(ref. 21) and 1 to 2 μg/ml (ref. 22). In our study, there has been good concordance between LJ MIC method and Etest. There is apparent need to analyse the relationship between cut-off points. There was 85% concordance between the two methods when 1 μg/ml on Middlebrook agar by Etest was used as cut-off. However, there was 100% concordance when the cut-off was changed to 0.75 μg/ml. This needs to be confirmed in a large number of isolates.

This study shows that Etest compares well with LJ medium MIC method. Though it needs to be compared in a large number of isolates, minor changes in cut-off point for INH to 0.75 μg/ml are possibly required. With minor changes among the criteria, Etest should be applicable for susceptibility testing of *M. tuberculosis* globally, even in countries like India where LJ medium is still used due to economic and logistic reasons.

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Psilotum complanatum Sw., a rare epiphytic fern ally of Great Nicobar Island: Exploration and habitat monitoring

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The Great Nicobar Island is considered as a unique zone of biodiversity housing many rare, endangered and endemic plant species. The pteridophytic species of the region possess a narrow range of adaptability and narrow ecological amplitude. *Psilotum complanatum* Sw., a rare epiphytic fern ally of the Great Nicobar Island is found in specific localities, particularly associated with tropical evergreen formations. Detailed assessment of biodiversity and its distribution pattern at species and community levels is necessary for bioprospecting. In this respect, the present study aims to establish species–habitat relationship based on field observations and also highlights interspecific relation of *P. complanatum* Sw. with another important fern species, *Sphaeropteris albosetacea* (Bedd.) Tyron (*Cyathea albosetaeca* Bedd; the tree fern).

THE Great Nicobar Island (Figure 1) is blessed with unique flora, interesting fauna and a network of five rivers (Alexandra, Jubilee, Galathea, Amrit Kaur and Dogmar). The tall and well-stratified trees provide a suitable habitat for growth of epiphytic ferns. Kurz, in 1876, reported a few ferns from here; later, in 1987, Ellis reported 120 species of pteridophytes, among which 60 are from the Great Nicobar Island alone[1]. Members under the genera *Psilotum* are referred to as a 'living rhyniophyte' by many palaeobotanists and plant morphologists. Further critical analysis of its morphology and shoot organization reveals that despite its simplicity, it exhibits the same level of organization as seed plants[2].

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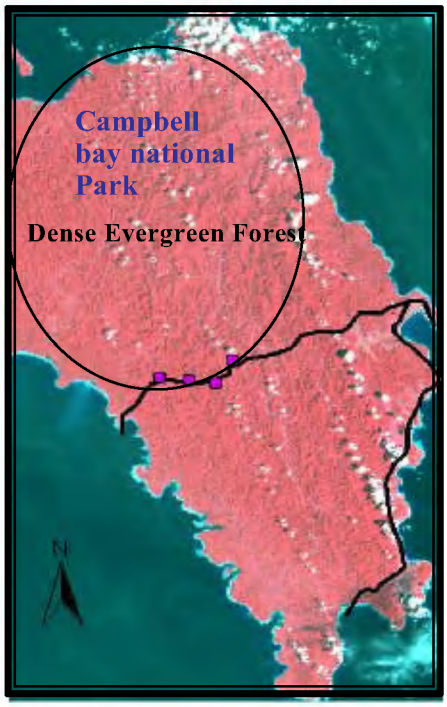

Figure 1. Imagery showing location points in Great Nicobar Island.

The species habitat relationship is a concept responsible for biodiversity status of a region, as species diversity is the measure of ecological, physiological, topographic and edaphic diversity[3]. High species diversity is considered as a desirable property of ecological and conservation evaluation in an ecosystem[4]. Associated with each forest type is variation in species diversity that conceivably influences diversity, and in turn can be linked to different physical and biological factors that influence the diversity of the region[5].

Designing of conservation strategies and management plans for a particular region is based on proper understanding of the composition of forest types and its relation to that habitat, and the past and present relationship of the forest with the surrounding land uses. The species under study was collected during a ground survey of the Great Nicobar Island, as part of biodiversity characterization mission at landscape level under Department of Space and Department of Biotechnology. The objectives behind the study are to highlight the environmental, ecological and climatic conditions required for species growth, and to understand its interspecific associations.

In India, two species of the genus *Psilotum* are reported, i.e. *P. nudum* (L.) P. Beauv. and *P. complantum* Sw.

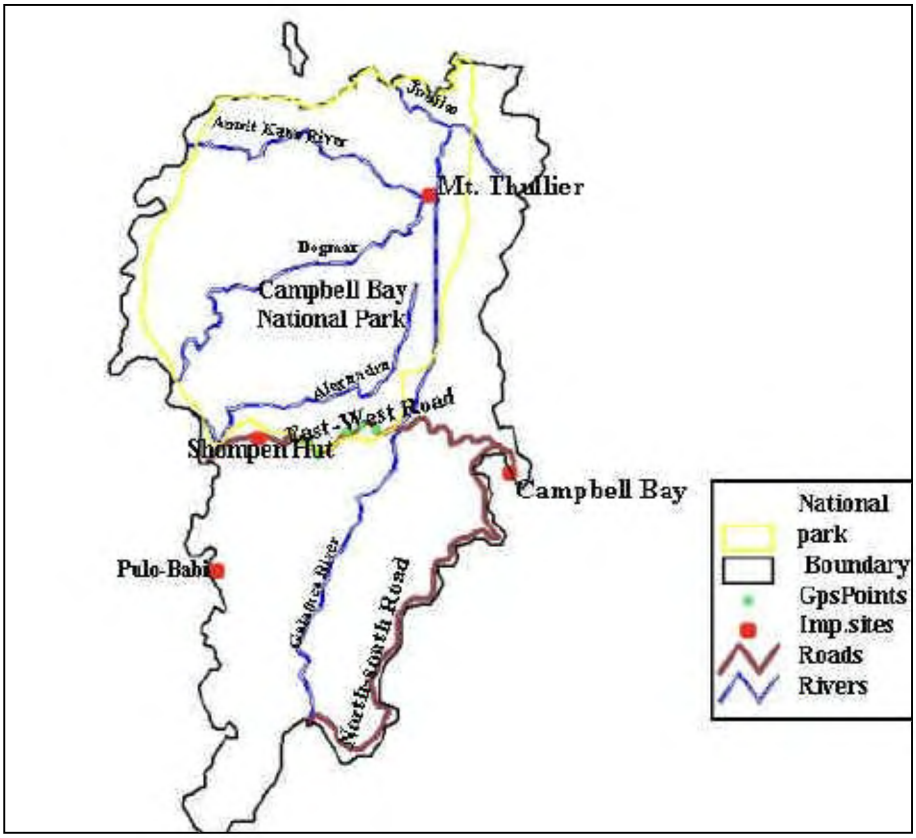

Figure 2. Location map of Great Nicobar Island.

Table 1. Location of collection of specimen

Location	Slope (°)	Aspect
13 km before Shompen Hut on the way to Kopen Hut	8	N
Sala Tikri on the way to Shompen Hut (10 km)	15	S–N
No. 12 on East-West Road	5	N–W
Bara Pahar 12 km from Campbell Bay on East-West Road	15	N–S

Table 2. Species encountered in association with *Sphaeropteris* sp., the host plant of *Psilotum complanatum* Sw.

Species number	Tree species	Family
1	*Ardisia solanacea* (Poir.) Roxb.	Myrsinaceae
2	*Aglaia andamanica* Hiern	Meliaceae
3	*Spondias pinnata* (L.f.) Kurz	Anacardiaceae
4	*Phyllanthus columnaris* Muell-.Arg.	Euphorbiaceae
5	*Anthocephalus chinensis* (Lam.) A. Rich. ex Walp.	Rubiaceae
6	*Artocarpus chama* Buch-Ham.	Moraceae
7	*Bouea oppositifolia* (Roxb.) Meissn.	Anacardiaceae
8	*Celtis timorensis* Span.	Ulmaceae
9	*Chydenanthus excelsus* (Bl.) Miers.	Barringtoniaceae
10	*Diospyros oocarpa* Thw.	Ebenaceae
11	*Diospyros variegata* Kurz	Ebenaceae
12	*Diploknema butyracea* (Roxb.) Lam.	Sapotaceae
13	*Dracaena spicata* Roxb.	Agavaceae
14	*Ficus hispida* L.f.	Moraceae
15	*Garcinia cowa* Roxb. ex DC.	Clusiaceae
16	*Garcinia speciosa* Wall.	Clusiaceae
17	*Goniothalamus macranthus* (Kurz) Boerl.	Annonaceae
18	*Maesa andamanica* Kurz	Myrsinaceae
19	*Mangifera camptosperma* Pierre	Anacardiaceae
20	*Myristica fragrans* Houtt.	Myrsticaceae
21	*Planchonella kingiana* Rakesh and Thoth.	Sapotaceae
22	*Planchonella obovata* (R. Br.) Pierre	Sapotaceae
23	*Pongamia glabra* Vent.	Fabaceae
24	*Pteris pillusida* Presl.	Pteridaceae
25	*Saccopetalum tectonum* (Hutch. ex. Parkin.) Chatt.	Annonaceae
26	*Euphorbia epiphylloides* Kurz.	Euphorbiaceae
27	*Saurauia bracteosa* DC.	Saurauiaceae
28	*Streblus asper* Lour.	Moraceae
29	*Syzygium samarangense* (Bl.) Merr. & Perr	Myrtaceae
30	*Sphaeropteris albosetacea* (Bedd.) Tryon	Sphaeropteriaceae
31	*Sphaeropteris nicobarica* (Balakr. et Dixit)	Sphaeropteriaceae
32	*Terminalia bialata* Steud.	Combretaceae
33	*Polyalthia parkinsonii* Hutch	Annonaceae

According to the survey reports and available information, *P. nudum* has been found in Burma, Malaysia and India (Arunachal Pradesh, Assam, Madhya Pradesh, southern and western India, West Bengal) and also in Bhutan and Sikkim. The first report of *Psilotum* in Andaman and Nicobar Islands was by Prain in 1893. *P. complanatum* Sw. (family Psilotaceae) is a rare and interesting plant mainly found distributed in Malay Peninsula, South Australia, Fiji islands, Mexico and South America. In India, the species is reported only from the Nicobar group of islands, distributed in central and south Nicobar group of Islands. In 1966, Thothathri et *al.*[6] during their extensive botanical exploration recorded the specimen from Galathea Bay (Great Nicobar Island). In 1975, Balakrishnan collected the specimen from Campbell Bay (Great Nicobar Island). The species was also reported from Katchal Island (North Nicobar)[7]. During our visit to the area, the species was found on the trunks of *Sphaeropteris albosetacea* (Bedd.) Tryon (*Cyathea alboseteca* Bedd) along the East-West Road, Campbell Bay National Park. The specimens were observed growing as pendulous epiphytic herb and were collected within a stretch of 5–10 km towards a spot known as the Shompem Hut (Figure 2). As the occurrence of the species was not so frequent, we collected three specimens during our 6–8 km walk along East-West Road, Great Nicobar Island. During our survey of the island, we could not locate the specimen in any other place or associated with other vegetation type. The species was collected from the locations shown in Table 1, which mostly fall in the evergreen forest vegetation type.

According to the classification by Champion and Seth[8], this forest type falls under moist tropical forests group (subgroup 1A, tropical wet evergreen forest and category C2 (Andaman tropical evergreen forest)). It is noteworthy to mention that distribution of the species was scarce, growing mainly in the northern aspect, as its growth is favoured by moist, shady and damp conditions which persist in the region due to continuous rainfall. The occurrence of the species is related to frequency of the host plant. In this context, photosociological analysis was also carried out using the obtained field data. The species observed growing in the area along with the host plant are listed in Table 2. The results showed that IVI (indicating abundance, density and frequency) of *S. albosetacea* (Bedd.) Tryon (species number 30), which in this case serves as the host plant, is quite high (Figure 3) compared to other plant species in the area, which shows its dominance in the area favouring growth of *P. complanatum* Sw. The conditions for growth are congenial, but since the occurrence is rare, we collected only three specimens so as to let such rare plants survive in their own natural habitat.

P. complanatum Sw. has a simple morphology, i.e. dichotomous branching, protostele and lack of leaves. Stems and branches are flattened. It bears simple sporangia on small stalk, in the axils of minute bifid sporophylls towards the apices of aerial shoots. The whole plant is 10–75 cm long, covered with brownish hair-like rhizoids. Leaves here are reduced to distant minute scales. They are coriaceous in nature and are arranged in two rows Stems and branches are flattened. Spores of *Psilotum* are bean-shaped and monolete rather than spherical and trilet

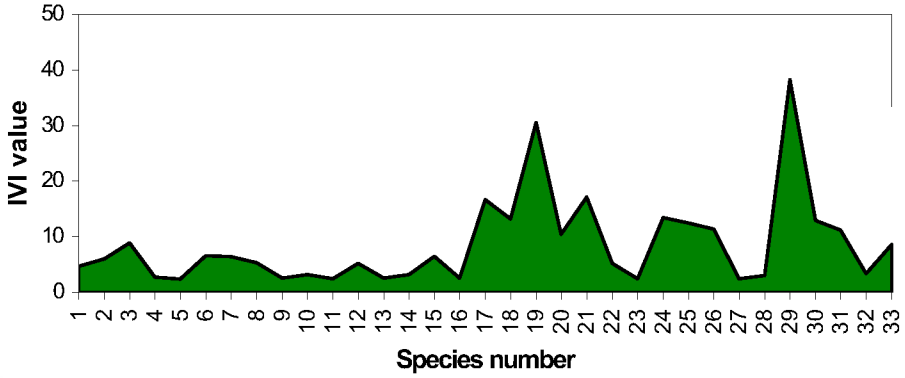

Figure 3. Important value index of species associated with *Sphaeropteris albosetacea* (Bedd.) Tryon.

Figure 4. *Psilotum complanatum* Sw. with the substratum.

like those of early land plants[4]. A subterranean rhizome (root-like stem) anchors the plant in place and absorbs nutrients by means of filaments called rhizoids. *Psilotum* spores germinate best in a dark environment, where ammonium is present. Many botanists believe that it is a survivor of the very primitive lineage of plants.

P. complanatum Sw., which has been accepted by some botanists as the most primitive-looking and simplest vascular plant alive today, is one of the only few surviving members of an ancient group of vascular plants. As a highly specialized version of the 'true' ferns, it requires attention and regular monitoring of not only the species, but its habitat as well. The area from where the species was collected falls on the boundary of Campbell Bay National Park, which houses unique flora and is also the residing place of an aboriginal tribe, Shompens. The area of occurrence of the species is marked on the IRS-LISS III imagery (Figure 1) with the help of GPS locations taken in the field in order to point out locations or 'zones of diversity' of the specimen. With the help of spatial information, major forest types in the area can be interpreted based on the spectral signatures. It was concluded that the region surrounding the East-West Road was categorized under evergreen formations and showed luxuriant growth of *S. albosetacea* (Bedd.) (*C. albosetaeca* Bedd.), particularly on the fringes of East-West Road. The concept of remote sensing is still to be utilized for species identification, but can be advantageous in demarcating areas of particular vegetation type of which the species dealt with is a part.

P. complanatum Sw. was observed to be associated with evergreen tree species, particularly *Cyathea* sp. (core species of tropical evergreen forests) and prefers to grow in undisturbed zone of moist evergreen forests. Thus mapping and monitoring of these forest types can be indirectly linked to mapping of such rare species, and will allow conservationists to focus on its distribution while designing the conservation strategies. The ecosystem of the place is quite fragile as the area is prone to natural disasters like landslides, heavy rainfall and cyclonic winds. During our survey we could see the East-West road totally damaged due to landslides and under construction. Since we could locate the species growing on the road fringes, extra care should be taken regarding this aspect in order to conserve this ecofragile system.

In addition, *ex situ* conservation measures should also be focused upon, and finally public awareness programmes should be intensified so as to effectively conserve such botanically interesting species.

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Phenotypic plasticity and plant invasiveness: Case study of congress grass

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This paper highlights the phenotypic variation of congress grass (*Parthenium hysterophorus*) to varying soil texture. Plants demonstrated significant differences in some traits among the different soil types and these phenotypically plastic traits, in combination, contribute to invasiveness of the species, allowing for the range expansion observed in different habitats.

MANY organisms can respond with considerable flexibility to a changing environment, generating a range of characteristics depending on the environment in which the developing organism finds itself[1]. A new species, when introduced into an alien environment, must become established within the constraints of physical site characteristics and competition with resident vegetation[2]. The ability of an organism to express different phenotypes in response to environmental cues, i.e. phenotypic plasticity[3], is generally interpreted as an adaptation for dealing with a variable environment. The primary benefit of being phenotypically plastic as an invading taxa lies in the ability of plasticity for traits that contribute directly to fitness[4] and broaden the niche width of the population, and therefore, its range of potentially available resources[5].

The success of an alien species depends on the degree of invasiveness, i.e. the potentiality to establish and spread[6]. A few simple biological attributes can be strong predictors of potential invasiveness of a species[6,7]. Plant height, relative growth rate (RGR) and seed mass, as indicators of both the establishment and regenerative phases of the life cycle[8] are the most relevant traits that address competitive ability[9–11].

The nature of soil, associated with soil attributes such as texture, organic matter, pH and bulk density[12], is aptly known to be a potent determinant of plant adaptation and distribution[13]. Soil texture is a surrogate index of soil quality. It influences organic matter accumulation[14], distribution of soil N (ref. 15) in association with topography and also independently[16], and the dynamics of soil water[17] that most frequently limits the biological processes in semi-arid regions[18].

We hypothesize that the colonizing ability of an invader is a function of plasticity for fitness-related traits, enabling it to cope with and perhaps to benefit from habitat conditions. In order to test this hypothesis, we evaluated the response of a well-known invader species, *Parthenium hysterophorus* (congress grass; Asteraceae) in terms of plant height, RGR and seed mass, when cultured in soils differing in texture. *P. hysterophorus*, native of tropical America, is a rapidly colonizing weed and a health hazard[19], especially in the tropics. In India, it was first recorded from Pune, Maharashtra[20]. During the last 30 years, it has spread alarmingly to virtually every state in the Indian territory, occupying vast areas of waste- and cultivated lands.

A pot culture experiment in a completely randomized design, was established in the Botanical Garden, Banaras Hindu University (BHU), Varanasi (25°18′N, 83°03′E, 129 m asl), India. The proportions of clay and sand were varied by thoroughly mixing the S_1 soil (collected from subsoil layer, below 25 cm of a pond) and the S_5 soil, nearly pure sand (collected from a river bank) to create homogenous soil mixtures (in 3 : 1, S_2 and 1 : 3, S_3). An alluvial garden soil (Inceptisol) was the fifth soil type (S_4). Sand, silt and clay fractions in the soil mixtures were determined by the hydrometer method[21] (Table 1). Thus five treatments reflecting a gradient of decreasing clay content (%), 14 (S_1), 10 (S_2), 3 (S_3), 2 (S_4), and 0 (S_5), were created.

For seed germination trial, fresh *P. hysterophorus* achenes (hereafter referred to as seeds) were collected from a single local population of plants of uniform height. The seeds were stored for six weeks in the dark at room temperature until the experiments commenced. On 25 May 2000, 45 seeds in each treatment (three replicates per treatment) were placed into earthen pots (2.87 l) filled with respective soil mixtures, moistened to field

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