Biodiversity and Colonization of Pteridophytes: An overview on Population Establishment in Indian Islands

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Introduction

Pteridophytes (ferns and fern allies) are non-flowering, vascular cryptogamous, spore bearing plants which preferentially grow in shade, cool, moist, tropical and rainy places of the world. They occur at high altitude (over 4400 m) in arctic-alpine to rain forests of tropic (except polar region) and are one of the oldest groups of plant on earth. They evolve 400 million years ago in Silurian period of late Palaeozoic era and reached to highest dominance on earth in carboniferous period of Mesozoic era. Henceforth, the carboniferous period is also known as "ages of pteridophytes". They have affinity with bryophytes by their representative genera *Rhynia, Horneophyton* and *gymnosperms* by *Protopteridium, Lygenopteris* (Progymnosperm), thus are placed between bryophytes and gymnosperms. Through the carboniferous period they countenance massive devastating catastrophe and struggled for survival. This led to evolve their diverse forms. On the basis of their distinctive forms they are usually divided into six class viz. Psilotopsida, Selaginellopsida, Lycopodiopsida, Equisetopsida, Isoetopsida and Polypodiopsida (Copeland 1947; Pichi-Sermoli 1977). Former five classes are known as fern allies and some of the common genera are *Psilotum, Selaginella, Lycopodium, Equisetum, Isoetes*. Polypodiopsida comprises true ferns and the most commonly known genera are *Adiantum, Pteris, Polypodium* etc. Pteridophyte produces spores for their reproduction and colonization. Thus the factors regulating spore formation, dispersal, germination, gametophyte development, fertilization and sporophyte development has significant role in structuring their population. Their population and community structure depends on qualitative make-up of the geographical area. Geographical areas are as much as favourable the quantum of species population and community structure increases. Mainland area varies in longitude, latitude, altitude. It ranges from dry-deciduous tropical to rain forests of tropics to arctic-alpine regions and is besieged with a wide range of environmental conditions including soil and torrential rainfall. Therefore, the pteridophyte's species composition across the world's mainland is high. Nevertheless, the geographical areas of islands are quite erratic than to the mainland ecosystem. Island is any piece of sub-continental land that is surrounded by water (Fig. 1 A). It subsists to huge water contact and tidal current. Andaman and Nicobar islands is exposed to tidal impact, high precipitation and torrential rainfall, in addition to other environmental factors. The littoral landmass of islands supports mangrove forest by their soil texture and water salinity (Fig. 1 B). Islands provide specific habitat and ecosystem for collective and continuous growth of pteridophytes. As islands are separated with mainland by a huge water resource, henceforth there is a barrier in movement of pteridophytes from island to mainland or vice-versa. Therefore, the species growing in islands are restricted to that area and different with the species of mainland. Due to their dwelling in isolated habitat, the island's species altogether with their area of occupancy remains under high risk. For the reason of co-existence of isolated habitat and ecosystem, the growth pattern and species composition of

Fig. 1 (A–B): A. Habitat in Andaman Islands, B. Habitat in Mangrove forests.

pteridophytes are unique and inimitable in islands, which are enumerated herein.

Habitat of Pteridophytes Growth

Although pteridophytes prefer cool and rainy places, but they occur in fresh water (*Marsilea minuta*), dry deserts (*Cheilanthus farrinosa*), moist land (*Ophioglossum reticulatum* Fig. 3 E), tropical rain forests (*Dipteris wallichii*) to lowland and high mountainous forests as terrestrials (*Christella dentata*), lithophytes (*Adiantum philippense*), epiphytes (*Drynaria quercifolia*) and as climbers (*Lygodium flexuosum*). Gametophyte needs water for movement of male gametangia, therefore they prefer moist and watery habitat. Pteridophytes in Andaman and Nicobar islands are quite unique for the reason of their isolation from mainland and occupancy of specific habitat. On the basis of their habitat, pteridophyte's vegetation in these islands may be classified in to epiphytes, terrestrial and lithophytes (Dixit and Sinha 2001).

Epiphytes: Tree species provide habitat for growth of the pteridophytes. In evergreen forests the ferns preferentially grow on tree trunk. Some common epiphytic ferns are *Asplenium nidus, Drynaria quercifolia* (Fig. 2 A), *Lycopodium nummulariifolium, Microsorum punctatum* (Fig. 2 B) and *Vandenboschia maxima* (Dixit and Sinha 2001).

Terrestrial: Majority of the ferns grow on the soil. Grey, brown and red soil derived from calcareous sandstone having good water holding capacity supports the growth of ferns. Common species in terrestrial habitat are Angiopteris evecta (Fig. 2 C), *Diplazium esculantum*, *Dicranopteris linearis, Helminthostachys zeylanica, Pteris vittata,* Christella sp (Fig. 3 F) and *Cyclosorus* sp (Fig. 4 A).

Lithophytes: Fern species growing on rocks or moist boulders are known as lithophytes. Some of common species are *Asplenium falcatum*, *Pityrogramma calomelanos, Pronephrium cuspidatum, Tectaria vasta* and *Vittaria elongata*.

Diversity of Pteridophytes in India

About 12,000 species of Pteridophytes are known across the world. These include 8 genera and 1600 species of fern allies and 240 genera and 10,400 species of ferns. Diversity of pteridophytes in India is predominant in Eastern Himalayas, Western Himalayas, Western Ghats and mountainous region of central India. Studies on the Indian Pteridophytes from the pioneer work (Beddome 1863-64, 1865-70, 1876, 1883-92; Clarke 1879-80; Hope 1899, 1900, 1902, 1903, 1904, 1921) up to the contributions of late 20th centuary (Nayar and Kaur 1974; Nayar and Kaur 1963-64; Nayar 1980; Chandra and Kaur 1987; Khullar 1994, 2001; Chandra 2000) has provided information about the pteridophytic wealth. About 1200 species belonging to 144 genera are known from India and 235 species as endemic (Chandra 2000). According to IUCN

Fig. 2 (A–F) : A. *Drynaria quercifolia*, B. *Microsorum punctatum*, C. *Angiopteris evecta*, D. *Lygodium flexuosum*, E. *Adiantum philippense*, F. *Helminthostachys zeylanica*

(2010) about 211 species worldwide are under endangered category, whereas vide Indian Red Data Book 33 taxa are in this category from India.

Andaman and Nicobar Islands: Geography, Ecology, Climate and Vegetation

Andaman and Nicobar archipelago consisting of about 572 islands and islets (with an area of 7,950 km^2) lies in the Bay of Bengal from 6°-14° N latitudes and 92°-94° E longitudes. Islands are oriented in north-south direction and widened over a length of about 912 km. The group of Andaman (with an area of 6,170 km^2) has 325 islands, and are separated from the Nicobar by 150 km wide area (Ten Degree Channel). The Nicobar group (with 1,765 km^2 area) has 24 islands. The northernmost Landfall Point of the Andaman island group is about 190 km from Cape Negrais in Burma. The southernmost Indira

Fig. 3 (A–F) : A. *Dicranopteris linearis*, B. *Diplazium esculentum*, C. *Pteris vittata*, D. *Psilotum nudum*, E. *Ophioglossum reticulatum*, F. *Christella dentata*

Point of the great Nicobar island group is about 150 km from Sumatra in Indonesia. Topography of most of the islands is hilly, and the highest point in north Andaman Islands is the Saddle Peak (732 metre), however in great Nicobar it is Mt. Thullier (670 metre). Coastal line of the islands is irregular and several creeks penetrate into the island. Creek makes availability of marine water into deep islands for vegetational growth. The island forest's ground contains richer grey, brown and red soils which

Fig. 4 (A–D) : A. *Cyclosorus* sp., B. *Pronephrium* sp., C. *Nephrolepis* sp., D. *Pteris vittata*

promotes establishment of pteridophytes. At the same time, the humus is not allowed to accumulate much as it is washed away by torrential rains. New individuals occupy the humus prior it is being washed up by torrential rains (Dixit and Sinha 2001).

Climate of islands is governed by the monsoon of south east Asiatic regions. The climate remains warm and humid tropic with average temperature of 22-30° C. Island receives heavy rainfall from both the south-west and north-east monsoon during May-September and October-December respectively. Average annual rainfall ranges from 300-380 cm with 82-85% mean relative humidity. Natural vegetation of islands is littoral and inland forests. The littoral forests include mangrove forests, strand vegetation, tidal or swamp forests, however the inland forests include evergreen forests, deciduous forests, grasslands and hydrophytic vegetation. These forests with torrential rain fall, high precipitation, recurrent tides and diverse habitat offer excellent opportunity for luxuriant growth and development of pteridophytes from ground vegetation up to the forest's canopy.

Pteridophytes Forest in Andaman and Nicobar Islands

Mangrove Forests: Due to irregular and deep indented coast line, innumerable creeks facilitate accumulation of brackish water with plenty of clay soil. The deep creeks provide shelter for establishment of fern species like *Acrostichum aureum* (Balakrishnan 1988).

***Beach Forests*:** Vast land cover in island is occupied with the sandy belt, where plenty of the tree and herbaceous plants dwell. The sandy belt occupied

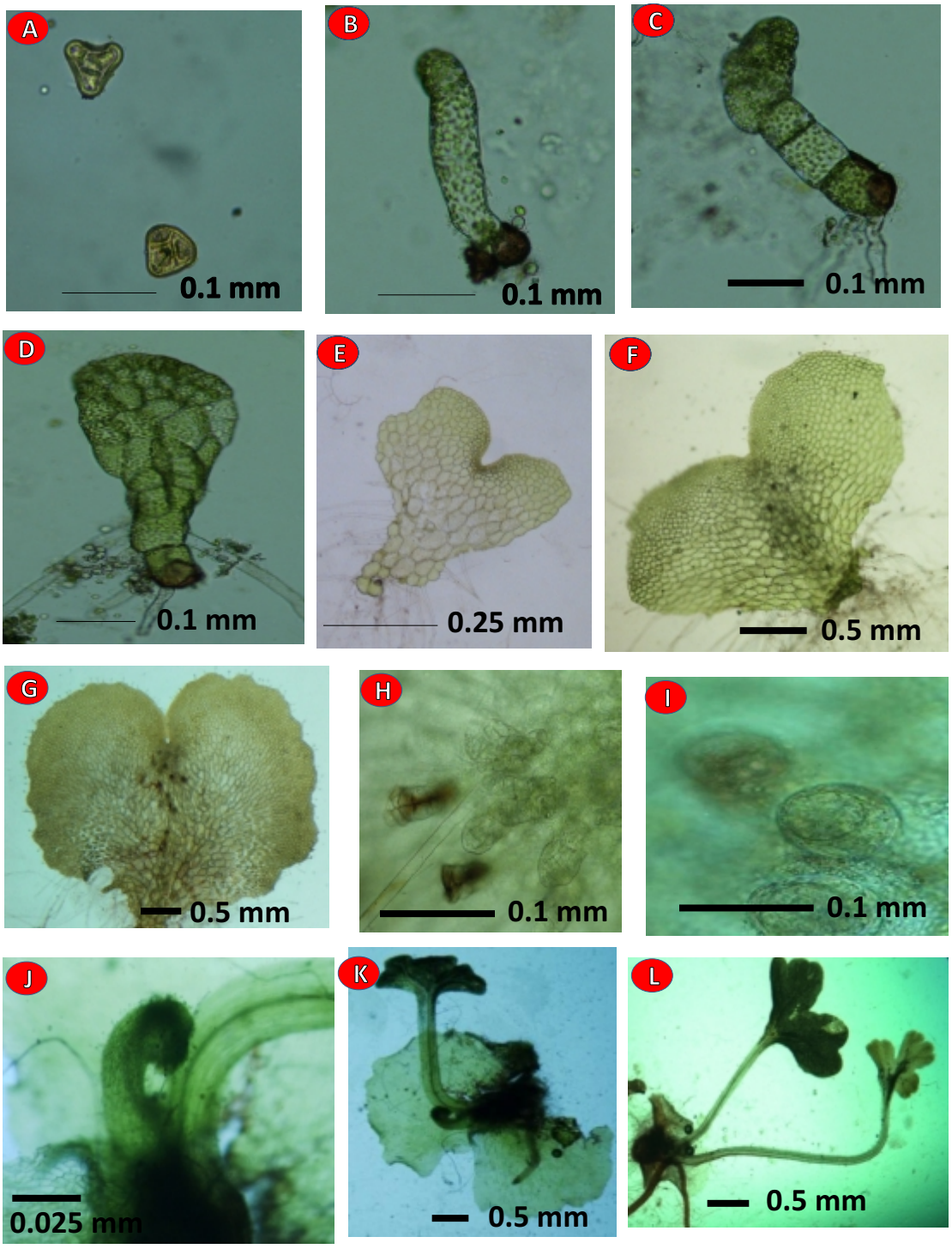

Fig. 5 (A–L): Reproductive behaviour and colonization in *Adiantum* sp. A. Spores sown on culture media, B. Two-celled filamentous stage, C. Three-celled filamentous stage with three dimensional stage of gametophyte in apical region, D. Spathulate stage (7-9 celled wide) with uniseriate (2-3 celled) basal filament, E. Young cordate gametophyte with apical notch and meristems cell, F. Mature cordate gametophyte with capitate marginal hairs, G. Mature gametophyte with undulate margins, capitate hairs and archegonia, H. Magnified view of archegonia, I. Magnified view of the antheridia with distinct operculum, J. Primordium of juvenile sporophyte with capitate hairs, K. Juvenile sporophyte with vasculature and dichotomous branching, L. Developing rhizome and hardening sporophyte

by these plants form small vegetational dune on open beach. Tree plants in beach forests provide habitat for epiphytic ferns such as *Dynaria quercifolia* (Dixit and Sinha 2001).

Swamp Forests: These forests grow in the tidal mud which is continuously wet with salt marine water. They are typically evergreen forest of medium sized trees which has special root formations particularly neumatophore. Pteridophytes such as *Drymoglossum* and *Lepisorus occur* as epiphytes on the tree species (Balakrishnan 1988).

Evergreen forests: These forests are comprised of herbaceous, shrubs, tree plants forming dense canopy, which allows less penetration of light. Less light penetration in these forests causes poor vegetation on the ground and under layer of the forest. The soil being comprised of clay loam with mica sandstones favours growth of vegetation. Epiphytic ferns mainly *Asplenium nidus*, *Drymoglossum piloselloides* grow on the tree trunk (Dixit and Sinha 2001).

Deciduous forests: These forests are comparatively poor in vegetation for the reason of dry soil. Forests are formed with less vegetation patches on undulating ground in the foothills. Ferns like *Pteris quadriaurita* is thinly scattered across the region (Balakrishnan 1988).

Grass Lands*:* Theses area are deforested and denuded for the reason of natural mishap or manmade problems. The areas are covered with grasses but the ferns like *Dicranopteris linearis* and *Lygodium flexuosum* (Fig. 2 D) grow intermixed (Dixit and Sinha 2001).

Diversity of Pteridophytes in Andaman and Nicobar Islands

Pteridophytes are known to invade and grow in moist, shady places with their immense tendency of diversification and polyploidy. Species diversity and high polyploidy are led by their irregular meiosis during sporogenesis and plasticity in reproductive behaviour (intragametophytic selfing, intergametophytic selfing, intergametophytic crossing). As a result six major lineages of fern allies and ferns are diversified in to about 230-250 genera and 12,000 species. In addition to the genetic makeup, the habitat, geographical area and other environmental factors (including water, mineral and light) has significant role in the diversification of pteridophytes. Andaman and Nicobar are separated from the mainland and numerous factors (salt water, tides, sea air pressure, soil profile, least clay and humus) in this area cause a severe impact on their diversity and distribution pattern. Pteridophytes complete life cycle by independent autotrophic gametophyte and sporophyte. Gametophyte requires water for fertilization, more particular for movement of antherozoids during fertilization. According to the extent of water availability in the substratum, diversity in gametophytes also occurs. Soil and humus retains bulk amount of water that's why pteridophytic diversity is abundant on the ground. Water is also present in groves and ridges of tree plant that creates ecological niche for many epiphytic species. Thus the pteridophytes in these islands are confined to grow on diverse habitat *viz.* terrestrial, lithophytic and epiphytic.

As the soil of terrestrial habitat is comprised of grey, brown soil mixed with calcareous sandstone. The water is well retained by the soil therefore common species growing in these areas are *Angiopteris evecta, Adiantum philippense, Helminthostachys zeylanica* (Fig. 2 E-F), *Dicranopteris linearis, Diplazium esculantum* (Fig. 3 A-B), *Lygodiym flexuosum* (Fig. 2 D), *Pteris vittata* (Fig. 3 C), *Pronephrium triphyllum, Blechnum* sp. (Fig. 4 D) and *Selaginella ciliaris*. The ridges and groves of tree trunks and their braches also retain water and micronutrients offering an opportunity for the growth of epiphytes. Some common epiphytic ferns species are *Asplenium nidus, Davallia denticulata, Huperzia carinata, Lycopodium nummulariifolium, Drynaria quercifolia* (Fig. 2 A), *Leptochilus axillaris, Microsorum punctatum* (Fig. 2 B), *Pyrrosia adnascens* and *Vandenboschia maxima* (Dixit and Sinha 2001). The rocks and boulders also serve as the substrata for pteridophytes growth. Some common fern species

Table 1. Families, genera and total number of species of Pteridophytes known from Andaman and Nicobar islands

S. No.	Name of Families	Name of Genera with respective species
1.	Huperziaceae	*Huperzia* (1 species); *Phlegmariurus* (2 species)
2.	Lycopodiaceae	*Lycopodium* (1 species); *Palhinhaea* (1 species)
3.	Selaginellaceae	*Selaginella* (5 species)
4.	Psilotaceae	*Psilotum* (2 species)
5.	Helminthostachyaceae	*Helminthostachys* (1 species)
6.	Ophioglossaceae	*Ophioglossum* (1 species) (Fig. 3 E); Ophioderma (1 species)
7.	Angiopteridaceae	Angiopteris (1 species)
8.	Dicranopteridaceae	Dicranopteris (2 species and 3 verities)
9.	Polypodiaceae	Colysis (1 species); *Leptochillus* (1 species); *Drymoglossum* (1 species); *Microsorium* (3 species); *Phymatosorus* (2 species); *Pyrrosia* (1 species)
10.	Drynariaceae	*Drynaria* (1 species)
11.	Schizaeaceae	*Schizaea* (2 species)
12.	Lygodiaceae	*Lygodium* (4 species)
13.	Cheilanthaceae	*Cheilanthes* (1 species)
14.	Cryptogrammaceae	*Onychium* (1 species)
15.	Acrostichaceae	*Acrostichum* (1 species)
16.	Adiantaceae	*Adiantum* (3 species)
17.	Hemionitidaceae	*Pityrogramma* (1 species); *Syngramma* (1 species)
18.	Antrophyaceae	*Antrophyum* (3 species)
19.	Vittariaceae	*Vittaria* (3 species)
20.	Taenitidaceae	*Taenitis* (1 species)
21.	Parkeriaceae	*Ceratopteris* (1 species)
22.	Marsileaceae	*Marsilea* (1 species)
23.	Hymenophyllopsidaceae	*Cephalomanes* (1 species); *Crepidomanes* (2 species)
24.	Hymenophyllaceae	*Mecodium* (1 species); *Nesopteris* (1 species); *Reediella*(1 species); *Vandenboschia* (1 species)
25.	Cytheaceae	*Sphaeropteris* (2 species)
26.	Denstaedtiaceae	*Microlepia* (1 species, 2 varieties)
27.	Pteridaceae	*Pteridium* (1 species); Pteris (10 species)
28.	Athyriaceae	*Diplazium* (2 species)
29.	Thelypteridaceae	*Amphineuron* (1 species); *Christella* (4 species) (Fig. 3 F); *Cyclosorus* (2 species) (Fig. 4 A); *Pronephrium* (4 species) (Fig. 4 B); *Pseudocyclosorus* (1 species)
30.	Lindsaeaceae	*Lindsaea* (14 species)
31.	Aspleniaceae	*Asplenium* (6 species, 1 variety)
32.	Aspidiaceae	*Heterogonium* (1 species), *Luerssenia* (1 species); *Tectaria* (4 species 1 variety)
33.	Lomariopsidaceae	*Egenolfia* (1 species, 1 subspecies); *Lomagramma* (1 species); *Bolbitis* (1 species)
34.	Nephroledipaceae	*Nephrolepis* (2 species) (Fig. 4 C)
35.	Davalliaceae	*Davallia* (2 species); *Humata* (3 species)
36.	Blechnaceae	*Blechnum* (2 species) (Fig. 4 D)
37.	Stenochlaenaceae	*Stenochlaena* (1 species)

are *Asplenium falcatum, Lindsaea tenera, Nephrolepis* sp. (Fig. 4 C), *Pityrogramma calomelanos, Selaginella biformis, Tectaria vasta* and *Vittaria elongata*.

As for **total diversity of pteridophytes are concerned, altogether about 126 species and 7 varieties belonging to 60 genera under 37 families are known from Andaman and Nicobar islands** (Dixit and Sinha 2001). As the Andaman and Nicobar islands are separated with an area of about 155 km (Ten Degree Channel), therefore the number of fern species in both the area is variable. Data reveals that 37 species were found in Andaman, 56 in Nicobars and remaining species were common to both Andaman and Nicobar islands. Seven species namely *Lindsaea andamanica, L. rutlandia, L. tenera, Pronephrium nakaikeuim, Sphaeropteris albosetacea, S. nicobarica, Sphaerostephenos kurzii* were also described as endemic to the Islands (Dixit and Sinha 2001).

It was quite interesting to note that amongst the non-endemic pteridophytes about 44 species were never encountered from the mainland of Indian territory, albeit they has shown their extended range of distribution to south-east Asia including Burma, Thailand, Malaya and Sumatra (Dixit and Sinha 2001). The ferns of Nicobar islands are very similar with the Malaysian flora, therefore the Nicobar's flora is also called sub-continental island flora (Balakrishnan 1988). Distribution pattern of ferns in both groups of islands has revealed that the fern flora of Andaman is entirely different with the Nicobar islands. The genera like *Pteridium, Pteris, Adiantum, Marsilea* and *Heterogonium common* in the Andaman islands are not found in Nicobar islands. Similarly the genera like *Huperzia, Crepidomanes, Pronephrium* (Fig. 4 B), *Bolbitis, Lomagramma, Sphaeropteris* so common in Nicobar islands are not found in Andaman. This data suggests that the species of Andaman islands are more common with the ferns of north-east India, whereas the fern species of Nicobar islands are common to the Malaysian and Indonesian species (Dixit and Sinha 2001).

Study on the diversity and distribution pattern of pteridophytes has revealed that amongst 37 families, most of the families were represented with 1 genus, however a few families *viz.* Polypodiaceae, Thelypteridaceae (6 genera) and Hymenophyllaceae (4 genera) were known with many genera. As per the floristic account (Dixit and Sinha 2001) and other information, total number of families, genera and species of pteridophytes known from the Andaman and Nicobar islands are provided in Table 1.

Fern flora of these islands has similarity with the fern species of Malaysian and Indonesian region, therefore, the island's vegetation is of more significance. For the reason of isolated occurrence, studies on reproductive behaviour may provide significance information about their possible way of transoceanic distribution and colonization potential.

Reproductive Behaviour and Colonization Potential of Pteridophytes in Islands

Reproduction and colonization capability are two main processes to develop floristic wealth in any area. Ecosystem of islands is quite different than to any other known habitat. In islands, the environmental conditions including torrential rains, sea current, wind velocity, salinity etc become operative altogether. They play significant role in reproductive behaviour and colonization of pteridophytes. The ferns and fern allies multiply through spores. Fern allies are heterosporous (micro and megaspore), however ferns are homosporous (similar spore). In former the microspores give rise antheridiate gametophytes whereas the megaspore gives archegoniate gametophyte. Antheridiate gametophytes bear male gametangia, whereas archegoniate gametophytes bear female gametangia. Both the gametangia participate in fertilization, as a result multiple sporophytes are produced (Fig. 5 A-L). Anthropogenic accelerated environmental changes and natural habitat degradation combined with climate change are causing pressure for the capacity in pteridophytes to colonize new area (Wubs *et al*. 2010). Pteridophytes colonize and occupy land by means of their ability to reproduce and invasion. Ability to

reproduce involves success in spore production, germination, gametophyte development, fertilization and sporophyte development. These reproductive abilities determine colonization potential, but the most important instance of reproductive determinants are mating system and genetic load, which decides establishment and long term survival of new population. Each species has devised particular ability of reproduction and colonize the geographical ranges. In addition they require light, nutrients, gases, water for gametophyte development, sexual expression and spermatozoid movement. Water and combination of various substrates have vast impact on the colonization potential in different habitat and ecosystem. Their ability to establish, reproduce and produce population depends on following factors.

Mating system: It is process of fusion of male and female gametangia to give rise new individual. Reproduction ability is determined by the genotype of gametophytes. Nature of homologous and heterologous gametophytes decides fate of sporophyte production. Genetic load persisting in homolgous alleles does not promote gametophytic fusion and causes inbreeding depression. Heterologous allele promotes the ability of reproduction and colonization potentiality. Mating system in ferns is of three type's *viz.* (a) Intra-gametophytic selfing (b) Intra-gametophytic crossing (c) Inter-gametophytic mating (Klekowski and Llyod 1968; Klekowski 1969a, 1969b). Reportedly there has been example of inbreeding depression in various species of ferns (Wubs *et al.* 2010; Behera *et al.* 2011; Singh *et al.* 2012; Singh *et al.* 2013). Above three mating systems and genotype of the gametophytes altogether with following factors are determinant for colonization of the pteridophytes in islands.

Water: In reproductive ability of ferns, the primary process involved is water mediated movement of the multi-flagellate spermatozoids from antheridia to archegonia. Physicochemical nature of water has significant role in survival of antheridia and to reach on to the archegoniate gametophyte.

Salt: The water and substratum available to the pteridophytes are comprised of salts and other elements. Salt and element induces spore germination and gametophyte development. Antheridiogen hormone also induces sexual expression. Excess amount of salt causes cell degradation, which results gametangial suppression and poor or nil colonization. As a result the forest landmass near to tidal areas exhibit poor colonization of pteridophytes than to offshore or less water lodged areas in islands.

Sea Tides: Incessant tides with huge water have impact on colonization potentiality of pteridophytes. Ground of the islands with litter, humus, spores and adolescent gametophytes are washed out frequently as a result fern population hardly establishes in coastal areas.

Air effect: Tides create severe air pressure in and around the vegetational cover of islands. Tree inhabited with epiphyte ferns comes under high pressure as a result the fern spores are flew away from their phorophytes. Therefore, reinvasion of the species on same phorophyte is hardly possible by means of spores.

Temperature: Increased temperature causes excessive transpiration from the vegetational cover of the forests. The ferns and their gametophytes loose water more rapidly as a result they die and population reduces at alarming rate. Optimum temperature (with less water loss) increases the colonization potential of ferns in the islands.

Rain fall: Torrential rain fall are governed by both north-east and west coast monsoon. Monsoon creates a situation of tropical rain forests. It results high germination percentage of spores and development of gametophytes, enhancing chances of reproduction ability and population colonization.

Precipitation: It is enhanced with increased temperature. It results huge water vapour in and around the vegetational cover. Water vapour is precipitated by cool air and transformed in to water drops. Drops fall on to the island's vegetation including trunk, braches of the tree and

accumulated in to the ridges and groves where spores are already deposited. These drops increase the chances of spore germination and their colonization as epiphytes on tree plants.

Substrate of growth: Pteridophytes grow as hydrophytes or on soil, rocks and bark of tree in combination with micro and macronutrients. Soil provides a wide range of elements including water. Rocks are consisted of calcareous and sandstones elements, but the smooth surface texture does not attract a wide range of ferns species to grow on it. The phorophytes with rough, ridged and groove surface attracts many epiphytes species to grow on it.

Isolation of land: Islands are isolated and separated land mass and surrounded by huge water resources (sea). For the reason of isolation from main land, the fern species becomes endemic through the coming period. They hardly emigrate from island to mainland or vice-versa and leave least possibility of mating with far relatives. Above factors in combination with biotic, abiotic and environmental components has enormous impact on community and diversity structure of pteridophytes. Sustainable development practice minimises the risks of threat to the flora and fauna. In such ecosystem like islands, it becomes imperative to assess the biodiversity, formulate conservation strategies and devise unsurpassed approaches for sustainable utilization of plant resources.

Conclusion

Diversity of pteridophytes of Andaman and Nicobar islands are quite unique and variable in regard to habitat (terrestrial, lithophyte, epiphyte), climate, vegetation and geographical amplitude. Islands are isolated and separated with the main land of Indian Territory; however exhibit some species which are common with the species of north-east Himalayas. The floristic composition of ferns had provided information about similarities and dissimilarities of the plant species with the Malaysian and Indonesian regions. Altogether, about 126 species and 7 varieties belonging to 60 genera and 37 families of pteridophytes are known. Reproduction ability and colonization potentiality has been put forth to address mating systems. Factors representing reproduction ability and colonization potentiality has also been addressed to look on to future perspectives for implementation of conservation approaches.

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Sustainable development is the pathway to the future we want for all. It offers a framework to generate economic growth, achieve social justice, exercise environmental stewardship and strengthen governance.

— Ban Ki-moon