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DIVERSITY AND DISTRIBUTION OF ORCHIDS OF GOA, WESTERN GHATS, INDIA

Jeewan Singh Jalal

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DIVERSITY AND DISTRIBUTION OF ORCHIDS OF GOA, WESTERN GHATS, INDIA

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PLATINUM
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Abstract: The Botanical Survey of India launched a pilot project during 2015–2017 on exploration of orchids of Goa State covering all the protected areas. A total of 68 orchid species belonging to 28 genera were documented of which 42 are epiphytic and 26 are terrestrial. Twenty-eight species are endemic, of which 23 species are strictly endemic to the Western Ghats, two are endemic to peninsular India, and three are endemic to the country. Distribution of orchids in Goa is concentrated mainly in the Western Ghats region, which accounts for 86% of the total orchid species richness of the state. The most favourable habitat was found to be semi-evergreen forests followed by moist-deciduous forests. Among all the protected areas, the Mhadei Wildlife Sanctuary was found to be rich in orchid diversity (39 species) followed by Bhagwan Mahavir Wildlife Sanctuary, and Cotigaon Wildlife Sanctuary. The MaxEnt data shows the highly suitable area for orchids in Goa is approximately 1,005km², which is 27% of the total geographic area of the state.

Keywords: Endemic, MaxEnt, peninsular India, protected area.

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INTRODUCTION

The Western Ghats region of Goa lies in the extreme east of the state and consists of a wide belt of rich forest with abundant biodiversity. This area is extensively protected by national parks and wildlife sanctuaries. It covers almost 600km² and has an average elevation of about 800m. Though, Goa State occupies just 2% area of the Western Ghats, it harbours c. 7% of the endemic flowering plant species of the Western Ghats (Joshi & Janarthanam 2004). Garcia de Orta described some interesting medicinal plants from this region way back in 1565 which marks the initiation of the botanical studies in the region, but, thereafter, for almost three centuries there was no contribution to the botany of Goa. Roxburgh (1820) occasionally referred to plants of this region as belonging to Konkan. Graham (1839) in his Catalogue of Bombay Plants often referred to Lush, who had earlier collected plants from Goa. Dalzell & Gibson (1861) and Nairne (1894) have also referred to plants from this region in their works. Most of these previous workers were often referred to by Hooker (1872–1897) in his majestic work on the Flora of British India in the context of plants occurring in Konkan and Goa in particular. Dalgado (1898) enumerated plants occurring in Goa and Sawantwadi based on earlier published reports but there was no orchid included in the enumeration. Subsequently, several botanists have made extensive plant collections in adjacent parts of Goa. Vartak (1966) reported 65 species of orchids belonging to 30 genera from Karnataka and Maharashtra including a few orchids from Goa, followed by Rao (1986) 21 species from Goa, Parab (2009) 26 species belonging to 20 genera from Goa and Mandar & Lakshminarasimhan (2013) presented the floristic account of Molem National Park which includes 34 species of orchids. Despite all these, the state of Goa is poorly explored in terms of orchid diversity. As such, the Botanical Survey of India launched a pilot project on exploration of orchids of Goa State covering all the protected areas (PAs), which resulted in several new distributional records of orchids for Goa (Jalal et al. 2015a,b; Jalal & Jayanthi 2016a,b; Jalal 2017). During the survey, taxonomic inventory of orchids was carried out in different PAs, and the status of orchids was documented. In the present work, an attempt has also been made to predict the suitability of potential orchid rich area based on MaxEnt (maximum entropy) niche approach (Phillips et al. 2006; Phillips & Dudik 2008).

MATERIAL AND METHODS

Study area

The state of Goa is located on the Indian west coast nestled between Maharashtra and Karnataka. The total geographical area of the state is approximately 3,702km². The state stretches out to a length of 105km from north to south and 60km wide from east to west and is divided into two districts, North Goa and South Goa (Figure 1). North Goa district comprises of six talukas, namely, Pernem, Bardez, Tiswadi, Bicholim, Ponda, and Sattari while the South Goa district comprises of six talukas, namely, Dharbandora, Mormugao, Salcete, Quepem, Sanguem, and Canacona (Figure 1). Physiographically, Goa is divided into three main regions, viz., i) the eastern Sahyadris—sub-region of the Western Ghats, and covering ~43% of the total state area, ii) the central uplands—the tract between the coast and the Ghats, consisting of rolling hills, slopes and valleys, which covers ~35% of the state area, and iii) the western coastal plains—the coastal belt which accounts for ~22% of the total area of the state. As per Champion & Seth (1968) classification of forest types of India, the forests of Goa fall in the following types: i) estuarine vegetation consisting of mangrove species along narrow muddy banks of rivers, ii) strand vegetation along the coastal belts, iii) plateau vegetation confined especially in low altitudes, and iv) semi-evergreen and evergreen forests. It has a tropical monsoon climate and the region is generally warm and humid throughout the year. The temperature ranges from 20°C to 34°C, and atmospheric humidity ranges from 60% to 90% throughout the year due to the proximity of the state to the Arabian Sea. The average annual rainfall received in the state is about 3200mm. Over 90% of annual rainfall occurs during monsoon months of June to September (Ibrampurkar 2012). Goa is the only state in India which has protected the complete Western Ghats section within the state. The state has one national park (Bhagwan Mahavir) and six wildlife sanctuaries, which contributes about 52% of the forested area.

Data collection

After obtaining the survey permission from Forest Department of Goa, botanical explorations were undertaken from August 2015 to 2017, in different districts of Goa covering all the protected areas. Orchid species in flowering and fruiting stages were collected and photographed. All macro-morphological characters, such as vegetative and floral structures, were likewise recorded in the field. Species in the non-flowering stage were collected and maintained as living collections for

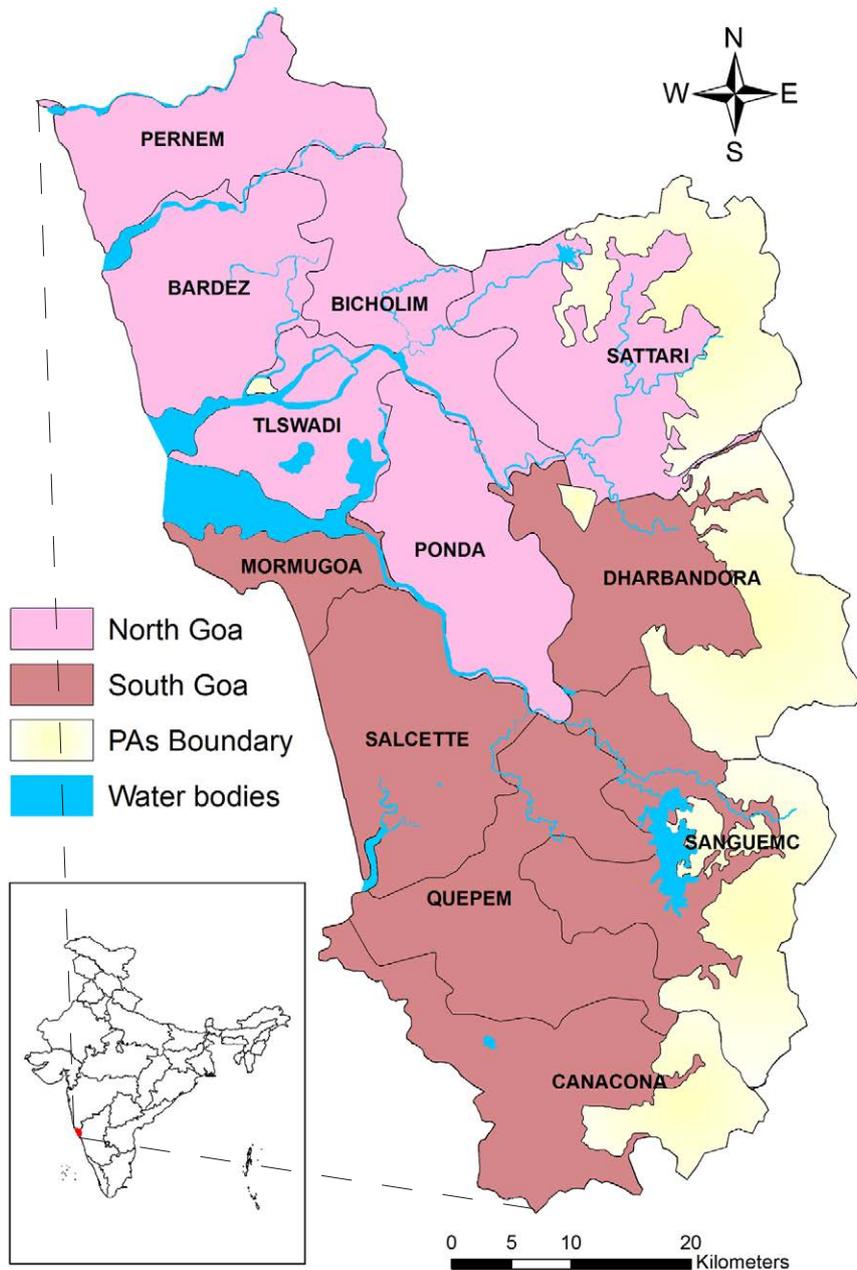


Figure 1. Study area map.

further studies. The geographical co-ordinate of each orchid was recorded using Garmin GPS etrex30. The herbarium specimens were processed following Jain & Rao (1977). Collected specimens were identified using Cooke (1967), Santapau & Kapadia (1966) and Abraham & Vatsala (1981). All the herbarium specimens collected, were deposited in the Herbarium of the Botanical Survey of India, Pune (BSI).

A total 552 GPS records were collected during the field survey for species distribution model. This study was restricted only to species with five or more occurrence records, thus 49 species were taken for

modeling purposes. Nineteen bioclimatic variables (Hijmans et al. 2005) derived from climatic data from the 1950–2000 period were used. All variables were reduced to a grid resolution of 30 arc-seconds or 0.008333° (approximately 1km^2) for the analysis. MaxEnt ver. 3.3 was used for species prediction modeling as it works with presence-only data (Phillips et al. 2006). The analysis was performed using the default parameters: maximum iterations to 500 and using convergence threshold in $1.0\text{E}-5$. Duplicate presence records were removed by the program prior to model development. For the potential habitat map cells reported by MaxEnt, cell values of 1

are considered the most suitable, whereas closer to zero regarded as less suitable. The probability values that were equal or greater than a threshold value of 0.5 indicates the potential suitable habitat of a species (Phillips et al. 2006). The MaxEnt produces continuous outputs of potential habitat suitability ranging from 0 to 1, which were further reclassified into two classes—suitable and unsuitable. The threshold was selected as per ‘minimum training presence’ threshold technique limits. The priority areas were calculated by summing up the thresholded binary maps of all 49 species and reclassifying the grid cells. The priority zones were further divided into low, medium and high zones for the sake of convenience.

RESULTS AND DISCUSSION

The present outcome is based on intensive field surveys as well as information collected from different herbaria and literature. A total of 68 species of orchids belonging to 28 genera were documented, of which 42 are epiphytic and 26 are terrestrial (Table 1) (Images 1–3). In the present survey presence of 58 species were confirmed and the remaining 10 species were included based on herbarium records and literature (Images 4–67). *Habenaria*, *Dendrobium* and *Oberonia* were the most species rich genera in the study area. Twenty-eight species were endemic, of which 23 species are restricted to the Western Ghats, while two are endemic to peninsular India and three are Indian endemic. Three broad habitats were categorized for orchids, viz., semi-evergreen forests, moist-deciduous forests, and plateaus (Fig 2). The most favourable habitat was found to be semi-evergreen forests hosting 40 species followed by moist-deciduous forests (37 species). Very few terrestrial orchids were reported from plateaus (6 species), which are mainly found at higher elevations. These plateaus are threatened due to local grazing. In Goa, these plateaus are known as ‘sada’.

Distribution of orchids in Goa is concentrated mainly in the Western Ghats region, which accounts for 86% of the total orchid diversity of the state (Fig. 3). The high undulating mountains are covered with semi-evergreen forests and provide suitable habitats for many endemic orchids. Half a dozen important rivers, e.g., Mandovi, Mhadei, and Zuari, flow between these mountains and maintain high humidity levels throughout the year which is an important factor for the growth and development of epiphytic orchids.

The entire Western Ghats of the state is covered

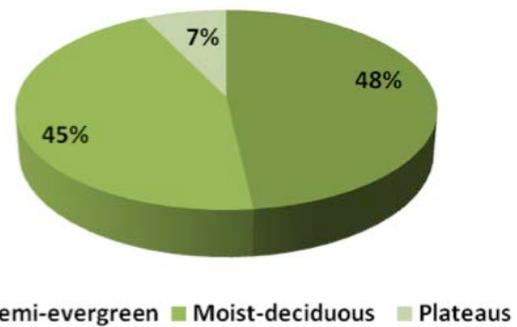


Figure 2. Different habitat types of orchids in Goa.

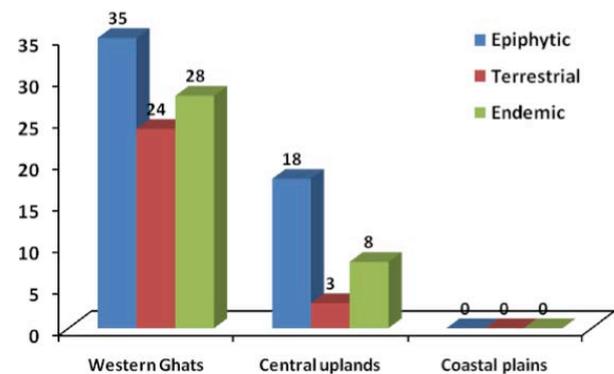


Figure 3. Distribution of orchids in different phyogeographic zones of Goa.

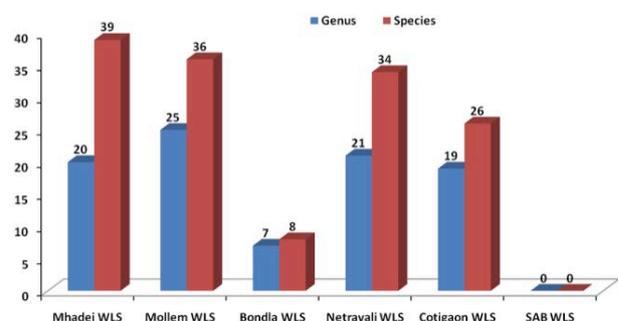


Figure 4. Orchid species richness in different PAs of Goa.

under protected areas and there is no direct threat to these orchids; however, a few human settlements still exist inside the wildlife sanctuary as a result of which some pockets of these natural habitats are disturbed due to lopping of forests and from cattle grazing. The central upland is a transition zone between the Western Ghats and the coastal plains. The area, adjoining the Western Ghats, has semi-evergreen and moist-deciduous forests at the base of the hills which provide a very favorable habitat for epiphytic as well as terrestrial orchids. These forests are moderately dense and receive less

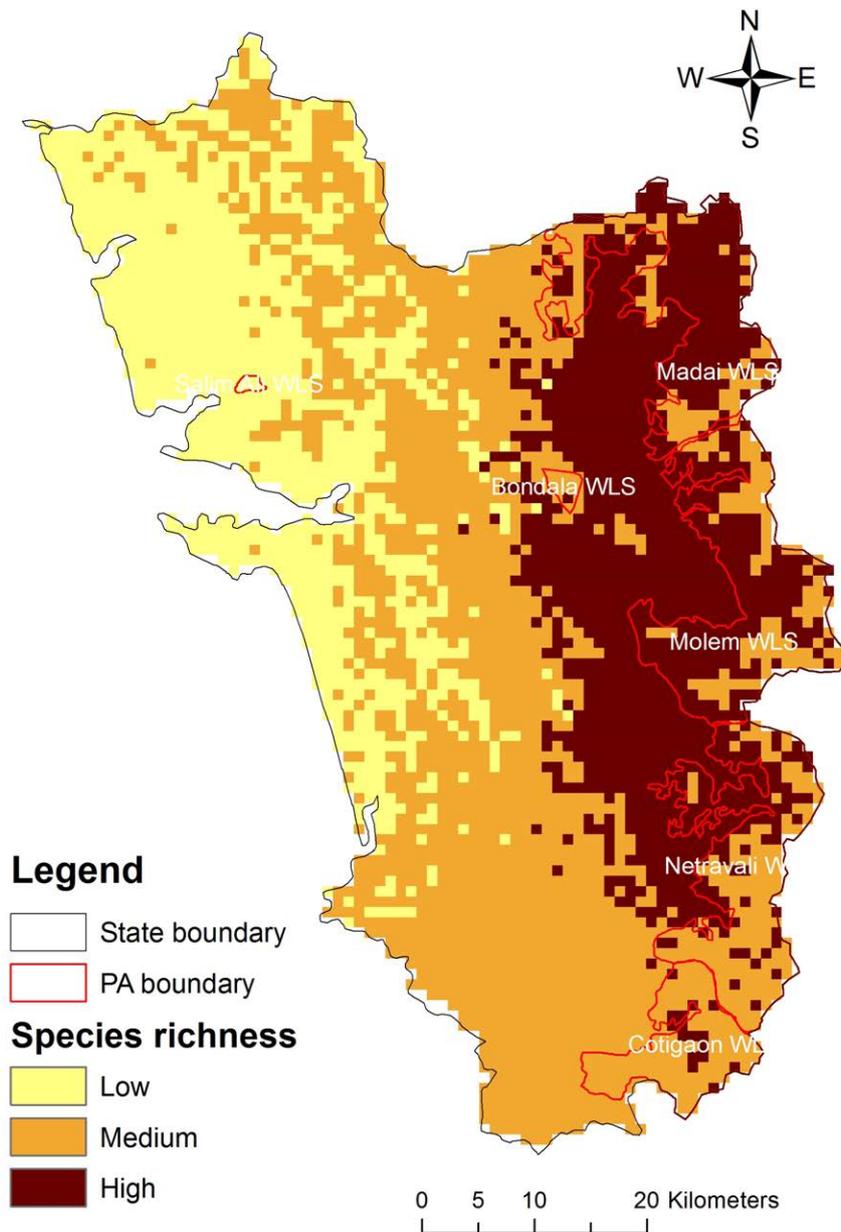


Figure 5. Potential orchid richness map.

intense sunlight and have high humidity as well. It has an average height ranging 30–100 m and most of the landscape is covered with coconut palms, paddy fields, betelnut farms, commercial establishments, human settlements, and many active iron ore mines. A total of 18 species are distributed in this part of which eight are endemic. Threats to the orchids are high in this part as many forest patches are being cleared for developmental purposes and new mining activities. Large forest patches are private or community land for which mining clearance is not necessary. The rampant encroachment is destroying the pristine forest habitat. Species such as *Acampe praemorsa*, *Bulbophyllum sterile*, *Cymbidium*

bicolor, *Dendrobium ovatum*, and *Rhynchostylis retusa* are encountered mostly in such disturbed habitats, along roadside and forests edges.

The coastal plains have no orchid presence. This is a narrow stretch of low-lying area dominated by estuarine mangroves.

In the present survey all the protected areas of Goa were also surveyed to know the orchid diversity and to identify the best protected area for in situ conservation. The findings reveal that Mhadei Wildlife Sanctuary has orchid richness (Fig. 4). This sanctuary covers most of the northeastern portion of Goa and the average rainfall in this region is above 3,200mm.



Image 1. A—*Acampe praemorsa* | B—*Aerides maculosa* | C—*Aerides ringens* | D—*Bulbophyllum sterile* | E—*Cleisostoma tenuifolium* | F—*Cottonia peduncularis* | G—*Cymbidium bicolor* | H—*Dendrobium aqueum* | I—*Dendrobium barbatulum*. © Jeewan Singh Jalal.

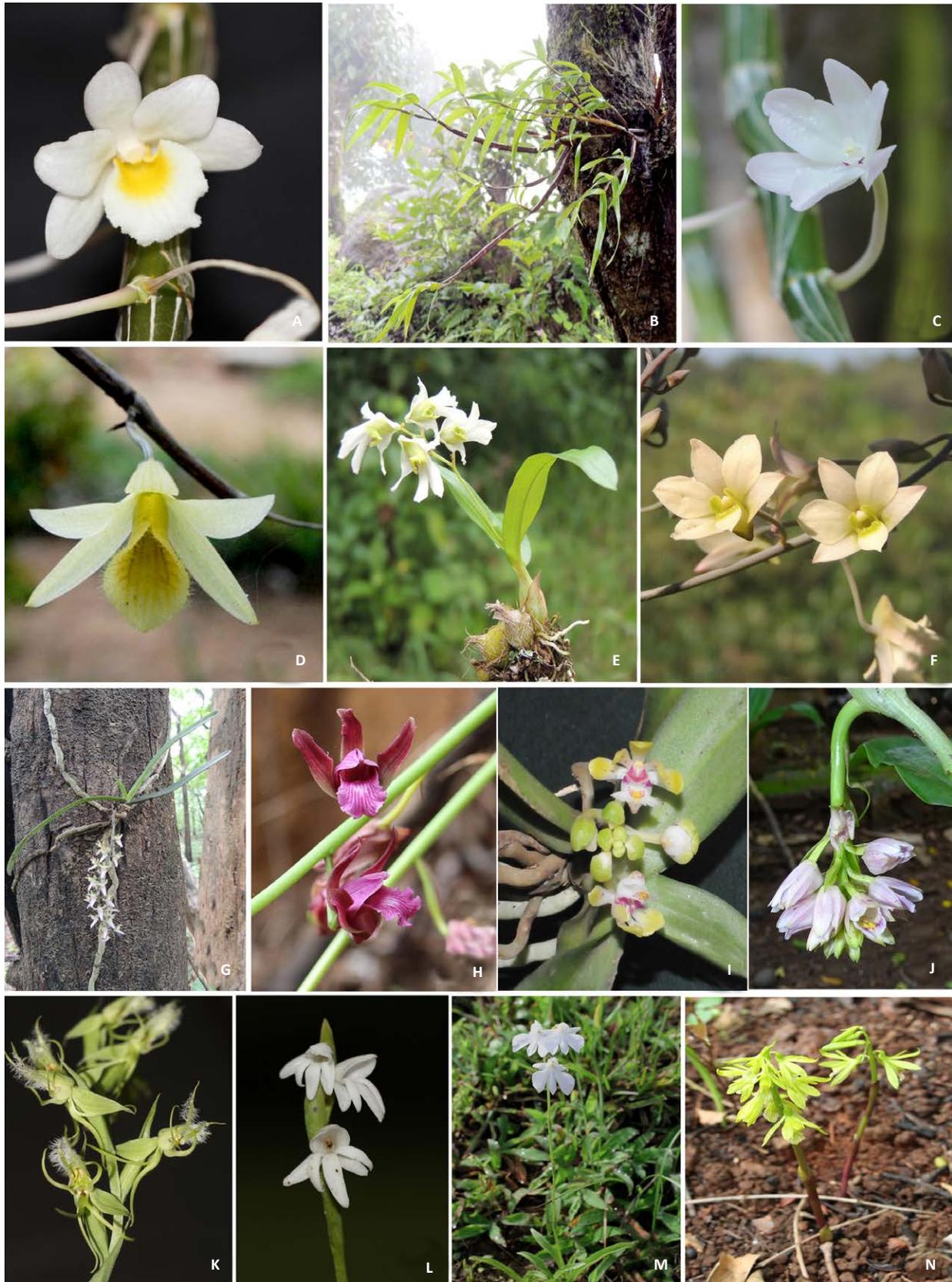


Image 2. A—*Dendrobium crepidatum* | B—*Dendrobium herbaceum* | C—*Dendrobium lawianum* | D—*Dendrobium macrostachyum* | E—*Dendrobium nanum* | F—*Dendrobium ovatum* | G—*Diplozentrum congestum* | H—*Eulophia spectabilis* | I—*Gastrochilus flabelliformis* | J—*Geodorum densiflorum* | K—*Habenaria elwesii* | L—*Habenaria heyneana* | M—*Habenaria suaveolens* | N—*Nervilia concolor*. © Jeewan Singh Jalal.

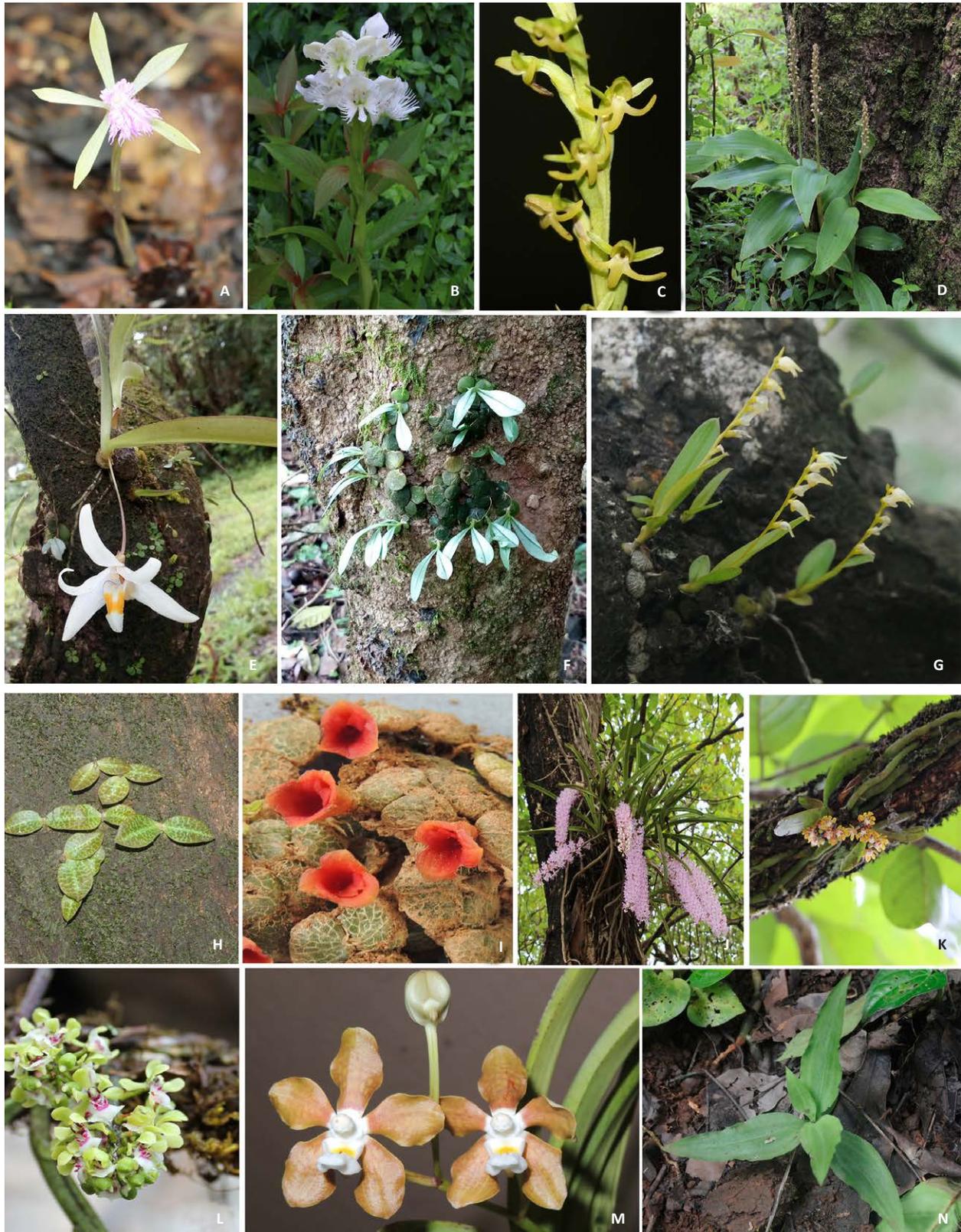


Image 3. A—*Nervilia crociformis* | B—*Pecteilis gigantea* | C—*Peristylus densus* | D—*Peristylus plantagineus* | E—*Pinalia reticosa* | F—*Porpax exilis* | G—*Porpax filiformis* | H—*Porpax jerdoniana* | I—*Porpax reticulata* | J—*Rhynchostylis retusa* | K—*Smithsonia straminea* | L—*Smithsonia viridiflora* | M—*Vanda wightii* | N—*Zeuxine longilabris*. © Jeewan Singh Jalal.

Table 1. List of orchids of Goa.

	Name of species	Habit	Phenology	Endemic	Habitat	Herbarium number	Occurrence in different protected areas				
							Mhadei	Mollem	Bondla	Netravali	Cotigaon
1	<i>Acampe praemorsa</i> (Roxb.) Blatt. & McCann	E	Apr–Dec		MDF	JSJ 203603	+	+	+	+	+
2	<i>Aerides crispa</i> Lindl.	E	May–Jun		SEF	JSJ 203637	+	+		+	
3	<i>Aerides maculosa</i> Lindl.	E	May–Jul	EPI	MDF, SEF	JSJ 203745	+	+	+	+	
4	<i>Aerides ringens</i> (Lindl.) C.E.C.Fisch.	E	Mar–Jul.		MDF	JSJ 203698A		+			+
5	<i>Bulbophyllum sterile</i> (Lam.) Suresh	E	Dec–May	WG	MDF	JSJ 203682	+	+	+	+	+
6	<i>Cleisostoma tenuifolium</i> (L.) Garay	E	Jun–Nov		MSD, SEF	JSJ 203615	+	+		+	+
7	<i>Cottonia peduncularis</i> (Lindl.) Rchb.f.	E	Mar–Apr		MDF	JSJ 203601	+	+		+	+
8	<i>Cymbidium bicolor</i> Lindl.	E	May–Jun		MDF	JSJ 203687		+		+	+
9	<i>Dendrobium aqueum</i> Lindl.	E	Sep–Dec	WG	SEF	JSJ 203667	+				
10	<i>Dendrobium barbatulum</i> Lindl.	E	Jan–May	WG	MDF, SEF	JSJ 203613	+	+	+	+	+
11	<i>Dendrobium crepidatum</i> Lindl.	E	Jan–Mar		MDF	JSJ 203697					+
12	<i>Dendrobium herbageum</i> Lindl.	E	Feb–Mar		SEF	JSJ 203630	+				
13	<i>Dendrobium lawianum</i> Lindl.	E	Mar–Apr	WG	SEF	JSJ 203634					+
14	<i>Dendrobium macrostachyum</i> Lindl.	E	May–Jun		MDF, SEF	JSJ 203707				+	+
15	<i>Dendrobium microbulbon</i> A.Rich.	E	Dec–Jan	WG	SEF	JSJ 203666	+				
16	<i>Dendrobium nanum</i> Hook.f.	E	Jul– Aug	WG	SEF	JSJ 203632	+				
17	<i>Dendrobium ovatum</i> (L.) Kranzl.	E	Sep–Feb	WG	MDF	JSJ 203696	+		+	+	+
18	<i>Dendrobium nodosum</i> Dalzell	E	Jul–Aug	WG	SEF	JSJ 203641	+				
19	<i>Dendrobium peguanum</i> Lindl.	E	Oct–Dec		MDF	JSJ 203743					
20	<i>Diplocentrum congestum</i> Wight	E	Apr–May	WG	MDF, SEF	JSJ 203754		+			
21	<i>Eulophia spectabilis</i> (Dennst.) Suresh	T	May–Jun		MDF, SEF	JSJ 203628	+			+	
22	<i>Gastrochilus flabelliformis</i> (Blatt. & McCann) C.J. Saldanha	E	Apr–Jun	WG	SEF	JSJ 203742		+			
23	<i>Geodorum densiflorum</i> (Lam.) Schltr.	T	Jun–Jul		MDF	JSJ 203610	+				
24	<i>Habenaria crinifera</i> Lindl.	T	Jul–Aug		SEF	JSJ 203640	+				
25	<i>Habenaria diphylla</i> (Nimmo) Dalzell	T	Aug–Sep		MDF	MND 186774		+			
26	<i>Habenaria elwesii</i> Hook.f.	T	Aug–Sep	WG	SEF	JSJ 203765				+	
27	<i>Habenaria foliosa</i> A.Rich.	T	Jul–Aug	WG	SEF	JSJ 203665	+				
28	<i>Habenaria grandifloriformis</i> Blatt. & McCann	T	May–Jul	EPI	PL	JSJ 203757					
29	<i>Habenaria heyneana</i> Lindl.	T	Jul–Sep	WG	PL	JSJ 203673		+			
30	<i>Habenaria longicorniculata</i> Graham	T	Aug–Sep		PL	JSJ 203779	+	+		+	
31	<i>Habenaria marginata</i> Colebr.	T	Sep–Oct		SEF	RSR 103443		+			

	Name of species	Habit	Phenology	Endemic	Habitat	Herbarium number	Occurrence in different protected areas				
							Mhadei	Mollem	Bondla	Netravali	Cotigaon
32	<i>Habenaria multicaudata</i> Sedgw.	T	Aug–Sep	WG	SEF	NPS124207		+			
33	<i>Habenaria plantaginea</i> Lindl.	T	Aug–Sep		MDF	***		+			
34	<i>Habenaria rariflora</i> A.Rich.	T	Jul–Aug	WG	PL	JSJ 203768				+	
35	<i>Habenaria suaveolens</i> Dalzell	T	Jul–Sep	WG	PL	JSJ 203668	+				
36	<i>Liparis deflexa</i> Hook.f.	T	Aug–Sep		MDF	MND179179		+			
37	<i>Liparis odorata</i> (Willd.) Lindl.	T	Jun–Sep		MDF, SEF	JSJ 203762	+	+		+	+
38	<i>Luisia tenuifolia</i> Blume	E	Mar–Apr		MDF, SEF	MND179064		+			
39	<i>Luisia zeylanica</i> Lindl.	E	May–Jun		MDF	JSJ 203621	+			+	+
40	<i>Malaxis versicolor</i> (Lindl.) Abeyw.	T	Jul–Aug		MDF, SEF	JSJ 203769	+	+	+	+	+
41	<i>Nervilia concolor</i> (Blume) Schltr.	T	May–Aug		MDF, SEF	JSJ 203674		+		+	+
42	<i>Nervilia crociformis</i> (Zoll. & Moritzi) Seidenf.	T	Jun–Aug		SEF	JSJ 203647	+				
43	<i>Oberonia brachyphylla</i> Blatter & McCann	E	May–Jun		SEF	V&SR1528		+			
44	<i>Oberonia brunoniana</i> Wight	E	Feb–Mar	WG	MDF	***	+			+	
45	<i>Oberonia mucronata</i> (D. Don) Ormerod & Seidenf.	E	Sep–Oct		MDF	JSJ 203715				+	
46	<i>Oberonia recurva</i> Lindl.	E	Sep–Oct		SEF	JSJ 203770				+	
47	<i>Oberonia verticillata</i> Wight	E	Sep–Oct	WG	MDF	JSJ 203708				+	
48	<i>Pecteilis gigantea</i> (Sm.) Raf.	T	Sep–Oct		SEF	JSJ 203766		+		+	
49	<i>Peristylus aristatus</i> Lindl.	T	Jul–Sep		SEF	JSJ 203629	+				
50	<i>Peristylus densus</i> (Lindl.) Santapau & Kapadia	T	Jul–Sep		PL	JSJ 203643	+			+	
51	<i>Peristylus plantagineus</i> (Lindl.) Lindl.	T	Jul–Sep		MDF, SEF	JSJ 203645	+	+		+	+
52	<i>Peristylus stocksii</i> (Hook.f.) Kraenzl.	T	Jul–Sep	IE	SEF	JSJ 203646	+				
53	<i>Phalaenopsis deliciosa</i> Rchb.f.	E	Aug–Sep		SEF	CRJ184871					+
54	<i>Pholidota imbricata</i> Lindl.	E	Jun–Jul		MDF	JSJ 203614	+	+		+	+
55	<i>Pinalia reticosa</i> (Wight) Kuntze	E	May–Jun	IE	SEF	JSJ 203649	+				
56	<i>Porpax exilis</i> (Hook.f.) Schuit., Y.P.Ng & H.A.Pedersen	E	Oct–Dec	WG	SEF	JSJ 203642	+			+	
57	<i>Porpax filiformis</i> (Wight) Schuit., Y.P.Ng & H.A.Pedersen	E	Jul–Aug	WG	MDF, SEF	JSJ 203604	+		+	+	+
58	<i>Porpax jerdoniana</i> (Wight) Rolfe	E	Jun–Jul	IE	MDF, SEF	JSJ 203606	+	+	+	+	+
59	<i>Porpax microchilos</i> (Dalzell) Schuit., Y.P.Ng & H.A.Pedersen	E	Jul–Aug	WG	MDF, SEF	JSJ 203648	+	+		+	+
60	<i>Porpax reticulata</i> Lindl.	E	Apr–Jun		MDF, SEF	JSJ 203755	+	+			
61	<i>Rhynchostylis retusa</i> (L.) Bl.	E	Jun–Jul		MDF	JSJ 203729		+		+	+
62	<i>Smithsonia straminea</i> C.J.Saldanha	E	May–Jun	WG	MDF	JSJ 203756	+			+	+
63	<i>Smithsonia viridiflora</i> (Dalzell) C.J.Saldanha	E	May–Jun	WG	SEF	JSJ 203721		+		+	+

	Name of species	Habit	Phenology	Endemic	Habitat	Herbarium number	Occurrence in different protected areas				
							Mhadei	Mollem	Bondla	Netravali	Cotigaon
64	<i>Tropidia angulosa</i> (Lindl.) Blume	T	Jan–Feb		SEF	MND187515		+			
65	<i>Vanda tessellata</i> (Roxb.) Hook. ex G. Don	E	May–Jun		MDF	JSJ 203741	+	+			+
66	<i>Vanda testacea</i> (Lindl.) Rchb.f.	E	May–Jun		MDF	JSJ 203607	+	+		+	+
67	<i>Vanda wightii</i> Rchb.f.	E	Sep–Oct		MDF	JSJ 203700		+			
68	<i>Zeuxine longilabris</i> (Lindl.) Benth. ex Hook.f.	T	Feb–Mar		SEF	JSJ 203611	+	+			

E—Epiphytic | T—Terrestrial | EPI—Endemic to Peninsular India | WG—Western Ghats | IE—Indian Endemic | SEF—Semi-evergreen Forest | MDF—Moist Deciduous forest | PL—Plateau | ***—Included from published record.

Figure 5 represents summation of potential orchid distribution of 49 orchid species in Goa (constituting 72% of total orchids of Goa) which was predicted using MaxEnt algorithm. The output has been further categorized into areas with high (21–34 species), medium (8–21 species) and low (less than 8 species) richness or suitability zones. The high richness zone is dominated by moist-deciduous forests interspersed with semi-evergreen forests and open plateaus, which are suitable for orchids. Many endemic species are restricted to the evergreen forest habitat pointing towards high habitat specificity and also towards the ecological importance of these habitats. Approximately, 1,005km² is found to be highly suitable for orchids, which is 27% of the total geographic area of Goa State.

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Image 4. *Acampe praemorsa* (203603)



Image 5. *Aerides crispa* (203637)



Image 6. *Aerides maculosa* (203745)

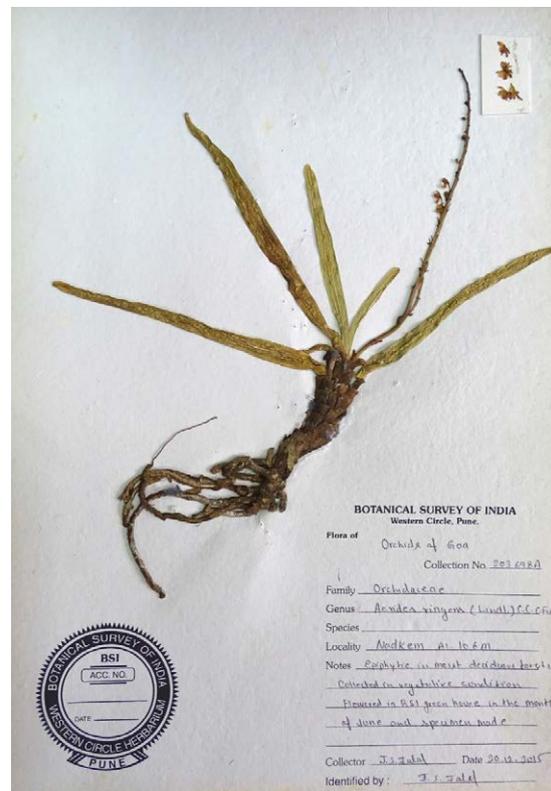


Image 7. *Aerides ringens* (203698A)



Image 8. *Bulbophyllum sterile* (203682)



Image 9. *Cleistostoma tenuifolium* (203615)

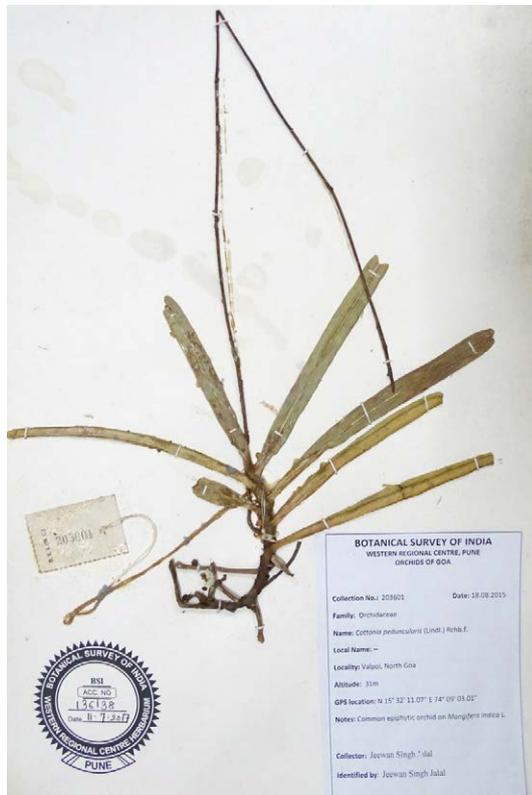


Image 10. *Cottonia peduncularis* (203601)



Image 11. *Cymbidium bicolor* (203687)



Image 11. *Dendrobium aqueum* (203667)

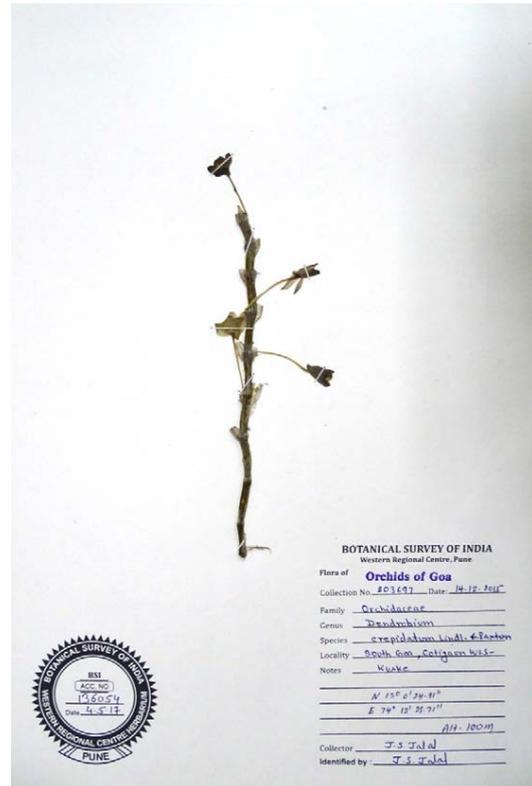


Image 12. *Dendrobium barbatulum* (203697)



Image 13. *Dendrobium crepidatum* (203697)



Image 14. *Dendrobium herbaceum* (203630)



Image 15. *Dendrobium lawianum* (203634)

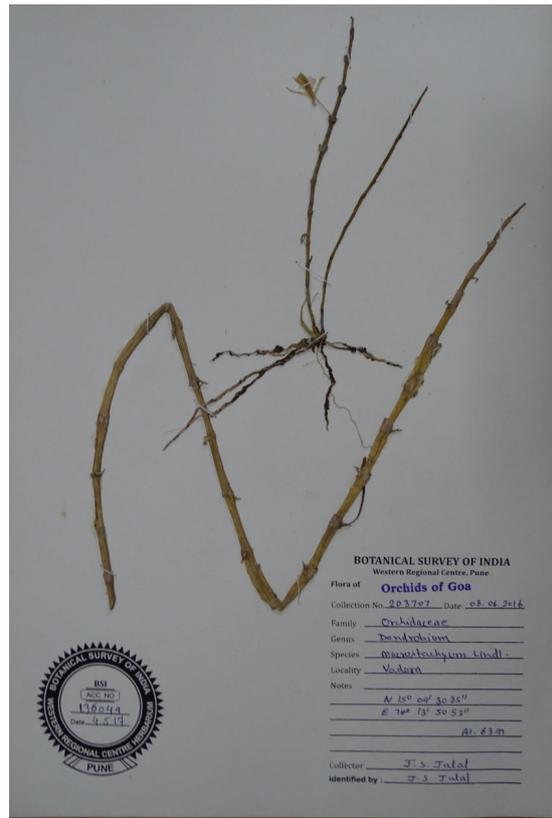


Image 16. *Dendrobium macrostachyum* (203707)



Image 17. *Dendrobium microbulbon* (203666)

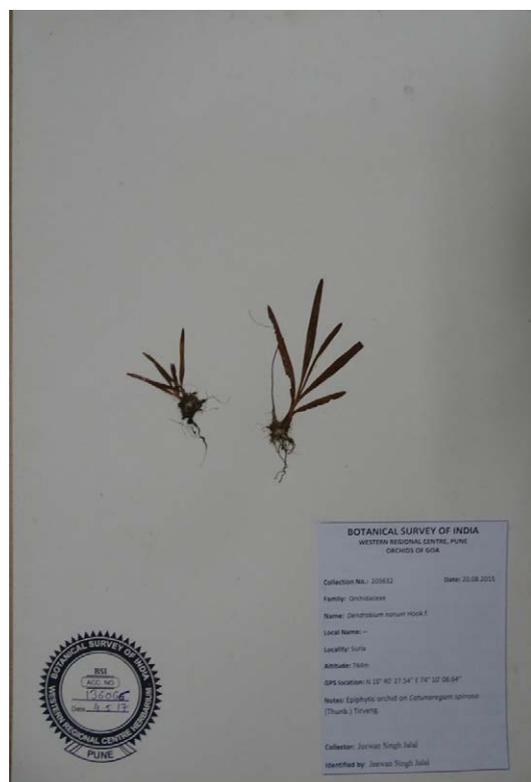


Image 18. *Dendrobium nanum* (203632)

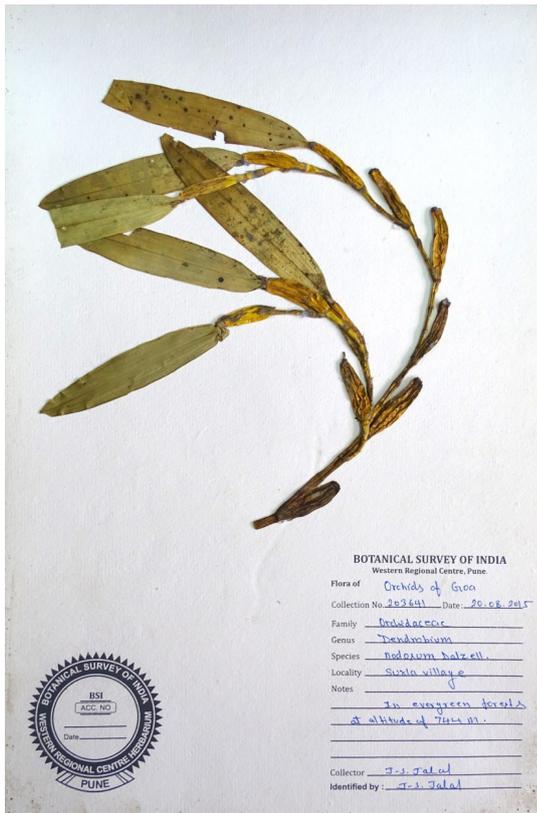


Image 19. *Dendrobium nodosum* (203641)



Image 20. *Dendrobium ovatum* (203696)



Image 21. *Dendrobium peguanum* (203743)

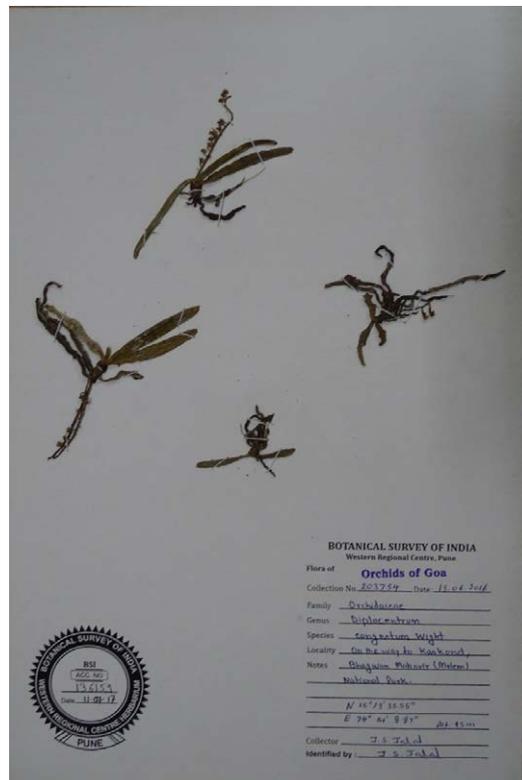


Image 22. *Diplozentrum congestum* (203754)

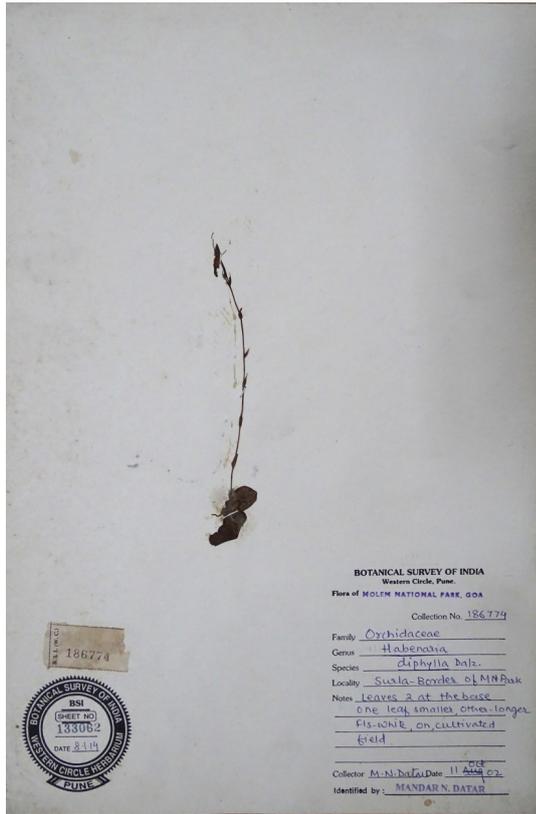


Image 27. *Habenaria diphylla* (186774)

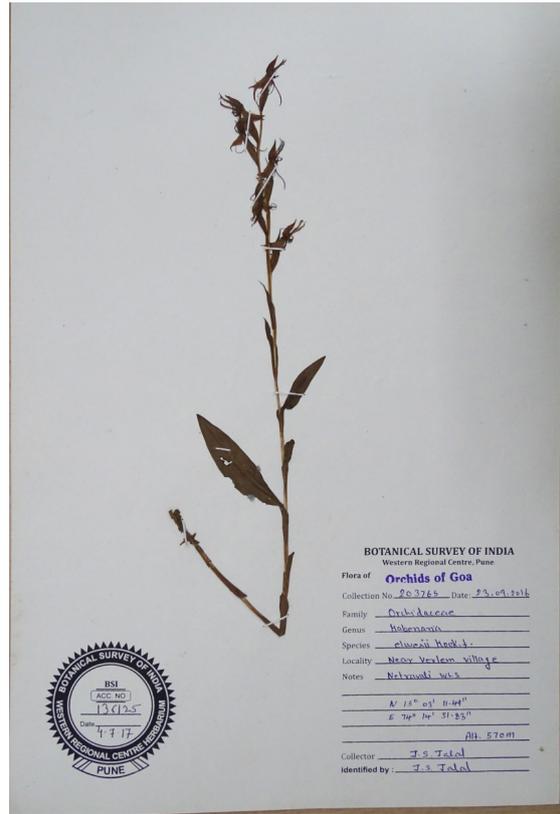


Image 28. *Habenaria elwesii* (203765)

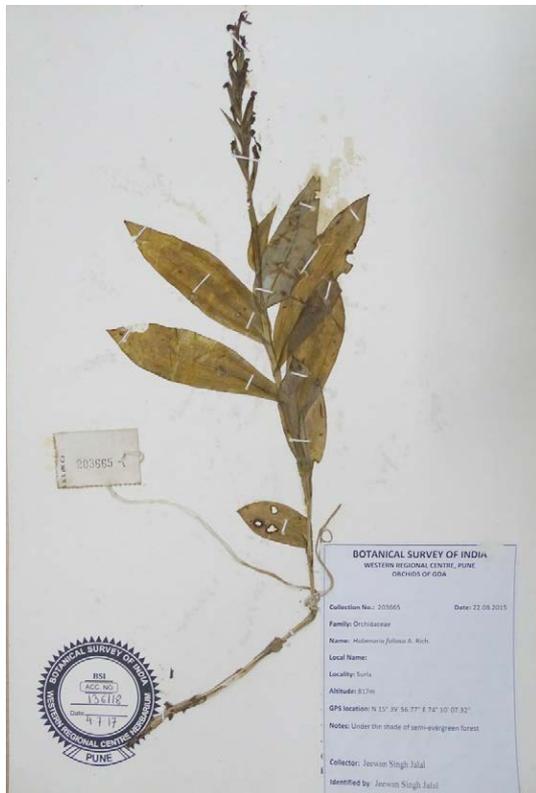


Image 29. *Habenaria foliosa* (203665)

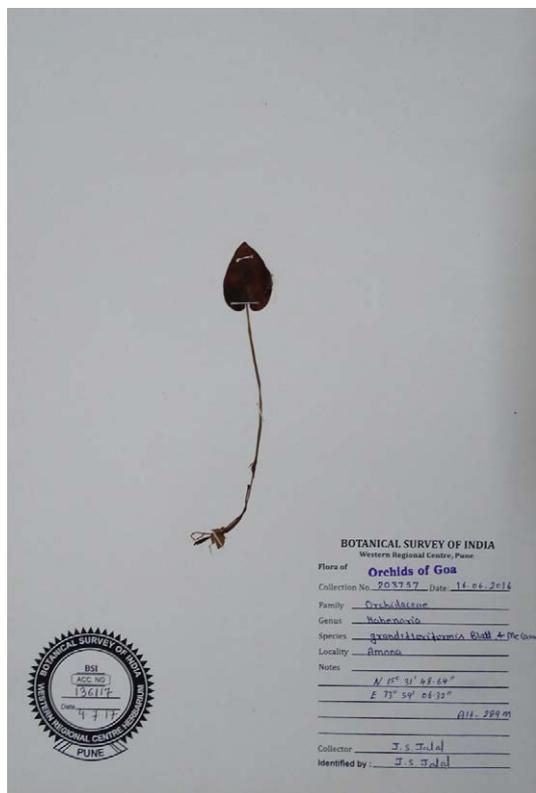


Image 30. *Habenaria grandfolriformis* (203757)

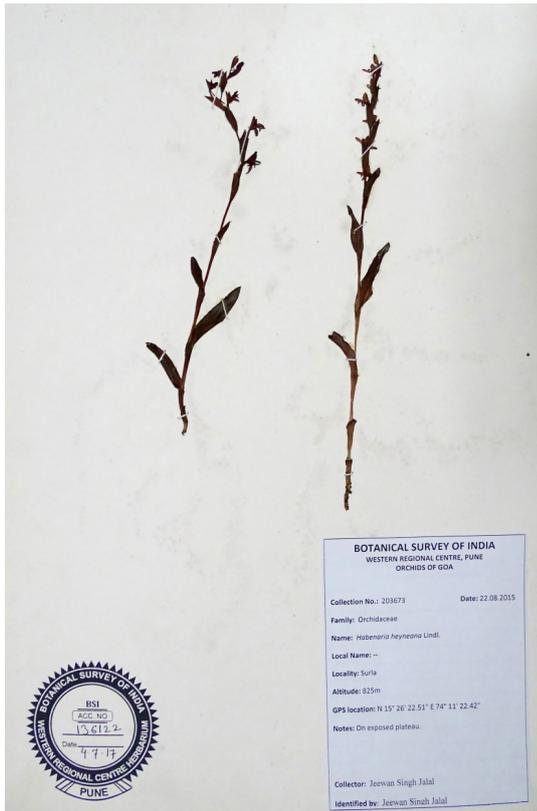


Image 31. *Habenaria heyneana* (203673)

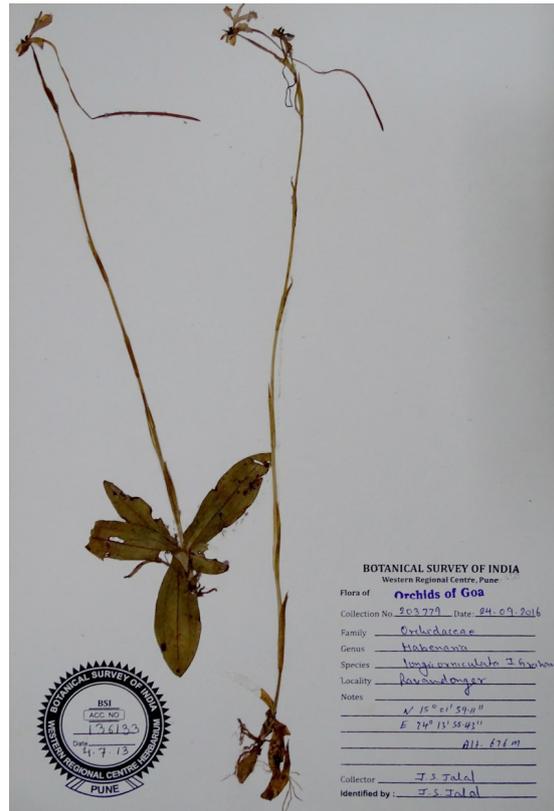


Image 32. *Habenaria longicorniculata* (203779)

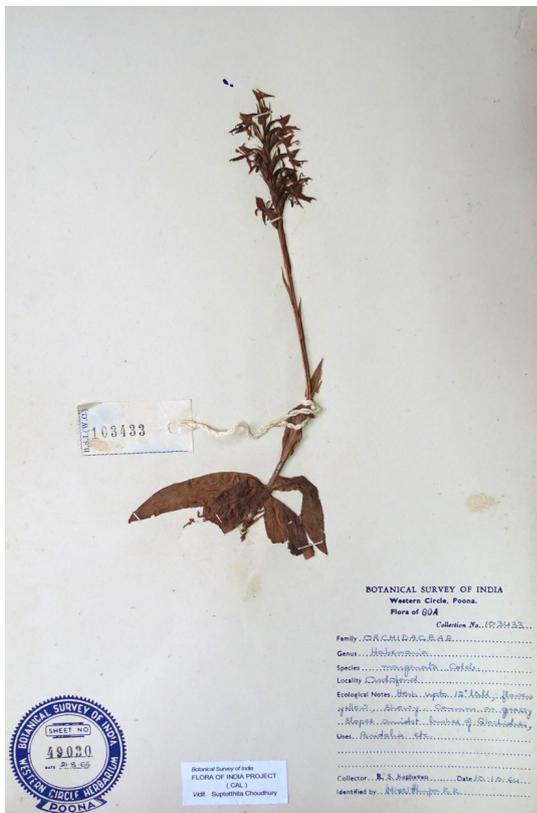


Image 33. *Habenaria marginata* (103433)



Image 34. *Habenaria multicaudata* (124207)



Image 35. *Habenaria rariflora* (124207)

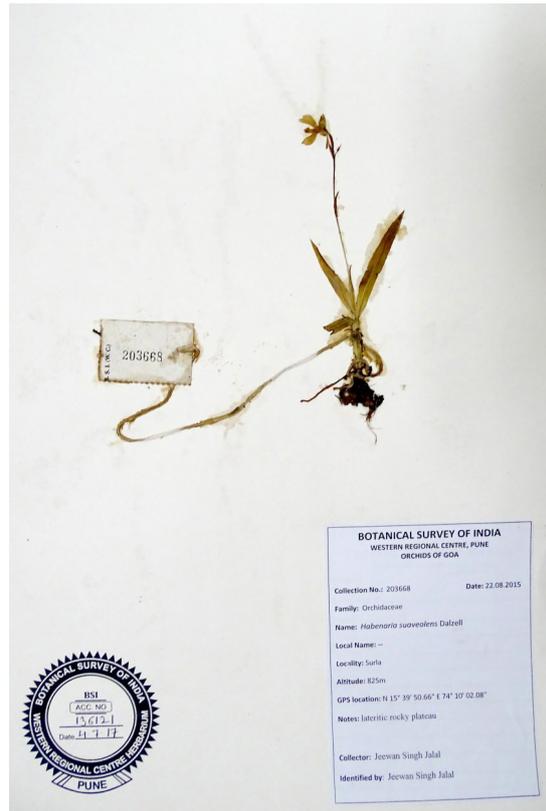


Image 36. *Habenaria suaveolens* (203668)

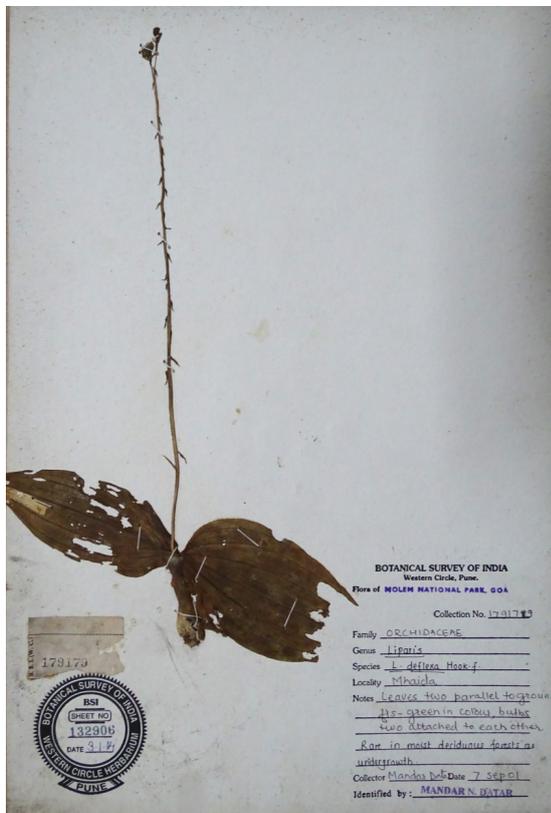


Image 37. *Liparis deflexa* (179179)



Image 38. *Liparis odorata* (203762)

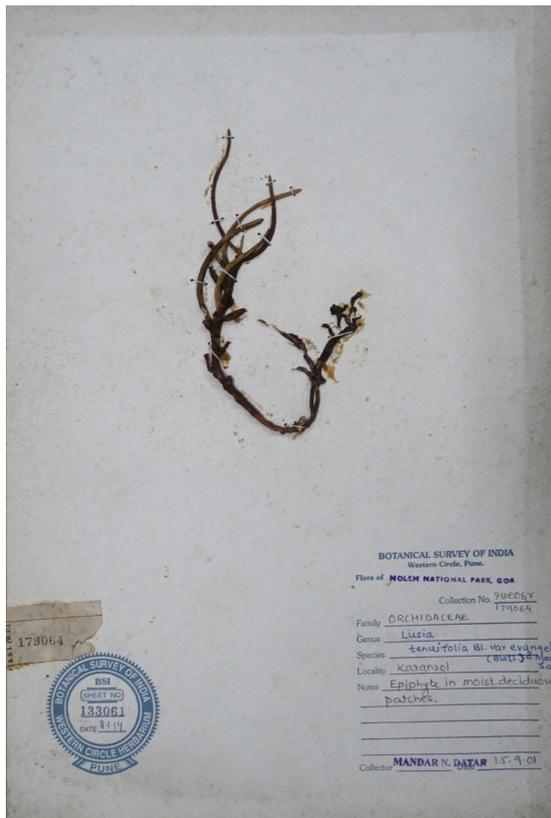


Image 39. *Luisia teunifolia* (179064)

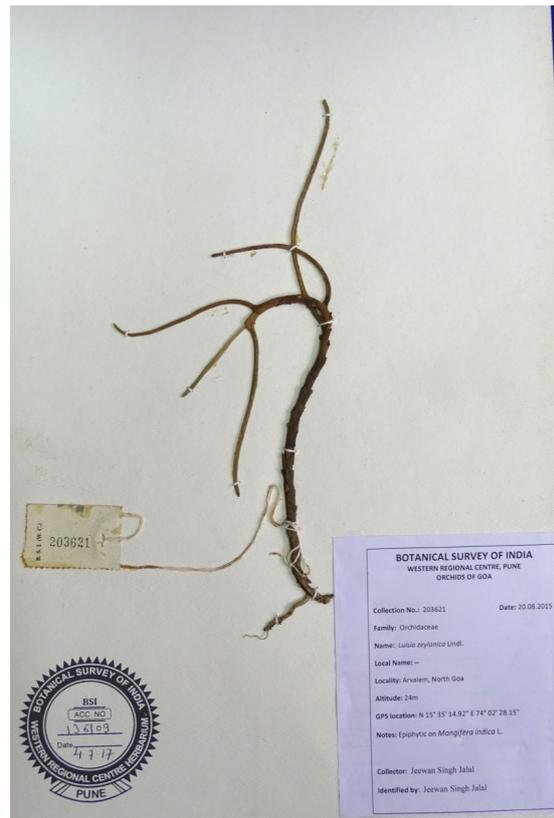


Image 540. *Luisia zeylanica* (203621)

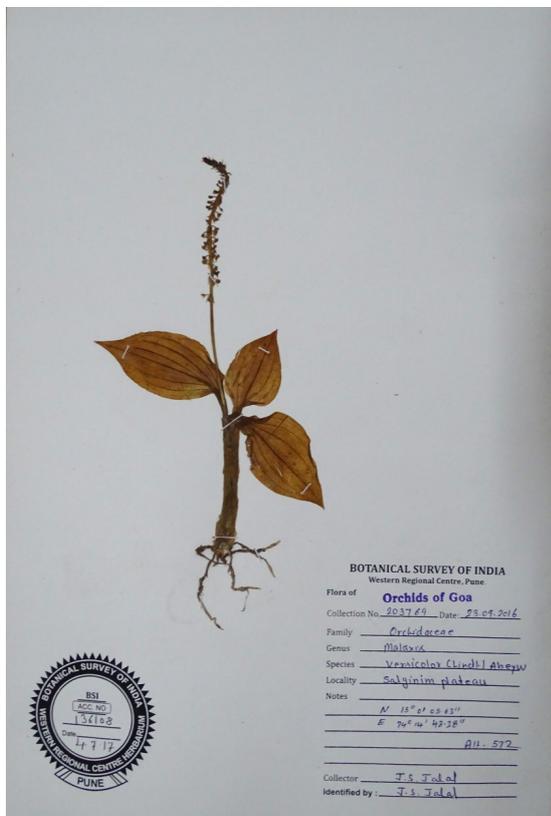


Image 41. *Malaxis versicolor* (203769)

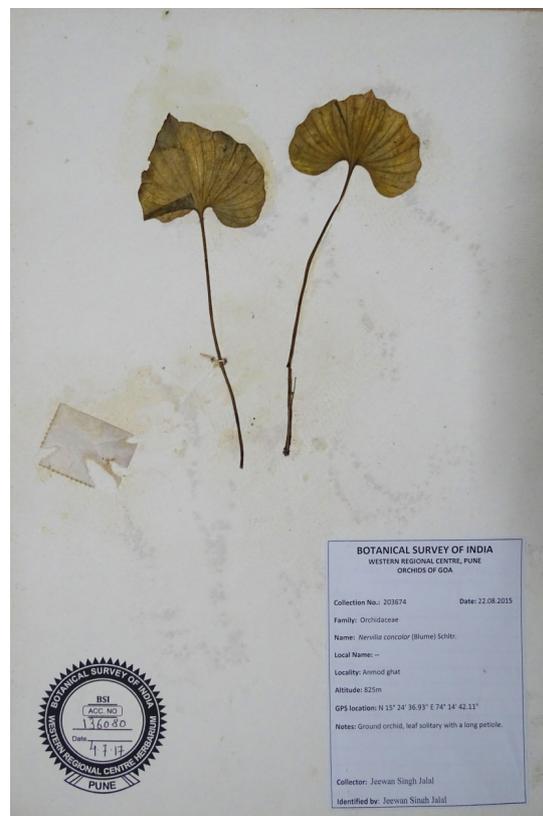


Image 42. *Nervilia concolor* (203674)

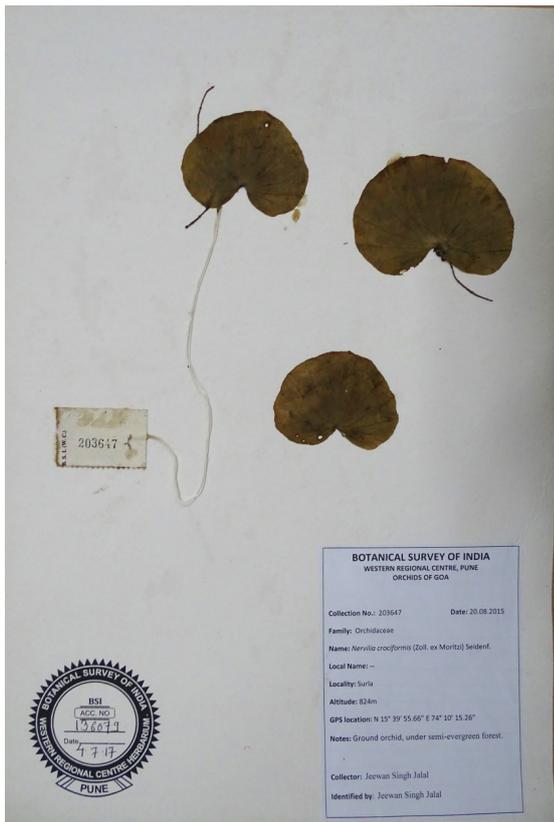


Image 43. *Nervilia crociformis* (203647)

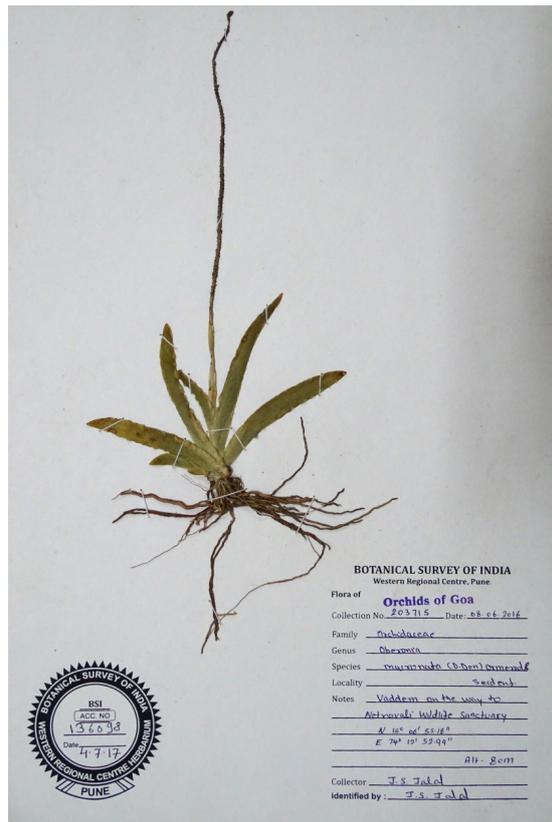


Image 44. *Oberonia mucronata* (203715)

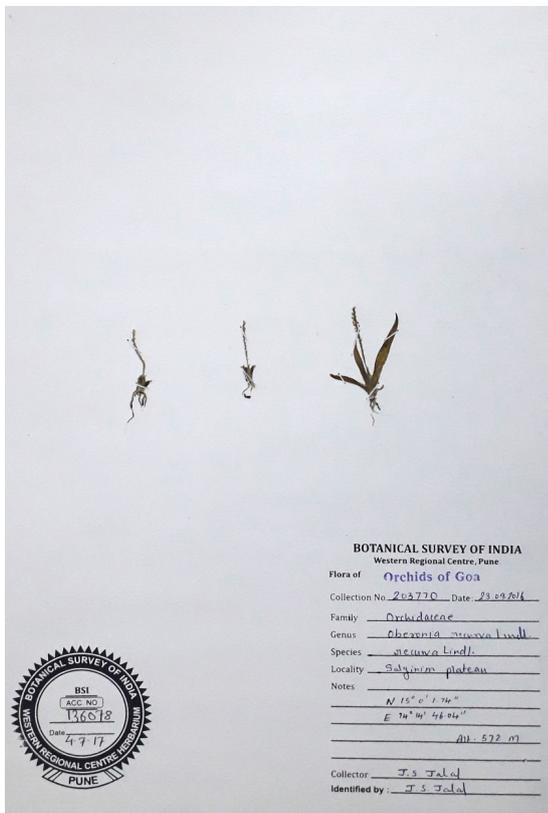


Image 45. *Oberonia recurva* (203770)



Image 46. *Oberonia verticillata* (203708)

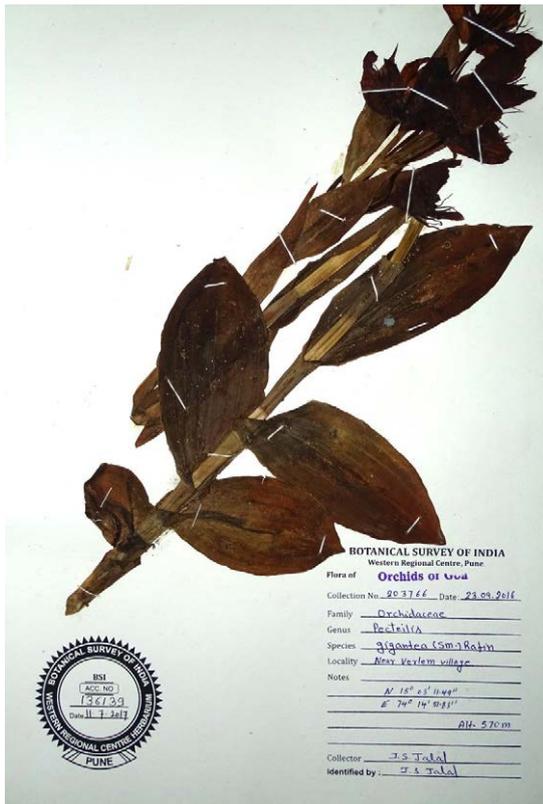


Image 47. *Pecteilis gigantea* (203766)

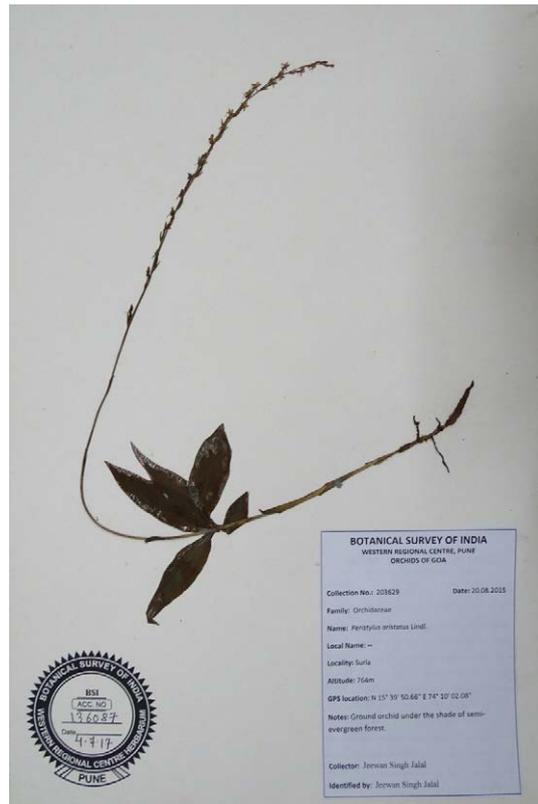


Image 48. *Peristylus aristatus* (203629)

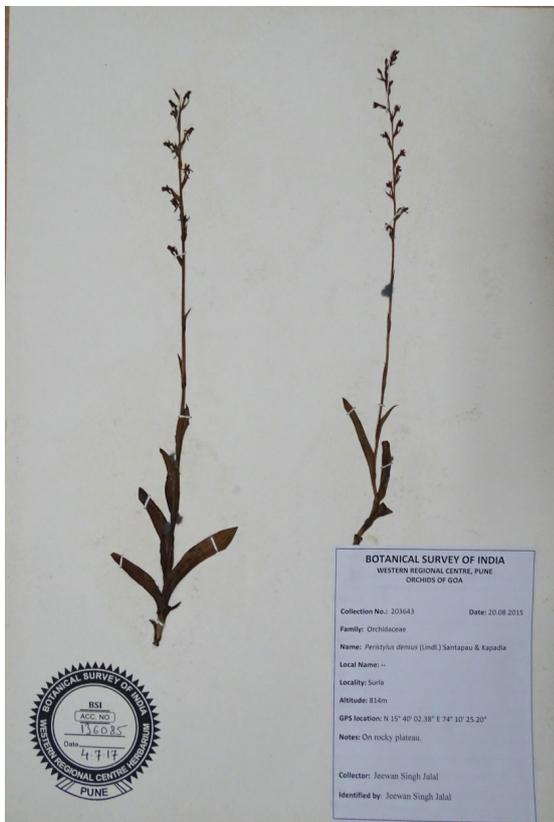


Image 49. *Peristylus densus* (203643)

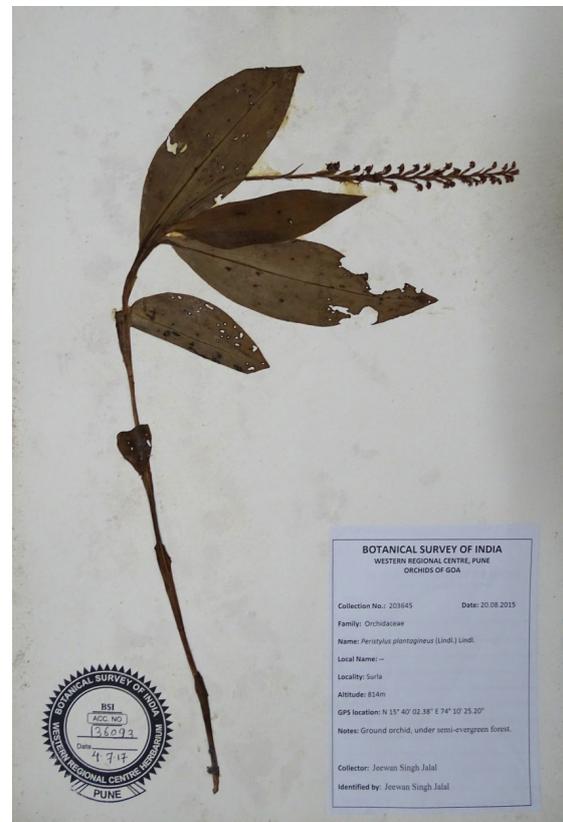


Image 50. *Peristylus plantagineus* (203645)

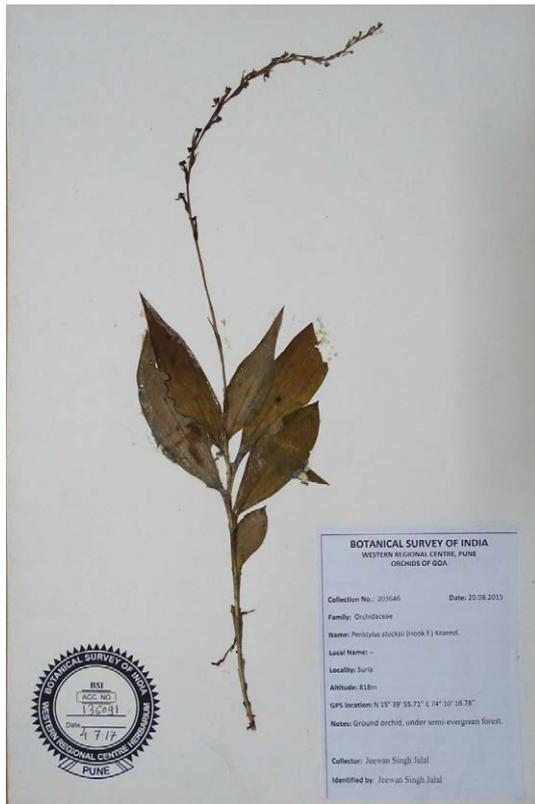


Image 51. *Peristylus stocksii* (203646)

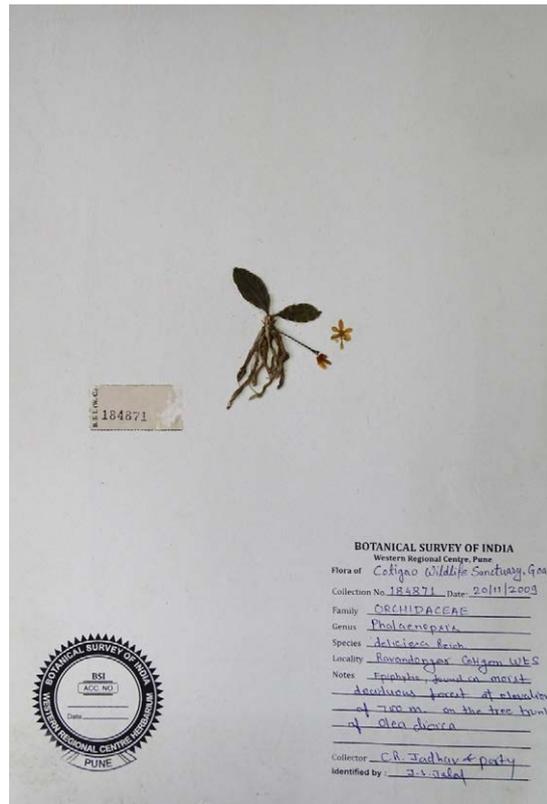


Image 52. *Phalaenopsis deliciosa* (184871)



Image 53. *Pholidota articulata* (203614)



Image 54. *Pinalia reticosa* (203649)



Image 55. *Porpax exilis* (203642)

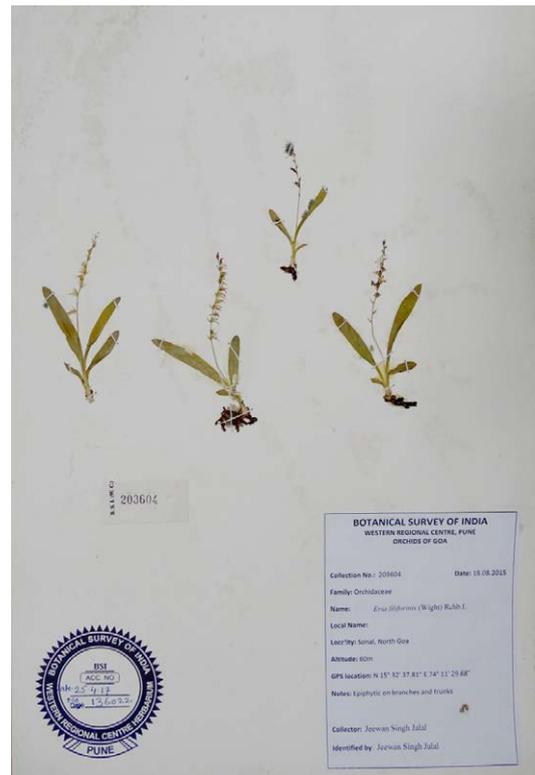


Image 56. *Porpax filiformis* (203604)

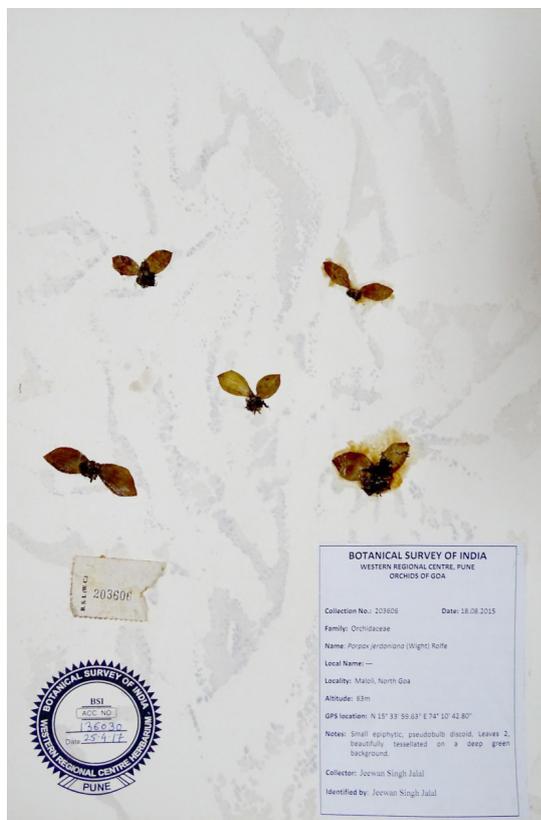


Image 57. *Porpax jerdoniana* (203606)

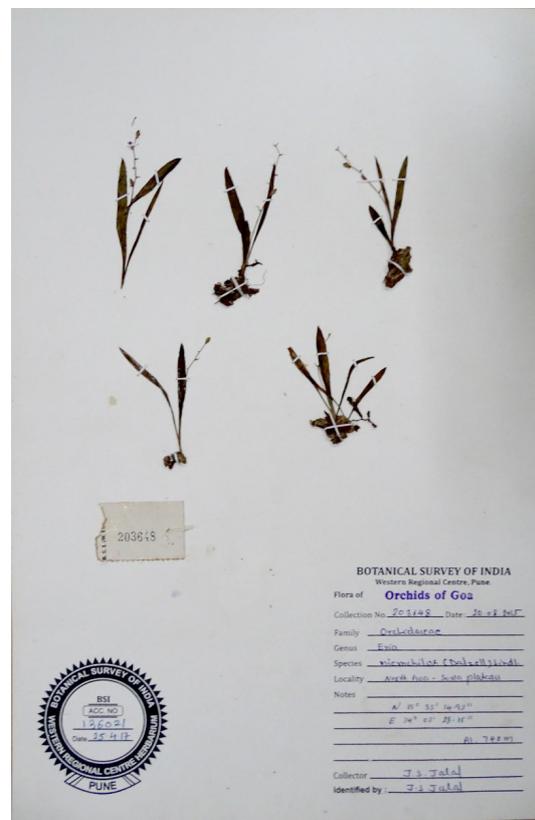


Image 58. *Porpax microchilos* (203648)

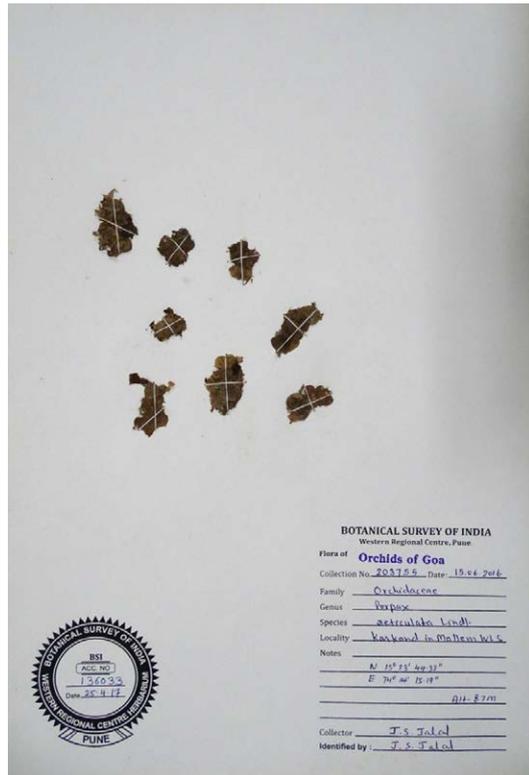


Image 59. *Porpax reticulata* (203755)

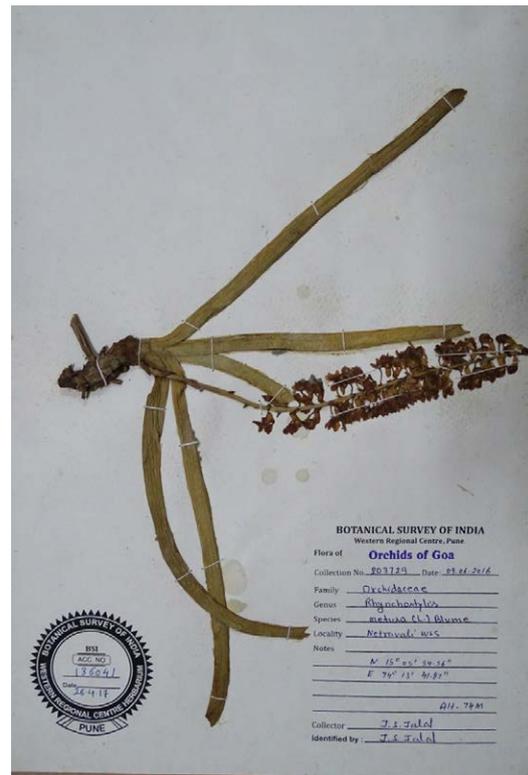


Image 60. *Rhynchostylis retusa* (203729)

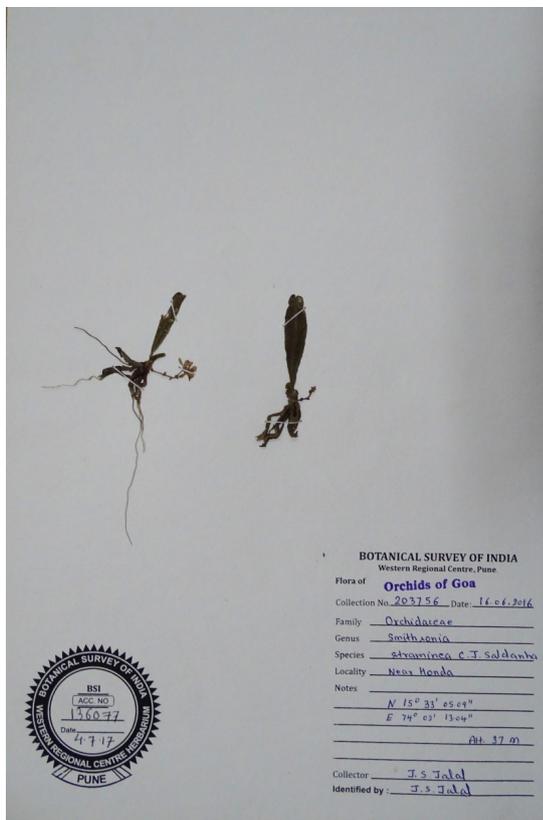


Image 61. *Smithsonia straminea* (203756)

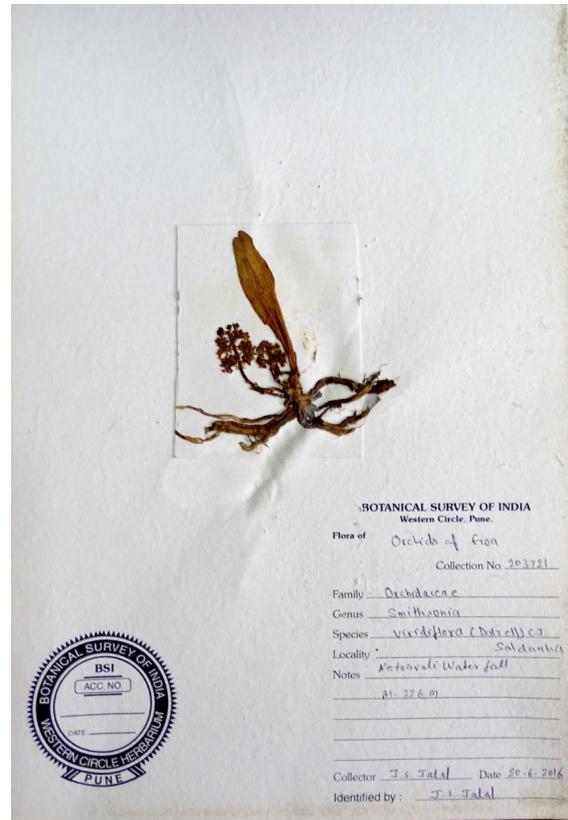


Image 62. *Smithsonia viridiflora* (203721)

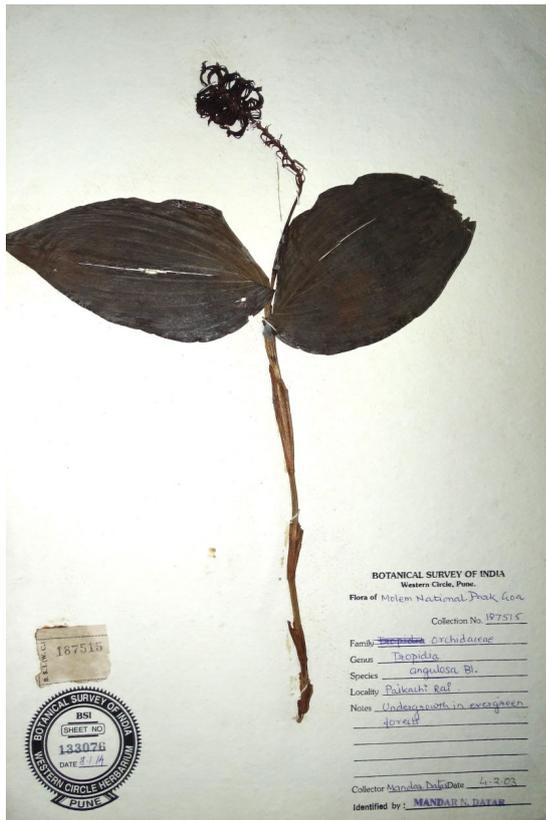


Image 63. *Tropidia angulosa* (187515)

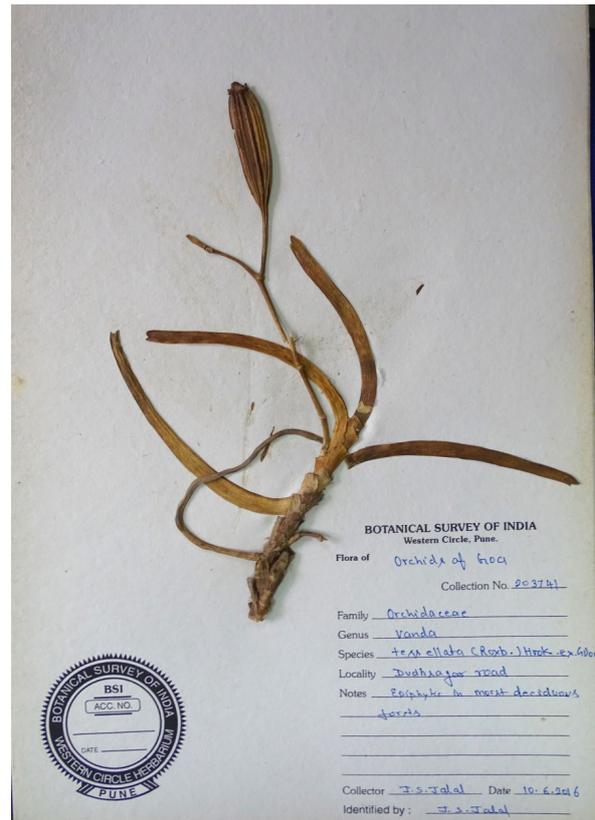


Image 64. *Vanda tessellata* (203741)



Image 65. *Vanda testacea* (203607)

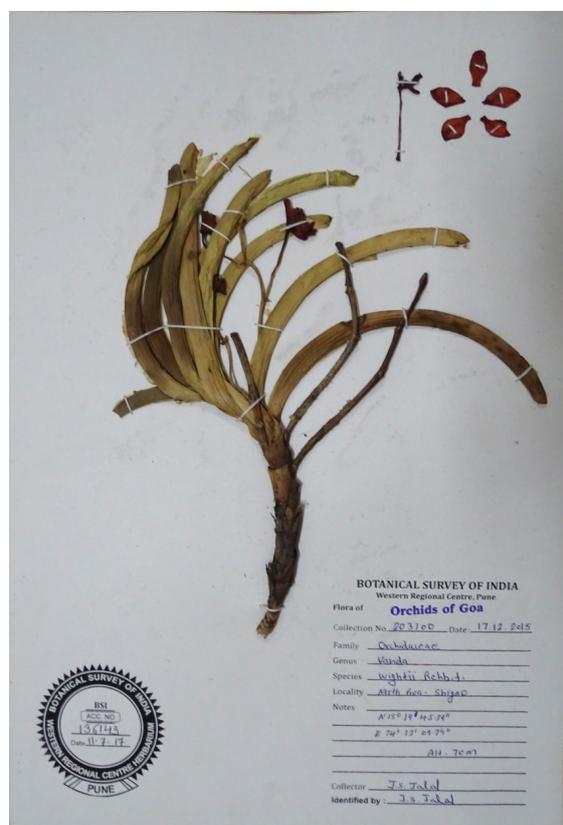


Image 66. *Vanda wightii* (203700)

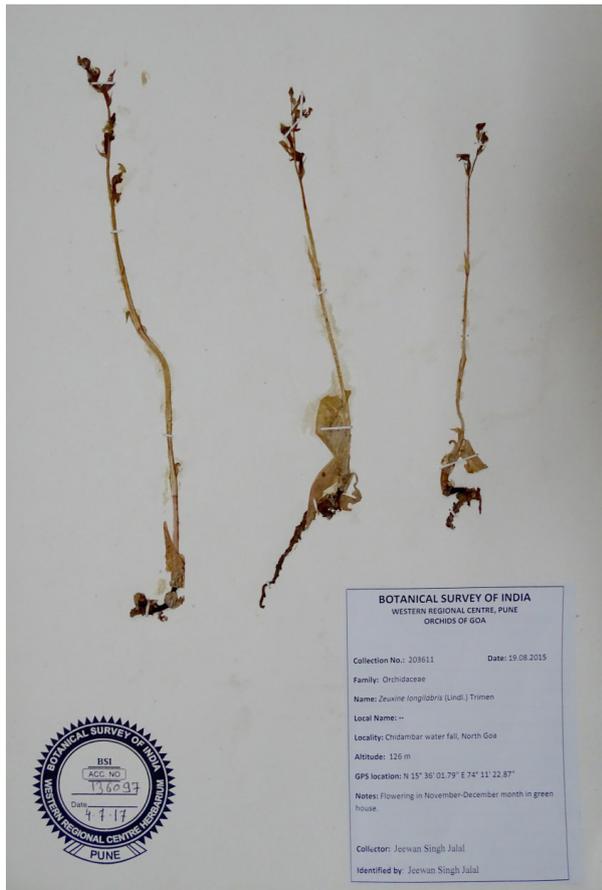


Image 67. *Zeuxine longilabris* (203611)





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First record in 129 years of the Tamil Treebrown *Lethe drypetis todara* Moore, 1881 (Lepidoptera: Nymphalidae: Satyrinae) from Odisha, India by fruit-baiting

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