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RESEARCH ARTICLE

THREATENED VASCULAR PLANTS OF KARNAPHULI RANGE UNDER KAPTAI RESERVE FOREST OF RANGAMATI, BANGLADESH

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ABSTRACT

Many plant species in protected areas and reserves are endangered and some of them are in the age of extinction. The present study was conducted to relocate listed/targeted threatened species during 2015-2018 from Karnaphuli range in Kaptai reserve forest, Rangamati, Bangladesh. An amalgamation of intersect with centered quadrat method was applied for sampling. This study obtained 25 targeted plants out of 45 from 6 main blocks in the study area. This study also foound that mixed plantation/block comprised with the maximum level of threatened plant species (16 species), followed by *Syzygium* dominant plantation/block (15 species) and *Lagerstroemia* dominant community (13 species), while 11 species obtained each from *Dipterocarpus* dominant vegetation and *Swietenia* dominant vegetation. Whereas the minimum species was observed in Teak dominant vegetation (9 species). Specific focus ought to maintain environs of those plants with small numbers for additional studies on ecology and ecological needs of those vulnerable/threatened species.

KEYWORDS

Biodiversity conservation, endangered species, species composition, species richness, forest plantation, Wildlife Sanctuary

1. INTRODUCTION

Bangladesh characterizes as a small island and is enriched with 5700 species of angiosperms (Ahammad and Stacey, 2016). Among these, 2260 species are naturally found in the mountain areas of Chittagong (Mukul, 2007). The Chittagong Hill Tracts (CHTs) is the most biologically diverse region of Bangladesh that makeup about 43 percent of the country's total forestland (Rahman et al., 2017; GOB and FAO, 2013). The CHTs in Bangladesh support nearly 80% of the total biodiversity of the country (Hossain et al., 2020). It is made up of different habitats, from hills to bodies of water, and is rich in flora and fauna. The mixture of Indo-Chinese floristic elements is phyto-geographically illustrated. The CHTs own one-third of the country's flowering plant species, despite having just about 10 percent of the country's land area. The majority of the tribal communities reside in this area and depend on the forest for their livelihoods (Sarker et al., 2020). Destruction and alteration of natural habitat in the Hill districts are widespread due to different activities including burning forest for Jhum cultivation and illegal logging (Chakma et al., 2021).

These activities threatened plant species leading to their extinction from the wild. Bangladesh's problems with endangered plant species were first addressed in the early 1990s (Khan et al., 2001). According to the 1997 IUCN Red List of Endangered Plants, 24 Bangladeshi plant species were at risk of extinction at different levels (IUCN, 2010). Later on, though not citing any sources, a group researchers listed 95 vascular plants as threatened (92 angiosperms and three gymnosperms) (Khan et al., 2001). According to the 2006 Global Red List, there were 12 plant species in 2006, and 16 plant species were listed as endangered in Bangladesh in 2010 (IUCN, 2010). By reference to the eight volumes of the Bangladesh Encyclopedia of Flora and Fauna (Volumes 5-12) on vascular plants, about 13% species were found to be threatened in the country (Ahammad and Stacey, 2016). The Bangladesh National Herbarium also listed 106 plant species in the endangered category (Khan, 1991). In Bangladesh, 21 plants have been classified according to the IUCN Red List (2010-2011), including 5 Critically Endangered (CR), 7 Endangered (EN), 9 Vulnerable (VU), 5 Near Threatened (NT), 9 Data Deficient (DD) and 326 Least Concerned (LC) species. The Bangladesh National Herbarium has listed 120 vascular plant species in a very recent publication that face threats of varying degrees, while listed 213 species as endangered (Ara et al., 2013; Ahammad and Stacey, 2016).

One of the most important steps is the precise assessment of the survival status of a plant species to effectively prevent the extinction of that plant species. The country's geographical location and climate support rich biodiversity, but unfortunately, there was not yet investigated work on threatened floras and many of the endemic floras have not been collected or reported since they were first described (Ghosh et al., 2020). Many of these threatened florae are represented by only a single taxon (Sarwar, 2015). Due to their limited geographic ranges, low abundances, and greater vulnerability to environmental changes, rare species may be under big challanges of extinction (Brunbjerg et al., 2018; Lomba et al., 2010; Lange et al., 2004). As mentioned in different literature, past work on threatened species was scattered and inform of unpublished reports.

From the conservation point of view, this situation demands urgent attention to conserve these endangered taxa from extirpation. To answer crucial questions like how fast are we losing species and why, and what are the conservation measures thathave to be taken, we need to create a baseline so that we've one thing against that to quantity modification. Further, scarcity of data on plant conservation and distributions typically collected in a long time and with a less spatial accuracy, assesses those species notably difficult (Marcer et al., 2013). However, like many areas of the country, Karnaphuli range has not been focus properly in the previous

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studies. Therefore, this study was taken to relocate the threatened plant species that were said to exist in this area.

2. Materials and Methods

2.1 Study Area

The study area extends over Karnaphuli range (KR) (Figure 1) of more than 2212.68 ha covering was surveyed during March 2015 to October 2018. KR is the largest unexplored forest under the Kaptai reserve forest of Rangamati district, Bangladesh. KR lies between 22°26' N to 22°38' N latitude and 92°8' E to 92°17' E longitude that is 60 km far from Chittagong city (Rahman, 2019). The mean monthly minimum and maximum temperatures were 24°C (in December) and 35°C (in May), respectively. The average annual rainfall is 2,540 mm. The highest wind velocity was 96.54 km/h (Feroz et al., 2014).

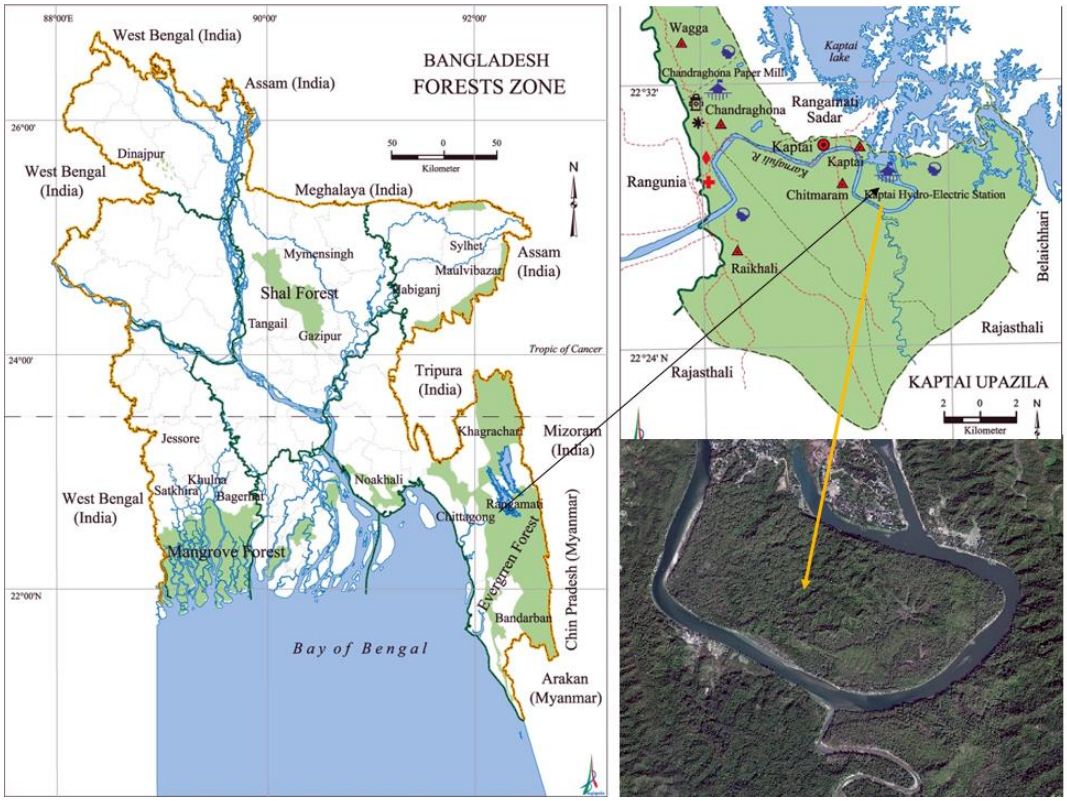

Figure 1: Map of Karnaphuli range

The highest concentration of rainfall prevails during the period from June to September, with pre and post monsoonal periods of rainfall received during April, May and October. November to March constitutes the dry season of KR (Figure 2).

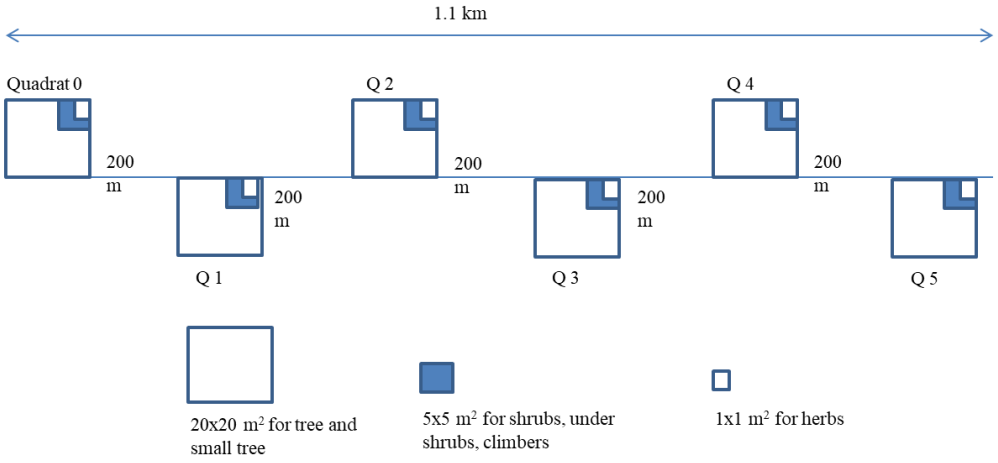

Figure 2: Diagrammatic sketch of sample plot in Transect

2.2 Methodology

Before starting the field survey, the study area was stratified into plantation category such Teak dominant. block (Tb), Dipterocarpus sp. dominant block (Db), Lagerstroemia sp. dominant block (Lb), Swietenia sp. dominant block (Swb), Sygyzium sp. dominant block (Syb) and Mixed block (Mb) ie. naturally grown plants area. Before the standardization of the plot size for each block, species-area curve methods were used to know the plot's minimum size. Based on that, in each planted area, 36 quadrats were laid down with each quadrat's size being 20 × 20 m for tree strata, 5 × 5 m for shrubs, and 1 × 1 m for herbs.

2.3 Data Analysis

The collected field data were compiled and analyzed with the help of MS Excel. For diversity indices analysis PAST 3.01 software was used. The species diversity was measured by using Shannon –Wiener (1963) index of diversity as;

$$H = -\sum (Ni/N) \log n (Ni/N)$$

Where,

N*i* is the total density value for species I and N is the total density value of all the species in a stand

Besides, the plants' conservation status was determined based on field observations and consultation (Rahman et al., 2009; Rahman et al., 2020; Rudra et al., 2020). All of the plants were gathered in one place, and their numbers were counted under their distinct families and conservation statuses.

3. Results and Discussion

3.1 Status of Threatened Plants

A total number of 25 threatened plant species under 25 genera as well as 16 families were found from the Karanphuli forest range. Uddin and Hassan recorded 19 threatened species from the near area of Rampaher (Uddin and Hassan, 2010). Like other PA area mentioned by some researchers this area harbored many plant species (Mukul et al., 2012). A group researchers recorded a total of 29 rare and threatened species in Sitakunda botanical garden and eco-park in Chittagong (Dutta et al., 2014). In contrast, 19 threatened plant species from Lawachara National Park of Bangladesh were recorded by Uddin and Hassan (Uddin and Hassan, 2012). Similarly, Arefin et al. recorded 17 threatened species in Satchari National Park of Bangladesh (Arefin et al., 2011). The recorded 25 species which were listed as threatened in different categories i.e. endangered (EN), vulnerable (VU), near threatened (NT), Data deficient (DD) (Table 1) (Ara et al., 2013). The highest number of threatened species were reported from the family Rubiaceae (5) which followed by Araceae (3), Apocynaceae, Orchidaceae and Sapindaceae (2 of each plant). Rests of the 11 families represented by a single species (Table 1). The majority of these species were found to be shrubs (36%), while the rest included herbs (32%) trees (28%) and climbers (4%) (Figure 3).

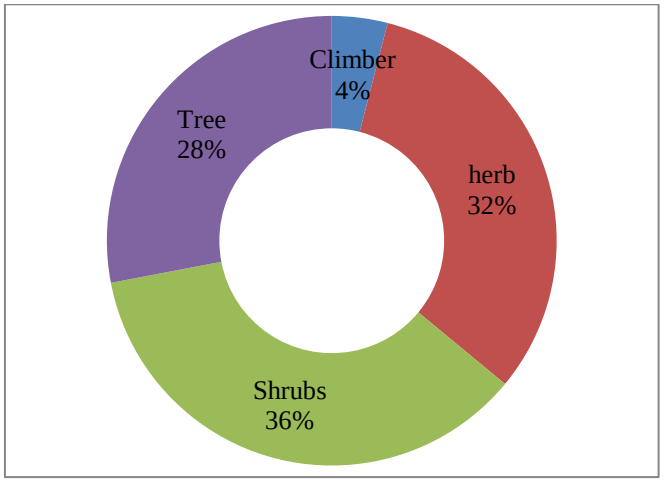

Figure 3: Life form of recorded threatened species of Karnaphuli range

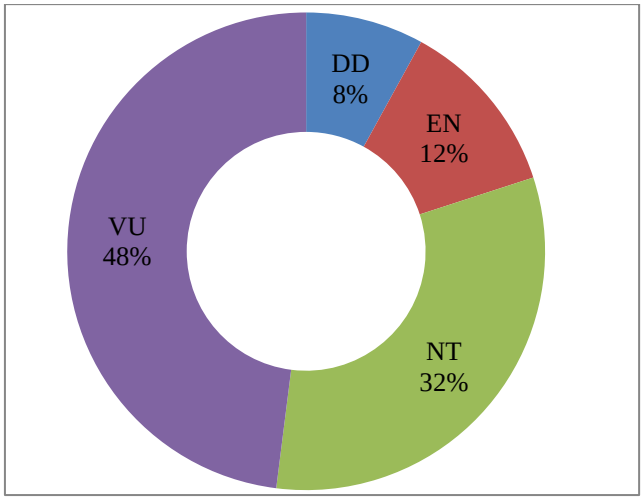

Figure 4: Conservation status recorded threatened species of Karnaphuli range

The conservation status of recorded threatened plants was assessed according to (Khan et al., 2001; Ara et al., 2013). Forty eight percent of them were vulnerable (VU), 32% were near threatened, 12% of them were endangered (EN) and the rest 8%, were data deficient (Figure 4).

3.2 Distribution of Threatened Species over the Study Area

The study revealed that all the plant habitats supported a good number of threatened plants except the teak plantation/block (Figure 6). The mixed block supported the maximum number of threatened plant species (16 species) with 17% of the total individual (48) and it recorded the highest threatened plant species diversity (H'=4.69). Syb recorded the second highest (n=14) number of threatened species with second highest species diversity (H'=4.54) followed by Lb representing 3rd highest diversity (H'=4.49). Though the diversity of Db (H'=3.68) and Swb (H'=3.64) varied from each but both of them supported same number of threatened plants. Teak block (Tb) recorded 8 threatened plant species with 38 individuals and it had the lowest species diversity (H'=2.62) (Figure 5).

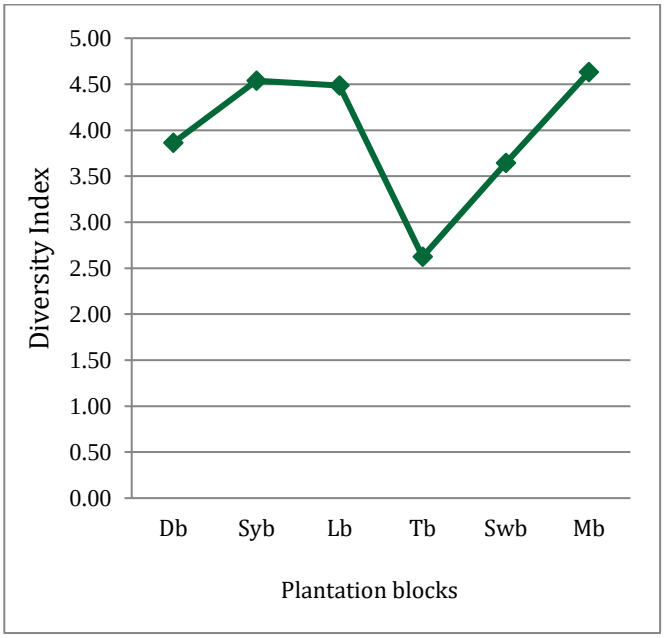

Figure 5: Shanon Weiner Diversity Index (H') in different plantations of Karnaphuli range

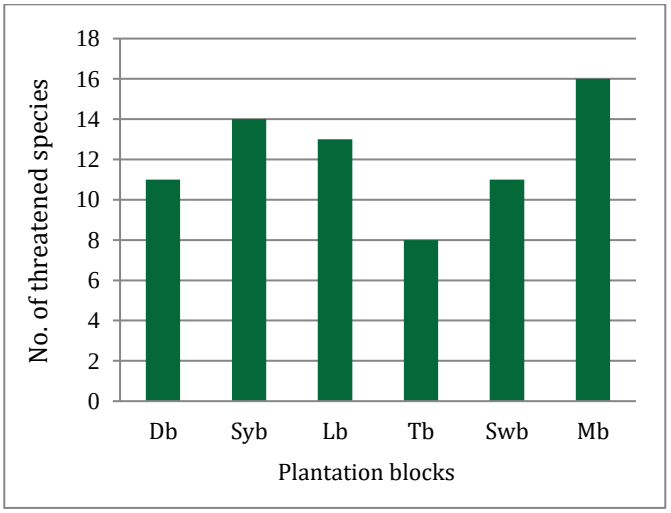

Figure 6: Number of threatened plant species in different plantations of Karnaphuli range

Aglaonema hookerianum, *Rhyncotechum ellipticum*, *Mussaenda roxburghii*, *Psychotria calocarpa* and *Holigrana longifilia* had wider distribution with 51, 32, 29, 27 and 24 individuals, respectively (Table 1). While *Scaphium scaphigerum* and *Symplocos macrophylla* were represented only one individual. On the other hand, *Harpullia arborea* represent only 2 species and *Cucumis hystrix* and *Rhaphidophora hongkongensis* each represent only 3 species. However some of the species were recorded in single habitat. Among these *Harpullia arborea*, *Scaphium scaphigerum* and *Symplocos macrophylla* were recorded from mixed plantation. *Cucumis hystrix* Chakrav. and *Nervilia aragoana* recorded from Syb. *Ophiorrhiza villosa, Crepidium biauritum* and *Bhesa robusta* were recorded only from the Lb, Tb and Swb blocks.

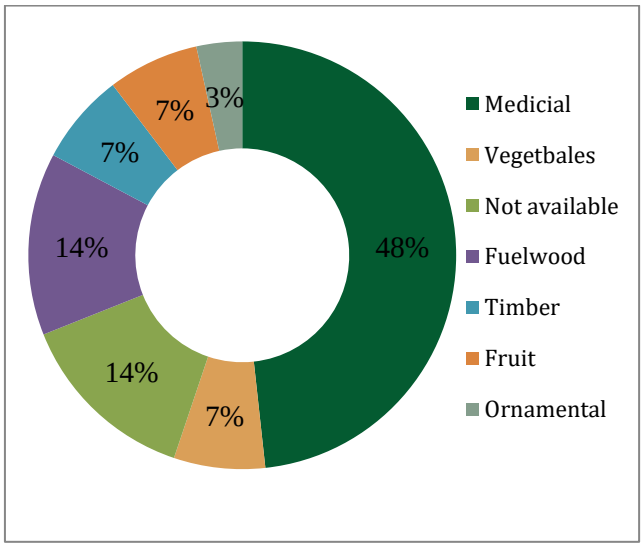

Figure 7: Uses of recorded threatened plants of Karnaphuli range

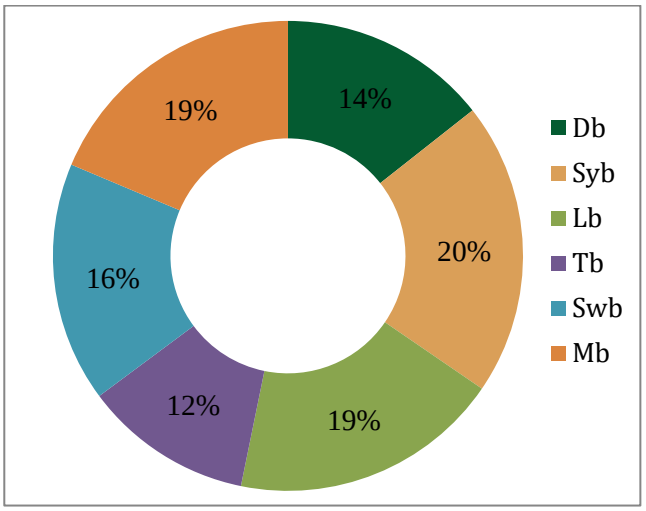

Figure 8: Total population of threatened plant species in different block of Karnaphuli range

Most of these threatened plants had very small population size (Table 1). These threatened plants were used for different purposes. Fourty eight percent of recorded species were traditionally used for medicinal purpose. The two threatened plants (*Cucumis hystrix* and *Homalomena aromatica*) were consumed as vegetables, fruits from two of these species (*Diospyros ramiflora* and *Xerospermum laevigatum*) were popular among local people rest of them used for fuelwood, timber and also as ornamental purpose (Figure 7) (Abdullah et al., 2020; Ara et al., 2013).

Kaptai reserved forest harbored many threatened species (Uddin and Hassan, 2012). From our study on plantation or block wise distribution of recorded threatened plants suggested that mixed plantation supported most conservation significant habitat, supporting 16 threatened plants out of 25 and 19% of total population. Whereas 20% population found in Syb followed by Lb (19%), Swb (14%) and Db (14%). The lowest population recorded in Tb (12%) (Figure 8). Thus population ratio of the block showed that prevailing conditions in all the plantation are favorable for the existence of threatened species except the teak plantation/block.

Table 1: Distribution of threatened plants in different blocks of Karnaphuli Range

Botanical Name	Db	Rel (%)	Syb	Rel (%)	Lb	Rel (%)	Tb	Rel (%)	Swb	Rel (%)	Mb	Rel (%)	Total
Aglaonema hookerianum Schott.	8	15.69	15	29.41	4	7.84	5	9.80	12	23.53	7	13.73	51
Ardisia solanacea (Poir.) Roxb.	0	0	0	0.00	3	50.00	0	0.00	3	50.00	0	0.00	6
Bhesa robusta (Roxb.) Ding Hou	0	0	0	0.00	0	0.00	0	0.00	5	100.00	0	0.00	5
Crepidium biauritum (Lindl.) D.L.	0	0	0	0.00	0	0.00	17	100.00	0	0.00	0	0.00	17
Cucumis hystrix Chakrav.	0	0	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00	3
Diospyros ramiflora Roxb.	1	16.67	3	50.00	0	0.00	2	33.33	0	0.00	0	0.00	6
Harpullia arborea (Blanco) Radlk.	0	0	0	0.00	0	0.00	0	0.00	0	0.00	2	100.00	2
Hedyotis thomsonii Hook. f.	0	0	0	0.00	0	0.00	2	25.00	0	0.00	6	75.00	8
Holigrana longifolia Buch.-Hum. *ex* Roxb.	1	12.5	1	12.50	0	0.00	3	37.50	0	0.00	3	37.50	8
Homalomena aromatica (Spreng.) Schott.	0	0	0	0.00	5	20.83	5	20.83	4	16.67	10	41.67	24
Marsdenia tenacissima (Roxb.) Moon	0	0	3	13.04	9	39.13	0	0.00	6	26.09	5	21.74	23
Mussaenda roxburghii Hook.f.	7	24.14	11	37.93	0	0.00	1	3.45	0	0.00	10	34.48	29
Mycetia longifolia (Wall.) Kuntz.	3	17.65	4	23.53	6	35.29	0	0.00	1	5.88	3	17.65	17
Myxopyrum smilacifolia Blume	0	0	4	44.44	1	11.11	0	0.00	1	11.11	3	33.33	9
Nervilia aragoana Geudich.	0	0	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00	5
Ophiorrhiza villosa Roxb.	0	0	0	0.00	7	100.00	0	0.00	0	0.00	0	0.00	7
Pilea melastomoides (Poir.) Wedd.	7	33.33	8	38.10	3	14.29	0	0.00	2	9.52	1	4.76	21
Psychotria calocarpa Kurz.	9	33.33	5	18.52	6	22.22	0	0.00	5	18.52	2	7.41	27
Rhaphidophora hongkongensis Schott	0	0	1	33.33	0	0.00	0	0.00	0	0.00	2	66.67	3
Rhyncotechum ellipticum (Wall *ex* D. Dietr.) A. DC.	4	12.5	1	3.13	10	31.25	0	0.00	13	40.63	4	12.50	32
Scaphium scaphigerum	0	0	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	1
Symplocos macrophylla Wall. *ex* DC ssp. macrophylla	0	0	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	1
Wrigtia arborea (Dennst.) Mabb.	3	37.5	0	0.00	2	25.00	0	0.00	2	25.00	1	12.50	8
Xerospermum laevigatum Radlk.	2	22.22	2	22.22	2	22.22	3	33.33	0	0.00	0	0.00	9
Zingiber rubens Roxb.	2	40	0	0.00	3	60.00	0	0.00	0	0.00	0	0.00	5
Over all threatened plants	47	14.37	66	20.18	61	18.65	38	11.62	54	16.51	61	18.65	327

Note: Teak dominant. block (Tb), *Dipterocarpus* sp. dominant block (Db), *Lagerstroemia* sp. dominant block (Lb), *Swietenia* sp. dominant block (Swb), *Sygyzium* sp. dominant block (Syb) and Mixed block (Mb)

4. Conclusion

Among the forest of Bangladesh, the selected forest is one of the major localities of threatened species in terms of number of species of threatened plant species located from a single place. Most of these recorded plants with very small populations indicate an urgent need to take conservation measures by the government of Bangladesh. Mixed plantation *i.e.* the natural forest, was more preferable to other forest plantations for threatened plant species. Most of these plants were with various types of uses other than the ecological importance. However, given the increasing

anthropogenic pressures on land there is an urgent need to protect the impending areas from conserving regional and threatened plant diversity, not only for ecosystem health but also for the benefit of the indigenous tribes who heavily depend on local plant diversity for their day-to-day requirements. The main limitation of this study lies on the data from a specific place. This kind of study can be extended in the future covering more areas. This study recommends an in-depth future research on biodiversity conservation and adpatation strategies for protecting the threatend species of plants.

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