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Myrica esculenta Buch.– Ham. ex D. Don. – a potential ethnomedicinal species in a subtropical forest of Meghalaya, northeast India

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ABSTRACT

Objective: To determine the effect of anthropogenic activities on the population structure and regeneration efficacy of *Myrica esculenta* (*M. esculenta*), an ethnomedicinally important tree species in sub–tropical forests of Meghalaya. **Methods:** The population structure and regeneration potential of *M. esculenta* were studied by using quadrat method. **Results:** The regeneration status of *M. esculenta* was highly influenced by disturbance. Presence of limited number of seedlings in the forest floor denotes the lack of seeds in the forests. The low conversion of seedling into saplings was mainly due to the removal saplings by the indigenous community, who residing in the vicinity of the forest for meeting their requirement of fuel wood. **Conclusions:** The findings of the present study indicate that overexploitation of *M. esculenta* may cause threat to extinction from wild. There is an obvious need to explore non timber forest products to a desired pace that will minimize the pressure on a particular species by providing alternative to a species, leading to sustainable utilization of genetic resources.

1. Introduction

Plants have been used in the traditional healthcare system from time immemorial, particularly among the local and indigenous communities[1–3]. In Meghalaya, *Myrica esculenta* (*M. esculenta*) (Myricaceae) is an economically important multipurpose tree species and locally known as 'Soh–Phi' by Khasi tribal community. This species is distributed in Indo–Malaya and sub–tropical Himalayas at higher elevations. The height of *M. esculenta* tree is moderate, and it is an evergreen and dioecious plant. Bark is brownish in color, rough and vertically wrinkled. Fruits are ellipsoidal or ovoid drupe almost the size of cherry, reddish or cheese colored when ripe with rugose nut. Trees of *M. esculenta* are growing naturally in the forest edges at high elevation and in high rain fed areas. The flowering starts in the last part of October and lasts upto December. The fruit setting begins in November and ripe fruits are made available from April to June.

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The *M. esculenta* possesses unique medicinal and industrial values. The bark of the species is known to possess many medicinal properties and have industrial use as well. Bark is used for tanning and dyeing, yellow colored dye. It is astringent, carminative and possesses antiseptic properties. Decoction is considered to be useful in asthma, diarrhoea, fever, chronic bronchitis, lung infections, dysentery and stomach problems. The bark is chewed to relieve toothache and lotion prepared from bark is used for washing putrid sores, and also used in fish poisoning by the indigenous comminutes of Meghalaya especially Khasis. It is also used as an external plaster in rheumatism. The oil from the flowers is a tonic, useful in earache, diarrhoea, inflammations and paralysis[1]. The leaves are rich in wax. The sub–sweetish fruits are eaten as raw and also used for making refreshing drink known as 'Um Soh–Phi' by Khasi people. The fruits can also be used for making beverages and jelly due to presence of high contents of total soluble sugar and pectin. The pickles can also be made using fruits. The villagers collect the wild edible fruits of *M. esculenta* from the forests and sell it in the market at 20–25 Rs. per kg[4]. Multipurpose nature of this plant has led to over harvesting, and negligence of sustainable utilization has adversely affected regeneration in natural condition. Therefore, in the present study an attempt has been made to determine how anthropogenic activities affect the population structure and regeneration efficacy of *M. esculenta* in sub-tropical mixed pine forest of Meghalaya.

2. Materials and methods

The present study was conducted in a sub-tropical mixed pine forest, which is located near the North-Eastern Hill University Permanent Campus, Umshing-Mawkynroh, Mawlai, Shillong (latitude 25°34′N, longitude 91°54′E, altitude 1 500 m asl), the capital of Meghalaya, India. These forests are developed as a result of degradation of primary broad-leaved forests by anthropogenic disturbance throughout northeastern India. The disturbance index was estimated as 28.2%. Cattle grazing, clear felling, fuel wood collection, harvesting of non timber forest products (NTFPs) inside the forest, timber extraction have resulted the massive destruction of the forest. This forest supports occasional supply of medicinal plants and wild edibles to the indigenous community who residing in the vicinity of the forest area in the season of availability.

The climate is monsoonic with distinct warm-wet and cold-dry seasons. During the study period the average annual rainfall was 2054 mm and mean monthly maximum and minimum temperatures were 21.2 ℃ and 13.4 ℃, respectively. The soils (latosol) which are derived largely from pre-Cambrian igneous rocks are highly weathered and acidic in reaction.

The canopy layer is largely composed of evergreen species such as *Rhododendron arboreum, Syzygium cumini* and *Schima wallichii* with some deciduous elements namely *Acacia* sp., *Callicarpa arborea, Engelhardtia spicata* and *Erythrina stricta*. The sub-canopy is composed of *Castanopsis, Cinnamomum verum, Docynia indica, Eurya acuminata, Eurya japonica, Pteris ovalifolia, Saurauia nepalensis, Symplocos* spp., and *M. esculenta*. Understorey vegetation was dominated by *Arundinella khasiana, Arundinella bengalensis, Axonopus compressus, Begonia* spp., *Eupatorium* spp., *Gleichinia, Houtinia cordata, Lantana camara, Rubus khasianus* and *Rubus ellipticus*. The perturbation of exotic invader *Eupatorium* spp. and *Lantana camara* denotes the anthropogenic disturbance of the forest.

Vegetation analysis was done between October 2005 and March 2007 as per the methods outlined by Mueller-Dombois and Ellenberg[5]. The quadrat method was adopted to study the vegetation. The community characteristics such as density, frequency and basal area of the trees (gbh >15 cm) were determined. For studying population structure of trees, saplings and seedlings, 40 quadrats of (10 m × 10 m) were laid. Coppice/sprout population was studied by counting the number of stems arising from the cut stumps. The stumped were grouped into five girth classes, *viz.*, 0-15, 15-30, 30-45, 45-60 and >60 cm. The number of sprouts emerging from the individual stump of each girth and height class was counted to study the sprouting behaviour of the species. Disturbance index was calculated by using the following formula: DI = (NTS/TNTS×100). DI represents disturbance index and NTS represents number of tree stumps presents in the forest stand whereas, TNTS represents total number of trees including the tree stumps. Canopy cover and light interception were also determined and enumerated in Table 1. Plant specimens were identified with the help of regional and local floras and counterchecked with the Herbarium of the Botanical Survey of India, Eastern Circle, Shillong for confirmation of species identified.

Table 1
Canopy cover, light intensity, tree density and number of tree stumps (ha^{-1}) and the level of disturbance in the sub tropical mixed pine forest stands of Meghalaya.

Parameters	Value
Canopy cover (%)	<40
Light interception (%)	>50
Tree density (individuals ha^{-1})	930
Density of *M. esculenta* (ha^{-1})	122.5
Number of tree stumps (ha^{-1})	318
Disturbance index (%)	25.48

Five soil samples were collected from two soil depths *viz.* 0-15 and 15-30 by using soil corer. The soil samples of a given depth were mixed thoroughly, passed through a 2-mm sieve and used for physico-chemical analysis. Soil texture was determined by the Bouyoucos hydrometer method. Moisture content was estimated gravimetrically that using freshly collected soil samples. pH was determined in a solution of soil and distilled water (1:2.5 w/v). Organic carbon content was determined by Walkely Black method and total Kjeldahl nitrogen by micro-distillation method. Available phosphorus was determined using molybdenum blue after extracting the soil phosphorous in 0.5 M sodium bicarbonate solution[6]. The analysis of the soil showed that, the soil was sandy and acidic, the concentration of organic carbon, nitrogen and phosphorus was low and was described in Table 2. The low nutrient concentration and acidic nature of the forest may be the over leaching of organic materials in the forest floor because of heavy rainfall in the area.

Table 2
Soil characteristics of the study area (mean±SE).

Parameters	Soil depth (cm)	
	0-15	15-30
Sand (%)	84.20±0.40	78.30±0.40
Clay (%)	10.10±0.01	8.40±0.20
Bulk density (g/cm^3)	0.88±0.20	0.98±0.01
pH	4.98±0.10	5.20±0.10
Moisture content (mg/g)	342.00±16.20	358.00±18.20
Organic carbon (mg/g)	11.20±0.10	9.40±0.10
Total Kjeldahl nitrogen (mg/g)	1.50±0.02	1.25±0.01
Available phosphorous (mg/g)	0.03±0.00	0.03±0.00

3. Results

A total of 21 tree species belonging to 15 families were identified from the present study in the 0.4 ha area, however understorey species were found to be high in the forest (72 species). Theaceae was the dominant family having 5 species, followed by Symplocaceae and Verbenaceae having 2 species each, whereas 12 families were monospecific. Disturbance was directly linked with species composition resulting in low tree species content (21 species) and high number of understorey species in the forest. The total tree density accounted from the present study was 930 individuals per hectare (Table 1). *M. esculenta* is the dominant species in terms of stem density (122.5 ha^{-1}). However, IVI value of *Pinus kesiya* (83.44) was greater than *M. esculenta* (64.75).

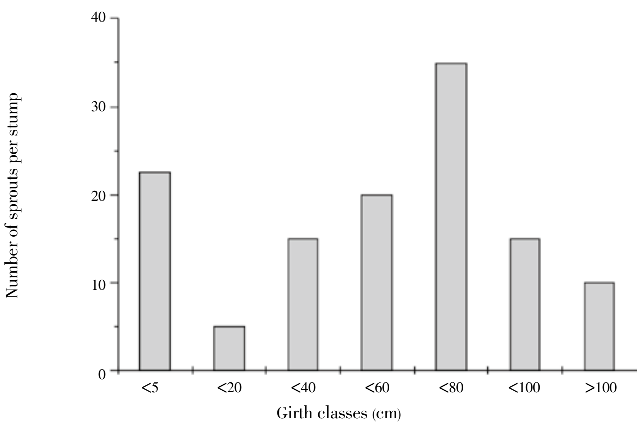

Figure 1. Stem density of seedlings (<5 cm), sapling (5–20 cm) and trees (> 20 cm) population of *M. esculenta* in the study area.

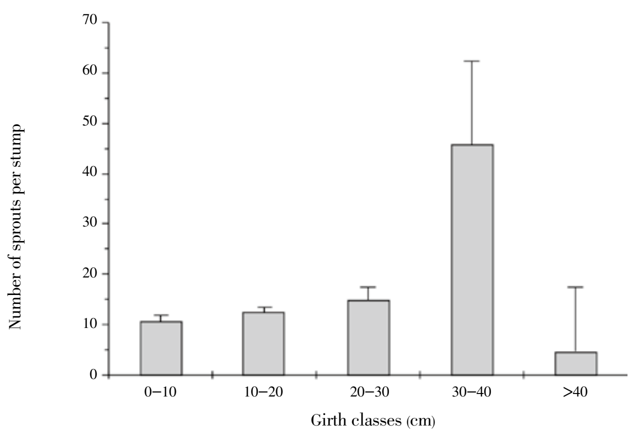

Figure 2. Effect of stump girth on sprouting behaviour of *M. esculenta* in the study area.
Line bar indicates ± SE.

The regeneration status of *M. esculenta* was highly influenced by disturbance. Percentage of seedlings (22.25) in the forest floor was very low (Figure 1). Presence of limited number of seedlings in the forest floor denotes the lack of seeds in the forests. The indigenous communities residing in the vicinity of the forests are mostly depending on the forest products for income especially women; they cut the branches using small sickles tied with the bamboo sticks and collect the available fruits in the trees. It could be the reason for the low availability of seedlings. The percentage of seedlings that grew into saplings is found to be very low (about 5). The low conversion of seedling into saplings was mainly due to the removal saplings by the indigenous community, who residing in the vicinity of the forest for meeting their requirement of fuel wood. The percent conversion of saplings into trees was 15.33. Sprouts are the important means of tree regeneration where tree felling and cutting is common. The sprouting behaviour of *M. esculenta* was high in the stumps of intermediate (30–40 cm) girth classes (Figure 2).

4. Discussion

The anthropogenic disturbance was responsible for change in community characterization and altering the floristic composition. Past studies reported that anthropogenic activities often accelerate species loss whose speed is greater than that of operations of internal biological processes[1]. The majority of the single species family shows the change in microenvironment because of disturbance in the forests.

The disturbance adversely affected growth and survival of plants in seedling stage. The studies conducted by earlier workers found that there is the presence of good regeneration of same species in the sacred forests (protected forests) of Meghalaya[7]. From the above results it is strongly suggested that the poor regeneration of *M. esculenta* in the forest stand shows the disturbance. About 46 percent of the stems of *M. esculenta* were found to be moderate girth size ranging from 40 to 80 cm and 13.3 percent were in the range of 80–100 cm, whereas about 6 percent of the species are in larger girth class (>100). The majority of moderate girth class stemmed trees indicated thereby that trees had been good regeneration potential in the past.

The greater light intensity is favored for the sprouting of *M. esculenta* in the forest stand. Similar results were obtained in the studies conducted by other workers in the sacred forests of Meghalaya. The stumps of intermediate girth classes produced maximum number of sprouts, which may be related to change in tree physiology with age. Reduced sprouting from the mature stumps indicates arrest of vegetative propagation in old trees. In fact, vegetative propagation predominates in the juvenile phase, whilst sexual reproduction in the adult phase. With the increase in tree age, the number of dormant buds, which subsequently give rise to sprouts, is reduced due to their death. The low population of trace buds in the tree stumps having low girth causes decreased sprouting. The earlier workers reported that, it is particularly true in northeast India where microbial decomposition is fast due to edapho–climatic conditions[8,9]. The present study found that disturbance in the form of clear felling of trees plays a positive role in regeneration of forest trees through coppicing, which is an agreement with a study in the Appalachian forest. Thus the regeneration behaviour of forest trees seems to be closely linked with the level of disturbance in the forest ecosystem and regeneration of the various component tree species, a detailed investigation would be required.

The findings of the present study indicate that overexploitation of *M. esculenta* may cause threat to extinction from wild. There is an obvious need to explore NTFPs to a desired pace that will minimize the pressure on a particular species by providing alternative to a species, leading to sustainable utilization of genetic resources. Because indigenous communities depend on natural resources and have shared interests with conservationists, and therefore in the appropriate policy environment, the two are natural allies[10-14]. This can easily be achieved, if the government of India launches programmes involving local community on care and share basis for conservation of such genetic resources. The necessary steps should also be taken for cultivation of this important potential multipurpose tree species in agroforestry systems. Development and introduction of advanced nursery technique, protection of natural regeneration and sustainable utilization could be the basic tool for conservation of this biological resource for future generation without compromising the needs of present generation.

Conflict of interest statement

We declare that we have no conflict of interest.

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