Orchid Inventory of the Yotoco Forest Reserve, Cauca Valley, Colombia

Inventario Orquideológico de la Reserva Bosque de Yotoco, Valle del Cauca

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Rec. 1-08-09 Acept. 03-09-09

Abstract

Orchids were collected over three years in the Yotoco Forest Reserve, in the Municipality of Yotoco, Department of Valle del Cauca, Colombia (3°50'N, 76° 20'W, 1200 - 1700 m.a.s.l.), a remnant sub-Andean forest of approximately 500 ha. Eighty species distributed in 46 genera were found. The most species-rich genera are *Epidendrum* L. (thirteen species) and *Maxillaria* Ruiz & Pav. (six species). *Macroclinium oberonia* (Schltr.) Dodson and *Porroglossum muscosum* (Rchb. f.) Schltr. were restricted to certain zones. *Epidendrum porpax* Rchb. f., *Campylocentrum micranthum* (Lindl.) Rolfe, and *Oncidium adelaidae* Königer were abundant and widely distributed. *Cryptocentrum latifolium* Schltr. and *Specklinia picta* (Lindl.) Pridgeon & M.W. Chase. were scarce.

Key words:; Orchidaceae; nature reserves, Yotoco, Cauca Valley, Colombia

Resumen

En la Reserva Bosque de Yotoco (76° 20´ O, 3° 50´ N, 1200 - 1700 m.s.n.m.) relicto de selva subandina de aproximadamente 500 ha, durante 3 años (marzo de 2006 y mayo de 2009) se realizaron búsquedas intensivas aleatorias de especies de la familia Orchidaceae. Hasta junio de 2009 se habían reportado 80 especies pertenecientes a 46 géneros, siendo los de mayor riqueza específica *Epidendrum* L. con 13 y *Maxillaria* Ruiz y Pav. con seis. Como exclusivas de algunas zonas fueron identificadas *Macroclinium oberonia* (Schltr.) Dodson y *Porroglossum muscosum* (Rchb. f.) Schltr.; como abundantes y ampliamente distribuidas *Epidendrum porpax* Rchb.f., *Campylocentrum micranthum* (Lindl.) Rolfe y *Oncidium adelaidae* Königer; y como poco abundantes *Cryptocentrum latifolium* Schltr. y *Specklinia picta* (Lindl.) Pridgeon & M.W. Chase.

Palabras clave: Orchidaceae, reservas naturales, Yotoco, Valle del Cauca, Colombia.

Introduction

The Orchidaceae family comprises approximately 24,629 species, within over 950 genera with a cosmopolitan distribution (Hassler, 2001). In Colombia nearly 4000 wild species, and 232 genera have been reported (Ortiz, 2008 personal communication). Anthropogenic intervention has increased rates of destruction and fragmentation of tropical forests, placing numerous species at risk of extinction and affecting populations of others (García & Galeano, 2006), amongst them species in the Orchidaceae family. These species are particularly affected, given their sensitivity of their complex ecological interactions, their poor genetic base and restricted distributions (Calderón, 2007).

Despite the great richness of this family in Colombia, the advances in understanding of the species diversity has not been as expected, and much investigative work is neeed in order to obtain a more accurate perspective regarding its actual state (Calderón et al., 2002). Equally, it is evident that the high degree of perturbation to which the natural ecosystems are being subjected makes the evaluation and conservation and management of biodiversity a priority (Salinas & Betancur, 2005).

For this reason, keys tool for the diffusion of basic knowledge regarding the Colombian biota are the floristic and faunal inventories (Moreno & Murillo, 2005). Escobar (2001) carried out a taxonomic study of the orchid diversity in the Yotoco Forest Reserve, and reported 37 species in 27 genera. Unfortunately, adequate collections were not established. Thus, the objective of the present study was to perform a taxonomic inventory of species in the Orchidaceae family present in the Yotoco Forest Reserve, to facilitate the design of conservation strategies.

Materials and methods

The Yotoco Forest Reserve, with an area of 500 ha and vegetative formations characteristic of sub-Andean forest (Cuatrecasas, 1958), is located in the municipality of Yotoco, department of Valle del Cauca (3°50'N, 76° 20'W, 1200 - 1700 m.a.s.l., 20 °C & 1500 mm precipitation, 85% average annual relative humidity) (Escobar, 2001). It comprises two fragmented forest relicts on the highway Buga - Loboguerrero, the higher with an area of approximately 42 ha and the lower with around 455 ha.

Between March 2006 and May 2009 intensive random searches were performed in strategic sites: banks of streams, boundaries and areas with some degree of human disturbance in the

buffer zone, using the sampling method validated by the Exploration and Environmental Monitoring Group – GEMA (Villareal et al., 2004). In each search, the abundant orchid species wer eregistered, and on average five photographs taken of each, with two or three botanical samples collected. Abundance was estimated from field notes. Taxonomic determination was perfroemd using taxonomic keys and through comparison with accessions on visits to the following herbaria: COL, CUVC, HUA and JAUM. Additionally, the data bases of the Missouri Botanical Garden were consulted.

Individuals that were not flowering at the time of sampling were established in the orchid collection of the Reserve. The vegetative material collected was deposited in the Herbaria Jose Cuatrecasas Arumi (VALLE) and Luis Sigifredo Espinal Tascon (CUVC).

Results and discussion

Up to June 2009 80 species in 46 genera were registered (Box 1). Escobar (2001) reported 37 species in 27 genera (Box 2). The genera with the highest richness were *Epidendrum* L. (13 species), *Maxillaria* Ruiz & Pav. (6 species) and *Stelis* Sw. (4 species); the most abundant were *Campylocentrum* Benth., *Oncidium* Sw. and *Epidendrum* L. The least abundant genera were *Specklinia* Lindl., *Macroclinium* Barb. Rodr. and *Porroglosum* Schltr. The best distributed genera were, found on both the borders and in the interior of the relicts were *Campylocentrum* Benth., *Epidendrum* L. and *Stelis* Sw.; *Eurystyles* Wawra, *Macroclinium* Barb. Rodr. and *Porroglosum* Schltr. Were only found in some locations interior of the lower portion of the reserve. The specie *Masdevallia pteroglossa* Schltr. (Category of Global Threat – vulnerable VU) (Calderón, 2007) was exclusive to the higher relict, with scarce populations.

The predominant growth habit was epiphytic (88%), with representative genera being *Epidendrum* L. and *Maxillaria* Ruiz y Pav. Amongst the terrestrial species (10%) *Sobralia* Ruiz, and Pav. Predominated, and amongst the rock-dwelling species (4%), *Cleistes* Rich. ex Lindl. and *Epistephium* Kunth.

These results show that he Yotoco Forest Reserve is a locality that harbours approximately 2% of the total orchid species reported in Colombia, some of which are exclusive and threatened with extinction such as *Masdevallia pteroglossa* Schltr. (Calderón, 2007) and almost 20% of the genera registered in Colombia, making it a ecosystem with a high diversity for this taxonomic group. However, the highway Buga – Buenaventura passes through the high part of the reserve. The portion is the smaller relict and suffers under the border effects in the unprotected relicts in the buffer zone. Thus conservation measures are required in the short, medium and long term to

avoid as much as possible the impact of these phenomena on the natural populations of the species of Orchidaceae. These measures should focus on the species that possess restricted distributions and that are endemic, such as those of the genus *Masdevallia* Ruiz y Pav. The former characteristics imply that these species are relatively susceptible to disappearing as a consequence of unpredictable environmental changes or through habitat deterioration (Calderón, 2007).

Box 1. List of species of Orchidaceae found in the Yotoco Forest Reserve, with their respective botanical collections and photographic registers.

Genus	Species	Collector	Collection Number	Photographic Register	Reference Herbarium
Acronia C. Presl	*Acronia marthae* (Luer & R. Escobar) Luer	O. Pérez & E. Parra		1	
Brassia R. Br.	*Brassia* cf. *forgetiana* hort.	O. Pérez & E. Parra	172		VALLE
Campylocentrum Benth.	*Campylocentrum micranthum* (Lindl.) Rolfe	O. Pérez & E. Parra	165		VALLE; CUVC
		O. Pérez & E. Parra	170		CUVC
		O. Pérez	184		VALLE
Catasetum Rich. ex Kunth	*Catasetum* cf. *ochraceum* Lindl.	O. Pérez & E. Parra	176		VALLE
Cischweinfia Dressler & N.H. Williams	*Cischweinfia dasyandra* (Rchb. f.) Dressler & N.H. Williams	O. Pérez & E. Parra		31	
Cleistes Rich. ex Lindl.	*Cleistes rosea* Lindl.	O. Pérez & E. Parra		68	
Comparettia Poepp. & Endl.	*Comparettia falcata* Poepp. & Endl.	O. Pérez & E. Parra		16	
Crocodeilanthe Rchb. f. & Warsz.	*Crocodeilanthe* sp.	O. Pérez	183		VALLE
Cryptocentrum Benth.	*Cryptocentrum latifolium* Schltr.	O. Pérez	80 (Photo 4)		VALLE
		O. Pérez & E. Parra	151		CUVC
Cyrtochilum Kunth	*Cyrtochilum meirax* (Rchb. f.) Dälstrom	O. Pérez & E. Parra	156		VALLE
		O. Pérez & E. Parra	159		VALLE; CUVC
Dichaea Lindl.	*Dichaea hystricina* Rchb. f.	O. Pérez & E. Parra		3	
	Dichaea cf. *latifolia* Lindl.	O. Pérez	79		VALLE
	Dichaeae cf. *pendula* (Aubl.) Cogn.	O. Pérez & E. Parra	173		VALLE
		O. Pérez & E. Parra	180		CUVC
Encyclia Hook.	*Encyclia* aff. *aspera* (Lindl.) Schltr.	O. Pérez & E. Parra		38	
Epidendrum L.	*Epidendrum* cf. *cirrhochilum* F. Lehm. & Kraenzl.	E. Parra & O. Pérez	82		VALLE
		O. Pérez & E. Parra	164		CUVC
	Epidendrum dentiferum Ames & C. Schweinf.	O. Pérez	35		VALLE
	Epidendrum funckii Rchb. f	E. Parra & O. Pérez	153		VALLE; CUVC
		O. Pérez	188		CUVC
	Epidendrum ionophyllum Ortiz	O. Pérez & E. Parra	174		VALLE
	Epidendrum porpax Rchb. f.	O. Pérez	19		VALLE
	Epidendrum porquerense F. Lehm. & Kraenzl.	O. Pérez & E. Parra		15	
	Epidendrum ramosum Jacq.	E. Parra & O. Pérez	147		VALLE
		O. Pérez & E. Parra	168		CUVC
		O. Pérez	189		VALLE

	Epidendrum rigidum Jacq.	O. Pérez & E. Parra		6	
	Epidendrum rostratum Garay & Dunst.	O. Pérez & E. Parra		12	
	Epidemdrum scharfii Hágsater & Dodson	O. Pérez & E. Parra	155		VALLE
	Epidendrum summerhayesii Hágsater	O. Pérez & E. Parra		67	
	Epidendrum xanthinum Lindl.	O. Pérez & E. Parra	85		VALLE
	Epidendrum sp.	O. Pérez			VALLE
Epistephium Kunth	*Epistephium* aff. *elatum* Kunth	O. Pérez & E. Parra	87		VALLE
Erycina Lindl.	*Erycina pumilio* (Rchb.f) N.H. Williams & M.W. Chase	E. Parra & O. Pérez		22	
Eurystyles Wawra	*Eurystyles cotyledon* Wawra	E. Parra & O. Pérez		27	
Galeandra Lindl.	*Galeandra beyrichii* Rchb. f.	O. Pérez			VALLE
Gongora Ruiz & Pav.	*Gongora gratulabunda* Rchb. f.	O. Pérez & E. Parra		65	
Ida A. Ryan & Oakeley	*Ida fimbriata* (Poepp. & Endl.) A. Ryan & Oakeley	O. Pérez & E. Parra		34	
Jacquiniella Schltr.	*Jacquiniella* cf. *globosa* (Jacq.) Schltr.	O. Pérez & E. Parra	157		VALLE
Kefersteinia Rchb. f.	*Kefersteinia tolimensis* Schltr.	O. Pérez & E. Parra		19	
Lepanthes Sw.	*Lepanthes* sp.1	O. Pérez & E. Parra		35	
	Lepanthes sp.2	E. Parra & O. Pérez		39	
Lepanthes Sw.	*Lepanthes* sp.3	O. Pérez & E. Parra		42	
Lepanthopsis (Cogn.) Ames	*Lepanthopsis floripecten* (Rchb. f.) Ames	O. Pérez & V. Llánten	70		VALLE
Liparis Rich.	*Liparis* sp.	O. Pérez & E. Parra	83		VALLE
Lycaste Lindl.	*Lycaste macrophylla* (Poepp. & Endl.) Lindl.	O. Pérez & E. Parra		47	
Macroclinium Barb. Rodr.	*Macroclinium* cf. *oberonia* (Schltr.) Dodson	E. Parra & O. Pérez	148		VALLE
Masdevallia Ruiz & Pav.	*Masdevallia bicolor* Poepp. & Endl.	O. Pérez & E. Parra			VALLE
	Masdevallia picturata Rchb. f.	O. Pérez & E. Parra		26	
	Masdevallia pteroglossa Schltr.	O. Pérez & E. Parra	(Photo 3)	30	
Maxillaria Ruiz & Pav.	*Maxillaria* cf. *crassifolia* (Lindl.) Rchb. f.	O. Pérez & E. Parra	86		VALLE
	Maxillaria lawrenceana (Rolfe) Garay & Dunst.	O. Pérez & E. Parra		9	
	Maxillaria pseudoreichenheimiana Dodson	O. Pérez & E. Parra		52	
	Maxillaria cf. *rufescens* Lindl.	O. Pérez & E. Parra	84		VALLE
	Maxillaria sp. 1	O. Pérez & E. Parra		62	
	Maxillaria sp. 2	E. Parra & O. Pérez	161		VALLE; CUVC
Microchilus C. Presl	*Microchilus* sp.	O. Pérez & E. Parra	178		VALLE
Oncidium Sw.	*Oncidium adelaidae* Königer	O. Pérez & E. Parra	154 (Photo 2)		VALLE
		O. Pérez & E. Parra	169		CUVC
		O. Pérez	187		VALLE
	Oncidium chrysomorphum Lindl.	E. Parra & O. Pérez	149		VALLE; CUVC
	Oncidium pictum Kunth	E. Parra & O. Pérez	68		VALLE
Panmorphia Luer	*Panmorphia cuspidata* (Luer) Luer	E. Parra & O. Pérez	177		
Pescatoria Rchb. f.	*Pescatoria klabochorum* Rchb. f.	O. Pérez & E. Parra	175		VALLE
Platystele Schltr.	*Platystele consobrina* Luer	O. Pérez & E. Parra		64	
	Platystele sp.	O. Pérez & E. Parra	166		VALLE; CUVC

Pleurothallis R. Br.	*Pleurothallis ruscifolia* (Jacq.) R. Br.	O. Pérez		88		VALLE
	Pleurothallis sp.	O. Pérez				VALLE
Polystachya Hook.	*Polystachya concreta* (Jacq.) Garay & H.R. Sweet	O. Pérez & E. Parra	179			VALLE
Porroglossum Schltr.	*Porroglossum muscosum* (Rchb. f.) Schltr.	O. Pérez & E. Parra			52	
Prescottia Lindl.	*Prescottia stachyodes* (Sw.) Lindl.	O. Pérez & E. Duarte	130			VALLE
Restrepia Kunth	*Restrepia* cf. *antennifera* Kunth	O. Pérez & E. Parra	167			VALLE
	Restrepia contorta (Ruiz & Pav.) Luer	O. Pérez & E. Parra			0	
Rodrigezia Ruiz & Pav.	*Rodriguezia granadensis* Rchb. f.	O. Pérez	37			VALLE
		O. Pérez & E. Parra	160			VALLE
		O. Pérez	190			VALLE
Sobralia Ruiz & Pav.	*Sobralia roezlii* Rchb. f.	O. Pérez & E. Parra			32 (Photo 1)	
	Sobralia virginalis F. Peeters & Cogn.	O. Pérez & E. Parra			2	
Specklinia Lindl.	*Specklinia angustilabia* (Schltr.) Luer	O. Pérez & E. Parra			28	
	Specklinia picta (Lindl.) Pridgeon & M.W. Chase	E. Parra & O. Pérez	150			
Stanhopea Frost ex Hook.	*Stanhopea tricornis* Lindl.	O. Pérez & E. Parra				VALLE
Stelis Sw.	*Stelis argentata* Lindl.	O. Pérez	20			VALLE
		E. Parra & O. Pérez	152			VALLE
		E. Parra & O. Pérez	158			CUVC
		O. Pérez & E. Parra	162			VALLE
	Stelis cf. *spathulata* Poepp. & Endl.	E. Parra & O. Pérez	71			VALLE
		O. Pérez	81			VALLE
		O. Pérez	185			VALLE
	Stelis sp. 1	O. Pérez	186			VALLE
	Stelis sp. 2	O. Pérez	36			VALLE
Trichosalpinx Luer	*Trichosalpinx* cf. *ciliaris* (Lindl.) Luer	O. Pérez & E. Parra	181			VALLE
Trigonidium Lindl.	*Trigonidium egertonianum* Bateman ex Lindl.	O. Pérez & E. Parra			33	
Xylobium Lindl.	*Xylobium* cf. *corrugatum* (Lindl.) Rolfe	O. Pérez & E. Parra	171			
	Xylobium cf. *pallidiflorum* (Hook.) G. Nicholson	O. Pérez & E. Parra	163			VALLE

Thus, the Yotoco Forest Reserve is an important locality with a high degree of orchid species diversity and is an ecosystem that should be conserved as a refuge for endemic and threatened species. Conservation measures should always be taken in collaboration with the rural community associated with this ecosystem.

Box 2. List of orchid species reported by Escobar (2001) in the Yotoco Forest Reserve.

Genus	Species	Collector	Collection Number	Reference Herbarium
Campylocentrum Benth.	*Campylocentrum micranthum* (Lindl.) Rolfe			
Dichaea Lindl.	*Dichaea muricata* (Sw.) Lindl.			
Dracula Luer	*Dracula vespertilio* (Rchb. f.) Luer			
Elleanthus C. Presl	*Elleanthus capitatus* (Poepp. & Endl.) Rchb. f.			
	Elleanthus linifolius C. Presl.			
Encyclia Hook.	*Encyclia luteorosa* (A. Rich. & Galeotti) Dressler & G.E Pollard			
Epidendrum L.	*Epidendrum difforme* Jacq.	M. Guarín O.	128	VALLE
	Epidendrum excisum Lindl.			
	Epidendrum paniculatum Ruiz & Pav.	M. Guarín O.	49	VALLE
	Epidendrum peperomia Rchb. f.			
	Epidendrum ramosum Jacq.			
	Epidendrum xanthinum Lindl.			
Epistephium Kunth	*Epistephium elatum* Kunth			
Erycina Lindl.	*Erycina pusilla* (L.) N.H Williams & W.M. Chase			
Galeandra Lindl.	*Galeandra beyrichii* Rchb. f.			
Ionopsis Kunth	*Ionopsis utricularioides* (Sw.) Lindl.	M. Guarín O.	137	VALLE
Lepanthes Sw.	*Lepanthes calimae* Ortiz	M. Guarín O.		
Lepanthopsis (Cogn.) Ames	*Lepanthopsis* sp.			
Liparis Rich.	*Liparis* sp.	E. Escobar	240	VALLE
Lycaste Lindl.	*Lycaste macrophylla* (Poepp. & Endl.) Lindl.			
Macroclinium Barb. Rodr.	*Macroclinium junctum* (Dressler) Dodson			
Masdevallia Ruiz & Pav.	*Masdevallia bicolor* Poepp. & Endl.			
	Masdevallia impostor Luer & r. Escobar			
Maxillaria Ruiz & Pav.	*Maxillaria valenzuelana* (A. Rich.) Nash	M. Guarín O.		
Oliveriana Rchb. f.	*Oliveriana* sp.	M. Guarín O.	124	VALLE
Oncidium Sw.	*Oncidium abortivum* Rchb. f.	M. Guarín O.		
	Oncidium klotzschianum Rchb. f.			
Pescatoria Rchb. f.	*Pescatoria klabochiorum* Rchb. f.			

Pleurothallis R. Br.	*Pleurothallis cardiantha* Rchb. f.		
	Pleurothallis secunda Poepp. & Endl.	M. Guarín O.	
	Pleurothallis marthae Luer & R. Escobar		
Prosthechea Knowles & Westc.	*Prosthechea grammatoglossa* (Rchb. f.) W.E. Higgins		
Restrepia Kunth	*Restrepia antennifera* Kunth		
Rodriguezia Ruiz & Pav.	*Rodriguezia granadensis* Rchb. f.	M. Guarín O.	
Stelis Sw.	*Stelis ciliaris* Lindl.		
Sobralia Ruiz & Pav.	*Sobralia klotzscheana* Rchb. f.		Foto 1
Xylobium Lindl.	*Xylobium pallidiflorum* (Hook.) G. Nicholson	M. Guarín O.	

Photo 1. *Sobralia roezlii* Rchb. f., terrestrial, common on the edges of the reserve. (Photo: Parra & Pérez, 2007)

Photo 2. *Oncidium adelaidae* Königer, epiphyte common on the edges and in the buffer zone of the reserve. (Photo: Parra & Pérez, 2008)

Photo 3. *Masdevallia pteroglossa* Schltr., specie endemic to Colombia and threatened with extinction. Epiphyte found in the lower relict of the Reserve. Rare. (Photo: Pérez & Parra, 2007)

Photo 4. *Cryptocentrum latifolium* Schltr., Epiphyte species of limited abundance and distribution in the lower and upper relicts of the reserve (Photo: Pérez & Parra, 2007)

Conclusions

- The Yotoco Forest Reserve is a biogeographic locality with a high alpha diversity, given the number of genera, richness and abundance of some species of the Orchidaceae family that it harbors, compared with other ecosystems in the region (Morales et al., 2008; Pérez et al., 2009).
- The reserve is in good conservation state, taking into account that the majority of orchid species are ecological indicators of the increasing temperatures associated with large-scale deforestation in the tropics. In agreement with Christenson (2003), a reduction in the orchid populations is a frequent sign of harmful long-term environmental change, phenomena caused principally by deforestation of the native vegetation and the border effect.
- The development of both *in situ* and *ex situ* conservation projects should begin, focused on endemic species with a high degree of extinction threat at the global level.

Acknowledgements

To the Agricultural Science Faculty for logistical support. To the biologist Germán Morales, for financing some field trips. To the professors Luis Eduardo Forero Pinto and Philip A. Silverstone - Sopkin, for scientific supervision. To Carlos Gutiérrez, Valentín Hidalgo and Gamaliel Ríos for their support and collaboration on field trips. To the professors Diego Macías Pinto, Héctor Fabio Ramos and the biologist Germán Parra, for revisions to the manuscript. To the professor Nora Cristina Mesa for a great logistical and moral support. To the professor Creuci María Caetano, for believing in us, and supporting this work.

References

Calderón, E.; Galeano, G.; y García, N. eds. 2002 Libro rojo de plantas fanerogamas de Colombia. Chrysobalanaceae, Dichapetalaceae y Lecythidaceae. Serie libros rojos de especies amenazadas de Colombia. Instituto Alexander von Humboldt, Instituto de Ciencias Naturales – Universidad Nacional de Colombia, Ministerio del Medio Ambiente, Vivienda y Desarrollo Territorial. Colombia. Vol. 1.

Calderón, E. ed. 2007 Libro rojo de plantas de Colombia. Orquídeas. Serie libros rojos de especies amenazadas de Colombia. Instituto Alexander von Humboldt – Ministerio del Medio Ambiente, Vivienda y Desarrollo Territorial. Colombia. Vol. 6, Primera parte

Christenson, E. 2003 Machu Picchu: Orchids. Manual Técnico. PROFONANPE. Perú. 200 p.

Cuatrecasas, J. 1958 Aspectos de la vegetación colombiana. Rev. Acad. Col. Ci. Exact. 10 40: 221-268.

Escobar, M. 2001 Presentación de Yotoco. Reserva Natural. Flora: Plantas vasculares. Universidad Nacional de Colombia, Sede Palmira. Colombia.

García, N.; Galeano, G. eds. 2006 Libro rojo de plantas de Colombia. Las bromelias, las labiadas y las pasifloras. Serie libros rojos de especies amenazadas de Colombia. Instituto Alexander von Humboldt – Instituto de Ciencias Naturales de la Universidad Nacional de Colombia – Ministerio del Medio Ambiente, Vivienda y Desarrollo Territorial. Colombia. vol. 3.

Hassler, M. 2001 Statistische Überblick über die Familie Orchidaceae une eine weltweite Checkliste der Orchideen. En: R. Schlechter, Die Orchideen. 3rht. ed. I/C, p. 2826-2891.

Villareal, H.: Álvarez, M.; Córdoba, F.; Fagua, G.; Gast, F.; Mendoza, H.: Ospina, M.; y Umaña, A. M. 2004. Manual de métodos para el desarrollo de inventarios de biodiversidad. Programa de Inventarios de Biodiversidad. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Colombia.

Morales, G.; Montaño, P.; Pérez, O.; y Parra, E. 2008 Inventario florístico y entomofaunístico de la Reserva Nuestra Herencia, Municipio de Riofrío, Valle del Cauca. Informe Técnico. Instituto Mayor Campesino IMCA. Colombia. 37 p.

Moreno, L. y Murillo, J. 2005 Helechos y plantas afines de Albán Cundinamarca: El bosque subandino y su diversidad. Instituto de Ciencias Naturales – Universidad Nacional de

Colombia, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Colombia.

Pérez, O.; Parra, E.; y Morales, G. 2009 Inventario florístico de la Reserva Bosque de Pubenza, Municipio de Restrepo, Departamento del Valle del Cauca Colombia. En: Baca, A.; González, M.; y Patiño, A. eds.. Quinto Congreso Colombiano de Botánica, San Juan de Pasto Colombia, p. 80-81.

Salinas, R. y Betancur, J. 2005 Ericaceas de la vertiente Pacífica de Nariño, Colombia. Primera edición. Instituto de Ciencias Naturales, Instituto de Recursos Biológicos Alexander von Humboldt. Colombia.