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DISTRIBUTION OF ANGIOSPERMIC MONOTYPIC TAXA IN NORTH EAST INDIA AND THEIR CONSERVATIONAL IMPORTANCE

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Abstract

The term monotypic is self-explanatory and is important group of plants for taxonomic, phytogeography and phylogenetic studies. As North east India has a rich array of species diversity, it is the monotypic taxa that have invariably confounded taxonomic circumscription. Feeling the acute need for further researches, a review on the distribution of Angiospermic monotypic taxa in North east India has been done which result into 93 monotypic genera (represented by 44 families) in the North east Indian flora out of 236 in the Indian flora. Some of the interesting findings and their status in the region reflects the conservational importance of the artificial group.

Keywords: *Monotypic taxa; North east India; Conservation*

Introduction

India has two of the 25 recognised biodiversity hotspots in the world – the Eastern Himalaya and the Western Ghat [1]. North east India has a rich array of species diversity which covers the major part of Eastern Himalaya and is considered as the 'cradle of flowering plants' along with Northern Myanmar and Yunan axis [2]. Northeastern region of India, comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura with a geographical area of 2,65,037 Sq. Km. representing about 7.8% of India's total geographical area (32,87,263 Sq. Km.), including hills and plains with varied topography, climate and soil is basically a forest based region [3]. The entire terrain in this region is predominantly hilly and mountainous starting from the plains with humid tropical conditions (river basin of the great Brahmaputra River) rising up to about 8000 m elevation in the Eastern Himalayas with temperate climate and snow covered peaks. The region experiences heavy to moderate rainfall, high humidity and cold winter (Table 1 shows Physiography and climate along with number of angiosperms of North east India). The region, on account of its unique ecological diversities, represents an important floristic zone in the world in respect of biodiversity [4]. Geographically the area is in between latitude $22^0$10' N – $29^0$80' N and longitude $89^0$90' E – $97^0$10' E. This biogeographic zone is the most significant one among the ten protected areas of India [5] and represents a transition among the India, Indo-Malayan and Indo-Chinese regions as well as a meeting place of Himalayan Mountains with that of

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Peninsular India. This region thus acts as a biogeographic gateway for plant migration at the community level, species level and in endemics. Most of the species contributing to the biological diversity of North east India are either restricted to the region as a whole or even to smaller localities as in Khasi and Jaintia hills, a set of twin hills in the state of Meghalaya, probably the richest habitat in the whole Asia [6]. This region being a part of Eastern Himalaya represents one of the internationally recognized "Hot-spots" known for its richness and uniqueness of plant wealth [7].

Table 1. Physiography and climate, along with number of Angiosperms of North east India. [8]

States in North east India	Area (Km^2)	Forest cover (%)	No. of Angiosperms	Altitude range (m)	Annual rainfall (mm)	Temp. range (^0C)	Climate in the region
Arunachal Pradesh	83743	61.54	5000	146-7089	2000-4000	-20 to 28	Tropical to alpine
Assam	78438	39.15	3010	42-1736	800-3000	06 to 36	Tropical to subtropical
Manipur	22327	67.87	2500	205-2995	1400-4000	05 to 28	Tropical to temperate
Meghalaya	22429	42.34	3500	90-1961	2000-12000	10 to 30	Tropical to temperate
Mizoram	21081	75.59	2200	330-2140	2000-3200	12 to 30	Tropical to temperate
Nagaland	6579	52.04	2250	170-3100	1050-2000	03 to 27	Tropical to temperate
Sikkim	7096	37.34	4500	200-9330	1200-6000	-04 to 23	Tropical to alpine
Tripura	10486	60.01	1600	63-783	1200-2800	10 to 34	Tropical to subtropical

India is rich in all the three levels of biodiversity-such as species diversity, genetic diversity and habitat diversity. There are about 426 biomes representing different habitat diversity that gave rise to one of the richest centres in the world for plant genetic resources. The total number of flowering plant species although only 18,000, the intra-specific variability found in them make it one of the highest in the world. Moreover, 38% of the flowering plants and 18% of the total flora are endemic to this country [9]. The wide range of plant diversity is reflected even within each taxonomic level in the total flora. Amongst the flowering plants, several families show great diversity and are represented by more than 100 species. On the other end of spectrum, there are as many as 63 monotypic families in the Indian flora; among which about 236 genera of the flowering plants are monotypic which have 176 genera of Dicots and 60 of Monocot genera [10].

A taxa is said to be monotypic if it represents a single taxa within it, *i.e*., a family is monotypic if represented by a single genus with single species and a genus is monotypic if represented by the 'type species' only. Many monotypic genera have been described because a species possesses a number of distinct autapomorphies, *i.e.*, character unique to that species, making it easily distinguishable from other related species. Divergence is thus used to justify recognizing a separate genus, but it is only synapomorphies with other species that are informative about relationship [11]. Monotypic taxa are different from endemic plants in the sense that all monotypic taxa are likely to be endemic to a region, but all endemic plants are not monotypic taxa [10]. A recent taxonomic study showed that only about 38% of the monotypic taxa is endemic to India and restricted to different bio-geographic regions of the country [10]. Geographical isolation of the species is a barrier for complete circumscription of the plants. Though the Himalayan range acts as a geographical barrier, it also functions as a crucible for the evolution of new species complexes in the ecological niches and habitats offered by the Himalayan mountain systems [7].

The richness of the Northeastern region of India in flora was described by Hooker *et al*. [12], Kanjilal *et al*. [13], Rao and Hajra [14], Rao and Murti [15], Singh and Mao [16], Mao and

Hynniewta [17], Handique [18] etc. The recent exploration by BSI has indicated about 10,000 species, which equal about 50% of total flora of the country [17].

Documentation of monotypic taxa is not an easy task for a taxonomist. The high level of endemism, incomplete and insufficient updated floristic records [13, 19 – 31] etc. makes the task more challenging. In spite of such problems, an attempt has been made to document this major artificial group of taxa of North east region of India keeping in view the major role played by the flora of this region to make authentic evidence and to contribute for flora inventory of the region.

Monotypic taxa are important not only in floristic studies, but also in phytogeography and phylogenetic studies. They have the most important role in identifying the origin and route of migration of those taxa with the help of the distribution pattern. It helps in tracing the evolutionary line among the lower taxa. They represents species which could be lost forever and their related genomes do not exist anywhere else in the region, which opens up further attention to study of molecular biology and cytogenetics to tap the information as they are threatened in terms of related taxa and from the conservational point of view. Likewise, the region harbours numerous plant species having medicinal, aromatic and other economic use, which deserve immediate attention for conservation and sustainable use.

Objective of the study

Keeping the above facts in mind the study was aimed with following objectives:

1.To enumerate monotypic angiosperm taxa of India found in North east India with their distribution in the region along with conservational status,

2.To justify taxonomic implications of monotypic taxa,

3.To comprehend perspective for future studies,

4.To make authentic evidence and to contribute for flora inventory of the region.

Methodology

Review of literature related to the study was done to collect names of monotypic Angiosperm taxa of India which are found in North east India, their occurrence, habit and habitat distribution in different parts of India along with conservational status. For the study, almost all major floristic accounts of India are considered and scientific publications related to monotypism are taken into account. Data for distribution and conservational status were collected from data published by Botanical Survey of India. An enumeration is prepared accordingly and analysed for the purpose.

Results

Monotypic taxa are an unusual, but important group of plants that are interesting not only in floristic, but also in phytogeography and phylogenetics studies [32]. In this review, collection of information about their numbers, occurrence, habit-wise distribution and their representation in the North east region of the country was recorded. An enumeration of monotypic angiosperm taxa of India found in North east India are given in Table 2 where scientific name, family, habit, distribution in the NE India are mentioned along with their conservational status.

Table 2. An enumeration of monotypic angiosperms of North east Indian flora.

Sl.	Botanical name	Family	Habit	Distribution in NE India	Status
1	*Aboriella myriantha* (Dunn) Bennet	Urticaceae	H	Arunachal Pradesh	En
2	*Aegle marmelos* Corr.	Rutaceae	T	* All over India except the most arid regions and higher altitudes in Himalayas	-
3	*Albertisia mecistophylla* (Miers) Forman	Menispermaceae	WC	Assam and Meghalaya	-
4	*Anthogonium gracile* Wall. ex Lindl.	Orchidaceae	H	Meghalaya, Nagaland, Sikkim	-
5	*Ariopsis peltata* Nimmo	Araceae	H	* Sikkim	
6	*Ascopholis gamblei* Fischer	Cyperaceae	H	* Sikkim	
7	*Aspidocarya uvifera* Hook.f. & Thoms.	Menispermaceae	WC	Arunachal Pradesh, Sikkim	
8	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae	C	Throughout India	-
9	*Biswarea tonglensis* (Cl.) Cogn.	Cucurbitaceae	C	* Assam, Manipur, Sikkim	En
10	*Brachycaulos simplicifolius* Dixit *et* Panigrahi	Rosaceae	S	Sikkim	En
11	*Brachystemma calycinum* D.Don	Caryophyllaceae	H	* NE India	-
12	*Brasenia schreberi* J.F.Gmel.	Cabombaceae	H	Meghalaya	-
13	*Bryocarpum himalaicum* Hook.f. & Thoms.	Primulaceae	H	Arunachal Pradesh, Sikkim	
14	*Bulleyia yunnanensis* Schltr.	Orchidaceae	H	* Arunachal Pradesh, Sikkim	I
15	*Butomopsis latifolia* (D. Don) Kunth.	Butomaceae	H	* Assam	-
16	*Bythophyton indicum* Hook. f.	Scrophulariaceae	H	Meghalaya	En
17	*Cannabis sativa* L.	Cannabinaceae	H	Throughout India	-
18	*Centrostachys aquatica* Wall. ex Moq	Amaranthaceae	H	* Assam	-
19	*Chionocharis hookeri* (Clarke) I.M.Johnston	Boraginaceae	S	* Arunachal Pradesh, Sikkim	
20	*Craniotome versicolor* Reichb	Lamiaceae	H	* Meghalaya	En
21	*Curcumorpha longiflora* (Wall.) A.S. Rao & D. M. Verma	Zingiberaceae	H	Assam, Meghalaya	-
22	*Cyathopus sikkimensis* Stapf.	Poaceae	H	Sikkim	En
23	*Decaisnea insignis* (Griff.) Hook.f. & Thoms.	Lardizabalaceae	S	Arunachal Pradesh, Sikkim	
24	*Desmostachya bipinnata* (L.) Stapf.	Poaceae	H	Cosmopolitan in India	-
25	*Dickasonia vernicosa* L.O.Williums	Orchidaceae	H	Manipur	-
26	*Didiciea cunninghamii* King & Prain ex King & Prantl.	Orchidaceae	H	* Sikkim	E
27	*Dittelasma rarak* (DC.) Hook. f.	Sapindaceae	T	* Assam and Meghalaya	-
28	*Edgaria darjeelingensis* Clarke	Cucurbitaceae	H	* Sikkim	En
29	*Eleutharrhena macrocarpa* (Diels) Forman	Menispermaceae	WC	Meghalaya	-
30	*Eriodes barbata* (Lindl.) Rolfe	Orchidaceae	H	Meghalaya	-
31	*Eriophyton wallichianum* Benth.	Lamiaceae	H	Sikkim	-
32	*Flagellaria indica* L.	Flagellariaceae	T	Throughout India	
33	*Getonia floribunda* Lam.	Combretaceae	S	* Assam	
34	*Gynocardia odorata* R. Br.	Flacourtiaceae	S	Meghalaya, Sikkim	-
35	*Gynostemma pedata* Blume	Cucurbitaceae	C	Throughout India	
36	*Haldina cordifolia* (Roxb.) C.E.Ridsdale	Rubiaceae	T	Throughout hilly parts of India	-
37	*Hedina tibetica* (Thoms.) Ostenf.	Brassicaceae	H	* Sikkim	
38	*Hemidesmus indicus* (Willd.) Schult	Periplocaceae	WC	* Meghalaya, Sikkim	-
39	*Hemiphragma heterophyllum* Wall.	Scrophulariaceae	H	* Meghalaya	En
40	*Hodgsonia heteroclita* (Roxb.) Hook. f. & Thoms.	Cucurbitaceae	C	Assam, Sikkim, Meghalaya	-
41	*Hygrorhiza aristata* (Retz.) Nees ex Wight & Arn.	Poaceae	H	Throughout India	-
42	*Indofevellia khasiana* Chatterjee	Cucurbitaceae	C	Assam, Meghalaya, Arunachal Pradesh	En
43	*Jansenella griffithiana* (C. Muller) Bor	Poaceae	H	* Assam	-
44	*Jejosephia pusilla* (Joseph & Deka) Rao & Mani	Orchidaceae	H	Meghalaya	En
45	*Keenania modesta* Hook. f.	Rubiaceae	S	Assam	-
46	*Khasiaclunea oligocephala* (Havil) Ridsdale	Rubiaceae	T	Assam, Manipur, Meghalaya	-
47	*Lawsonia inermis* L.	Lythraceae	H	Throughout India	-
48	*Lepidostemon pedunculosus* Hook.f. & Thoms.	Brassicaceae	H	Sikkim	En
49	*Leptocodon gracilis* Hook.f. & Thoms.	Campanulaceae	H	Arunachal Pradesh, Sikkim	En
50	*Metadina trichotoma* (Zoll. & Mor.) Bakhuizen	Rubiaceae	S	Assam, Manipur, Meghalaya	-

Sl.	Botanical name	Family	Habit	Distribution in NE India	Status
51	*Micholitzia obcordata* N.E. Br.	Asclepiadaceae	S	Meghalaya, Manipur	En
52	*Myriopteron paniculatum* Griff	Periplocaceae	S	Assam	-
53	*Naringi crenulata* (Roxb.) Nicolson	Rutaceae	ST	* Assam	-
54	*Natsiatum herpeticum* Hamilt. ex Arnott.	Icacinaceae	C	Arunachal Pradesh, Sikkim	
55	*Nayariophyton zizyphifolium* (Griff.) Long & Miller	Malvaceae	T	* Manipur, Meghalaya, Mizoram, Sikkim	-
56	*Neodistemon indicum* (Wedd.) Babu & Henry	Urticaceae	H	* Assam	-
57	*Neogyna gardneriana* Lindl	Orchidaceae	H	Meghalaya	-
58	*Nicandra physaloides* (L.) Gaertn.	Solanaceae	S	* Sikkim	
59	*Notochaete hamosa* Benth.	Lamiaceae	H	Arunachal Pradesh, Sikkim	
60	*Ophrestia pentaphylla* (Dalz.) Verdc.	Fabaceae	H	* Meghalaya	En
61	*Pajanelia rheedii* DC.	Bignoniaceae	T	* Meghalaya	-
62	*Parakaempferia synantha* Rao & Verma	Zingiberaceae	H	Assam	En
63	*Parochetus communis* Buch.-Ham. ex D. Don	Fabaceae	H	* Assam	-
64	*Paroxygraphis sikkimensis* Smith	Ranunculaceae	H	Sikkim	-
65	*Pauia belladonna* Deb & Dutta	Solanaceae	H	Arunachal Pradesh	En, R
66	*Pauldopia ghorta* (Buch.-Ham. ex G.Don) Van Steenis	Bignoniaceae	C	NE India	-
67	*Pentabothra nana* Hook. f.	Asclepiadaceae	US	* Assam	-
68	*Peracarpa carnosa* Hook. f. & Thoms.	Campanulaceae	H	* NE India	-
69	*Phaenosperma globosa* Benth.	Poaceae	H	NE India	-
70	*Pistia stratiotes* L.	Araceae	H	Throughout India	-
71	*Polysolenia wallichii* Hook. f.	Rubiaceae	US	Assam	En
72	*Polyura germinata* (Wall.) Hook. f.	Rubiaceae	H	Meghalaya, Arunachal Pradesh	En
73	*Pongamia pinnata* (L.) Pierre	Fabaceae	T	Throughout India	-
74	*Pseudostachyum polymorphum* Munro.	Poaceae	H	Arunachal Pradesh, Sikkim	
75	*Pterocymbium tinctoria* (Blanco) Merr.	Sterculiaceae	T	* Tripura	-
76	*Pycnospora lutescens* (Poir.) Schindler	Fabaceae	H	Throughout India	-
77	*Risleya atropurpurea* King & Prantl.	Orchidaceae	H	Sikkim	En, I
78	*Sarcochlamys pulcherrima* Gaud.	Urticaceae	ST	Assam, Meghalaya	-
79	*Schima wallichii* (DC.) Korthals	Theaceae	T	* Arunachal Pradesh, Sikkim	-
80	*Souliea vaginata* (Maxim.) Franch	Ranunculaceae	H	Sikkim	-
81	*Sphaerocaryum malaccense* (Trin.) Pilger	Poaceae	H	Assam, Manipur	-
82	*Sphaerosacme decandra* (Wall.) Penington	Meliaceae	T	Sikkim	-
83	*Stilbanthus scandens* Hook.f.	Amaranthaceae	C	Arunachal Pradesh, Sikkim	En
84	*Streptolirion volubile* Edgew	Commelinaceae	H	* Assam, Manipur	-
85	*Sumbaviopsis albicans* (Blume) J. J. Sm.	Euphorbiaceae	H	Assam, Arunachal Pradesh, Tripura, Nagaland	-
86	*Tamarindus indica* L.	Caesalpiniaceae	T	Throughout India	-
87	*Tetracentron sinense* D.Oliver	Tetracentraceae	T	Arunachal Pradesh, Sikkim	
88	*Theropogon pallidus* (Kunth.) Maxim.	Liliaceae	H	* Meghalaya, Sikkim	En
89	*Thysanolaena maxima* (Roxb.) O. Ktze.	Poaceae	H	Throughout India	-
90	*Tinomiscium petiolare* Hook. f. & Thoms.	Menispermaceae	C	* Assam	-
91	*Treutlera insignis* Miq.	Asclepiadaceae	WC	Arunachal Pradesh, Sikkim	En
92	*Urena lobata* L.	Malvaceae	US	Throughout India	-
93	*Vossia cuspidata* (Roxb.) Griff.	Poaceae	H	* Assam	-

(*) in the distribution table indicates distribution of the taxa in other parts of India; Herb (H), Shrub (S), Undershrub (US), Climber (C), Woody climber (WC), Small tree (ST), Tree (T), Endangered (E), Vulnerable (V), Rare (R), Indeterminate (I), Endemic (En)

Discussion

Present day taxonomists involving molecular taxonomy consider both Monotypic taxa and endemic taxa as challenging and stimulating groups that has gained emphasis for conservation also. The Indian as well as North east Indian flora is thus unique in having not only a high proportion of endemic plants, but also monotypic taxa that exhibit global or regional affinities. Total 93 genera of the flowering plants are monotypic in the North east Indian flora represented by 44 families. Dicots (70 genera of 38 families) outnumber the monocots (23

genera of 6 families). The family Poaceae with 9 taxa can be considered the most dominant, followed by Orchidaceae (8), Cucurbitaceae (6), Rubiaceae (6), Fabaceae (4) and Menispermaceae (4) and these six families together account for almost 40% of the total number of monotypic taxa in the region (Table 3). The other families with multiple monotypic genera include Lamiaceae (3), Urticaceae (3), Asclepiadaceae (3), Rutaceae (2), Araceae (2), Scrophulariaceae (2), Amaranthaceae (2), Zingiberaceae (2), Brassicaceae (2), Periplocaceae (2), Campanulaceae (2), Malvaceae (2), Solanaceae (2), Bignoniaceae (2) and Ranunculaceae (2).

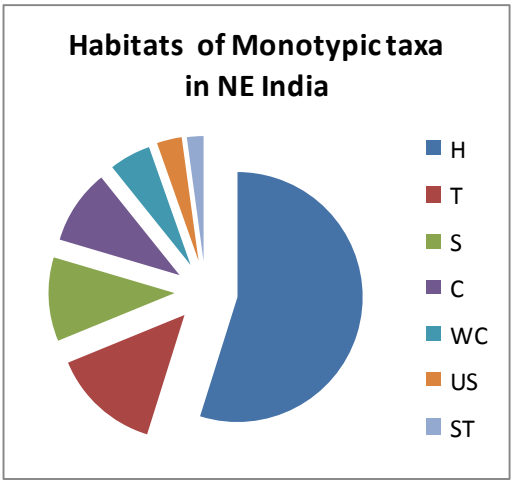
An examination of the monotypic taxa of North east Indian flora in terms of their habits is also informative. Herbs (51) constitute the largest group and contribute about 55% to the total number of monotypic taxa followed by trees (13), shrubs (10), climbers (9), woody climbers (5), undershrubs (3) and small trees (2) (Table 4).

Table 3. Dominant families of monotypic genera of North east India in Indian context

Family	No. of species in India	Monotypic genera in India	Monotypic genera in North east India
Poaceae	1100	32	9
Orchidaceae	890	10	8
Rubiaceae	275	11	6
Cucurbitaceae	97	08	6
Fabaceae	750	15	4
Menispermaceae	43	05	4

Table 4. Statistical analysis of the habitats of monotypic taxa of North east India

Habit	No. of taxa
Herbs	51
Trees	13
Shrubs	10
Climbers	9
Woody climbers	5
Under-shrubs	3
Small trees	2



The monotypic taxa, especially the endemic ones ought to have special attention from the conservation and sustainable point of view, because they represent species which could be lost forever in near future because their related genomes do not exist anywhere else in the world. Monotypic taxa are different from endemic plants in the sense that all monotypic taxa

are likely to be endemic to a region, but all endemic plants are not monotypic taxa. About 24 monotypic genera are under various categories of threat and among these 22 genera are endemic to the region. However, this rationale is not absolute as will be evident from the break-up of monotypic taxa in India as well as in North east India. Only about 38% of the monotypic taxa is endemic to India (Rana and Ranade, 2009) and restricted to different bio-geographical regions of the country among which 16 genera are restricted to North east India only.

As is evident from the records, monotypic plants like *Aboriella myriantha* (Dunn) Bennet (Arunachal Pradesh), *Brachycaulos simplicifolius* Dixit *et* Panigrahi (Sikkim), *Bythophyton indicum* Hook. f. (Meghalaya), *Cyathopus sikkimensis* Stapf. (Sikkim), *Indofevellia khasiana* Chatterjee (Assam, Meghalaya and Arunachal Pradesh), *Jejosephia pusilla* (Joseph & Deka) Rao & Mani (Meghalaya), *Lepidostemon pedunculosus* Hook.f. & Thoms. (Sikkim), *Leptocodon gracilis* Hook.f. & Thoms. (Arunachal Pradesh and Sikkim), *Micholitzia obcordata* N.E. Br. (Meghalaya, Manipur), *Parakaempferia synantha* Rao & Verma (Assam), *Pauia belladonna* Deb & Dutta (Arunachal Pradesh), *Polysolenia wallichii* Hook. f. (Assam), *Polyura germinata* (Wall.) Hook. f. (Meghalaya and Arunachal Pradesh), *Risleya atropurpurea* King & Prantl. (Sikkim), *Stilbanthus scandens* Hook.f. (Arunachal Pradesh and Sikkim) and *Treutlera insignis* Miq. (Arunachal Pradesh and Sikkim) are not only endemic to some small states of North east India but are also restricted to very small areas. *Didiciea cunninghamii* King & Prain ex King & Prantl. has become endangered and *Pauia belladonna* Deb & Dutta is rare and endemic to Arunachal Pradesh according to the data published by Botanical Survey of India.

It is a matter of concern that some of the monotypes of India (*Albertisia mecistophylla* (Miers) Forman and *Pauia belladenna* Deb *et* Dutta from NE India) have not been collected again after their original type collection [33]. Among these two monotypes, the type specimen of *Albertisia mecistophylla* (Miers) Forman was collected from India (Assam and Meghalaya) and Africa and type specimen of *Pauia belladenna* Deb *et* Dutta was collected from Arunachal Pradesh of India only which is also become rare as evident from floristic records of Botanical Survey of India.

Out of a total number of 236 monotypic genera, about 54% are found to occur in the Asian region including India [10] and among these 93 monotypic genera (39% of world monotypic taxa) are found in North east region of India.

Conclusion

Population size is a very important factor, which appears to have received little attention so far. A proper conservation strategy needs to consider different factors responsible for the decline of the population. Small plant population attracts less pollinator and has low reproductive success; less gene flow and demographic functioning. In the Origin of species, Darwin (1859) wrote “Extinction was an almost inevitable consequence of evolution. No fixed law seems to determine the length of time during which any single species or any single genus endures.” Monotypism is also a consequence of evolution which also could be thought in the light of Post-Darwinian conservation philosophy. Whatever be the distribution of monotypes,

collectively, all the monotypic taxa in a region are also perhaps the best descriptor of the biodiversity in that region.

In conservation and sustainable developmental programmes of biological diversity, the need to maximize the important taxa and methods for its sustainability are very essential; but it is also important to guarantee the maintenance of high level of biological diversity in the future, and to achieve this, consideration of phylogeny is essential. Floristic studies on Monotypic taxa as well as omega taxonomic approach are need of the hour.

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