The family Orchidaceae in the Serra do Japi, São Paulo state, Brazil

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The idea behind the preparation of this orchid book arose in 1998, during the elaboration of my Master Dissertation while I was studying the floral biology and pollinators of five species of orchids occurring in the Serra do Japi. Following several visits to the Serra do Japi, I perceived that there was potential for developing a floristic survey of the region, based on the increasing number of species which I found on each fresh visit to the area. The participation of Ludmila M. Pansarin in this project began three years later, in 2001, during her investigation of the reproductive biology of *Grobya amherstiae*, an orchid species common in altitudinal areas of the Serra do Japi. After a lengthy period of work extending seven years, the book was completed and presents a taxonomic treatment of 125 species, distributed among 61 genera. Two species (*Acianthera* sp. and *Habenaria* sp.), however, could not be identified and appear to be new to science. As a consequence, both taxa are excluded in this treatment.

The Serra do Japi is located in Southeastern Brazil, between two large urban centres (the municipalities of Campinas and São Paulo). As a consequence, the studied region is, inevitably, affected by anthropogenic disturbance such as deforestation, wild animal hunting, intense property speculation and criminal burning. As far as orchids are concerned, the problem is further aggravated by the collection of plants by orchidophiles. Unfortunately, many people with erroneous views about preservation have removed orchids from the native forest arguing that the plants are better "protected" in their homes. Furthermore, some orchidophiles have collected orchids from the Serra do Japi for the purpose of selling them or showing them at expositions. The indiscriminate removal of orchids from native forests disrupts not only the reproduction of the species in its natural environment, but affects a whole fauna that collects floral rewards, such as nectar, floral oils, pollen, fragrance and edible trichomes, from their flowers. Nevertheless, some regions of the Serra do Japi are still very well preserved and are inhabited by species that are currently considered rare in the natural environment, such as *Cattleya loddigesii* and *Stanhopea lietzeii*. It is also possible to find species in the region that occur preferentially in areas of the Atlantic rain forest, such as *Zygostates lunata*. Other species found in the Serra do Japi, such as *Ionopsis utricularioides*, are more common in regions of cerrado vegetation.

This book is written in simple language with the aim of making the information it contains accessible to the whole population. The book is intended to help raise awareness about the wealth and importance of the Serra do Japi for the population and we hope that future generations will be able to continue to enjoy all the riches the region contains. The Serra do Japi is important not only due to the number of species of orchids occurring there, but also because it is the home of several other groups of plants and animals. Furthermore, the Serra do Japi provides water of excellent quality for thousands of families living in the municipalities adjacent to the region. Natural areas, such as the Serra do Japi, besides offering water for human consumption, are also home to a number of species of medicinal plants that can potentially be used for the production of new drugs, aimed at curing several types of diseases. In fact, the Serra do Japi needs neither large projects nor expensive investments for its preservation. The respect of the local population and the effects of passing time are sufficient to ensure the regeneration of the degraded areas, by placing each species in its proper place. The preservation of the Serra do Japi is an urgent necessity if we are to ensure the continuing existence of all the richesit contains. After all, we depend on it considerably more than it does on us.

Emerson Ricardo Pansarin

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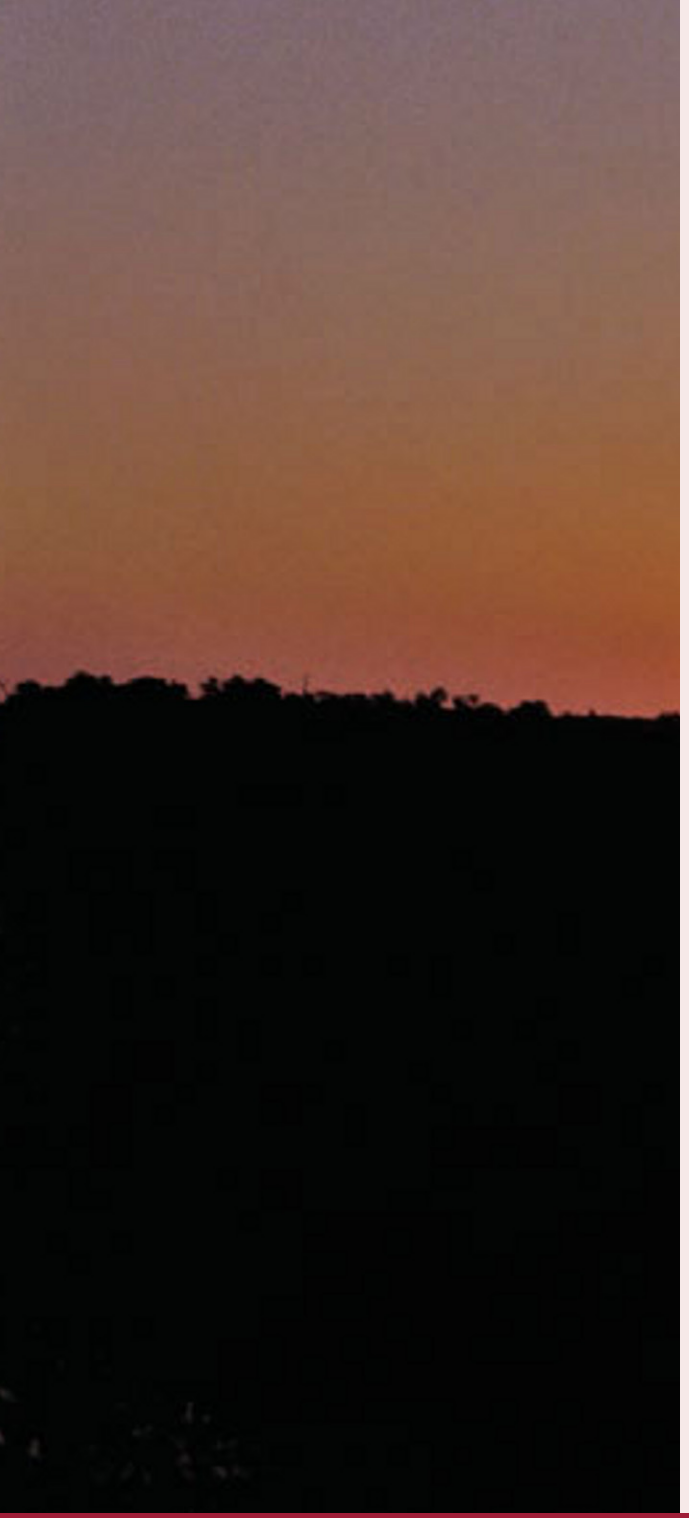

Sophronitis pygmaea (Pabst) Withner (State of Espírito Santo, Brazil)

Rodrigueziella handroi (Hoehne) Pabst

Bufo ictericus Spix (Female) 5

The family Orchidaceae comprises about 7% of all angiosperms and is considered one of the largest families of this group. The family presents more than 25,000 species, distributed around the world, but showing greatest diversity in tropical regions. A vast number of orchid species occur especially in the Neotropics. Most orchids are epiphytic. Nevertheless, many species are rupiculous, terrestrial, mico-heterothrophic or occur in marshy areas.

Orchids present great diversity with respect to their floral and vegetative morphology. The vast majority of orchids have sympodial habit, presenting lateral inflorescences, as observed in representatives of the tribes Stanhopeinae, Maxillariinae and Oncidiinae, or terminal inflorescences, as occur in species of *Epidendrum*. Other orchid groups, however, such as some genera belonging to the tribe Vandeae (subfamily Epidendroideae) and Vanilleae (subfamily Vanilloideae), present a monopodial habit and, in these cases, the inflorescences are lateral.

Orchids, as well as other monocotyledons, have a fasciculate root system. In this system the primary root degenerates early in development and in their place many other roots are produced, arising from a unique point. The aerial roots of epiphytic species of Orchidaceae and other families, such as Araceae, have a multisseriate epidermis called velamen which consists of dead and densely arranged cells in whose walls occur secondary thickening of cellulose. The velamen has several functions, the most important of which are to capture moisture so that the water can be absorbed by cells of the root, protect against excessive loss of water in more arid periods and protect the cells of the root against the action of ultraviolet light. In many terrestrial orchids, the roots (or certain regions of the roots) are thickened and form organs for the reservation of substances. In many Spiranthoideae, such as *Sauroglossum*, *Sarcoglottis*, *Cyclopogon* etc, all the roots are showy and assume the function of reserving nutrients and water. In species of *Cleistes* and *Habenaria*, however, only some of the roots or some portion of the roots (called "tuberoide organs" or tuberose roots) are succulent and, consequently, exhibit the function of storing substances. Some epiphytic species, such as *Isochilus* and some species of *Epidendrum* and *Campylocentrum* which have thin or reduced stems and membranaceous leaves (leaves absent in some species of *Campylocentrum*), can also present showy roots that present the function of nutrient storage.

The stem of orchids with sympodial habit is composed, basically, of a horizontal portion which may be above or below the substrate, also called rhizome, and a portion for the reservation of nutrients and of determined growth may be present as a corm-like pseudobulb, bulb-like pseudobulb or a true pseudobulb. In some species of *Epidendrum* and *Arundina,* the stem does not form pseudobulbs. These genera eventually have a thin and erect stem, with distichously disposed leaves, resembling *Sacharium* (sugar-cane). Orchids with a monopodial habit, such as *Vanilla*, have an indeterminate (monopodial) growth and, in this case, the rhizome is absent or much reduced. The leaves of orchids present a model typically found in many other monocotyledons, with numerous parallel veins and generally not obvious connections between the parallel venation. The genus *Epistephium*, however, differently from most other species of Orchidaceae, presents secondary ner-

vations in the form of a network. In most orchids, the leaves are alternae and distichously disposed. Sometimes, however, certain groups present rosulate leaves (as in the case of most Orchidoideae), opposite or sub-opposite, or equitant. Leaf characters can be very important in the classification of Orchidaceae. Several epiphyte species, such as many *Cattley*a and *Oncidium*, for example, present conduplicate leaves. The conduplicate leaves, as well as being cylindrical and triangular, are often fleshy and assume the function of reserving nutrients.

Some species of *Pleurothallis* and *Brassavola* present cylindrical leaves. The leaves of some members of these orchid genera species seem to be a continuation of the aerial stem and can often be differentiated only by an abscission layer. Some groups of orchids, such as *Stanhopea*, *Cirrhaea* and *Eulophia,* present plicate leaves. Plicate leaves are usually membranaceous and are not designed for the reservation of nutrients. The base of the leaves of orchids usually presents as a sheath surrounding the stem or pseudobulb. In some orchids, such as members of the subtribe Stanhopeinae, the base of the leaves form a structure similar to a petiole, called a pseudopetiole. In many orchids of the subfamily Epidendroideae, the base of the leaves or petiole presents an abscission layer in which the leaves break and fall when conditions become unfavorable or in autumn. The rest of the subfamilies do not present an abscission zone in the base of leaf.

The majority of orchids present an indeterminate inflorescence: usually a terminal or lateral raceme or panicle. Racemes and panicles are elevated by a scape. In some orchid groups the flowers are solitary, as occurs in the genera *Basiliorchis*, *Heterotaxis* and *Trigonidium*, and each flower is elevated by a scape. Many species with single-flowered inflorescences are hypothetized as being derived from multi-flowered ancestral plants. In some cases, as in *Epidendrum nocturnum*, the scape of the inflorescence is reduced and the flowers seem to leave a single point. In species of *Elleanthus,* the flowers are produced in a very dense inflorescence, with well-developed bracts. Determined inflorescences (cymes) are rare in orchids and other monocotyledons. However, in *Lockhartia*, the inflorescence is cymose. In *Dichaea*, solitary flowers are produced from the base of leaves. Already in *Cleistes* (Vanilloideae), the inflorescence is a continuation of the aerial stem and each flower is produced at the base of the leaf (bract). Some species of orchids have special types of raceme. In *Epidendrum secundum*, for example, the inflorescence is a corymb. In *Rhizanthella,* the inflorescence is a capitulum, as is commonly observed in species of the family Asteraceae. Inflorescences of umbel type can be found in some species of *Bulbophyllum*. In orchids with sympodial habit, the inflorescence may be terminal and, in this case, is produced at the apex of the pseudobulbs. Some orchid groups, however, produce lateral inflorescences and, in this case, the scape arises from the base of the stem. In orchids with a monopodial habit, the inflorescences are obligatorily lateral. The flowers of orchids are subtended by bracts. Usually the bracts are green or hyaline, but in some cases they are coloured. The flowers can be spirally arranged or secund along a glabrous or pubescent rachis.

Flowers of Orchidaceae are usually zygomorphic and trimerous. The three sepals usually have the function of protecting the floral bud or may be involved in the process of attracting pollinators.

Oncidium harrisonianum Lindl.

Some species of Pleurothallidinae for example, have osmophores on the sepals. The sepals may be free, as in *Cattleya*, or may present a full or partial fusion of the two lateral sepals, as occur in *Gomesa*. Sometimes all three sepals are fused, as in *Dryadella*. In some cases, a fusion of the three sepals with the column can also occur. The genera, *Epistephium* and *Lacanorchis* (Vanilloideae), present an epicalix (calyculus) externally and at the base of the perianth.

Orchid flowers have three petals, one of which (the one opposite the anther) is usually differentiated into a labellum, also called a lip. Usually the labellum is more complex than the other two petals and, depending on the group within the family, may present several degrees of adnation with the column. In some genera, there is a region of articulation between the labellum and the column that, in many cases, as in *Govenia* and many Pleurothallidiinae, is involved with the pollination process. The labellum can be entire or divided into three lobes: two lateral lobes and one apical lobe.

In some genera, as in *Stanhopea*, the labellum can be divided into three distinct regions, the hypochile, which is the basal portion, the mesochile, which is the middle portion, and the epichile, which is the apical portion. Usually the labellum is the region directly involved in the pollination process of the species. Generally it is larger and may present a different coloration from other parts of the flower. Sometimes it presents several types of callosities, which can be nectar guides, elaiophores, osmophores, or it can contain a number of other structures, such as trichomes, that can be collected or act on the attraction of pollinators. Sometimes the labellum is modified at the base and produces or stores nectar (nectary). The labellum is usually located on the underside of the flower, on the opposite side of the column that commonly is oriented towards the upper side, in relation to the lip. In the floral bud, however, the labellum usually occupies an upper or adaxial position. During floral bud maturation, soon before flower opening, the pedicel frequently twists 180º, probably due to gravity, and the labellum becomes positioned on the lower side of the flower. Flowers that have this feature are called resupinate. In some species of orchids, however, the pedicel does not twist during bud maturation (e.g. *Polystachya estrellensis*) or it undergoes a torsion of 360º (e.g. *Cirrhaea dependens*) and the labellum remains on the top side of the column and, in this case, the flower is called non-resupinate.

In Orchidaceae, the reproductive organs (androecium and gynoecium) are fused into a singular structure, the column or gynostemium. The column presents one or, more rarely, two or three anthers and a stigmatic region formed by the fusion of the three stigmatic lobes. In the more basal subfamilies, as in Apostasioideae (*Neuwiedia*) and Cypripedioideae, stamens are only partially fused and both lateral stamens are fertile. Sometimes the three stamens are fertile, as in *Apostasia* (Apostasioideae). In orchids with a single fertile anther, such as representatives of families Orchidoideae, Vanilloideae and Epidendroideae, both lateral stamens are sterile and are absent or are reduced to staminodes. In many orchids, as in species of *Oncidium*, the column often presents lateral projections (wings) that have frequently been interpreted as staminodes. In some orchids, as

in species of *Bifrenaria*, the column base form an extension called a foot (column-foot). In orchids that present a column-foot, the labellum and often the base of sepals, or more rarely petals, are adnate to this structure.

Although the floral construction of orchids is more or less uniform in relation to the number and disposition of its floral parts, there is variation in structural details, in shape and size of the basic elements (sepals, petals, labellum and collumn), leading to the occurrence of very complex structures in some groups within Orchidaceae.

In the case of most Orchidaceae, the pollen grains are aggregated into cohesive units called pollinia. In the most basal orchid subfamily (Apostasioideae), however, the pollen grains (monads) are free. Vanilloid orchids also present free pollen monads, although some species of *Vanilla* release pollen aggregated in massulae. With relation to the pollinia, several types exist within Orchidaceae, which are classified according to the grade of pollen cohesion, as the sectile pollinia, soft pollinia, massulae, and hard pollinia. Among Epidendroid orchids, the pollinia, together with the viscidium (and stipe, in some genera), that is the adhesive extremity responsible for attachment to the pollinator, form the pollinarium. A pollinarium may contain two, four, six or eight pollinia, depending on the group within Orchidaceae. In general, the number of pollinia is very important in the traditional taxonomy of orchids. The pollinarium is separated from the stigma by a region called rostellum.

The ovary of orchids is inferior (below the insertion point of the petals and sepals) and presents three carpels. The fruit in Orchidaceae is usually a capsule and the dehiscence (aperture) usually occurs through splits in midline between carpels. In many orchids, depending on the group, a unique ovary can produce thousands of ovules. In many species in the family, however, the ovary is not completely differentiated during the flowering. Differentiation takes place after the occurrence of pollination. This strategy is important because the species invests little energy if the flower is not pollinated.

After the occurrence of pollination, which is the deposition of pollen grains on the stigmatic surface (or stigma) of a flower, pollen tubes grow and head through the style, which is located inside the column. Each pollen tube can fertilize an ovule and form an embryo. In many other seed plants, the product of this fusion results in the formation of a nutritive tissue called endosperm. In orchids, however, the endosperm development is disrupted in the early stages of seed development. Therefore, a mature seed of an orchid comprises a large embryo and a unicellular layer of cells called a seed coat. A single orchid fruit can contain thousands of seeds which are very light and usually dispersed by wind. Some members of the tribe Vanilleae, however, have sclerotic seeds.

As the seeds of orchids have no endosperm, the embryo cannot be nourished by nutrients contained in its own seed. In this case, when the seeds fall onto an appropriate location, specific fungal hyphae penetrate through the seed coat and nourish the embryo with carbohydrates and minerals.

Galeandra beyrichii Rchb. f. (Fruits)

This symbiotic association between a species of fungus and a particular plant is called mycorrhizae (endomycorrhizae in the case of orchids).

Read more:

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Plant species, as well as animal and fungi, have a Latin name, which follows the binomial system of Linnaeus (Carl von Linné, 1707–1778). The first name refers to the genus (e.g. *Cleistes*, *Bulbophyllum*, *Constantia* and *Cattleya*). The second name is the specific epithet (e.g. *montana*, *punctatum*, *cipoensis* and *loddigesii*). The Latin names can be assigned, for example, according to the habitat of the plant (e.g. *Cleistes montana*), floral or vegetative character (e.g. *Bulbophyllum punctatum*), locality where the plant occurs, mainly when it is considered endemic of a region (e.g. *Constantia cipoensis*), which occur exclusively in the Serra do Cipó (state of Minas Gerais, Brazil). Some plant names are attributed in honour of a particular person (e.g. *Cattleya loddigesii*), in honour of Joachin Conrad Loddiges. Names of species are always writing in italics and the first letter of the genus is capitalized. The names of species should always be accompanied by the names of their respective authors (e.g. *Cattleya loddigesii* Lindley, *Bulbophyllum punctatum* Barbosa Rodrigues). In citations of plant names, authors's names are often abbreviated according to Brummit & Powell (1992) "Authors of Plant Names" (e.g. *Cattleya loddigesii* Lindl., *Bulbophyllum punctatum* Barb. Rodr.).

The genera are grouped into subtribes. The names of subtribes present the termination "inae" (e.g. Laeliinae). The subtribes are grouped into tribes and receive the termination "eae" (e.g. Epidendreae). The tribes are grouped into subfamilies and receive the termination "oideae" (e.g. Epidendroideae). Finally, the subfamilies are grouped into families. Names of families end in "aceae" (e.g. Orchidaceae). Names of taxa above genera are not italicized. The principles, rules and recommendations governing the correct naming of plants, are encompassed in the "International Code of Botanical Nomenclature" (St Louis Code).

Regarding the classification of the family Orchidaceae since Linnaeus, who has described *Orchis* (typus of Orchidaceae) up until today, many botanists have investigated hierarchic relationships within Orchidaceae based on similarities between their floral and vegetative characters. The evolutionary history of the family has been hypothesized and classifications have been made, based on studies of the current taxa through phylogenetic analysis, based on several kinds of data, such as ecological, morphological, anatomical, chemical and, more recently, the study of molecular characteristics. Orchids, at least as far as is known, have no fossil records. Recently, however, a fossil of an extinct species of bee from Mioecene was found with a pollinarium attached to its scutellum. With the advancement of phylogenetic systematics, the hierarchical levels of groups of species within family Orchidaceae tend to change. Dressler (1993), in his treatment of the orchid family, recognizes five subfamilies: Apostasioidae, Cypripedioideae, Epidendroideae, Spiranthoideae and Orchidoideae. In the more recent morphological and macromolecular studies within Orchidaceae, the number of subfamilies is maintained, but with hierarchical modifications. Currently, several authors have elevated the tribe Vanilleae to the rank of subfamily (Vanilloideae). The subfamilies Spiranthoideae and Orchidoideae are united in a single subfamily (Orchidoideae). Among these five subfamilies, Epidendroideae is the largest, present-

Capanemia superflua (Rchb. f.) Garay

ing more genera and species than all the other subfamilies together. Epidendroideae is a paraphyletic group and divided into two large groups: the basal Epidendroideae that comprise a group in which pollen is free (not aggregated into pollinia) and anther erect or suberect, and the remainder of epidendroids ("derived Epidendroideae"), presenting hard pollinia and an incumbent anther (Cameron et al. 1999).

A more recent classification system for Orchidaceae is presented by Pridgeon *et al.* (1999–2009) and published in five volumes. The classification system of Pridgeon *et al.* (1999–2009) which is based on a set of data, including molecular characters, is tending gradually to replace the current systems. Pridgeon's system is composed of five subfamilies: Apostasioideae, Vanilloideae, Cypripedioideae, Orchidoideae and Epidendroideae.

In the Serra do Japi, the family Orchidaceae is represented by species belonging to three subfamilies: Orchidoideae, Vanilloideae and Epidendroideae. Among the Epidendroideae, the Serra do Japi is listed as having representatives of nine tribes. The presentation according to tribe follows Dressler (1993).

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14 *Grobya amherstiae* Lindl.

Family Orchidaceae in the Serra do Japi

Classification according to Pridgeon et al. (1999–2005). Division in tribes and subtribes follow Dressler (1993)

Subfamily Orchidoideae Dressler

Tribe Cranichideae Endlicher

Subtribe Goodyerinae Klotzsch

Genus *Aspidogyne* Garay
*Aspidogyne hylibate*s (Rchb.f.) Garay
Aspidogyne metallescens (Barb. Rodr.) Garay

Subtribe Prescottiinae Dressler
Genus *Prescottia* Lindl.
Prescottia colorans Lindl.
Prescottia montana Barb. Rodr.
Prescottia oligantha Lindl.
Prescottia stachyodes (Sw.) Lindl.

Subtribe Cyclopogoninae Szlach.
Genus *Cyclopogon* C. Presl
Cyclopogon atroviridis Barb. Rodr.
Cyclopogon calophyllus (Barb. Rodr.) Barb. Rodr.
Cyclopogon chloroleucus (Barb. Rodr.) Schltr.
Cyclopogon congestus (Vell.) Hoehne
Cyclopogon elatus (Sw.) Schltr.
Cyclopogon variegatus Barb. Rodr.

Subtribe Spiranthinae Lindley
Genus *Eurystyles* Wawra
Eurystyles actinosophila (Barb. Rodr.) Schltr.
Genus *Hapalorchis* Schltr.

Hapalorchis lineatus (Lindl.) Schltr.
Hapalorchis micranthus (Barb. Rodr.) Hoehne
Genus *Mesadenella* Pabst & Garay
Mesadenella cuspidata (Lindl.) Garay
Genus *Pelexia* Poit. ex Lindl.
Pelexia oestrifera (Rchb. f. & Warm.) Schltr.
Genus *Pteroglossa* Schltr.
Pteroglossa glazioviana (Cogn.) Garay
Genus *Sarcoglottis* C. Presl
Sarcoglottis fasciculata (Vell.) Schltr.
Genus *Sauroglossum* Lindl.
Sauroglossum nitidum (Vell.) Schltr.

Subtribe *Stenorrhynchidinae* Szlach.
Genus *Stenorrhynchos* Rich. ex Spreng.
Stenorrhynchos lanceolatum (Aubl.) Rich. ex Spreng.

Tribe Orchideae

Subtribe Orchidinae
Genus *Habenaria* Willd.
Habenaria araneiflora Barb. Rodr.
Habenaria glaucophylla Barb. Rodr.
Habenaria johannensis Barb. Rodr.
Habenaria josephensis Barb. Rodr.
Habenaria parviflora Lindl.
Habenaria paulistana Batista & Bianchetti
Habenaria pleiophylla Hoehne & Schltr.
Habenaria riedelii Cogn.

Watercourse

Subfamily Epidendroideae Lindley

Tribe Tropidieae Dressler

Genus *Corymborkis* Thouars
Corymborkis flava (Sw.) Kuntze

Tribe Triphoreae Dressler

Genus *Psilochilus* Barb. Rodr.
Psilochilus modestus Barb. Rodr.

Tribe Gastrodieae Lindley

Subtribe Wullschlaegeliinae Dressler
Genus *Wullschlaegelia* Rchb.f.
Wullschlaegelia aphylla (Sw.) Rchb.f.

Tribe Malaxideae Lindley

Genus *Liparis* Rich.
Liparis nervosa (Thunb.) Lindl.
Genus *Malaxis* *Sw.*
Malaxis excavata (Lindl.) Kuntze

Tribe Epidendreae H.B.K.

Subtribe Laeliinae Bentham
Genus *Cattleya* Lindl.
Cattleya loddigesii Lindl.
Genus *Encyclia* Hook.
Encyclia patens Hook.
Genus *Epidendrum* L.
Epidendrum armeniacum Lindl.
Epidendrum chlorinum Barb. Rodr.
Epidendrum difforme Jacq.

Epidendrum henschenii Barb. Rodr.
Epidendrum latilabre Lindl.
Epidendrum martianum Lindl.
Epidendrum ochroclorum Barb. Rodr.
Epidendrum paniculatum Ruiz & Pav.
Epidendrum proligerum Barb. Rodr.
Epidendrum secundum Jacq.
Genus *Isabelia* Barb. Rodr.
Isabelia violacea (Lindl.) Van den Berg & M. W. Chase
Isabelia virginalis Barb. Rodr.
Genus *Isochilus* R. Br.
Isochilus linearis (Jacq.) R. Br.
Genus *Prosthechea* Knowles & Westc.
Prosthechea bulbosa (Vell.) W. E. Higgins
Prosthechea calamaria (Lindl.) W. E. Higgins

Subtribe Pleurothallidinae Lindl.
Genus *Acianthera* Scheidw.
Acianthera aphthosa (Lindl.) Pridgeon & M. W. Chase
Acianthera auriculata (Lindl.) Pridgeon & M. W. Chase
Acianthera leptotifolia (Barb. Rodr.) Pridgeon & M. W. Chase
Acianthera luteola (Lindl.) Pridgeon & M. W. Chase
Acianthera saundersiana (Rchb. f.) Pridgeon & M. W. Chase
Acianthera saurocephala (Lodd.) Pridgeon & M. W. Chase
Genus *Barbosella* Schltr.
Barbosella cogniauxiana (Speg. & Kraenzl.) Schltr.
Genus *Dryadella* Luer
Dryadella aviceps (Rchb. f.) Luer
Genus *Octomeria* R. Br.
Octomeria crassifolia Lindl.
Octomeria diaphana Lindl.
Octomeria fasciculata Barb. Rodr.

Encyclia sp.