



Phenological Study of Grasses of Tadoba Andhari Tiger Reserve, Chandrapur, Maharashtra State, India

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Abstract

"Tadoba" is taken from the name of the god "Tadoba" or "Taru", worshipped by the tribes who live in the dense forests of the Tadoba and Andhari region, while "Andhari" refers to the Andhari river that meanders through the forest. Tadoba Andhari Reserve is the largest national park in Maharashtra. The total area of the reserve is 625.4 square kilometres (241.5 sq mi). This includes Tadoba National Park, with an area of 116.55 square kilometres (45.00 sq mi) and Andhari Wildlife Sanctuary with an area of 508.85 square kilometres (196.47 sq mi). The reserve also includes 32.51 square kilometres (12.55 sq mi) of protected forest and 14.93 square kilometres (5.76 sq mi) of uncategorised land. Tadoba National Park and Andhari wildlife sanctuary together form the Tadoba-Andhari Tiger Reserve. The total area of the Tadoba-Andhari tiger reserve is about 1,727 km². Tadoba National Park was established in the year of 1955. Total area of the park is 116.55 Km². The Andhari Wildlife Sanctuary was formed in the year 1986. Total area of the Andhari Wildlife Sanctuary is 508.85 Km².

A grass is taxonomically defined as any species within the large family (Gramineae or Poaceae) of monocotyledonous plants having narrow leaves, hollow stems, and clusters of very small, usually windpollinated flowers. Grasses include many varieties of plants grown for food, fodder, and ground cover (Grass 2014)

Phenological study of grasses includes the study of the timing of regular biological events, like grasses flowering, and the processes that alter their timing. Phenological stages: Stages during plant growth that are a distinct phase of the plant's development. The grasses of Tadoba Andhari Tiger Reserve are annual, perennial, soft and coarse distributed in all natural and artificial man made grasslands after rehabilitation of villages. TATR grasses are with 59 genera and 74 species. there are 15 grass genera and species which are wild relatives of grasses. The present study comprises phenological study of grasses includes germination of grass seeds, vegetative growth changes, flowering and fruiting of grasses of TATR.

Key Words : Phenolgy Grasses, TATR.

Introduction :

Grasses are one of the largest and most valuable groups of flowering plants, consisting of 610 genera and 10,000 species (Cope, 1982). Clayton and Renvoize (1986) put the total number of grasses in the world about 10,000 species, 651 genera were recognized and assigned numbers indicating their phylogenic status based upon various evidences. It ranks third in number of genera after the Compositeae and Orchidaceae and fifth in number of species after the Compositeae, Orchidaceae, Leguminoseae and Rubiaceae (Good, 1953). Grasses are widespread than any other family of flowering plants. The great adaptability of



different species has enabled them to thrive under the most varied conditions. They form the climax vegetation of the semiarid prairies of the American continent, the steppes of Asia and the savannas of Africa. Grasses exceed all other in the importance of its products. It provides food in the form of cereals for man and forage for most animals. Many species of native and introduced grasses are utilized in improved pastures (Salter, 1952). A grass is taxonomically defined as any species within the large family (Gramineae or Poaceae) of monocotyledonous plants having narrow leaves, hollow stems, and clusters of very small, usually windpollinated flowers. Grasses include many varieties of plants grown for food, fodder, and ground cover (Grass 2014). Grasses are often confused with sedges (Cyperaceae family) and reeds (Restionaceae family). However, sedges do not have a leaf sheath and their leaves are attached directly to the culm—a diagram of grass anatomy is provided in Appendix C. The culms of sedges are also angular, while grass culms are circular. The grass family is the fifth largest plant family on earth with over 700 genera and 9700 species. About ten percent of the grass species worldwide can be found in southern and tropical Africa; the major genera of which are *Eragrostis*, *Pentstemon*, *Panicum*, *Sporobolus*, *Aristida*, *Digitaria*, *Stipagrotis*, *Setaria*, *Brachiaria*, and *Hyparrhenia* (Van Oudtshoorn 2009).

Almost all animal species and food chains depend on grass because grass occurs across the world and is almost always edible. The groups of animals that depend most directly on grass for food are birds, insects, rodents, and grazers. There are many bird species, such as *Quelea* finches, the most common bird on earth with a population of over 1.5 billion in Africa alone, that solely eat grass seeds. Grass provides the only food source for seed-eating birds, and the birds play an integral role in seed dispersal. Insects use grass for both food and shelter. Disruption of these grassland ecosystems can cause a dangerous under or overabundance of insect species. Rodents consume grass seeds or the base of the plant where the most nutrients are stored. Grazers have the largest impact on grasslands and typically graze in large herds which makes spatially expansive impact.. Grazers remove old plant material, stimulate new growth, and provide nutrients in the form of manure. Although predators and decomposers are also ultimately dependent on grass species, it is primary consumers specifically herbivores- that have the biggest causal relationship with grass species. Herbivores and grass species composition are highly interdependent. Evaluating a Grassland There are four main measures to evaluate a grassland: grazing value, ecological indicator status, succession stage, and perenniality. Several factors that can help conservation managers determine whether their area is providing valuable grazing material. By identifying grass species in the area, grazing value can be determined. Grazing value is defined as the quality and quantity of material from an individual available for grazing (Van Oudtshoorn 2009).

Tadoba Andhari Tiger Reserve Forest Diversity :

"Tadoba" is taken from the name of the god "Tadoba" or "Taru", worshipped by the tribes who live in the dense forests of the Tadoba and Andhari region, while "Andhari" refers to the Andhari river that meanders through the forest. Tadoba Andhari Reserve is the largest national park in Maharashtra. The total area of the reserve is 625.4 square kilometres (241.5 sq mi). This includes Tadoba National Park, with an area of 116.55 square kilometres (45.00 sq mi) and Andhari Wildlife Sanctuary with an area of 508.85 square kilometres (196.47 sq mi). The reserve also includes 32.51 square kilometres (12.55 sq mi) of protected forest and 14.93 square kilometres (5.76 sq mi) of uncategorised land. Tadoba National Park and Andhari wildlife sanctuary together form the Tadoba-Andhari Tiger Reserve. The total area of the Tadoba-Andhari tiger reserve is about 1,727 km² . Tadoba National Park was established in



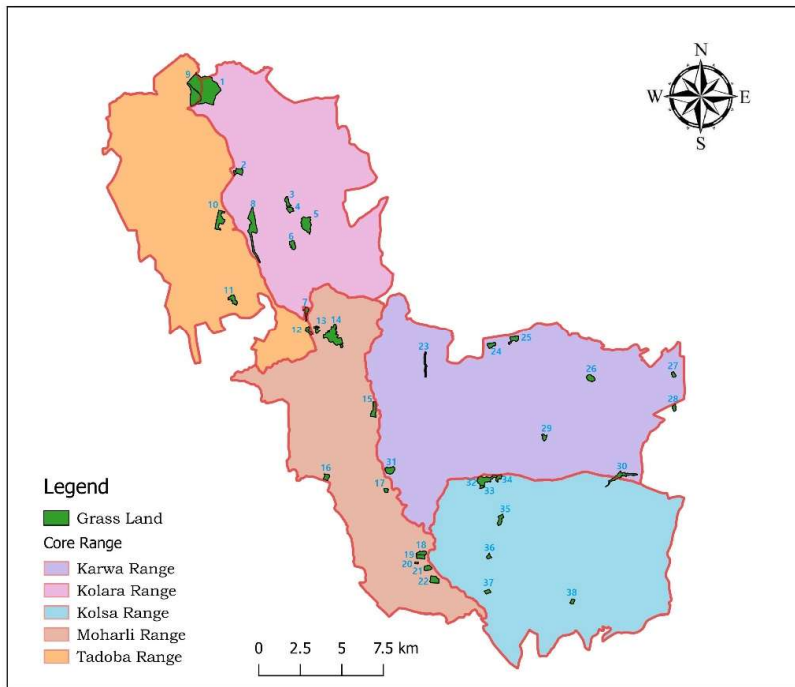
the year of 1955. Total area of the park is 116.55 Km². The Andhari Wildlife Sanctuary was formed in the year 1986. Total area of the Andhari Wildlife Sanctuary is 508.85 Km². Total core area of the tiger reserve is 625.40 Km². Total buffer area of the tiger reserve is 1101.60 Km². The reserve also includes 32.51 Km² of protected forest and 14.93 Km² of other areas. The monsoon season begins in June; the area receives heavy rainfall during this season (approx. 1275 mm) and humidity around 66-70%. Tadoba Andhari Tiger Reserve is a predominantly southern tropical dry deciduous forest with dense woodlands comprising about eighty seven per cent of the protected area. Teak is the predominant tree species. Other deciduous trees found in this area include ain (crocodile bark), bija, dhauda, salai, semal and tendu. Beheda, hirda, karayagum, mahuamadhuca (cr epe myrtle), palas (flame-of-the-forest, *Butea monosperma*) and *Lannea coromandelica* (woder tree). Axlewood (*Anogeissus latifolia*, a fire-resistant species), black plum and arjun are some of the other tropical trees that grow in this reserve. Aside from the keystone species, the Bengal tiger, Tadoba Tiger Reserve is home to other mammals, including: Indian leopards, sloth bears, gaur, nilgai, dhole, striped hyena, small Indian civet, jungle cats, sambar, barking deer, chital, chausingha and honey badger. Tadoba lake sustains the marsh crocodile, which was once common. Indian star tortoise, Indian cobra and Russel's viper also live in Tadoba. The lake contains a wide variety of water birds, and raptors. 195 species of birds have been recorded, including three endangered species. The grey-headed fish eagle, the crested serpent eagle, and the changeable hawk eagle are some of the raptors seen in the park. Poaceae is the one of the largest family among the monocotyledons in the world. The grass vegetation broadly divided into two types depending upon their life-span, Ephemeral vegetation consisting mainly of the grasses that complete the life cycle during rainy season or after rainy season. Grasses autumn or long lived vegetation with species that grow with the rains but complete their life-cycle after rains. The species like *Arthraxon lancifolius*, *Arundinella pumila*, *Sporobolus coromandelianus*, *Digitaria ternata*, are the chief components of farmers category. On the contrary the species like *Heteropogon contortus*, *Andropogon pumilus*, *Chrysopogon fulvus*, *Dicanthium caricosum*, *Setaria forbesiana*, *Pennisetum hohenackeri* which form the autumn vegetation are either perennial vegetation forming large tufts.

Tadoba-Andhari National Park/Coordinates 20.2484° N, 79.3607° E

Sr. No.	Name of grassland	Area in Hectares
	Kolara Range grasslands	
1	Navegaon part 1 (Rehabilitated Site)	235 Hectare
2	Kosekanar	10 Hectare
3	Pandharpauni	30 Hectare
4	Jamni (Rehabilitated Site)	47 Hectare
5	Samadhi	08 Hectare
6	Rampur	12 Hactre
7	Saradh	10 Hectare
	Tadoba Range Grasslands	
1	Navegaon part 2	40 Hectare
2	Tadoba beat Comp. No. 90	33 Hectare
3	Khatoda	10 Hectare
	Mohrli Range Grasslands	
1	Palasgaon (Rehabilitated Site)	95 Hectare
2	Girghat	58 Hectare
3	Astkoni Com. No. 146	20 Hectare

	Karwa Range	
1	Sukdobodi	10 Hectare
	Kolsa Range Grasslands	
1	Botezari	41 Hectare
2	Kohapari	11 Hectare
	Doni	65 Hectare
	Kolsa (Rehabilitated village)	150 Hectare

Map Showing Grass Land TATR (Core)



Rt. No.	Grass Land Name	Area
1	Navegaon Grass Land	235 Ha.
2	Pandharwani G. Land	30 Ha.
3	Saradh Grass Land	10 Ha.
4	Samadhi Grass Land	8 Ha.
5	Jamni Grass Land	47 Ha.
6	Rampur Grass Land	12 Ha.
7	Kosckanar Grass Land	10 Ha.
8	Jamunbodi Grass Land	35 Ha.
	Kolara Range- Total	387 Ha.
9	Navegaon Grass Land Part- 2	40 Ha.
10	Tadoba beat C.No. 90	33 Ha.
11	Ghosari Beat C.No. 114	17 Ha.
12	Khatoda Grass Land	10 Ha.
	Tadoba Range- Total	100 Ha.
13	Palsgaon C.No. 128	10 Ha.
14	Palsgaon Grass Land	85 Ha.
15	Ashtkomi C.No. 146	20 Ha.
16	Andhari C.No. 150	10 Ha.
17	Andhari C.No. 151	7 Ha.
18	Girghat C.No. 157	13 Ha.
19	Girghat C.No. 157	11 Ha.
20	Girghat C.No.158	2 Ha.
21	Girghat C.No.158	12 Ha.
22	Girghat C.No.158	20 Ha.
	Moharli Range- Total	190 Ha.
23	Karwa-II C.No. 251	10 Ha.
24	Anandgaon C.No. 254	10 Ha.
25	Anandgaon C.No. 254	15 Ha.
26	Piparheti-II C.No. 260	15 Ha.
27	Pandharwani C.No. 267	5 Ha.
28	Pandharwani C.No. 267	7 Ha.
29	Bantsabodi-I C.No.284	7 Ha.
30	Sukadi Bodi G. Land	10 Ha.
31	Zinganat-I C.No. 299	20 Ha.
	Karwa Range- Total	99 Ha.
32	Botezari Grass Land	35 Ha.
33	Botezari Lake 1	3 Ha.
34	Botezari Lake 2	6 Ha.
35	Kohapari C.No.311	11 Ha.
36	Fulzari Lake G. Land	5 Ha.
37	Panghat Hut Road	6 Ha.
38	Belan Square C.No.342	6 Ha.
	Kolsa Range- Total	72 Ha.
	Grand - Total	848 Ha.

Objectives

- Identification and Enumeration of grass flora of TATR.
- To identify the grass plants from open grasslands with the help of morphological study by using regional floras.
- Exploration of grass flora from TATR.
- To determine diversity of grass plants and its ecological significance in forest ecosystem.
- Grasses association in grassland ecosystem .
- Enumeration and documentation of grasses with reference to GPS co-ordinates, Phenological study.

Material and Method :

Study area (Tadoba Andhari Tiger Reserve)

All grasslands of Core Area, Kolara Range grasslands, Tadoba Range Grasslands, Moharli Range Grasslands, Karwa Range and Kolsa Range Grasslands

Data Collection:

Floristic :

Extensive and repeated field surveys are carried out in the study area, covering three predominant seasons and for a period of 2- 3 years, from 2021 document the species richness of grasses from study area. The grasses plant species are photographed in the field using



DSLR camera with GPS locations .A comprehensive list of grasses occurring in grasslands of Tadoba Aandhari Tiger Reserve prepared grasses classification into palatable and non palatable, annual, perennial, terrestrial, aquatic and amphiterrestrial prepared. During field visits, focus given to document habitat, phenology and association on grassland, composition of grassland.. Morphological characters recorded of grass specimens. The morphological characters, of the grasses, arrangement of floral parts, habit, habitat and locality will be recorded carefully in field note book.

The collection of grasses from the different localities of the forest areas and systematic study of grasses and their uses by the local peoples of the Tadoba forest area.. Nomenclature of each taxon will be checked under the rules of International Code of Botanical Nomenclature. A map of the area with the important places of collection is given. Detailed morphological studies carried down under dissecting microscope and different morphological characters observed and their identification confirmed by flora of Maharashtra (B.D. Sharma & S. Kartikeyan,2001) Flora of British India (J.D. Hooker, 1998).

Morphological study:1. Plants collection from selected sites 2. Morphological study under dissection microscope 3. Plants classification 4. Ecological study 5. Ecological significance 6.. Lat. long study with GPS. Herbarium samples examined through the conventional taxonomical procedure adopted by Bentham and Hooker (1873) and Prain (1903).

Observations :

In TATR there is diversity of grasses and grasslands the phenological data of grasses is given as under.

Sr. No.	Botanical name	Common name	Flowering season	fruiting season	Seeds germination period	Leaf primordia formation season
01	<i>Acrachne recemosa</i>		August	October	July	July -August
02	<i>Andropogon pumilus</i> Rox		Sept	Nov	July	July
03	<i>Apluda mutica</i> L	Moti tura	Sept	Nov	July	July -Aug
04	<i>Aristida funiculata</i> trin	Zadu grass	Aug-Dec	Oct	Dec	July
05	<i>Aristida reducta</i> Stapf	Zasu grass	Aug-Dec	Oct	Dec	July
06	<i>Anthraxon lancifolius</i> trin	Chakarpatti	Oct	Dec	July	July
07	<i>Bothrichloa bladhi</i>	Vaidya gawat	Nov	Dec	Aug	Aug
08	<i>Brachiaria mutica</i>	Sawa gawat	Sep	Dec	July	July
09	<i>Brachiaria ramosa</i> L	Sama, sawa gawat	Sep	Dec	July	July
10	<i>Brachiaria repans</i> L	Sawa gawat	Aug-Jan	Dec	July	July
11	<i>Brachiaria eruciformis</i> (JESM)	Sawa	Aug-Dec	Dec	July	July
12	<i>Bothriochloa tuberosa</i>	Vaidya	Nov	Dec	July	Aug
13	<i>Chloris barbata</i>	Gondali gawat	Aug-Jan	Nov – Feb	July	July
14	<i>Chloris virgata</i>	Gondali	Aug-Jan	Dec	July	July
15	<i>Chloris dolichostachya</i>	Sikka gawat	Oct	Dec	July	July
16	<i>Chloris gyana</i>	Lahan sika gawat	Nov	Jan	July	July



Sr. No.	Botanical name	Common name	Flowering season	fruiting season	Seeds germination period	Leaf primordia formation season
17	<i>Coix lacryma jobi-L</i>	Ran jondhali	Nov	Dec –Jan	Sept	Sept
18	<i>Cymbopogon martiniae Wals</i>	Tikhadi	Sept	Dec	July	July
19	<i>Cynodon dactylon Pears</i>	Durva,Harali	Oct	--	---	Propagate by rhizome/runner
20	<i>Dactyloctenium aegypticum L</i>	Crow foot grass	Nov	Dec	July	July
21	<i>Dactyloctenium indicum Bioss</i>	Crow foot grass	Nov	Dec	July	July
22	<i>Dendracalamus strictus Nees</i>	Bamboo	Dec	March – April	Aug	Aug
23	<i>Dicanthium aristatum (Poir)</i>	Marvel.	Oct	Nov	July	July
24	<i>Dicanthium annulatum (Forssk)</i>	Marvel	Oct to Feb	Nov – Dec.	July	July / vegetative propagation
25	<i>Dicanthium caricosum (L)</i>	Marvel.	Oct to Feb	Oct to Feb	July	July/ vegetative propagation
26	<i>Digitaria abludens(Roem & schult)</i>	Ravi gawat	Sept	Nov.	July	July
27	<i>Digitaria stricta</i>	Ravi gawat	Sept	Nov	July	July
	<i>Dimeria blatteri</i>	Harin shingi gawat	Oct	Nov.	July	July
28						
29	<i>Eleusine glauca</i>	Nachani	Oct	Nov -Dec	July	July
30	<i>Eleusine indica (L)</i>	Jangli nachni	Oct	Nov. – Dec.	July	July
31	<i>Eragrostiella biferia (Vahl)</i>		Oct	Dec	July	July
32	<i>Eragrostiella coromondeliana</i>		Sept	Oct	July	July
33	<i>Eragrostiella brachylla (Stapf)</i>		Sept	Oct	July	July
34	<i>Eragrostris major (L)</i>	Ran Poha	Sept	Oct	July	July
35	<i>Eragrostris cillianensis</i>		Sept	Oct	July	July
36	<i>Eragrostris japonica (Thunb)</i>		Sept	Oct	July	July
37	<i>Eragrostris tenella (L)</i>		Sept	Oct	July	July
38	<i>Eragrostris namaquensis</i>		Sept	Oct	July	July
39	<i>Eragrostris tenuifolia</i>		Sept	Oct	July	July
40	<i>Eragrostris uniolooides (Retz)</i>	Ran poha	Sept	Oct	July	July
41	<i>Eragrostris viscosa (Retz)</i>		Sept	Oct	June	July
42	<i>Eragrostris Minor (Host)</i>	Bhurbhusi	Sept	Oct	June	July
43	<i>Heteropogon contorpus (L)</i>	Kusal gawat	Oct	Dec	July	July
44	<i>Imperata cylindrica (L)</i>	Dhab gawat	Jan	Feb	July	July



Sr. No.	Botanical name	Common name	Flowering season	fruiting season	Seeds germination period	Leaf primordia formation season
45	<i>Ischaemum pilosum (kleinex.willd)</i>	Kunda	Nov	Dec –Jan	July	July
46	<i>Ischaemum rugosum</i>	Ber grass	Oct	Nov -Dec	July	July
47	<i>Iseilema laxum</i>	Moshan grass	Oct	Dec	July	July
48	<i>Iselima prostratum</i>	Moshan gawat	Oct	Dec	July	July
49	<i>Oplismenus burmannii (Retz)</i>	Futana gawat	Oct	Nov	July	July
50	<i>Oriyza rufipogon (Jriff)</i>	Wild dhan	Oct	Dec	July	July
51	<i>Panicum antilotale (Rtz)</i>		Oct	Nov	July	July
52	<i>Panicum psilopodium (Trin)</i>	Kutki	Oct	Nov	July	July
53	<i>Panicum sumatrense (Roth ex.)</i>	Kutki	Oct	Nov	July	July
54	<i>Paspalidium flavidium (Retz)</i>	Bodila gawat	Oct	Nov	July	July
55	<i>Paspalum canare (Stcut)</i>	Kodo	Oct	Dec	July	July
56	<i>Paspalum paspalodes (Michx)</i>	Kodo	Oct	Dec	July	July
57	<i>Pennisetum pedicellatum (Trin)</i>	Deenanth gawat	Oct	Dec	July	July
58	<i>Rottbolia cochinchinensis (Lour)</i>		Oct	Dec	July	July
59	<i>Saccharum spontaneum (L)</i>	Padyal gawat	Oct	Dec.	June	June – July
60	<i>Sacciolepis indica (Willed)</i>		Nov	Dec.	July	July
61	<i>Sehima nervosum (Rott)</i>	Pawanya gawat	Oct	Nov.	July	July
62	<i>Setaria intermedia (Roem)</i>	Ran bajra	Sept	Nov.	June	July
63	<i>Setaria tomentosa (Roxb)</i>	Ran bajra	Sept	Nov.	June	July
64	<i>Setaria italica (L)</i>	Bhagar	Sept	Nov.	June	July
65	<i>Setaria pumilla (Poir)</i>	Kolu grass/ ran bajra	Sept	Nov.	June	July
66	<i>Setaria verticillata (L)</i>	Chikta	Sept	Nov.	June	July
67	<i>Sorghum haplense</i>	Barwad	Oct	Dec.	July	July
68	<i>Sporobolus coromandelianus (Retz)</i>	Bhubhusi	Aug	Oct	June	July
69	<i>Sporobolus indicus (L)</i>	Bhurbhusi	Aug	Oct	June	July
70	<i>Themeda quadrivalvis (L)</i>	Gonyad	Oct.	Dec	July	July
71	<i>Tripogon jacquemontii (Stapf)</i>	Tifati	Oct.	Nov.	July	July
72	<i>Vitivera zizanioides (L)</i>	Khus	Nov.	Jan	July –Aug.	Aug.



Sr. No.	Botanical name	Common name	Flowering season	fruiting season	Seeds germination period	Leaf primordia formation season
73	<i>Cymbopogon martiniae</i> <i>Wals Var sofia</i>	Tikhali	Nov.	Jan.	June	June –July

Result and discussion:

Grasses flowering mostly started from October to November exceptionally some species of *Setaria*, *Sporobolus* and *Eragrostris* like *Setaria pumilla*, *S. italica*. The species of *Imperata* shows late flowering in January Flowering in grasses is the reproductive stage generally from observations environmental factors like temperature, humidity plays important role in flowering season of grasses. Mostly annual grasses show early flowering as compare to perennial grasses in Protected Areas of Central India. The grasses like *Vitiver*, *Saccharum* growing in amphiterrestrial habitat are perennial show variation in flowering . The grasses growing on hard strata of soil, sands, rocks shows early flowering. The phenological characters of grasses like growth – vegetative and reproductive growth, seeds germination, leaf primordia, leaf radical, culm formation, flowering, seeds formation, seeds maturity, seeds germination depends upon temperature, humidity and edaphic factors.

Conclusion:

The vegetative and reproductive growth of grasses in forest areas specially seeds germination, flowering and seeds maturation plays important role in grassland management. The seeds maturity, seeds collection of fodder grasses are useful for enrichment of desired grasses useful for herbivores and grass seeds are useful for ecological restoration of degraded and over grazed grassland. The phenological characters are important in Protected Areas for Wildlife habitat management.

Acknowledgement:

Author is very much thankful to Field Director and Deputy Director of Tadoba Andhari Tiger Reserve, Chandrapur Maharashtra State for permission to carry out phenological and morpho taxonomical study of grasses.

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