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A survey and documentation on the flora of Dr. YSR Smruthi Vanam a conservative area near Nallakalva Village, Atmakur Mandal, Kurnool, Andhra Pradesh, India

B. Kavitha*, R. Srikala, U. Thikka Swami

School of Life Sciences, Rayalaseema University, Kurnool, Andhra Pradesh, India

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Key words: Biodiversity, Ex-situ conservation, Protected areas, Dr.YSR Smruthi Vanam, Floristic enumeration

Abstract

Protected areas are the most suitable places on this earth for conservation of biodiversity and also have significant role in scientific, educational and cultural activities. Dr. YSR Smruthi Vanam is a protected area of Ex-situ conservation for certain flora comes under the velgode reserve forest of Atmakur Mandal of Kurnool district, a 22.20 acre site. The project site is 18.5 km away from the crash site of Pavurala Gutta located in the thick of the Gundla Brahmeswaram Wildlife Sanctuary. The systemic floristic studies of the selected area resulted 174 species include Gymnosperms (3) along with the Angiosperms (171) with Dicotyledons (151) and Monocotyledons (20). Angiosperms species represented a total of 61 families; Monocots (07), Dicots (52). The park dominates with Trees (98), followed by Shrubs (46) Herbs (20) and climbers (10) species in its overall distribution, Major family represents Leguminosae (16 species Fabaceae) equally to that of the Madras Presidency and flora of Andhra Pradesh. Next largest family is Apocynaceae with 12 species. Top 06 genera more than 03 species as the largest genus *Ficus* with 05 species flowed by *Cinnamomum* 03, *Jasminum* 03 and *Cassia* 03. The Park also comprises IUCN Red Listed species like *Aegle marmelous, Boswellia ovalifoliolata* and *Santalum album*. Hence, it is very essential to enumerate the flora of a protected area for future generation and to maintain the sustainable biodiversity conservation.

***Corresponding Author:** B. Kavitha ✉ kavithab15@gmail.com

Introduction

According to World Conservation Strategy (IUCN, UNEP and WWF, 1980) conservation is defined as "the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirates of future generations" (Udvardy, 1984).

Ex situ conservation, while helpful in humankind's efforts to sustain and protect our environment, is rarely enough to save a species from extinction. It is to be used as a last resort, or as a supplement to in situ conservation. *Ex-situ* conservation is the process of protecting an endangered species of plant or animal by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. *Ex-situ* conservation deals with protection of biological diversity components outside their natural habitats. It provides the opportunity to study the biology and to understand the threats to endangered species, in order to eventually consider successful species recovery programs, which would involve restoration and reintroduction. It also has the advantage of preserving plant material and making it available for research purposes, without damaging the natural populations ((Glowka *et al.,* 1994 and Anegbeh *et al.,* 2004; Ida *et al.,* 2003).

Materials & methods

About the selected study area

Geographical Conditions

The study area Dr. YSR Smruthi Vanam is a protected area of Ex-situ conservation for certain flora comes under the Velgode reserve forest of Atmakur Mandal of Kurnool district, a 22.20 acre site. The project site is 18.5 km away from the crash site of Pavurala Gutta located in the thick of the Gundla Brahmeswaram Wildlife Sanctuary. The park is situated between the latitudes of 45 15°50'4" North 78°35'35" East with an average elevation of 291.52 feet MSL altitudinal range. Park area generally comprises with daily temperatures ranging from 24.61°C – 42°C, and an average annual rainfall about 934 mm received mainly from North east monsoon.

The Park has been established on the modern concepts of Government of A.P. protected areas opened to the public on 02.09.2010.

Soils and climate in the area

The soil of Kurnool region is red with calcareous shale's. This region is abundant medicinal plants because of its rich soil, congenial eco climate conditions undulated topography from 90 m below to 1320 m above sea level. Soil erosion has been identified as one of the worst problems in this area.

A landscape garden with amenities for the visitors, and an interpretation center depicting the life and projects of YSR will be part of the memorial site. The interpretation center would also act as a hub of environmental education with various models and reading material on wild flora and fauna and ecology of Nallamala. The park contains three gardens like Pavitra Vanam, Fragrance garden and Butterfly shaped garden 150 species of carefully chosen plants to attract butterflies. Germplasm of all the endangered and rare plant species of Nallamala will be conserved with due documentation. *Ex situ* conservation was done for plants which are not naturally present in the Smruthi Vanam area through various methods of propagation. 17 Endangered, Rare and Endemic species have been identified of which about 10,000 seedlings will be planted with due display of signage.

Field work & Herbarium Preparation

Survey was undertaken during August 2016 to March 2017 for a period of 8 months, with an intense care all over the park. During the present investigation sufficient care was taken for collection, preservation and in the preparation of herbarium, adopting the standard methods (Jain and Rao, 1977). All the plant taxa encountered in the selected area were recorded and representative specimens of every taxon were collected, except in the case of some rare plants. Repeated collections were avoided if plants once collected and were recorded. Every attempt has been made to study the habit, habitat, associated species and the extent of distribution.

Identification of Taxa

All the herbarium specimens were identified by following Bentham and Hooker System of Classification with the help of the Flora presidency of Madras, Flora of Nallamalai Hills, Flora of Andhra Pradesh, Flora of Kurnool and Flowering plants of Chittoor District (Gamble and Fisher, 1915-1936; Ellis, 1997; Pullaiah *et al.,* 1997, 1998, 2008; Venkata Raju and Pullaiah, 1995; Madhava Chetty *et al.,* 2008).

Nomenclature

All species were tallied with the latest accepted names, author citations and families with "The Plant List Version1, 2010". The representative voucher specimens (70) were deposited in the herbarium (RUK) Department of Botany, Rayalaseema University, Kurnool

Floristic Studies

All the taxa were tabulated under three plant groups: Dicotyledons, Gymnosperms and Monocotyledons according to Bentham and Hooker classification. Families with number of Genera and Species, the Dominant Families with Genera and Species and their medicinal value were reported. And also identified IUCN threatened species distribution within the Park.

Plate 1. Dr. YSR Smruthi Vanam Google Maps.

Results & discussion

Floristic studies of the selected area resulted 174 species include Gymnosperms (3) along with the Angiosperms (171) with Dicotyledons (151) and Monocotyledons (20). Angiosperms species represented a total of 59 families; Monocots (07), Dicots (52). The park dominates with Trees (98), followed by Shrubs (46) Herbs (20) and climbers (10) species in its overall distribution, Major family represents Leguminosae (16 species Fabaceae) equally to that of the Madras Presidency and flora of Andhra Pradesh. Next largest family is Apocynaceae with 12 species. We identified top 06 genera more than 03 species; as the largest genus *Ficus* with 05 species flowed by *Cinnamomum* 03, *Jasminum* 03 and *Cassia* 03. The Park also comprises IUCN Red Listed species of Endemic 04, Endangered 04, Vulnerable 6, and least concerned 06.

Table 1. Habit wise distribution of seed flora in Dr. YSR Smruthi Vanam.

S. No	Habit	Total No. of Species
1	Trees	98
2	Shrub	46
3	Herbs	20
4	Climbers/Creepers	10
	Total	174

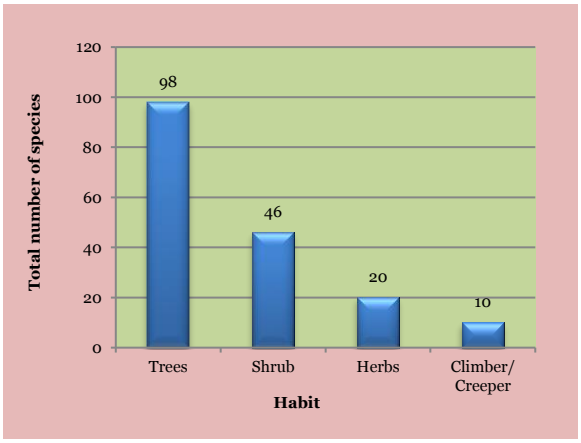

Fig. 1. Habit wise distribution of seed plants at Dr. YSR Smruthi Vanam.

Table 2. Floristic studies of Dr. YSR Smruthi Vanam - total number of families, genus, species.

Dicotyledons							
Polypetalae				Monochlamydeae			
S. No	Family	Genus	Species	S. No	Family	Genus	Species
1	Dilleniaceae	1	1	1	Nyctaginaceae	1	2
2	Magnoliaceae	1	1	2	Amaranthaceae	3	3
3	Annonaceae	2	2	3	Aristolochiaceae	1	1
4	Capparidaceae	1	1	4	Piperaceae	1	1
5	Clusiaceae	2	2	5	Lauraceae	1	3
6	Malvaceae	6	6	6	Santalaceae	1	1
7	Bombacaceae	1	1	7	Euphorbiaceae	5	6
8	Sterculiaceae	1	1	8	Salicaceae	1	1
9	Elaeocarpaceae	1	1	9	Moraceae	2	6
10	Malphighiaceae	1	1		TOTAL	16	24
11	Rutaceae	5	7	GYMNOSPERMS			
12	Burseraceae	3	4	1	Araucariaceae	1	1
13	Meliaceae	2	2	2	Cycadaceae	1	2
14	Rhamnaceae	1	1		Total	2	3
15	Vitaceae	2	2	MONOCOTYLEDONS			
16	Anacardiaceae	2	2	1	Zingiberaceae	1	1
17	Moringceae	1	1	2	Steriliziaceae	1	1
18	Fabaceae	7	8	3	Liliaceae	2	2
19	Caesalpiniaceae	2	4	4	Asparagaceae	3	4
20	Mimosaceae	2	3	5	Arecaceae	6	7
21	Rosaceae	1	1	6	Pandanaceae	1	1
22	Crassulaceae	2	2	7	Poaceae	4	4
23	Combretaceae	2	2		Total	18	20
24	Myrtaceae	3	3				
25	Lythraceae	3	4				
26	Passifloraceae	1	1				
27	Cactaceae	2	2				
28	Corinaceae	1	1				
	TOTAL	59	67				
GAMOPETALAE							
1	Rubiaceae	7	7				
2	Asteraceae	3	4				
3	Sapotaceae	3	4				
4	Oleaceae	2	4				
5	Apocynaceae	10	12				
6	Asclepiadaceae	2	3				
7	Loganiaceae	1	1				
8	Boraginaceae	2	2				
9	Convolulaceae	1	1				
10	Solanaceae	2	3				
11	Bignoniaceae	5	6				
12	Acanthaceae	2	2				
13	Verbinaceae	4	4				
14	Lamiaceae	3	5				
15	Plantaginaceae	1	1				
	TOTAL	48	59				

Table 3. Family, genus and species distribution in Dr. YSR Smruthi Vanam.

S. No.	Davison	Family	Genus	Species
1	Dicotyledons	52	123	151
2	Gymnosperms	2	2	3
3	Monocotyledons	7	18	20
	Total	61	143	174

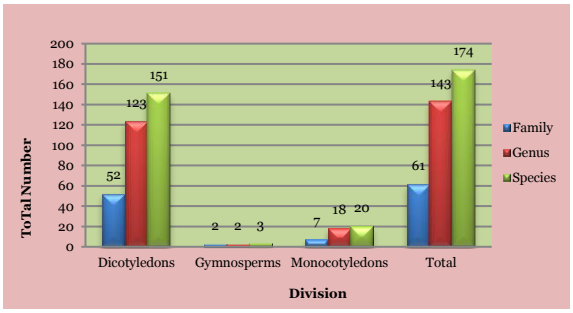

Fig. 2. Family, genus and species distribution in Dr. YSR Smruthi Vanam.

Table 4. Percentage among the seed plants species, genera & family.

Division	Species	%	Genus	%	Family	%
Dicotyledons	151	86.78	121	69.54	52	29.88
Gymnosperms	3	01.72	02	01.14	02	01.14
Monocotyledons	20	11.49	18	10.34	07	04.02
Total	174	99.99	141	81.02	61	35.04

Table 5. Top 10 families.

S.No.	Family	Species	Genera
1	Leguminaceae	16	11
2	Apocynaceae	12	9
3	Rubiaceae	7	7
4	Rutaceae	7	5
5	Malvaceae	6	6
6	Bignoniaceae	6	5
7	Euphorbiaceae	6	5
8	Moraceae	6	2
9	Aracaceae	7	6
10	Lamiaceae	5	6

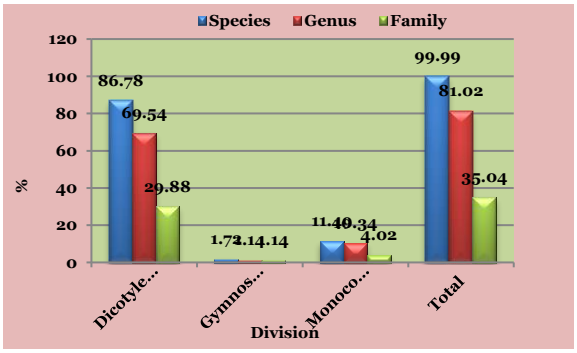

Fig. 3. Percentage of seed plants species, genera, family.

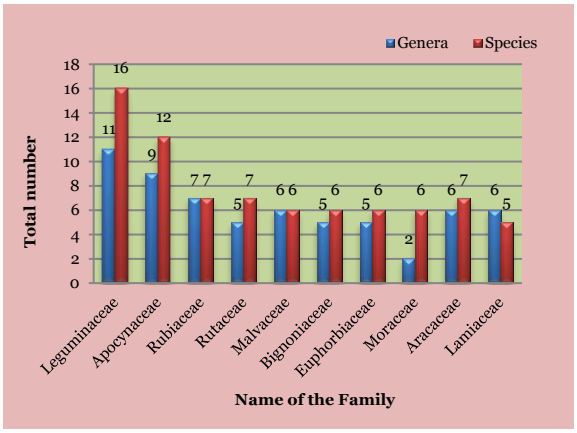

Fig. 4. Top 10 Families.

Table 6. Top 06 genera with more than 03 species.

S. No.	Genera	Family	No. of Species
1	*Ficus*	Moraceae	5
2	*Jasminum*	Oleaceae	3
3	*Bauhinia*	Fabaceae	3
4	*Cinnamomum*	Lauraceae	3
5	*Cassia*	Caesalpiniaceae	3
6	*Ocimum*	Lamiaceae	3

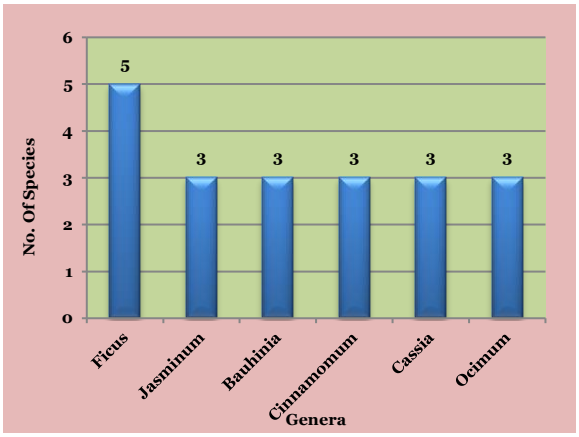

Fig. 5. Top 06 Genera.

Floristic studies of Dr. YSR Smruthi Vanam Park Revealed that the distribution of Dicotyledon species than Monocotyledon is high in the diversity. The dominant Dicotyledon species are *Ficus racemosa, F. carica, Limonia acidissima, Barliria prionitis, Euphorbia milii, Mimusops elengi, Plumaria rubra* and *Tamarindus indica*. The spiny species constitutes *Asparagus racemosus, Bogunvilia* sp, *Carissa carandas, Citrus aurantiifolia* and *Limonia acidissima*. The important creepers are *Jasminum* sp., *Combretum indicum, Clitoria ternatea* and *Passiflora edulis*. The common ground herbaceous vegetation covers with *Cyndon doctylon* and *Cymbopogon flexuosus*.

The Park Flora contributes a large number of significant medicinal plants as *Aegle marmelos, Abutilon indica, Alove vera, Annona sqamosa, Bauhinia recemosa, Boswellia serrate, B. ovalifolliolata, Citrus reticulate, Casia fistula, C. auriculata, Ficus* sp, *Limonia acidissima, Murrya koenigii, Syzygium cumini* and *Tamarindus indica*.

The Ornamental and the alien (Exotic) species also represented the flora namely, *Asporagus racemosus, Allamanda cathartica, Dracena reflexa*, *Duranta erecta*, *Ixora chinensis, Mesua ferrea, Mussaenda erthrophylla, Plumeria* sp., *Rondeletia odorata*, *Spathodea companulata* and also three of the Gymnosperms under cultivation.

The important timber yielding and economically important tree species which are also distributed all over the park are *Acacia catechu, A. leucocephala, A. nilotica, Areca catechu, Ceiba pentandra, Chloroxylon swietenia*, *Cinnamomum* sp., *Elettaria cardamom*, *Limonia acidissima, Madhuca indica, Murrya* sp., *Santalum album.*

Table 7. Emdemic and red listed medicinal plants of selected area.

S. No	Botanical name	Family	IUCN Status
1	*Calophyllum inophyllum* L.	Clusiaceae	Least Concern
2	*Aegle marmelous* (L.) Correa	Rutaceae	Vulnerable
3	*Chloroxylon swietenia* DC.	Rutaceae	Vulnerable
4	*Boswellia ovalifoliolata* Roxb & Colebr.	Burseraceae	Endamic
5	*Butea monosperma* (Lam.) Taub.	Fabaceae	Endangered
6	*Bauhinia galpini* N.E.Br.	Fabaceae	Enadamic
7	*Saraca asoca* (Roxb.) Willd.	Fabaceae	Vulnarable
8	*Cassia fistula* L.	Caesalphinaceae	Nearly Endangered
9	*Heliotropium indicum* L.	Boraginaceae	Least concern
10	*Manilkara hexandra* (Roxb).	Sapotaceae	Wild
11	*Nerium oleander* L.	Apocynaceae	Least Concern
12	*Barleria prinotis* L.	Acanthaceae	Vulnerable
13	*Piper nigrum* L.	Piperaceae	Endangered
14	*Santalum album* L.	Santalaceae	Rare Endemic
15	*Artocarpus heterophylla* Lam.	Moraceae	Vulanerable
16	Araucaria *heterophylla* (Salisb.) Franco	Araucariaceae	Vulanerable
17	*Cycas circinialis* L.	Cycadaceae	Least Critical
18	*Cycas revolute* Thunb.	Cycadaceae	Endangered
19	*Couroupita guianensis* Aubl.	Liliaceae	Least critical
20	*Bismarckia nobilis* (Hildeber. H. Wendl)	Arecaceae	Endemic
21	*Phoenix syivestris* L.	Araceceae	Wild
22	*Pandanus odorifer* (Forssk.)Kuntze.	Pandanaceae	Least Critcal

IUCN Threatened Species Report from Dr. YSR Smruthi Vanam

From Smruthi Vanam park distribution of threatened species is also observed and noticed under IUCN categories as Critically Rare one Species *Santalum album*; Under Endamic Category three species *Boswellia ovalifoliolata, Bauhinia galpini, Bismarckia nobilis;* Under Endangered Category four species *Butea monosperma, Cassia fistula, Piper nigrum, Cycas revolute;* Under Least concern six species *Calophyllum inophyllum, Couroupita guianensis, C. circinalis, Heliotropium indicum, Nerium oleander, Pandanus odorifer;* Under Vulnerable criteria six species *Aegle marmelous, Artocarpus heterophylla, Araucaria heterophylla, Barleria prinotis, Chloroxylon swietenia*, *Saraca asoca* (Table 07).

1. Entrance

2. Aerial View of Park

3. Smruthi Vanam Layout

4. Statue of YSR

5. Fragrance Garden

6. Pavithra Vanam

7. Butterfly Garden

8. Interpretation Centre

Plate 2. Major Enclosures of the Dr. YSR Smruthi Vanam.

Conclusion

Floristic studies of a protected area resulted in a good number of species with trees along with patches of ever green shrubs and herbs species includes rare and endangered highly threatened tree species in its natural habitat *S. album*, along with *B. nobilis and B. ovalifoliolata* endemic species. Smruthi Vanam flora comprises many creepers on spiny species especially the medicinal plants from Apocynaceae, Lamiaceae, Caesalpiniaceae and Euphorbiaceae families. Floral distribution revealed the presence of threatened species of high degree under conservation category group as 3 species under endemic, 4 species under endangered, 4 species under vulnerable criteria, and more than 10 species under least concern group indicates the importance of Ex-situ conservation of flora and also data documentation on the biological species especially floristic diversity in the protected areas for future generation.

It is recommended for repository for academic and research study. This Vanam also got First Greenery award for 2017 from Andhra Pradesh Government.

Acknowledgement
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