

DAVIS EXPEDITION FUND
REPORT ON EXPEDITION / PROJECT

Expedition/Project Title: Genetic diversity and reproductive trait evolution in the genus *Alpinia* Roxb. (Zingiberaceae)

Travel Dates: 10th May 2017- 24th August 2017

Location: India (South: Kerala, North-East: Meghalaya, Mizoram, Nagaland, Manipur)

Group Members: Surabhi Ranavat

Aims: Collection of leaf tissue, herbarium specimens and rhizomes of the species from the genus *Alpinia*

Outcome (not less than 300 words):-

Genetic diversity and reproductive trait evolution in the genus *Alpinia* Roxb. (Zingiberaceae)



Surabhi Ranavat



Royal
Botanic Garden
Edinburgh



Background

The tropics are the most species-rich regions in the world. Understanding the evolution and maintenance of tropical diversity is one of the major questions in plant evolutionary biology. The mechanisms that lead to such high diversity have been well studied in the neotropics, but the same cannot be said for Old-world tropics, specifically in India. This study is aimed at explaining the causes of high diversity in the Old-world tropics focusing on the genus *Alpinia* Roxb. (Zingiberaceae) as a model system. It is the largest genus of the ginger family comprising more than 250 species. These species are widespread throughout tropical and subtropical Asia. I wish to focus on the *Alpinia* species in India by using a genetic approach to understand the biogeography of these species and to explain the genetic basis of a unique floral dimorphism known as flexistylly (Li et al, 2001).

Aims

The aim of my fieldwork was to collect leaf tissues, herbarium specimens and rhizomes of different *Alpinia* species in the Western Ghats and North-East India (Figure 1) for objectives mentioned below:

1. Population genetics- To collect 3 tissues per population for 20 different populations per species.
2. Genetics of flexistylly- To collect tissues of a minimum of 30 individuals of each morph type (anaflexistylous and cataflexistylous morphs) from the same population for 2-3 species.

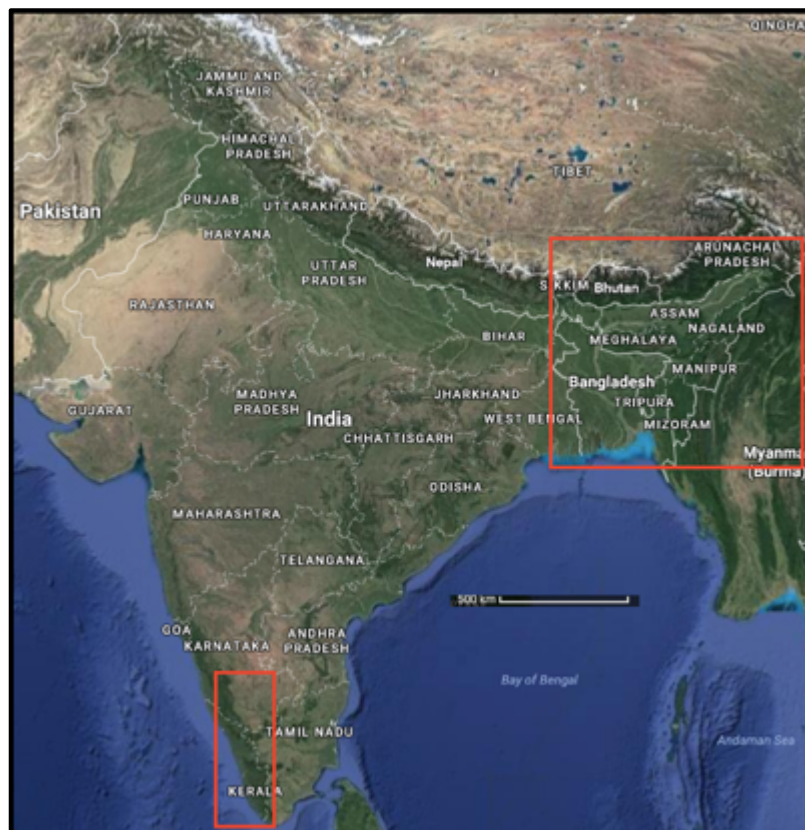


Figure 1: Locations of *Alpinia* species in India

Methods

I visited the local herbaria such as TBGRI, Palode (Kerala), BSI Coimbatore (Tamil Nadu) and BSI Shillong (Meghalaya) prior to collection in the field to get information on the locations of different *Alpinia* species. Based on this information, the fieldwork was carried out by collecting tissues, herbarium specimens and rhizomes of the species of interest.

Results

A total of 281 tissue samples were collected which include *Alpinia* as well as other Zingiberaceae, Commelinaceae and Marantaceae species from the Western Ghats (Figure 2) and North-East India (Figure 3). The species collected were *Alpinia calcarata*, *A. nigra*, *A. galanga*, *A. malaccensis*, and other *Alpinia* spp (Table 1). These species were found in damp areas, along streams, in the forest understory near light gaps, and forest margins. Some of the species were fruiting so they could not be identified. The herbarium specimens, rhizomes and spirit collections were deposited at IISER-Bhopal and the leaf tissues were brought back to Edinburgh.

Table 1: Summary of the population-wise collection of *Alpinia* species

Species name	No. of populations collected
<i>A. nigra</i>	19
<i>A. galanga</i> (cultivated)	14
<i>A. malaccensis</i>	7
<i>A. calcarata</i> (cultivated)	1
<i>Alpinia</i> sp. 1 (Rosemala)	1
<i>Alpinia</i> sp. 2 (Wayanad)	1
<i>Alpinia</i> sp. 3 (Mizoram)	1
<i>Alpinia</i> sp. 4 (Mizoram)	1

Feral populations of species having medicinal importance such as *A. galanga* and *A. calcarata* were not seen. Populations of species such as *A. nigra* were found to be fragmented due to urbanisation and were present in small clumps along the roadsides. I was unable to locate a large population for any of the *Alpinia* species comprising both the morphs for flexistylus genetics.

In terms of the flowering period, some species flower in March-April (summer) and some flower in June-August (monsoon). Therefore, the *Alpinia* species in India tend to have a non-overlapping flowering season.

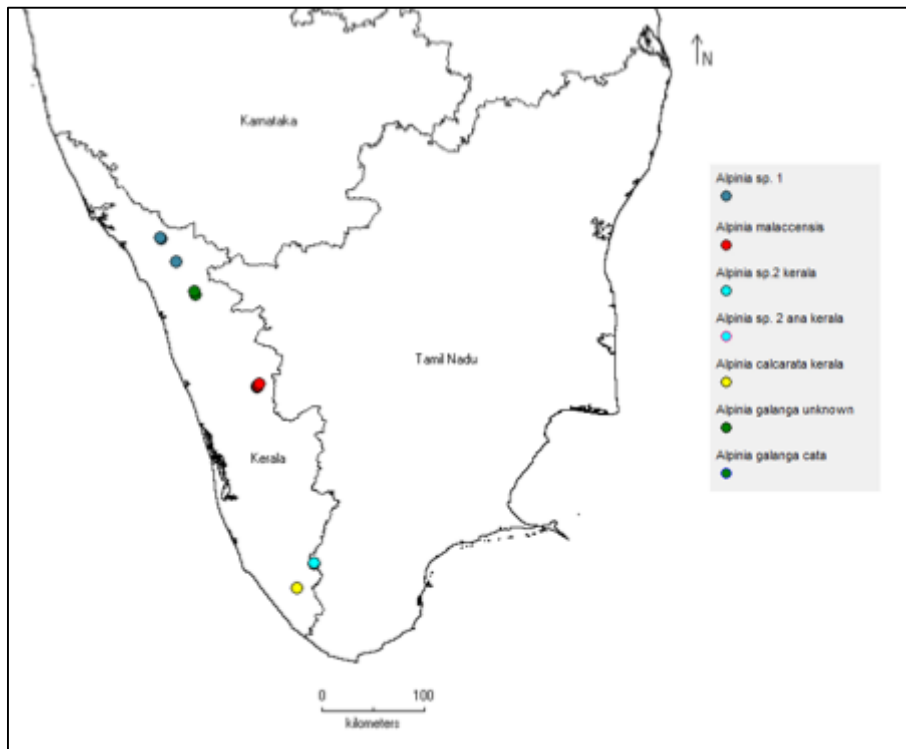


Figure 2: Collection localities in South India

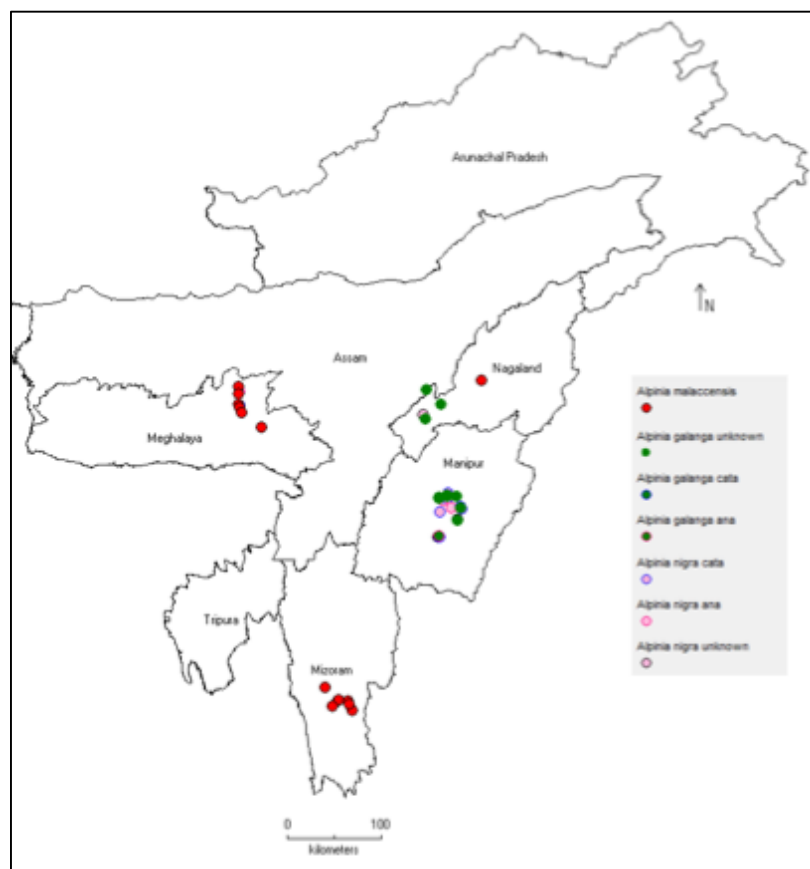


Figure 3: Collection localities in North-East India

Itinerary

Date	State	Description
10 th May	Maharashtra	Arrival in Mumbai from Edinburgh
14 th May	Madhya Pradesh	Arrival in Bhopal from Mumbai
17 th May	Kerala	Arrival in Palode from Bhopal via Trivandrum
18 th May	Kerala	Tropical Botanical Garden and Research Institute visit (Herbarium+ Live collection)
19 th May-23 rd May	Kerala	Fieldwork in Palode, Rosemala, Kallar and Ponmudi
24 th May	Kerala	Trivandrum-Coimbatore
25 th -26 th May	Tamil Nadu	Visit to the Botanical Survey of India, Coimbatore
28 th May	Kerala	Coimbatore-Kalpetta
29 th May-4 th June	Kerala	Fieldwork in Wayanad district
5 th June	Kerala	Kalpetta-Nilambur
6 th June	Kerala	Visit to Kakkadampoyil
7 th June	Kerala	Mannarkad-Mukkali
8 th June	Kerala	Visit to Silent Valley National Park and return to Nilambur
9 th June	Kerala	Nilambur-Thrissur-Peechi
10 th June	Kerala	Visit to Karadippara
11 th June	Kerala	Rested in Peechi
12 th June	Kerala	Visit to the Divisional Forest Office, Nenmara
13 th June	Kerala	Peechi-Nelliyampathy
14 th June-15 th June	Kerala	Visit to the Orange Farm and forest near the Inspection Bungalow, Kaikatty
16 th June	Tamil Nadu	Nelliyampathy-Coimbatore
17 th -19 th June	Tamil Nadu/Madhya Pradesh	Coimbatore-Bhopal
20 th -28 th June	Madhya Pradesh	Planted the rhizomes, deposited the herbarium specimens
29 th -30 th June	Madhya Pradesh/Delhi/Assam	Bhopal-Delhi-Guwahati
1 st July	Meghalaya	Visit to Upper Shillong
2 nd July	Meghalaya	Fieldwork in Nongpoh
3 rd -4 th July	Meghalaya	Shillong (Application for Inner Line Permits)
5 th July	Meghalaya	Shillong-Barapani-Jowai

6th July	Meghalaya	Fieldwork on the way from Jarain to Dawki
7th-8th July	Meghalaya	Visit to Hospital
9th -17th July	Maharashtra	Lonavla (sick leave)
18th July	Maharashtra/Mizoram	Pune-Aizawl
19th July	Mizoram	Fieldwork on the way to Thenzawl from Aizawl
20th July	Mizoram	Thenzawl-Lunglei
21st July	Mizoram	Fieldwork on the way to South Vanlaiphai from Lunglei
22nd July	Mizoram	Lunglei-Aizawl
23rd July	Mizoram	Fieldwork in Aizawl
24th July	Mizoram	Fieldwork in Reiek
25th July	Assam/Nagaland	Aizawl-Guwahati- Jharnapani
26th July	Nagaland	Fieldwork in Jalukie
27 th -28 th July	Nagaland	Fieldwork near Wokha and return to Jharnapani
29 th July	Nagaland	Fieldwork in Dimapur
30th July	Nagaland/Manipur	Dimapur-Senapati
31 st July-3 rd August	Manipur	Fieldwork in Bishnupur, Thoubal, Imphal East and West districts
4th August	Meghalaya	Visti to the Forest Office, Shillong
5th August	Meghalaya	Visit to Nongkhyllem National Park
6th August	Meghalaya	Mawsynram
7th August	Meghalaya/Madhya Pradesh	Shillong-Bhopal
8th August	Madhya Pradesh	Deposited all the herbarium specimens and rhizomes in IISER-Bhopal
9th-23rd August	Maharashtra	Personal holiday
24th August		Return to Edinburgh

Awards granted

Davis Expedition Fund- £2000
Stanley Smith Horticultural Trust- £2000

Expenses

Description	Expenses (INR)	Expenses (£)
Accommodation	31,570	382
Food	21,250	257
Flights	53,964	652
Taxi	54,892	664
Trains	19,205	232
Local Transport	6091	74
Field guides	5300	64
Consumables	5939	72
Permits and entry fees	1170	14
Total	1,99,381	2411
Edinburgh-Mumbai return flight	-	450
Photography cloth	-	24
Total		2885
Total amount received		4000
Remainder		1115

INR 82.70= £1

The remaining amount will be utilised for fieldwork in the next season.

Future plans

- The herbarium specimens and images will be examined to identify the flowering and fruiting species.
- The population-wise collection will be subjected to RADseq to check for contemporary gene flow between the two disjunct regions (i.e., North-East and South-West India).
- Leaf tissues will be collected in the next field season to improve the geographic scope of sampling.
- The tissues required for studying the genetics of flexistyly will be collected in the next field season (June-July 2018).

Acknowledgements

I would like to thank Dr Vinita Gowda (Assistant Professor, IISERB) for her guidance during fieldwork. I would also like to thank Prasanna NS, Siddhant Shetty, Ajith Ashokan, Saket Shrotri and Preeti (BS-MS and PhD students, IISERB) for helping me in the field. I am grateful to all the local and regional forest department personnel for granting permissions and assisting me to carry out the necessary work. I would also like to thank Dr Mathew Dan (TBGRI, Kerala), Dr Rajesha and Dr Azeze Seyee (ICAR, DImapur). Lastly, I would like to thank Davis Expedition Fund and Stanley Smith Horticultural Trust for their generous support for my field trip.

References

Li QJ, Xu ZF, Kress WJ, Xia YM, Zhang L, Deng XB, Gao JY and Bai ZL. 2001. Flexible style that encourages outcrossing. *Nature* 40:432

Appendix I: Images of *Alpinia* species collected during the expedition



Figure 4: *Alpinia* sp. found in Rosemala, Kerala. a- inflorescence, b- habitat, c- infructescence, d- dissected flower (L-R floral tube with anthers, labellum, petals, calyx and the flower)



Figure 5: *Alpinia malaccensis* found in Nelliampathy, Kerala. a- habitat, b- inflorescence, c- dissected flower (L-R floral tube with anthers, labellum, petals with lateral staminodes, and calyx), d- infructescence.



Figure 6: *Alpinia galanga* cultivated in Kerala and Nagaland a- flower, b- inflorescence, c- habitat, d- infructescence.



Figure 7: *Alpinia nigra* found in Meghalaya and Nagaland. a- infructescence, b- flower, c- habitat, d- inflorescence



Figure 8: *Alpinia* sp. found near Tseminyu, Nagaland. a- habit, b- infructescence, c- habitat.



Figure 9: *Alpinia calcarata* cultivated in Palode, Kerala. a- habit, b- inflorescence, c- habitat, d- flower.



Figure 10: *Alpinia malaccensis* found in Nongpoh, Meghalaya a and b- habitat, c- habit, d- infructescence.



Figure 11: *Alpinia* sp. 3 & 4 found near Darzo, Mizoram. *Alpinia* sp. 3: a- habit, b- infructescence, *Alpinia* sp. 4: c- habit, d- infructescence.