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Habitat preservation is a concern for conserving of *Heliotropium rariflorum* Stocks. in the forest of North Gujarat Region (NGR), Gujarat, India.

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ABSTRACT:

The present study deals with the status, distribution and conservation of habitats of *Heliotropium rariflorum* – a threatened plant in the forest area of North Gujarat Region. It is tall under shrub; the distribution is exclusive to specific habitat and substratum. Survey was conducted from May 2005 to Dec 2006. A probable list of locations of the species in the study area was prepared based on the literature, reports, thesis and informal interviews with the local people. Using the above information random transects were located and surveyed in two phases.

A total of 631 individuals of *H. rariflorum* were recorded from NGR. Distributions of *H. rariflorum* are restricted into two main habitats; Thorn and Scrub Forest. The sandy soil substratum was found to be the most suitable one for *H. rariflorum*. The major threats to this plant were recorded as cutting and grazing, while most of the individuals are facing indirect threats in the form of habitat dryness.

Keywords:
Conservation, Threatened plants, Gujarat, Encroachment.

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INTRODUCTION

The modern man's intervention in the forest environment has speeded up the process of degradation and losses. It leads to the fragmentation of forest areas into isolated patches, due to which species with wide and contiguous distribution gets separated and isolated into small sub-populations. Thus, a taxon is considered to be rare/endangered or endemic when its area of distribution is significantly smaller than the average taxa of the same rank in an area or region (Costa, 1997). These taxa face a high risk due to their low population, limited geographic distribution and disturbance (Vischi *et al.,* 2004). Hence, the habitats of these species must be protected from biotic and environmental degradations (Cox, 1993) in order to impede the species extinction process. Condit *et al.* (1998) proposed to understand and study the threatened species and their habitats, in order to make sound decisions for protecting those species and managing their habitats. An, attempt was made to study the status and conservation of *Heliotropium rariflorum* in North Gujarat Region.

It is a tall under shrub with an erect stem which is stiff and rigid and the whole plant has appressed hairs all over the surface (Shah, 1978). Leaves are linear appressed and hairy (Shah, 1978) alternate suborbicular or orbicular emarginated and mucronate. Inflorescence are terminal spikes paniculately arranged sessile slender elongate and bracteate. The bracts are long stalked or unstalked lanceolate hairy and scattered along the rachis.

The colour of the flower is white bracts are 5 -10 mm long, leaf like lanceolate hairy scattered along the rachis. Calyx is penta-partite and hairy tube is scarcely long and the segments are long linear-lanceolate and ciliate. Corolla is long and hairy outside tubes are broad cylindrical with hairs in the throat lobes are long ovate and subacute. The stigma is a very depressed cone sudcapitate but pointed at apex. The fruits are nutlets four lobed scrabid and hairy (Shah, 1978). Fruit lobes are projecting above the persistent above the persistent with spreading calyx segments densely hispid with appressed hairs (Bhandari, 1990).

H. rariflorum is widely distributed in India, Afghanistan, Sudan and Pakistan. In India it is mostly reported in Gujarat, Rajasthan and Punjab states (Bhandari, 1978; Shah, 1978; Bhandari, 1990). A survey shows that, this plant was recorded from three districts of Gujarat and the maximum numbers were found in Kachchh (GEC, MSU and GUIDE, 2002). The status of this plant is "**Intermediate (I)"** (WCMC, 1994), but habitat destruction is a main threat of this plant.

The purpose of evaluation of selected species is to prevent its degradation from native habitat. An important tool for this purpose is the determination of the degree of threat of the taxa to which a special significance is attributed.

To conserve these threatened plant species, three basic informations are needed which include collection of field data to understand the area specific population status, distribution and existing threats, which would help to plan appropriate conservation and management strategies for their long term conservation rather than allowing depletion and local extinction. This needs to be achieved with the following objectives:

To assess the status and distribution of *H. rariflorum* in North Gujarat Region.

To assess the existing threats to *H. rariflorum* and

To prepare a conservation plan for a plant and its habitats.

Study area

The North Gujarat region (NGR) lies between 23° 35' 13.0" to 24° 30' 57.0" N and 72° 10' 28.0" to 73° 24' 47.0" E and falls under three administrative districts *viz.* Banaskantha, Sabarkantha and Meshsana. It extends to about 8.7% (1638 km^2) of the total forest cover of Gujarat state (18,868.28 km^2) and includes protected areas *viz.* Jessore Sloth Bear Wildlife Sanctuary (JSBWS), Balaram Ambaji Wildlife Sanctuary (BAWS), Taranga hill and Vijaynagar forest.

Forest was the most predominant land use type of the study area covering 1638 km^2, followed by agriculture land use largely in the valleys. Third major land use is rocky barren surface, while mining areas cover over 15 km^2. Only 8 km^2 areas are in the form of water bodies or wetlands (Joshua *et al.,* 2007). Although major forest types are found in the study area, they have been classified into two major sub-groups *viz.* 5A - Southern Tropical Dry Deciduous Forest and 6B - Northern Tropical Thorn Forest (Champion and Seth, 1968). Zone 5A is further subdivided into various sub zones with different forest types. The Sabarkantha district alone holds conspicuous cover like Dry Teak Forest (C1a), Dry Forest (C1b) and Dry Bamboo Breaks (E9). While Banaskantha district owns two forest covers e.g. *Aegle marmelos* forest (E6) and *Acacia catechu* forest (IS2). These two districts together comprise many forest types such as Southern Dry Mixed Deciduous Forest (E5) and Secondary Dry

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Deciduous Scrub Forest (2S1). In addition to this, Banaskantha district together with Meshsana district and the adjoining areas of Little Rann of Kachchh (LRK) form the Saline Alkaline Scrub Savannahs (E8). The 6B zone, found in northern part of Banaskantha district, is formed by Desert Thorn Forest (C1), Desert Dune Scrub (IS1), Ravine Thorn Forest (C2) adjacent to Sabarmati River and scattered scrubs forest dominated by *Cassia auriculata*, and *Zizphus nummlaria*. (DS1). Rann Saline Desert Thorn Forest (dominated by *Prosopis juliflora*) and Scrublands (E3) occur in Sabarkantha, Banaskantha and Meshsana districts (Singh, 1998).

The dominant soil of this region is classified as alluvial sandy soil. This soil is a mixture of sandy and coarse particles. Sandy loame and black soil are distributed in Banaskantha and Sabarkantha districts. In Meshana, 90% of the area is covered by light sandy soil and at some patches where sandy soil is mixed with black soil where the cultivation is possible. The pure sandy soil usually distributed in the forest region of Meshana districts, mainly Taranga hill and Abarkantha forest, have good natural thorn forest (Chavan and Lal, 1984), which is also a home for threatened plants.

METHODS

Species inventory of the above mentioned threatened plant was carried out based on the forest map developed by Joshua *et al.,* (2005). The survey was carried from May 2005 to Dec 2006. A probable list of locations of the species in the study area was prepared based on the literature, reports, thesis and informal interviews with the local people following Vischi *et al.* (2004).

Using the above information random transects were located and surveyed in two phases. A total of 123 transects were developed and surveyed in the first phase. For the second phase, few patches were identified, where good numbers of *H. rariflorum* was recorded from the previous of studies.

Searches were made for the *H. rariflorum* along the entire diagonal length of belt transect within a width of 10-15 m. Along these transects whenever a targeted species was located, circular plot (8m radius) was used to enumerate its abundance. Other parameters *viz* associated species, macro and micro habitat parameters (habitats, terrain, slope, substrate, soil type and other related environmental information) and site specific threats were also noted.

RESULTS AND DISCUSSIONS

A total of 631 individuals of *H. rariflorum* were recorded from NGR. Distributions of *H. rariflorum* are restricted into two main habitats; 405 plants from Thorn Forest (TF) and 226 plants from Scrub Forest (SF) (Table 1).

The sandy soil substratum was found to be the most suitable one for *H. rariflorum,* an overall 96.4% of plants (608 individuals) were reported from this soil type. Rest of the individuals, 14 and 9 from loamy coarse and gravel substratum respectively (**Table 1**).

Earlier surveys showed on these plants were recorded from scrub forest, and coastal area with sandy soil, open rocks habitat with gravel substratum (Bhandari, 1978; GEC, MSU and GUIDE, 2002).

A total of 75 species were found to be growing along with *H. rariflorum*. The associated tree species were *Zizyphus mauritiana*, *Maytenus emarginata, Acacia raddiana* and *Balanites aegyptiaca,* shrubs were *Crotalaria burhia*, *Acacia jacquemontii*, *Leptadenia pyrotechnica* and *Cassia auriculata,* climbers were *Mukia maderaspatana*, *Ipomoea nil*, and *Citrullus colocynthis* and ground layer *Aristida adscensionis* subsp. *adscensionis*, *Indigofera cordifolia*, *Tephrosia purpurea*, *Cenchrus setigerus* and *Borreria stricta* (**Table 2**).

The major threats to this plant were recorded as cutting and grazing, while most of the individuals are facing indirect threats in the form of habitat dryness. The major % of *H. rariflorum* was observed from sandy soil. This is an unique habitat and represented in patches in NGR. Usually these kinds of soil type, poor retaining moisture. Hence, most of the time, habitat was in dry conditions. Heavy shower on this soil type will also causes soil erosion andis recorded as a major threats to this habitat (**Figure 1**).

Table 1: Abundance and distribution of *Heliotropium rariflorum* Stocks. in the North Gujarat Region (NGR)

Species Distribution		
Forest type	**Abundance**	**Relative %**
Thorn Forest	405	65
Scrub Forest	226	35
Total	631	100
Substratum	**Abundance**	**Relative %**
Sandy soil	608	96
Loamy coarse	14	3
Gravel	9	1
Total	631	100

Table 2: Species association with *Heliotropium rariflorum* Stocks.in the North Gujarat Region (NGR).

Sl. No	Scientific Name	No	Relative %
	Tree layer		
1	*Maytenus emarginata* (Willd.) D. Hou	2	0.10
2	*Acacia raddiana* Savi.	1	0.05
3	*Acacia senegal*(L.) Willd.	1	0.05
4	*Zizyphus mauritiana* Lam.	3	0.15
5	*Balanites aegyptiaca (L.) Del.*	1	0.05
	Shrub layer		
6	*Acacia jacquemontii* Bth.	11	0.55
7	*Cassia auriculata* L.	10	0.50
8	*Kirganelia reticulata* (Poir.) Baill.	1	0.05
9	*Crotalaria burhia* Buch-Ham. ex Bth	65	3.25
10	*Heliotropium rariflorum* Stock.	28	1.40
11	*Leptadenia pyrotechnica* (Forsk.) Decne.	11	0.55
12	*Hibiscus ovalifolius* (Forsk.) Vahl	7	0.35
13	*Pupalia lappacea* (L.) Juss.	4	0.20
	Climber layer		
14	*Ipomoea nil* (L.) Roth	2	0.10
15	*Mukia maderaspatana* (L.) M. Roem.	7	0.35
16	*Citrullus colocynthis* (L.) Schrad.	1	0.05
	Ground layer		
17	*Indigofera cordifolia* Heyne ex Willd.	348	17.38
18	*Tephrosia purpurea* (L.) Pers.	123	6.14
19	*Borreria stricta* (L. f.) Schum.	70	3.50
20	*Evolvulus alsinoides* (L.) L. var. *alsinoides*	66	3.30
21	*Crotalaria medicaginea* Lam.	36	1.80
22	*Cassia tora* L.	34	1.70
23	*Justicia simplex* Don	32	1.60
24	*Curcuma pseudomontana* Grah.	31	1.55
25	*Amaranthus viridis* L.	30	1.50
26	*Bergia ammannioides* Roxb. ex Roth	29	1.45
27	*Peristrophe paniculata* (Forsk.) Brumm.	20	1.00
28	*Indigofera linifolia* Retz. var. *linifolia*	17	0.85
29	*Commelina albescens* Hassk.	17	0.85
30	*Sida cordata* (Burm. f.) Borss	16	0.80
31	*Justicia procumbens* L.	16	0.80
32	*Gnaphalium luteo-album* L. subsp. *affine* (D. Don) Koster	15	0.75
33	*Xanthium strumarium* L.	14	0.70
34	*Boerhavia diffusa* L.	13	0.65
35	*Convolvulus microphyllus* (Roth) Sieb. ex Spr.	12	0.60
36	*Leucas stricta* Bth.	10	0.50
37	*Achyranthes aspera* L. var. *argentea* Hook. f.	10	0.50
38	*Aerva persica* (Burm.f.) Merrill	9	0.45

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39	*Tephrosia villosa* (L.) Pers.	8	0.40
40	*Corchorus aestuans* L.	8	0.40
41	*Cardiospermum halicacabum* L.	7	0.35
42	*Ocimum canum* Sims	7	0.35
43	*Euphorbia parviflora* L.	6	0.30
44	*Blepharis repens* (Vahl) Roth	6	0.30
45	*Acanthospermum hispidum* DC.	6	0.30
46	*Phyllanthus virgatus* Forst. F.	5	0.25
47	*Commicarpus chinensis* (L.) Heimerl	4	0.20
48	*Cassia holosericea* Fresen.	4	0.20
49	*Commicarpus verticillatus* (Poir.) Standl.	3	0.15
50	*Indoneesiella echioides* (L.) Sreem.	3	0.15
51	*Ocimum basillicum* L.	2	0.10
52	*Tridax procumbens* L.	2	0.10
53	*Cassia pumila* Lam.	2	0.10
54	*Vernonia cinerea* (L.) Less.	1	0.05
55	*Ipomoea eriocarpa* R. Br.	7	0.35
56	*Aristida adscensionis* L. *subsp. adscensionis*	459	22.93
57	*Cenchrus setigerus* Vahl	92	4.60
58	*Dactyloctenium aegypticum* (L.) P. Beauv.	50	2.50
59	*Cynodon dactylon* (L.) Pers.	49	2.45
60	*Cenchrus ciliaris* L.	29	1.45
61	*Brachiaria reptans* (L.) Gard. & C. E. Hubb.	26	1.30
62	*Sporobolus helvolus* (Trin.) Th. Dur. et Schinz	17	0.85
63	*Heteropogon contortus* (L.) P. Beauv. ex. R. & S.	12	0.60
64	*Acrachne ramosa* (Heyne ex R. & S.) Ohwi	12	0.60
65	*Cymbopogon martinii* (Roxb.) Wats	10	0.50
66	*Aristida funiculata* Trin. & Rupr.	8	0.40
67	*Echinochloa colonum* (L.) Link	7	0.35
68	*Eragrostis poaeoides* P. Beauv.	5	0.25
69	*Paspalum distichum* L.	5	0.25
70	*Brachiaria ramosa* (L.) Stapf	3	0.15
71	*Eragrostis ciliaris* (L.) R. Br. var. *ciliaris*	3	0.15
72	*Setaria tomentosa* (Roxb.) Kunth.	2	0.10
73	*Setaria verticillata* (L.) P. Beauv.	2	0.10
74	*Pennisetum pedicellatum* Trin.	1	0.05
75	*Cyperus triceps* (Rottb.) Endl.	6	0.30

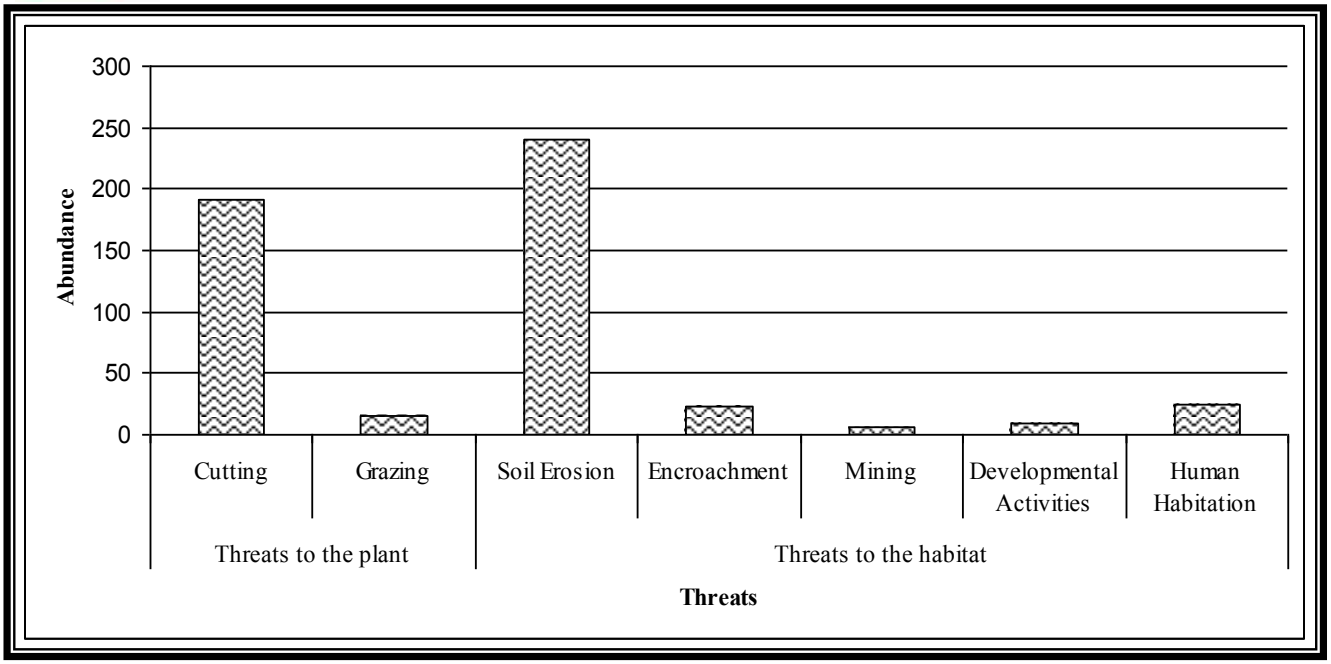

Figure 1: Threat factors to *Heliotropium rariflorum* Stocks. in the North Gujarat Region (NGR).

Site prioritizations

During our survey, 11 sites of *H. rariflorum* were recorded with different range of populations (Map 1). A total of 631 individuals were classified under different ranges 1-25, 26-50, 51-75, 76-100 and >101. The sites fall under this classes are 5, 1, 1, 2, and 2 and conservative rank were given as 5, 4, 3, 2 and 1 respectively (**Map 1**).

Conservation measures

As majority of the threatened plants species were found in Thorn Forest with Sandy substratum, more attention have to be paid to preserve this micro and macro habitat.

Awareness among the people on ecological importance of these plant species must be created. Large patches with threatened plants to be designated as Preservation Plot.

Conservation measures like soil and moisture conservation are to be taken up, to reduce soil erosion, a main cause of habitat loss.

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No of Plants	No of Sites	Rank
>101	2	1
76-100	2	2
51-75	1	3
26-50	1	4
1-25	5	5

Map 1: Distribution of *Heliotropium rariflorum* Stocks. in the North Gujarat Region (NGR)