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Eco-biology and artificial culture of a rare economic plant from an unregulated Himalayan river ecosystem

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ABSTRACT

Ecology and biology of Oxystelma esculentum (L. f.) Sm. [Asclepiadaceae], a rare economically important (medicinal value) amphibians climber, was recorded in a static water body (meander cut-offs) as well as in the adjacent riparian zone (riverbank) in the down stream of the proposed 2000 MW Lower Subansiri Hydel Project were investigated. The species is flourishing very satisfactorily in both the aquatic and terrestrial habitats but are abundant in aquatic habitat as an emergent climber and can be used as an ornamental. Success of artificial culture of this plant is also reported. The proposed large dam will disrupt the down stream by changing water flow regime; obstructions to organism dispersal, with subsequent changes could have a chance of riddance of this rare economic climber. Artificial culture practice can be adopted for both conservation and management of this economic plant and one can develop a law cost entrepreneurship to earn livelihood besides creating employment generation.

Key words: *Oxystelma esculentum* (L. *f.*) Sm., dam impact and conservation.

INTRODUCTION

On the basis of their geographical location and origin Indian rivers are classified into two types viz. Himalayan rivers and Peninsular rivers. Himalayan rivers are glacier fed and perennial, while peninsular rivers are altogether monsoon fed [1]. The Subansiri River is the largest tributary of the Brahmaputra River in the Indian states of Assam (Fig. 1) and Arunachal Pradesh and the Tibet Autonomous Region of China. The Subansiri is 442 km long, with a drainage basin 32,640 square km large [2]. Its maximum observed discharge was 18,799 cubic meters per second (663,900 cu ft/s), and its minimum discharge was 131 m^3/s (4,600 cu ft/s). It contributes

7.92% of the Brahmaputra's total flow [3]. The Subansiri River originates in the Himalayas in China. It flows east and southeast into India, then south to the Assam Valley, where it joins the Brahmaputra River in Lakhimpur district. It is sustained by snowmelt run off, the ablation of glaciers and monsoon rainfall. After flowing for 190 km in Tibet, it enters India and continues it journey through the Himalaya of India for 200 km and enters the plains of Assam near Gerukamukh of Dhemaji district. Its total length is 520 km and drains a basin of 37000 sq km [4]. Himalayan Rivers provide different gradient of habitat heterogeneity from its headwater to mouth for colonization of aquatic flora and fauna [1]. Down stream of river Subansiri support an enormous diversity of life by providing a range of habitats between aquatic and land ecosystems including the river channels, riparian zone, riparian wet lands, meander cut-offs. Both aquatic and floodplain ecosystems are maintained by the dynamic flow patterns of the river.

In the down stream, freshwater habitats associated with river systems include both static water bodies (such as floodplain pools and meander cut-offs) and flowing water environments rich in species diversity [4]. In a particular static water body and adjacent riparian corridor a rare macrophytic climber namely, *Oxystelma esculentum* exhibit its existence. This paper reports on ecobiology and ornamental values of the species prior to the construction of a large dam, upstream from this habitat. Probable impact upon this plant from the proposed dam is also discussed. An attempt has also been made for artificial culture of the plant.

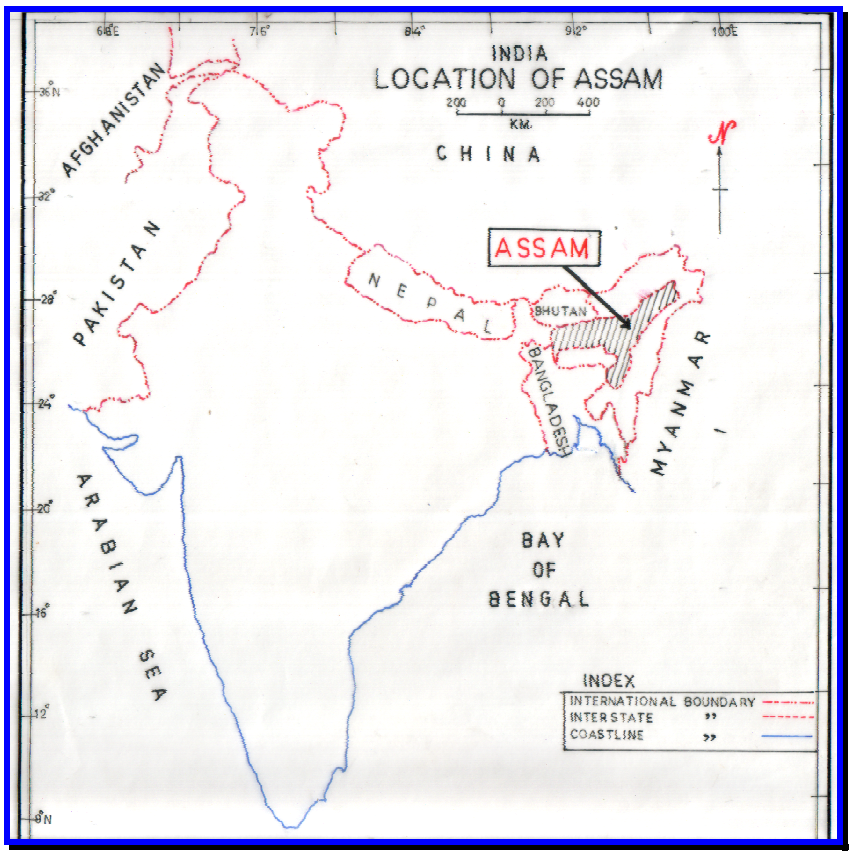


Fig.1. Location map of Assam

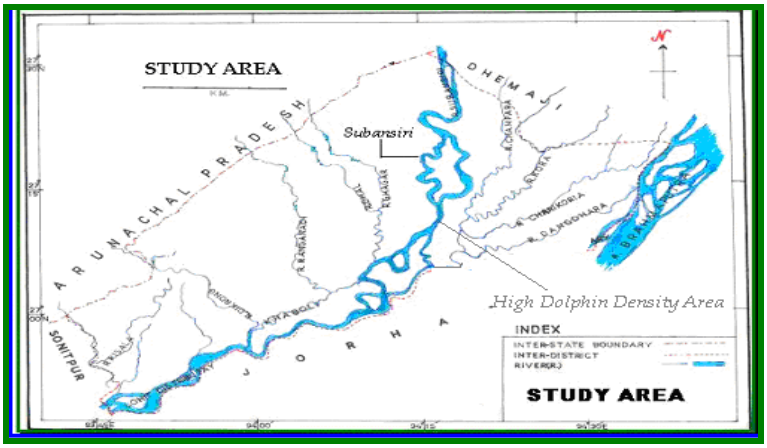


Fig. 2 Study area

MATERIALS AND METHODS

After identification of habitats (Fig. 2), the ecology of the plant was studied according to Ambasht [5]. For morphological characterization, the plant was collected and taken in the laboratory. Taxonomic and other related study was done in the laboratory with the help of standard literature of [6, 7 and 8] by dissecting the flower and studied their morphological characters. For artificial culture, a cement cistern was constructed (size 1.5 m .x .5 m x .75 m). Before planting the species, the cistern bed was filled with sandy-loamy soil (6-7 inches) and filled it with tap water. The plant parts used here was the base of the stem from where roots can be developed easily. The selected parts then planted in the bottom mud for regeneration.

RESULTS

3.1 Abundance: In the down stream of the proposed dam, a natural meandering cut-offs is developed, where the species is abundant as a pure aquatic climber [Fig. 3 (**a**)]. In the draw down zone and the deeper periphery, the plant is flourishing very well. In the deeper region the root system of the plant anchorage to the bottom. The submersed portion ranges from 1 meter to 4 meter. In contrast to the aquatic habitat, the species also found to be present in the adjacent sandy riverbank as a riparian climber [Fig. 3(**b**)]. The vegetative growth of the plant starts from April till October in both the habitats. Flowering occurs from June and continues up to October last. In the aquatic habitat, the plant used to climb on *Salix tetrasperma*, the only woody aquatic emergent plant available in the meander cut-offs. In the riverbank riparian corridor (terrestrial habitat), the climber used to climb on two amphibians plant namely *Tamarix diocia* and *Ipoeia carnea* abundant in the river bank. Abundance is lesser in the river bank in contrast to the meander cut-offs .No difference have been observed in their vegetative and reproductive structure between the plants growing in two different habitats. Anatomy of stem and leaf shows hydrophytic characters [Fig. 4 (**a**) and (**b**)].

3.2 Ecological status: As far as ecological status is concerned the plant is found to be rare in the Brahmaputra valley, Assam, India. According to our observation the habitat of the plant is in lentic water, water logged soils and sandy river bank.

Systematic Position

Kingdom: Plantae

Phylum: Spermatophyta

Sub-phylum: Angiosperm

Order: Gentianales

Family: Asclepiadaceae

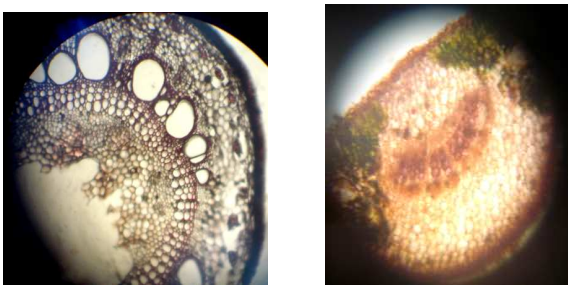
Genus: *Oxystelma*

Species*: esculentum*

3.3 Morphological characters: The plant is laticiferous **c**limber with faintly striped stem. Leaves are, opposite, petiolate, 4.5-9 x 0.6-3 cm, linear or linear-lanceolate, apex acute, base rounded, glabrous or nearly so; nerves slender, united in intra-marginal loops; petiole 8-10 mm long. Flowers are regular, bisexual, hypogynous, white-purple in colour occurring in lateral, drooping, lax, sub-umbellate or racemiform cymes; peduncle 9 cm long; pedicels 1-1.5 cm long; bracts minute. Calyx 5-lobed, connate; glands within; lobes 3 x 1 mm, ovate-oblong, acute Sepals 5, imbricate, polysepalous, 3 mm. Corolla white with purple streaks, 2 cm across, saucer-shaped; tube short, with a ring of hairs; lobes broadly ovate-deltoid, conspicuously ciliate at margins. Petals 5, valvate, gamopetalous, pink-purple veined. Stamens 5, epipetalous with outer protective layer slightly brownish, 1.cm. Corona 2-seriate, staminal; outer cupular, inner 5-lobed, ovate-lanceolate, apex narrow, acuminate, free, stamens 5; filaments connate; anther 2-celled; pollinia pendulous, 1 in each cell; connective prolonged into membranous tip. Carpels 2, style apex flat, bicarpellary, 2 locular, syncarpous, ovary superior, free, stigma convex, style short, greenish. Fruits are 4.5 cm. long. Seeds are berry, seed coat smooth, spongy, containing large air spaces, hairy. Roots are fibrous emerging from the lower nodes of the stem. Flowering starts from June and continues up to October.

(a) **(b)**

Fig. 3 *Oxystelma eslculentum* (a) Blooming on the host in the aquatic habitat (b) Blooming in the terrestrial habitat



(a) **(b)**

Fig. 4 (a) Stem anatomy (b) Leaf anatomy

3.4 Artificial Culture: In the artificial culture, the plant was found to be regenerated very well (Figure: 5). The vegetative growth was very fast and within 15 days the plant started their reproductive cycle. Flowering was observed with good numbers till 1st week of November unlike in wild condition where flowering occurs from early June to mid October.

Fig. 5 Oxystelma esculentum in artificial culture

DISCUSSION

Oxystelma esculentum (L. *f.*) Sm. [Asclepiadaceae] was first collected in 19-08-1854 by Schimper, W.,Kew No# 2305 from Ethiopia and kept in the Royal Botanic Garden, (Kew, London, England, UK, K000234398). According to the Royal Botanical Garden, the species is also found in South Africa, and some areas of China, India, Sri Lanka, Java. Shimoga. Literature on this plant argued that the plant is rare. In the present study, habitat of the species is confined to a particular region of the down stream of river Subansiri and it could be possible due to the natural flow pattern of the river helps in increasing the effectiveness of hydrochory of the seeds and other vegetative propagules of *Oxystelma esculentum* .The present aquatic conditions, where they create their habitat made a link with the river system at least for the four months. This ecological relationship provides a wide range of habitat for the aquatic, terrestrial and amphibian plants by supplying free flowing water and nutrients in the form of sediments and plant debris [4]. The woody emergent amphiphytes *Salix tetrasperma* Roxb.(Family: Salicaceae) and *Tamarix diocia* Roxb. (Family: Tamaricaceae) acts as hosts for this climber. Similarly, in the sandy riverbank riparian corridor, *Tamarix diocia* and *Ipomoea carnea* Jacq. (Family: Convovulaceae) helps these species to climb. *Oxystelma esculentum* prefers to grow in aquatic

condition rather than terrestrial condition, which reflects its abundance in oxbow (aquatic habitat) than to the riverbank. Presence of aerenchymatous tissue in the stem and leaf anatomy shows its hydrophytic adaptation (Fig. 4). There is no report with reference the occurrence of this plant in other parts of Assam.

The plant has tremendous medicinal values [9, 10, 11 and 12]. The plant is hot, bitter, tonic, expectorant, pungent, dry and indigestible; causes flatulence, diuretic, laxative, aphrodisiac, anthelmintic, useful in leucoderma and bronchitis. The juice is used in gonorrhea, pain in the muscles, cough and given to children as an astringent. The milky sap forms a wash for ulcers. A decoction of the plant is useful as a gargle in infections of throat and mouth [13].

Dam alteration of hydrologic processes may disrupt the natural dynamic equilibrium of a river system, and if somehow changed, it may take centuries for a new dynamic equilibrium to be attained by a channel and floodplain. The proposed 2000 MW large dam will fragment the down stream of the dam, which in turn may destroy the habitat of this rare species and could have a chance of elimination, because dams regulate most of the world's rivers and caused floristic disruptions of riparian corridors [14].

Artificial culture of this economic plant may be taken as a proper way for both conservation and management of this rare economic plant and can be used as a cultured pond plant without much expenditures and efforts. Artificial culture practice of this plant can be adopted only for short term conservation and management. The proposed large dam will disrupt the down stream by changing water flow regime; obstructions to organism dispersal, with subsequent changes could have a chance of riddance of this rare economic climber. Therefore, cataloguing of genetic diversity becomes essential for efficient and sustainable germplasm management of the species since there is no information available regarding the existing germplasm diversity of this plant in India. DNA profiling and nuclear DNA content estimation of the plant from different places of India growing in water and sand will help to assess the genetic diversity for improvement of the plant.

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