

POPULATION STATUS AND CONSERVATION REQUIREMENT OF SOME ENDANGERED PLANTS GROWING IN DAYALBAGH EDUCATIONAL INSTITUTE, AGRA

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Abstract

The study area is rich in plant diversity but there is an urgent need of conservation. Some rare and endangered plants are still found abundantly in the region, but without protection these plants may become endangered in the near future. Endangered plant species have been categorized by the IUCN (International union for conservation of nature) as the ones likely to become extinct. When the death rate of the species exceeds its birth rate for a prolonged duration, that species is called endangered and eventually it may become extinct. Such are *Adhatoda vasica*, *Ageratum conyzoides*, *Agave americana*, *Aloe vera*, *Ammania baccifera*, *Alternanthera sessilis*, *Asparagus adscendens*, *Cactus*, *Centella asiatica*, *Costus speciosus*, *Chlorophytum tuberosum*, *Gloriosa superba*, *Piper longum*, *Sinopodophyllum hexandrum*, *Rauwolfia serpentina*, *Saraca asoca*, *Streblus asper*, *Tribulus terrestris*, *Withania somnifera*, *Zamia pygmaea*. Among these threatened plants 4 species were assessed as Critically Endangered (CR), 7 as Endangered (EW), 2 as Vulnerable (VU), 5 as Least Concern (LC) and 1 as Data deficient (DD) by the IUCN Red List in Uttar Pradesh and in the study area. The extinction and decline in plant diversity is caused by many factors, such as population growth, high rates of habitat modification and deforestation, climate change, pollution, the spread of invasive alien species and over-exploitation. Threatened species are being rehabilitated and restored to a protected area from their former habitats.

Keywords: Threatened plants; Population status; Conservation requirement; Importance Value Index (IVI)

Introduction

Endangered plant species have been categorized by the IUCN (International union for conservation of nature) as the ones likely to become extinct. A species may become endangered and eventually extinct when the death rate of that species exceeds its birth rate for a prolonged duration. The reasons for that may be natural or anthropogenic. Nowadays anthropogenic activities are prominent and cause the extinction of many plant species of ecological and economic significance [1]. Many species are facing tremendous pressure and are on the verge of extinction in the whole world. Species may decline in number due to threats such as habitat destruction, climate change or pressure from invasive species.

A lot of research has been made on endangered animals but the reports on endangered plants are few. Several projects for conservation of endangered animals, such as – Project

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Tiger, Project Crocodile, Project Elephant and Project Rhino etc have been taken up by our government but very few such reports are related to plants.

In 1998, the Forest Department of Uttar Pradesh hosted a workshop on Conservation, Assessment and Management Plants (C.A.M.P) [2]. Many authors were concerned about the conservation of medicinal plants in India. P. Kumar and G.S. Walker [3] made reports on the special habitats of the threatened plants of Chotanagpur Plateau of India, P.N. Joshi et al., in 2012 [4] made reports on the ecology and conservation of threatened plants in the Tapkeshwari Hill ranges in the Kachchh Island (Gujarat), B. Singh et al., in 2012 made an assessment of the ethno-botanical values and threat status of some medicinal plants in Eastern Himalaya, J. Kalita and M.L. Khan in 2013 [6] presented the trade of medicinal plants from the high altitudes of the Western part of Arunachal Pradesh, P. Singh and B.L. Attr in 2014 [7] made a report on the exploration and conservation of some endangered medicinal plants in Bageshwar valley and R. Tilling et al. in 2015 [8] presented other ethno-medicinal plants used by Apatani Tribe of Ziro valley of Arunachal Pradesh.

Our environment has lost many valuable plant species due to threats like climate change, habitat loss, population reduction, restricted distribution and etc. So, there is a need to conserve these plant species which are endangered and which fall in any category within the IUCN RED LIST, like Critically Endangered, Extinct, Vulnerable, Least concern and others (Fig. 1) [9].

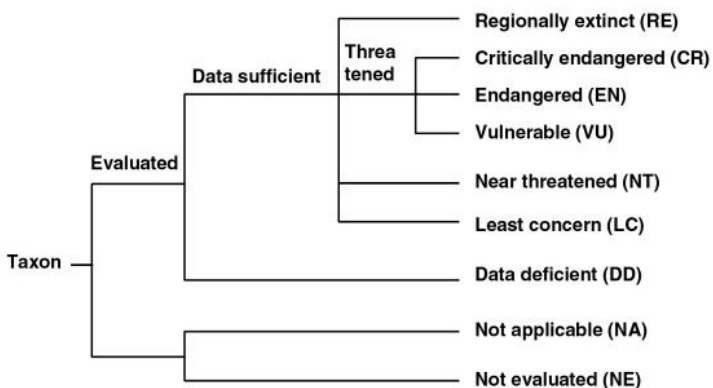


Fig. 1. The structure of the IUCN Red List Categories at national level [9, 10]

The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies [10].

These criteria are relevant to all species and all regions of the world which are recorded as:

- *Extinct (EX)* – there is no known individual is remaining.
- *Extinct in the wild (EW)* – they are known only to survive in captivity, or as a naturalized population outside its historic range.
- *Critically endangered (CR)* – species with an extremely high risk of extinction in the wild.
- *Endangered (EN)* – species with a high risk of extinction in the wild.
- *Vulnerable (VU)* – species with a high risk of endangerment in the wild.
- *Near threatened (NT)* – likely to become endangered in the near future.

- *Least concern* (LC) – species with the lowest risk of extinction. Does not qualify for a more at risk category.
- *Data deficient* (DD) – there is not enough data to make an assessment of its risk of extinction.
- *Not evaluated* (NE) – species has not yet been evaluated against the criteria.

The present study intends to highlight the status and distribution of the endangered plant species in the proposed study area, as well as their conservation and management practices. A detailed study of endangered plants growing in the D.E.I. Campus, mainly in the botanical garden and herbal garden in Dairy Campus, will be conducted.

Materials and methods

Survey of the study area

Different study areas, mainly the botanical garden and the herbal garden in the dairy campus were selected for a survey of threatened plants. The distribution of each of the studied species was recorded through extensive field survey.

Availability & Population structure of plants in the study area

Population structure was studied by quadrat method. Twenty quadrats of 1m x 1m size were laid randomly in and around the study species [1]. This method was used for small plants and trees, such as *Saraca asoca* etc., which were counted normally.

Randomly selected study areas (D.E.I. Campus, Botanical garden, Herbal garden, Dairy campus around D.E.I.) of different sizes were sampled, to study the species population, by following the same method.

Quantitative Analysis

Quantitative analysis of species for frequency, density and relative density was performed as done by *R. Misra* (1968) [11]. The importance value index (IVI) was computed by summing up relative frequency, relative density, and relative basal area [1]:

Density = Total number of individuals of a species in all quadrats/ Total number of quadrats studied

Dominance = Basal area of individual species X 100/ Total basal area of all species

(Total basal area of an individual species = Average basal area of the species x Density of the species)

Frequency = Number of quadrats in which the species occurred X 100/ Total number of quadrats studied

Abundance = Total number of individuals of a single species in all samples/ Total number of quadrats in which species occurred

Relative Density = Number of individual of the species X 100/ Number of individual of all the species

Relative Dominance = Total basal area of a species X 100/ Total basal area of all the species

Relative Frequency = Number of occurrence of the species X 100/ Number of occurrence of all the species

Importance Value Index = (Relative Density + Relative Dominance + Relative Frequency)

Categorization and Listing the observed plant biodiversity as per IUCN Categories

After assessment, the plant species were listed. Plant specimens were collected and identified according to different floras, as well as by consulting different herbaria and experts of the region. The collected plant species were categorized into different categories of threatened plants, according to the IUCN (International union for conservation of nature).

Conservation and management

Different study areas, mainly the botanical garden and the herbal garden in the dairy campus were selected for a survey of threatened plants. Different methods used for their conservation and management were studied.

Results and discussion

Assessment of availability and population status of plants in the study area is presented in Table 1.

Table 1. Total number of individual plants

S. No.	Name of species	Number of individual in each quadrat (No. of quadrats in which species occurs 1sqm.)								Total No. of species	Total No. of Quadrats		
		1	2	3	4	5	6	7	8			9	10
1.	<i>Adhatoda vasica</i>	3	3	-	8	-	-	4	5	2	-	25	6
2.	<i>Ageratum conyzoides</i>	10	12	-	12	-	10	4	7	5	-	60	7
3.	<i>Aloe vera</i>	5	3	-	5	-	-	3	5	-	-	21	5
4.	<i>Ammania baccifera</i>	10	8	-	7	15	12	-	8	-	-	60	6
5.	<i>Alternanthera sessilis</i>	-	15	10	-	8	4	7	2	4	-	50	7
6.	<i>Asparagus adscendens</i>	4	2	5	-	1	3	-	5	2	-	22	7
7.	<i>Centella asiatica</i>	8	-	7	10	-	5	7	-	5	-	42	6
8.	<i>Costus speciosus</i>	-	-	3	2	5	-	3	5	-	-	18	5
9.	<i>Chlorophytum tuberosum</i>	2	-	-	3	-	4	-	5	-	-	14	4
10.	<i>Piper longum</i>	-	10	7	-	9	8	4	5	-	-	43	6
11.	<i>Sinopodophyllum hexandrum</i>	2	3	-	-	1	-	2	3	-	-	11	5
12.	<i>Rauwolfia serpentina</i>	2	-	3	4	1	3	2	1	-	-	16	7
13.	<i>Tribulus terrestris</i>	2	-	3	2	-	1	-	2	3	-	13	6
14.	<i>Withania somnifera</i>	-	4	-	7	4	-	2	-	5	-	22	5
Total											417		

As per the assessment, through quadrat method, *Ageratum conyzoides* and *Ammania baccifera* have higher quantitative value (60) followed by *Alternanthera sessilis* (50) and *Piper longum* (43), *Sinopodophyllum hexandrum* (11) and *Tribulus terrestris* (13) followed by *Chlorophytum tuberosum* (14) and *Aloe vera* (21). The maximum number of quadrats is 7.

Table 2. Density, total basal area, frequency, abundance of medicinal plants

Species name	Density	Total basal area (cm ²)	Frequency (%)	Abundance
<i>Adhatoda vasica</i>	2.5	50.0	60	4.16
<i>Ageratum conyzoides</i>	6.0	30.0	70	8.57
<i>Aloe vera</i>	2.1	210.0	50	4.20
<i>Ammania baccifera</i>	6.0	60.0	60	10.00
<i>Alternanthera sessilis</i>	5.0	65.0	70	7.14
<i>Asparagus adscendens</i>	2.2	11.0	70	3.14
<i>Centella asiatica</i>	4.2	33.6	60	7.00
<i>Costus speciosus</i>	1.8	54.0	50	3.60
<i>Chlorophytum tuberosum</i>	1.4	49.0	40	3.50
<i>Piper longum</i>	4.3	38.7	60	7.16
<i>Sinopodophyllum hexandrum</i>	1.1	27.5	50	2.20
<i>Rauwolfia serpentina</i>	1.6	16.0	70	2.28
<i>Tribulus terrestris</i>	1.3	52.0	60	2.16
<i>Withania somnifera</i>	2.2	55.0	50	4.40
Total	41.7	751.8	820%	69.37

Further, evaluation of population status of plant in the study area was conducted by finding their density, total basal area, frequency and abundance; relative density, relative dominance, relative frequency & IVI, result are given in Table 2 and Table 3 respectively.

Density is a measure of the total number of species that make up a population in a studied area. *Ageratum conyzoides* and *Ammania baccifera* (6) have a high density, followed by *Alternanthera sessilis* (5) and *Piper longum* (4.3) .

Frequency refers to the total percentage of quadrats in which an individual species is present in a study area (contribution to the community through its distribution). *Ageratum conyzoides*, *Alternanthera sessilis*, *Asparagus adscendens*, *Rauwolfia serpentina* (70) have a high frequency, followed by *Adhatoda vasica*, *Ammania baccifera*, *Centella asiatica*, *Piper longum*, *Tribulus terrestris* (60).

Abundance refers to the relative representation of a species in a study area (number of plants within the quadrats). *Ammania baccifera* (10) and *Ageratum conyzoides* (8.57) have a high abundance, followed by *Piper longum* (7.16) and *Alternanthera sessilis* (7.14).

Table 3. Relative density, relative dominance, relative frequency and IVI for medicinal plants

Species name	Relative Density (%)	Relative Dominance (%)	Relative Frequency(%)	IVI
<i>Adhatoda vasica</i>	5.9	6.6	7.3	19.8
<i>Ageratum conyzoides</i>	14.3	3.9	8.5	26.7
<i>Aloe vera</i>	5.0	27.9	6.0	38.9
<i>Ammania baccifera</i>	14.3	7.9	7.3	29.5
<i>Alternanthera sessilis</i>	11.9	8.6	8.5	29
<i>Asparagus adscendens</i>	5.2	1.4	8.5	15.1
<i>Centella asiatica</i>	10.0	4.4	7.3	21.7
<i>Costus speciosus</i>	4.3	7.1	6.0	17.5
<i>Chlorophytum tuberosum</i>	3.3	6.5	4.8	14.6
<i>Piper longum</i>	10.3	5.1	7.3	22.7
<i>Sinopodophyllum hexandrum</i>	2.6	3.6	6.0	12.2
<i>Rauwolfia serpentina</i>	3.8	2.1	8.5	14.4
<i>Tribulus terrestris</i>	3.1	6.9	7.3	17.3
<i>Withania somnifera</i>	5.2	7.3	6.0	18.5
Total	99.2	99.3	99.3	297.8

IVI represents the dominant species in the study area. The dominant species can be quantified by calculating a statistic known as 'importance value' [12-15]. Once importance values are determined, a specific community can be described in terms of its most important species. *Aloe vera* has a high value (38.9) followed by *Ammania baccifera* (29.5), *Alternanthera sessilis* (29), *Ageratum conyzoides* (26.7), *Asparagus adscendens* (15.1), *Chlorophytum tuberosum* (14.6) and *Rauwolfia serpentina* (14.4).

Population status of remaining 6 species which were not covered by quadrat method was assessed by counting. Results are given in Table 4. Density, total basal area & frequency of these 6 species is given in the Table 5.

Table 4. Total number of individual species

Name of species	Total no. of species
<i>Agave americana</i>	10
<i>Cactus</i>	2
<i>Gloriosa superba</i>	No more
<i>Saraca asoca</i>	1
<i>Strebles asper</i>	5
<i>Zamia pygmaea</i>	No more
Total	18

Agave americana has a higher quantitative value (10), followed by *Strebles asper* (5).

Density is a measure of the total number of species that make up a population in the study area. *Agave americana* (1.0) has a high density, followed by *Streblus asper* (0.5).

Table 5. Density, total basal area and frequency

Species name	Density	Total basal area (cm ²)	Frequency (%)
<i>Agave americana</i>	1.0	50	10
<i>Cactus</i>	0.2	20	2
<i>Gloriosa superba</i>	0.0	0	0
<i>Saraca asoca</i>	0.1	60	1
<i>Streblus asper</i>	0.5	50	5
<i>Zamia pygmaea</i>	0.0	0	0
Total		180	18

Frequency refers to the total percentage of quadrats in which an individual species is present in a study area (contribution to the community through its distribution). *Agave americana* has a high frequency(10), followed by *Streblus asper* (5).

These six species have a very low density so they are separated from other species. Two species are presently not available in the study area (D.E.I.), but two years ago, many plants were available in the studied area.

Table 6. Relative density, relative dominance, relative frequency and IVI of the medicinal plants

Species name	Relative density (%)	Relative dominance (%)	Relative frequency (%)	IVI
<i>Agave americana</i>	55.55	27.77	55.55	138.87
<i>Cactus</i>	11.11	11.11	11.11	33.33
<i>Gloriosa superba</i>	0.00	0.00	0.00	0.00
<i>Saraca asoca</i>	5.55	33.33	5.55	44.43
<i>Streblus asper</i>	27.77	27.77	27.77	83.31
<i>Zamia pygmaea</i>	0.00	0.00	0.00	0.00
Total	99.98	99.98	99.98	299.94

Agave americana (138.87) has a high value index followed by *Streblus asper* (83.31). IVI is representing the dominant species in the study area.

Observed plant biodiversity were listed and categorized as per IUCN categories, in Table 7.

Table 7. Species name, family and categories of the medicinal plants

Species name	Family	Category
<i>Adhatoda vasica</i>	Acanthaceae	Endangered in Wild (EW)
<i>Ageratum conyzoides</i>	Asteraceae	Least concern (LC)
<i>Agave americana</i>	Asparagaceae	Least Concern (LC)
<i>Aloe vera</i>	Xanthorrhoeaceae	Data Deficient (DD)
<i>Ammania baccifera</i>	Lythraceae	Least Concern (LC)
<i>Alternanthera sessilis</i>	Amaranthaceae	Least concern (LC)
<i>Asparagus adscendens</i>	Asparagaceae	Vulnerable (VU)
<i>Cactus</i>	Cactaceae	Least Concern (LC)
<i>Centella asiatica</i>	Apiaceae	Critically endangered (CR)
<i>Costus speciosus</i>	Costaceae	Critically endangered (CR)
<i>Chlorophytum tuberosum</i>	Asparagaceae	Critically endangered (CR)
<i>Gloriosa superba</i>	Colchicaceae	Endangered (EW)
<i>Piper longum</i>	Piperaceae	Least Concern (LC)
<i>Sinopodophyllum hexandrum</i>	Berberidaceae	Critically endangered (CR)
<i>Rauwolfia serpentina</i>	Apocynaceae	Vulnerable (VU)
<i>Saraca asoca</i>	Fabaceae	Endangered (EW)
<i>Streblus asper</i>	Moraceae	Endangered (EW)
<i>Tribulus terrestris</i>	Zygophyllaceae	Endangered (EW)
<i>Withania somnifera</i>	Solanaceae	Endangered (EW)
<i>Zamia pygmaea</i>	Zamiaceae	Endangered (EW)

Conservation and management practices adopted in D.E.I. and Dairy campus for listed endangered plants.

Different studied areas, mainly the botanical garden and the herbal garden in the dairy campus were selected for a survey of threatened plants. Information was gathered about all threatened plants present in the study area. Threatened species are being rehabilitated and restored to protected areas from their former habitats. Different methods for the management of threatened species were followed.

In our university and around our study area, endangered species are being maintained for their conservation and preservation. The plants have been brought from various cities and nurseries and planted and taken care of. The plant tissue culture is also practiced in order to preserve species of *Piper longum*.

Proper care of plants is being taken. The caretakers, students and teachers regularly check and manage the garden. Some of the threatened plants, earlier found in the botanical garden are being rehabilitated in the Dairy Campus and Herbal garden.

The study area is rich in plant diversity, but there is an urgent need of conservation. Some rare and endangered plants are still found abundantly in the region, but without protection these plants may become endangered in the near future.

We found 22 species in the study area that are facing extinction in the wild.

As per literature reviewed, there are about 30 species in Uttar Pradesh.

The total number of most important threatened plants reported in the study area (D. E.I. Campus, Dairy Campus and around it) was 20. All these plants were frequently used for various purposes, such as medicine, decoration and others. A detailed list of plants and their IUCN categories is given in Table 8.

Table 8. Plant name, their IUCN categories, population status and IVI

Plant name	Family	IUCN Category	Population status	IVI
<i>Adhatoda vasica</i>	Acanthaceae	Endangered in Wild (EW)	25	19.80
<i>Ageratum conyzoides</i>	Asteraceae	Least concern (LC)	60	26.70
<i>Agave americana</i>	Asparagaceae	Least Concern (LC)	10	138.80
<i>Aloe vera</i>	Xanthorrhoeaceae	Data Deficient (DD)	21	38.90
<i>Ammania baccifera</i>	Lythraceae	Least Concern (LC)	60	29.50
<i>Alternanthera sessilis</i>	Amaranthaceae	Least concern (LC)	50	29.00
<i>Asparagus adscendens</i>	Asparagaceae	Vulnerable (VU)	22	15.10
<i>Cactus</i>	Cactaceae	Least Concern (LC)	2	33.33
<i>Centella asiatica</i>	Apiaceae	Critically endangered (CR)	42	21.70
<i>Costus speciosus</i>	Costaceae	Critically endangered (CR)	18	17.50
<i>Chlorophytum tuberosum</i>	Asparagaceae	Critically endangered (CR)	14	14.60
<i>Gloriosa superba</i>	Colchicaceae	Endangered (EW)	0	0.00
<i>Piper longum</i>	Piperaceae	Least Concern (LC)	43	22.70
<i>Sinopodophyllum hexandrum</i>	Berberidaceae	Critically endangered (CR)	11	12.20
<i>Rauwolfia serpentine</i>	Apocynaceae	Vulnerable (VU)	16	14.40
<i>Saraca asoca</i>	Fabaceae	Endangered (EW)	1	44.43
<i>Streblus asper</i>	Moraceae	Endangered (EW)	5	83.31
<i>Tribulus terrestris</i>	Zygophyllaceae	Endangered (EW)	13	17.30
<i>Withania somnifera</i>	Solanaceae	Endangered (EW)	22	18.50
<i>Zamia pygmaea</i>	Zamiaceae	Endangered (EW)	0	0.00

Among these 2 plants viz. *Zamia pygmaea* and *Gloriosa superba* are presently endangered in the study area. These 2 were also reported 2 year ago, but now these endangered plants are not seen in the botanical garden.

20 threatened plants were assessed, 4 of which were assessed as Critically endangered (CR), 7 as Endangered (EW), 2 as Vulnerable (VU), 5 as Least Concern (LC) and 1 as Data deficient (DD) by IUCN Red List in Uttar Pradesh and in study area.

The loss of biodiversity resulting in the extinction of many useful species has also posed a serious concern to the global medical scientists and researchers. We are conserving and managing species that are threatened and face extinction in the wild.

The extinction and decline in plant diversity is caused by a range of factors, such as population growth, high rates of habitat modification and deforestation, climate change, pollution, the spread of invasive alien species and over-exploitation.

According to A. Prakash in 2011 [12], N.K. Mishra in 2012 [13] and J.H. Franklin Benjamin et al. in 2012 [14] table 9 presents 30 threatened plants that were present in Uttar Pradesh, India.

Table 9. Threatened plants present in Uttar Pradesh, India

1. <i>Abrus precatorius</i> Linn.	11. <i>Cactus</i>	21. <i>Helminthostachys zeylanica</i> Hook.f.
2. <i>Acorus calamus</i> L.	12. <i>Centella asiatica</i> Linn.	22. <i>Perilla frutescens</i> (L.) Britt.
3. <i>Adhatoda vasica</i> Nees	13. <i>Celastrus paniculatus</i> Willd.	23. <i>Piper longum</i> L.
4. <i>Ageratum conyzoides</i> Linn.	14. <i>Costus speciosus</i> Smith	24. <i>Rauwolfia serpentina</i> Benth.
5. <i>Alternanthera sessilis</i> (L.) R. Br. Ex Dc.	15. <i>Chlorophytum tuberosum</i> Bak.	25. <i>Saraca asoca</i> Linn.
6. <i>Aloe vera</i> (L.) Burmf.	16. <i>Drimia indica</i> L.	26. <i>Sinopodophyllum hexandrum</i>
7. <i>Ammania baccifera</i> L.	17. <i>Euphorbia fusiformis</i> Buch.	27. <i>Strebles asper</i> Lour.
8. <i>Andrographis paniculata</i> (Burm.) Wall.	18. <i>Gloriosa superba</i> Linn.	28. <i>Tribulus terrestris</i> Linn.
9. <i>Agave americana</i> L.	19. <i>Gymnema sylvestre</i> (Retz.) Schult	29. <i>Withania somnifera</i> Dunal
10. <i>Asparagus adscendens</i> Roxb.	20. <i>Hemidesmus indicus</i> (L.) R. Br.	30. <i>Zamia pygmaea</i> Sims

A. Prakash in 2011 [12] reported the use of some threatened and potential ethno-medicinal plants among the tribes of Uttar Pradesh and Utrtrakhand in India and N.K. Mishra in 2012 [13] reported a study on exploration and conservation of some endangered medicinal plants growing in Ghazipur U.P. Both researchers declared some plants as threatened.

The present study revealed that we have lost endangered species such as *Zamia pygmaea*, but we are preserving *Sinopodophyllum hexandrum*, which is critically endangered (CR), *Agave Americana*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Ammania baccifera*, *Cactus*, which fall in the Least Concern category (LC). *Aloe vera* is part of the Data Deficient group (DD).

Because these are at a lower risk of extinction, the conservation practices are also minimum.

Acorus calamus, *Asparagus adscendens*, *Chlorophytum tuberosum*, *Piper longum* have been described in the report of A. Prakash [12] and in our study but have not been reported by N.K. Mishra [13]

Costus speciosus, *Gloriosa superba* and *Rauwolfia serpentina* have been reported in the report of A. Prakash [12] and N.K. Mishra [13] and also in our study.

Abrus precatorius, *Adhatoda vasica*, *Centella asiatica*, *Strebles asper*, *Tribulus terrestris*, *Withania somnifera*, *Saraca asoca* these 7 species have been reported in the report of N.K. Mishra [13]. and in our survey but have not been reported by A. Prakash [12]

The present study has shown that we have many plants, which have great value in our life and which are also listed in the Red List of IUCN.

Conclusions

It can be concluded that the study area is rich in plant diversity but there is an urgent need of conservation. Some rare and endangered plants are still found abundantly in the region. We have found 20 threatened plants species in study area. These are *Adhatoda vasica*, *Ageratum conyzoides*, *Agave americana*, *Aloe vera*, *Ammania baccifera*, *Alternanthera sessilis*, *Asparagus adscendens*, *Cactus*, *Centella asiatica*, *Costus speciosus*, *Chlorophytum tuberosum*, *Gloriosa superba*, *Piper longum*, *Sinopodophyllum hexandrum*, *Rauwolfia serpentina*, *Saraca asoca*, *Strebles asper*, *Tribulus terrestris*, *Withania somnifera*, *Zamia pygmaea*.

Among the above 2 plants (viz. *Zamia pygmaea*, *Gloriosa superba*) are presently endangered in the study area. These 2 have also been reported 2 years ago, but now these endangered plants are not present in the botanical garden. The cause of their extinction is habitat destruction. Due to a range of factors, such as population growth, high rates of habitat modification and deforestation, climate change, pollution and over-exploitation, some species are suffering a tremendous pressure of extinction.

Among these species, the population status and the Importance Value Index is as follows:

Ageratum conyzoides (60), *Ammania baccifera* (60), *Alternanthera sessilis* (50), *Piper longum* (43), *Centella asiatica* (42) have maximum population status followed by *Saraca asoca* (1), *Cactus* (2), *Strebles asper* (5), *Agave americana* (10), *Sinopodophyllum hexandrum* (11) have minimum population status followed by *Tribulus terrestris* (13).

Ammania baccifera (29.5), *Alternanthera sessilis* (29), *Piper longum* (22.7), *Centella asiatica* (21.7) have maximum IVI followed by *Saraca asoca* (44.43), *Cactus* (33.33), *Strebles asper* (83.31), *Agave americana* (138.87), *Sinopodophyllum hexandrum* (12.2) have minimum IVI followed by *Tribulus terrestris* (17.3).

Different study areas, mainly the botanical garden and the herbal garden in the dairy campus, were selected for a survey of threatened plants. Information was gathered about all threatened plants present in the study area. Threatened species are being rehabilitated and restored to protected areas from their former habitats. Different methods for the management of threatened species were followed.

In our university and around our study area, endangered species are being maintained for their conservation and preservation. The plants have been brought from various cities and nurseries, planted and taken care of. Plant tissue culture is also practiced in order to preserve the species of *Piper longum*.

Proper care of plants is being taken. The caretakers, students and teachers regularly check and manage the garden.

Some of the threatened plants, earlier found in botanical garden, are being rehabilitated in the Dairy Campus, Herbal garden.

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References

- [1] B. Choudhury, M.L. Khan, *Conservation and Management of Endangered Plant Species: A Case Study from Northeast India*, **Bioremediation, Biodiversity and Bioavailability**, 4(Special Issue 1), 2010, pp. 47-53.
- [2] S. Molur, S. Walker (Eds.) *Conservation Assessment and Management Plan (C.A.M.P.), Report of the Workshop of Conservation Assessment and Management Plant for Freshwater Fishes of India*, Zoo Outreach Organization Conservation and Branding Specialist Group, Coimbatore, India, 1998.
- [3] P. Kumar, G.S. Rawat, *Chotanagpur Plateau: Relict Habitats and Endemic Plants*. **Special Habitats and Threatened Plants of India** (ENVIS Bulletin: Wildlife and Protected Areas, Wildlife Institute of India, Dehradun), 11(1), 2008, pp. 167-173.
- [4] P.N. Joshi, E.B. Joshi, B.K. Jain, *Ecology and conservation of threatened plants in Tapkeshwari Hill ranges in the Kachchh Island, Gujarat, India*, **Journal of Threatened Taxa**, 4(2), 2012, pp. 2390-2397.

- [5] B. Singh, S.K. Borthakur, S.J.P. Phukan, B.K. Sinha, *Assessing ethnobotanical values and threat status of wild asparagus (stemona tuberosa lour.): A case study in eastern Himalaya, India*, **International Journal of Conservation Science**, **3**(4), 2012, pp. 319-324.
- [6] J. Kalita, M.L. Khan, *Medicinal plants from the high altitudes of the western part of Arunachal Pradesh, India and their trade*, **International Journal of Conservation Science**, **4**(3), 2013, pp. 337-346.
- [7] P. Singh, B.L. Attr, *Survey on traditional uses of medicinal plants of Bageshwar valley (Kumaun himalaya) of Uttarakhand, India*, **International Journal of Conservation Science**, **5**(2), 2014, pp. 223-234.
- [8] R. Tilling, P. Bharali, P. Dutta, G. Gogoi, A. Paul, A.K. Das, *Ethnomedicinal Plants Used by Apatani Tribe of Ziro Valley of Arunachal Pradesh*, **International Journal of Conservation Science**, **6**(3), 2015, pp. 411-418.
- [9] * * *, **IUCN Red List Categories**, IUCN, Gland, Switzerland and Cambridge, 1994, U.K..
- [10] K.S. Walter, H.J. Gillett (Eds.), **IUCN Red List of Threatened Plants**, IUCN - The World Conservation Union, 1998-2000, UK.
- [11] R. Misra, **Ecology Workbook**, Oxford an IBH Publishing Co., New Delhi, 1968.
- [12] A. Prakash, *Uses of some threatened and potential ethno-medicinal plants among the tribal's of Uttar Pradesh and Utrakhand in India*, **National Conference on Forest Biodiversity: Earth's Living Treasure**, 2011, .pp 93-99, <http://www.upsbdb.org/pdf/Souvenir2011/12.pdf>, [accessed on 01.12.2014].
- [13] N.K. Mishra, *Studies on Exploration and Conservation of Some Endangered Medicinal Plants Growing in Ghazipur, U.P.*, **Indian Journal of Life Science**, **1**(2), 2012, pp. 87-91.
- [14] J.H. Franklin Benjamin, P. Lakshminarasimhan, G.V.S. Murthy, Indian Plant species in various CITES Appendices and their trade **Awareness Training Workshop on Cites: The Convention on International Trade in Endangered Species of Wild Fauna and Flora** (Editors: M. Hegde, K.R. Sasidharan, K.C.S. Warriar, C. Buvanewaran, B. Gurudev Singh, T.P. Raghunath and N. Krishnakumar), Institute of Forest Genetics and Tree Breeding, Coimbatore, 2012, pp. 120-129.
- [15] P. Kumari, G.C. Joshi, L.M. Tewari, Biodiversity status, distribution and use pattern of some ethno-medicinal plants, **International Journal of Conservation Science**, **3**(4), 2012, pp. 309-318.

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