Davis Expedition Fund

Fieldwork in Sri Lanka for the project

The biogeographic affinities of the Sri Lankan flora

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Expedition/ Project Title:	The biogeographic affinities of the Sri Lankan flora
Travel Dates:	28th September 2013 to 13th February 2014
Location:	Sri Lanka
Group Members:	Lakmini Kumarage
Aims:	Plant collection of Sri Lankan Begoniaceae, Sapotaceae, Zingiberaceae, Gesneriaceae for biogeographic study

Project description

The island of Sri Lanka is located south-east of the southernmost tip of peninsular India, and has a total area of 65,610 km^2. The island consists of palaeozoic granitic rocks of the Deccan plate, of Gondwanan origin, which have been uplifted in the post-Miocene (Gunatilleke & Ashton 1987). Despite its small size, it has high floristic richness and species diversity, and one quarter of the angiosperm flora is endemic (Gunatilleke & Ashton 1987, Gunatilleke & Gunatilleke 1990).

The indigenous flora of Sri Lanka has about 3900 species of land plants and the endemic flora is heavily concentrated in the wet south-western quarter of the island (Gunatilleke & Ashton 1987). Among 2900 species of angiosperms, 830 are known to be endemic. Despite the fact that the flora of Sri Lanka has been extensively studied since the eighteenth century by various botanical experts, the biogeographic affinities of the flora remain poorly investigated (Gunatilleke & Ashton 1987). The flora can be devided in to six elements, i.e. Sri Lankan, Indo Sri Lankan, Himalayan, Malayan, African and Pantropical (Gunatilleke & Gunatilleke 1990)

The other four floristic elements in Sri Lanka, i.e. the Malayan, Himalayan, African and pantropical elements, might result from the immigration of Laurasian lineages through Asia and India after collisions of the Deccan plate with Laurasia during the late Cretaceous and early Tertiary, which resulted in the mixing of the Deccan Gondwanan flora with the tropical flora occupying southern Laurasia.

Diversification in pantropically distributed taxa may also be due to more recent long-distance dispersal and this hypothesis is supported by dated molecular phylogenies. Long distance dispersal has contributed to sharing of floristic elements between tropical Asia and Africa and it is considered as the reason for appearance of *Begonia afromigrata* in Indochina which was earlier reported in Africa (Wilde et al 2011). There are other striking examples such as the occurrence of *Gleditsia* in South America with its closest relatives living in China and long distance dispersal has been considered the reason for colonization of some lineages within pantropical families such as Annonaceae, Myristicacae and Boraginaceae to their current hotspots (Renner 2005). Most of the present day biota of Madagascar resulted from long distance dispersal since the majority of angiosperm families are not old enough to support the vicariance hypothesis and 60% of angiosperms are hypothesized to be transoceanic dispersers (Yoder et al 2006: Wilde et al 2011)

Another potentially important contributor to the Sri Lankan flora will have been diversification of lineages within the island (*in situ* speciation) which resulted in the evolution of new species. Species that are endemic to Sri Lanka, and also have sister species in Sri Lanka, are likely to have arisen by *in situ* speciation, whereas endemics whose closest relatives occur elsewhere might be paleoendemics that once had wider distributions.

Based on the fossil record Morley indicated that a substantial number of Indian sub-continental elements invaded Southeast Asia during the Oligocene when the Laurasian part of Southeast Asia and the Indian subcontinent were at similar latitudes and had similar climates. The Indian subcontinent is therefore important in contributing to the biogeographic history of Southeast Asia.

Thus, Sri Lanka is a key location for understanding patterns of migration and biome formation among tropical plants. To investigate its biogeographic affinities, study groups should be pantropical in distribution, well-sampled and thoroughly investigated in other regions. Sapotaceae, Begoniaceae and Zingiberaceae and Gesneriaceae are ideal in this respect since all have dated phylogenies produced by previous studies (Bartish et al 2010; Thomas2011; Poulsen et al. unpublished).

Objectives of my project are,

(1) To incorporate Sri Lankan taxa into worldwide phylogenies for four families: Sapotaceae, Begoniaceae, Zingiberaceae and Gesneriaceae.
(2) To estimate the relative contributions to the Sri Lankan flora of Gondwanan relicts, immigration from nearby landmasses (Asia), long distance dispersal from Southeast Asia, and long distance dispersal from Africa.
(3) To examine the contribution of in-situ speciation to biodiversity in Sri Lanka (bearing in mind the limitation of undersampling on the Indian mainland)
(4) To investigate the contribution of Sri Lanka to the assembly of biotas elsewhere, by examining whether examples exist of:
  (4a) clades of Asian taxa whose most basal members occur in Sri Lanka, indicating a group whose ancestors rafted northwards with the subcontinent and then radiated outwards into Asia.
  (4b) long distance dispersal events out of Sri Lanka, as might be indicated for example by a clade of Southeast Asian species whose closest relative was Sri Lankan and whose next closest relatives were also Sri Lankan or occurred further west.

Field collections in Sri Lanka

Field collections were made at pre identified locations (list of locations is given below) defined based on the distribution of the species according to the flora of Ceylon and existing herbarium specimens in different herbaria. Transportation was made by a vehicle to the forests and inside the forests on foot. Field assistants were accompanied me on all the excursions. For the DNA extractions leaf samples of each of the species were collected in silica. To prepare herbarium specimens a branch from each species was removed from the plant using secateurs and wrapped in newspaper. Then alcohol was added to prevent degradation of the specimens. All the information on the site and plant were recorded and the locations were recorded using a GPS. Plant habit, reproductive structures and any other important features were photographed. When collecting branches from trees tree climbers or poles were used.

All the local connections were made to get the collection permits and taken through proper channels to the Royal Botanic Gardens of Edinburgh, where I carry out my lab work. Silica dried specimens were used for DNA extractions and herbarium specimens were prepared and deposited at the Royal Botanic Gardens Edinburgh.

Schedule

26/10/2013-27/10/2013	Field work in Siripada Sanctuary, Central province
30/10/2013	Maskeliya region, Nuwara Eliya
18/01/2014-20/01/2018	Field work in Kanneliya Forest Reserve, Mulatiyana, Rathmale forests
22/01/2014	Knuckles Forest Reserve, Riverston, Matale
25/01/2014	Loolkandura mountainous area
27/01/2014	Peradeniya, Gannoruwa forest
01/02/2014	Collections in Ritigala Strict Nature Reserve, Polonnaruwa
02/02/2014	Kikiliyamana Forest Reserve

Results

All the collection localities, specimens collected are given in the Table No 01 .

Final budget

	Sri Lankan Rupees	GBP
Air tickets	115442	544.5
Vehicle Rental	322240	1520
Field Assistants	62000	292.45
Accomodation	24000	113
Food	18000	84.9
Taxi		55
Bus travel	2850	13.44
International Banking		58
	Total	2681.29

Davis Expedition Fund 2700£
Remaining Funds 18.71£
Exchange Rate 1£ = 212 LKR

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Table No: 01

Collections made during the expedition and deposited at RBGE

Coll no	Date	Collectors	Family	Name	Province	Locality	Habitat	Latitude	Longitude	Altitude (m)
LK70	26/10/13	Lakmini Kumarage	Zingiberaceae	*Alpinia abundiflora*	Sabaragamuwa	Siripada	in primary forest	6.4800	80.2900	2000
LK71	26/10/13	Lakmini Kumarage	Zingiberaceae	*Alpinia abundiflora*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK72	26/10/13	Lakmini Kumarage	Sapotaceae	*Palaquium sp*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK73	26/10/13	Lakmini Kumarage	Zingiberaceae	*Alpinia abundiflora*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK74	26/10/13	Lakmini Kumarage	Sapotaceae	*Palaquium sp*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK75	26/10/13	Lakmini Kumarage	Sapotaceae	*Palaquium sp*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK76	26/10/13	Lakmini Kumarage	Sapotaceae	*Isonandra sp*	Central	Siripada	in primary forest near stream	6.4800	80.2900	2020
LK77	26/10/13	Lakmini Kumarage	Sapotaceae	*Madhuca clavata*	Central	Siripada	in primary forest	6.4800	80.2900	2020
LK80	30/10/13	Lakmini Kumarage	Zingiberaceae	*Zingiber cylindricum*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK81	30/10/13	Lakmini Kumarage	Zingiberaceae	*Alpinia abundiflora*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK82	30/10/13	Lakmini Kumarage	Zingiberaceae	*Amomum fulviceps*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK84	30/10/13	Lakmini Kumarage	Zingiberaceae	*Zingiber cylindricum*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK85	30/10/13	Lakmini Kumarage	Zingiberaceae	*Amomum sp*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK86	30/10/13	Lakmini Kumarage	Zingiberaceae	*Amomum echinocarpum*	Central	Saptha Kanya	River bank	6.5300	80.2900	1500
LK88	18/01/14	Lakmini Kumarage	Zingiberaceae	*Amomum echinocarpum*	Southern	Mulatiyana	road side	7.5116	80.6495	230
LK89	18/01/14	Lakmini Kumarage	Zingiberaceae	*Amomum acuminatum*	Southern	Rathmale	in primary forest	7.5116	80.6495	230
LK90	18/01/14	Lakmini Kumarage	Gesneriaceae	*Chirita zeylanica*	Southern	Galle	Near strem in primary forest	7.5116	80.6495	230
LK91	18/01/14	Lakmini Kumarage	Gesneriaceae	*Chirita zeylanica*	Southern	Galle	Near strem in primary forest	7.5116	80.6495	230
LK92	22/01/14	Lakmini Kumarage	Gesneriaceae	*Didymocarpus humboldtianus*	Central	Riverston	Road side	7.14	80.64	500
LK93	22/01/14	Lakmini Kumarage	Sapotaceae	*Palaquium sp*	Central	Riverston	Road side	7.14	80.64	500
LK94	22/01/14	Lakmini Kumarage	Zingiberaceae	*Alpinia fax*	Central	Riverston	Road side	7.14	80.64	500
LK95	25/01/14	Lakmini Kumarage	Gesneriaceae	*Dydimocarpus sp*	Central	Loolkandura	in primary forest	7.1479	80.7007	1492
LK96	25/01/14	Lakmini Kumarage	Gesneriaceae	*Chirita walkeri*	Central	Loolkandura	in primary forest	7.1479	80.7007	1492
LK97	25/01/14	Lakmini Kumarage	Sapotaceae	*Isonandra sp*	Central	Loolkandura	Road side	7.1479	80.7007	1492
LK98	27/01/14	Lakmini Kumarage	Sapotaceae	*Mimusops elengi*	Central	Peradeniya	in secondary forest			
LK99	01/02/14	Lakmini Kumarage	Sapotaceae	*Madhuca clavata*	North Central	Ritigala	in primary forest			
LK100	02/02/14	Lakmini Kumarage	Gesneriaceae	*Aeschinanthus zeylanica*	Central	Kikiliyamana	in primary forest			
LK101	30/10/13	Lakmini Kumarage	Gesneriaceae	*Didymocarpus zeylanicus*	Central	Saptha Kanya	in primary forest	6.5300	80.2900	1500
LK102	02/02/14	Lakmini Kumarage	Gesneriaceae	*Chirita mooni*	Central	Kikiliyamana	in primary forest			