Structure and genetic variability of new populations of *Amentotaxus assamica* in the Eastern Himalaya, India

Amentotaxus assamica D.K. Ferguson (common name: Chinese yew) belongs to the gymnospermic family Taxaceae. It is one of the two members of this family found in India, the other being *Taxus wallichiana*. *Amentotaxus* is a tall dioecious tree reaching a height of 20 m with horizontal or drooping branches. It is confined to small pockets in the Eastern Himalaya, specifically in Arunachal Pradesh, India. The tree finds usage for making pillars and posts in house construction. Following the 'critically endangered' status assigned to the species by the Conservation Assessment and Management Prioritization (CAMP) workshop (February 2003), attempts have been made to locate and assess its population status. Gajurel *et al.*[1] recorded 22 individuals along with five saplings and two seedlings from Mithumna, Dalai Valley, Arunachal Pradesh, the site from where the plant was first reported by F. Kingdom War in 1928. Das *et al.*[2] reported a fairly large population at Turoo forest, Sagalee subdivision, Pampum Pare district, Arunachal Pradesh, having tree density of 40 individuals/ha.

Apart from these two reports, the species has not received much attention, probably because of its remote location and unknown economic value. It was only in 2012 when an initiative was taken by the Department of Biotechnology, Government of India, to conduct extensive surveys of critically endangered plants in the country, that the species came into limelight again. This note, which is part of the above-mentioned initiative, discusses the demographic and genetic structure of newly located populations in the Dalai Valley during 2013–2015. During the survey four new populations were located; Umling Agam, Milembam, Chipra Hill and Pattailiang Hill situated between an altitudinal range 1750 and 2100 m. Complete enumeration was carried out for Pattailiang Hill and Umling Agam, whereas 20 sample plots of 10×10 m for trees (>15 cm girth), 40 plots of 5×5 m for saplings (5–15 cm girth) and 80 plots of 1×1 m for seedlings (<5 cm girth) were laid at Milembam and Chipra Hill. Further, leaf samples from 20 trees were randomly collected for analysis of genetic diversity from these two populations.

The closest population of *Amentotaxus* in the Dalai Valley is located at Umling Agam (96°33′02.2″E, 28°12′43.4″N). The number of individual trees recorded was only six with no regeneration. The trees are of pole size with girth ranging between 18 and 46 cm. The second site is Pattailiang Hill (96°36′38.7″E, 28°18′15.0″N), which had only four adult individuals and one sapling. The other two populations, at Milembam (96°32′22.5″E, 28°14′19.8″N) and Chipra Hill (96°34′45.5″E, 28°16′39.7″N), had tree density of 175 and 104.16, sapling density of 180 and 883.33, and seedling density of 4800 and 2200 individuals/ha respectively. At both sites, trees across various girth classes were well represented (Figure 1). Both these populations may be considered stable as evident from the density of adult trees, saplings and seedlings, which takes the form of an inverted *J*-shaped curve. To the best of our knowledge, such stable populations of *Amentotaxus* have not been relocated so far. Locating good populations of any endangered species is a major breakthrough for any species recovery programme. The remnant populations can be used as a source for mass multiplication of the species for reintroduction, enhancement and reinforcement to extant populations as well species introduction in niche areas.

Successful management of many rare plant populations has been greatly improved by genetic data[3]. The collection of data on population genetic structure of rare species has become a common prelude to conservation planning[4,5]. Here we conducted a preliminary assessment of the genetic diversity based on seven ISSR primers for Milembam and Chipra Hill populations. The Shannon information index of the Milembam population calculated using GenAlEx software was 0.51 ± 0.03 and that of Chipra 0.30 ± 0.04. Table 1 shows other genetic parameters such as allele number and expected heterozygosity for both populations. Contradictory to theoretical expectations, the two populations possessed reasonably high levels of genetic variation. The genetic diversity was higher than some of the widely distributed species from the same family, such as *Taxus fauna*[6] and *Taxus wallichiana*[7]. *Amentotaxus* being a predominantly outcrossing species has accumulated high levels of diversity within the populations, and this diversity has been preserved due to the relatively undisturbed nature of the sites.

After a gap of almost 10 years, *A. assamica* is back to the scientific world. The new population located should trigger further studies on species and its habitat. However, the threat of large cardamom cultivation heavily looms over the region and massive land clearings

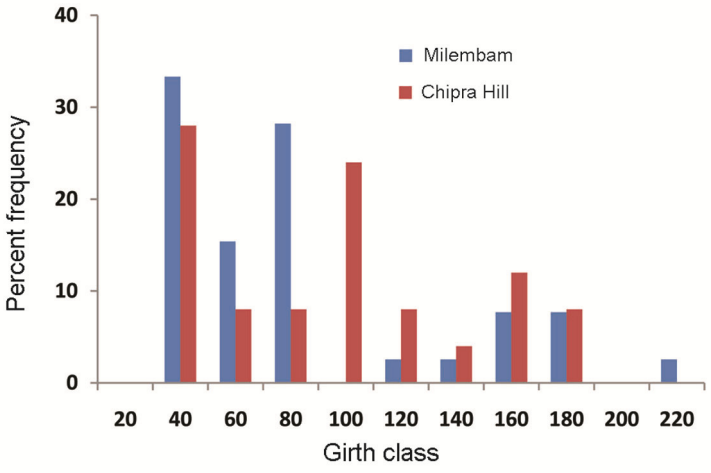

Figure 1. Percentage frequency of *Amentotaxus assamica* in Milembam and Chipra Hill site (Dalai Valley), Arunachal Pradesh, India.

Table 1. Genetic parameters of two populations of *Amentotaxus assamica*

Site	*N*	Na	Ne	*I*	He	uHe
Chipra Hill	14	1.51 ± 0.07	1.39 ± 0.06	0.30 ± 0.04	0.21 ± 0.03	0.22 ± 0.03
Milembam	17	1.82 ± 0.05	1.63 ± 0.05	0.51 ± 0.03	0.35 ± 0.02	0.36 ± 0.02

N, Number of individuals; Na, Allele number; Ne, Expected allele number; *I*, Shannon information index; He, Expected heterozygosity and uHe, Unbiased expected heterozygosity.

occur every year. Therefore, on a priority basis, our efforts should be first directed to convince the local population to conserve the habitat and the species, may be by providing incentives, up to a point where successful reintroduction, enhancement and reinforcement, and introduction in niche areas are achieved. Further, appropriate strategies need to be designed for the restoration and recovery of this endangered species and specific management protocols need to be developed for utilization of *A. assamica*[5]. Long-term monitoring programmes need to be developed to periodically assess the population changes of this species, especially in areas which are under threats and populations where planting would be taken up.

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