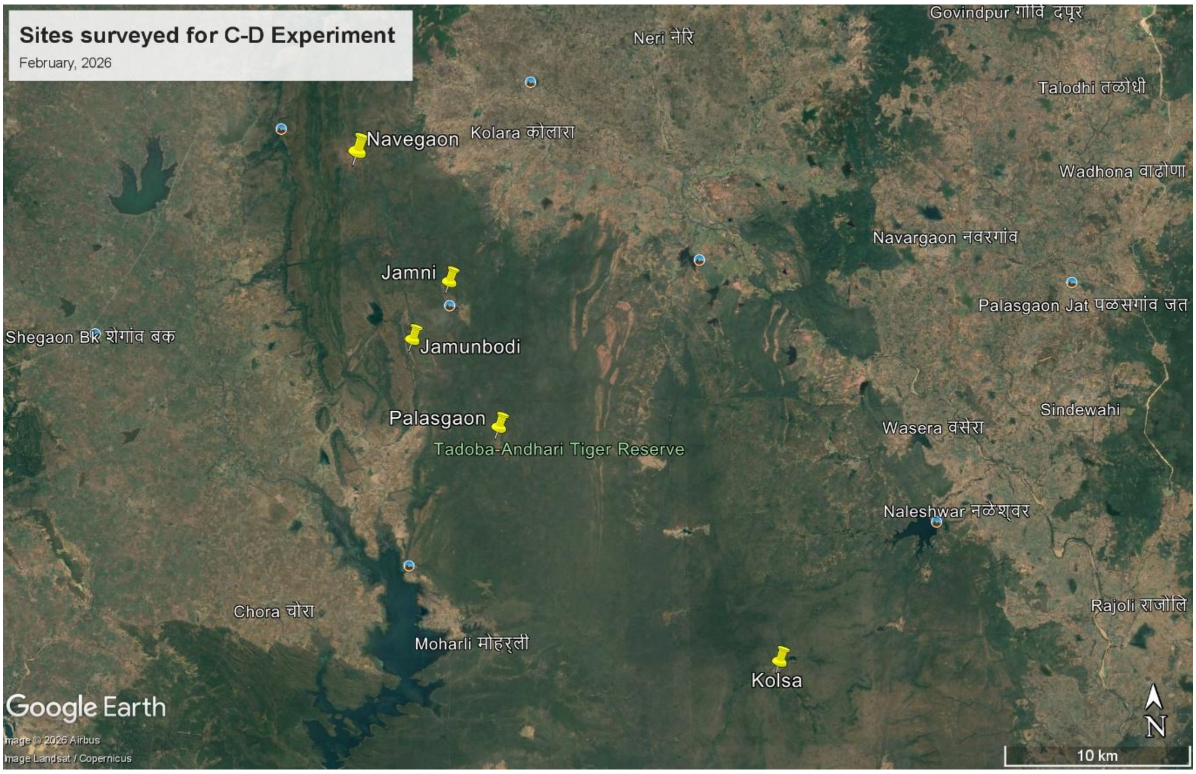

Figure 1: Locations of the grasslands surveyed for the Climate-Disturbance experiment in February, 2026

Experimental set up

At the site, a randomized block design is being used for the experiment. Five replicate blocks have been set up (Table 1). Each block consists of paired fenced and unfenced areas wherein a 20mx20m area is fenced to exclude herbivore activity, and a nearby 20mx10m area will be used as the grazing reference plots (Fig. 2). The fences for all five blocks along with experimental set up have been installed in the Navegaon grasslands (Fig.3). Each block consists of treatments to assess the impact of climate change factors (drought, warming and nutrient deposition) and disturbance factors (herbivory and fire).

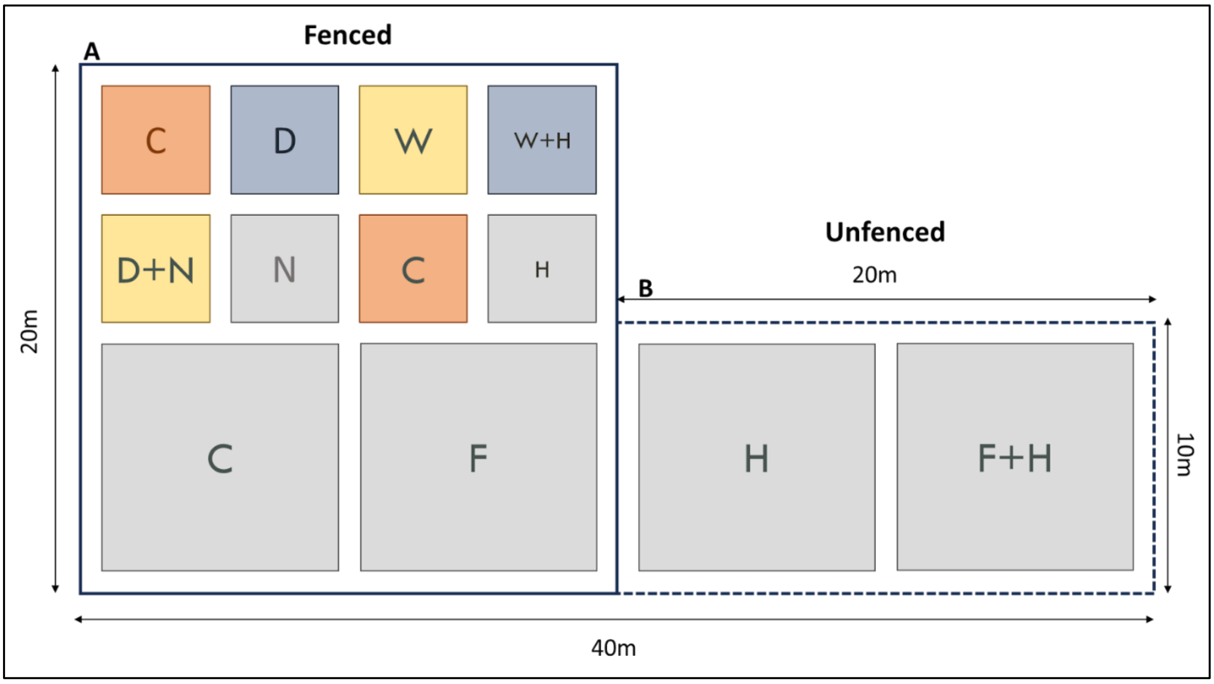

Figure 2: Block and plot layout at the site. Within each block, plot A (20 m x 20 m) will be fenced and plot B (20m x 10m) will be unfenced. Various treatments will be applied in each sub-plots, C = control, D = Drought, N = Nutrient addition and D + N = Drought + Nutrient addition, W = warming, W+D = warming + drought, F = fire, H = herbivory and F+H = fire and herbivory treatments.

Figure 3: Fenced block location in Navegaon site for the Climate-Disturbance Experiment.

In each block, drought is imposed by setting up rainout shelters to block 50% of the rain. Warming is implemented by setting up open top chambers (OTC) which will increase the temperature by 1-3℃ as compared to the ambient temperature (Fig.4). Herbivory in interaction with warming and drought will be simulated by manual clipping every two weeks in the particular demarcated subplots inside the fenced blocks, whereas herbivory by wild herbivores will be permitted in the unfenced plot. Fire on the other hand, will be imposed by doing controlled burns in the particular demarcated subplots of 10mx10m in the fenced and unfenced plots. The controlled burns will be done in year 2 of the experiment during dry season and restricted within the subplots by using physical barriers/fire breaks.

Figure 4: a. Fenced blocks 1 and 2; b. A block with Open Top Chamber (OTC) and rainout shelter; c. Close-up of an OTC installed for passive experimental warming; d. Close-up of rain-out shelter installed for imposing drought.

Table 1: GPS locations of the fenced blocks

Block	Plot	Longitude	Latitude
B1	P1	79.28703	20.40894444
B1	P2	79.28686	20.409
B1	P3	79.28683	20.40880556
B1	P4	79.28706	20.40877778
B2	P1	79.28744	20.40997222
B2	P2	79.28747	20.41013889
B2	P3	79.28728	20.41016667
B2	P4	79.28725	20.41
B3	P1	79.28747	20.41119444
B3	P2	79.28753	20.41138889
B3	P3	79.28775	20.41138889
B3	P4	79.28769	20.41116667
B4	P1	79.28767	20.41225
B4	P2	79.28769	20.41244444
B4	P3	79.28744	20.41244444
B4	P4	79.28744	20.41225
B5	P1	79.28878	20.41444444
B5	P2	79.28897	20.41441667
B5	P3	79.28903	20.41461111
B5	P4	79.28881	20.41461111

Work to be done

Nutrients will be added to the N and N+D plots in all the blocks before the community monitoring. In each treatment species richness and abundance (species cover) will be recorded twice a year, first during early growing season around early August and second during peak biomass season around October during the flowering season of grasses in each treatment in each block. The productivity of forbs and graminoids (by biomass collection in a demarcated area in each treatment), plant functional traits (leaf and root functional traits), below ground productivity and soil nutrients (carbon, nitrogen and phosphorus) will also be monitored in each block along with second round of species richness survey. Herbarium specimens will be collected during species diversity monitoring for species identification. In year 1 of sampling, vegetation structure will be mapped and the leaf traits of dominant tree species in the site will also be measured. A dung count survey will also be done at the site to determine the herbivore pressure at the site.

Acknowledgement

We would like to thank the Conservator of Forest & Field Director, Dr. Prabhu Nath Shukla; Deputy Director, Shri Anand Reddy Yellu; Assistant Conservator of Forests, Shri Aniruddha Dhage; Range Forest Officers, Shri Vishal Vaidya, Shri Arunkumar Gond, Shri Bhavik Chiwande, Shri Vinod Jambhule, Shri Rundan Katkar, and Biologist Taniya Dohare and other staff of Tadoba Andhari Tiger Reserve, Maharashtra Forest Department for permits and constant support for the experiment and help with the logistics.

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