

ORCHIDS OF VIETNAM

NEW DISCOVERIES AND SOME OF THEIR CHARACTERISTICS

Abstract. Results of the enumeration up to November, 2007 of the orchid family, which is the richest in number of species in the flora of Vietnam, its geographical groups and endemism centers, and new discoveries are presented. More than 3000 numbers of orchid specimens collected during the last nearly twenty years were studied. The orchid flora of Vietnam includes 155 (100%) genera and 1005 (100%) species. Among them 82 (53%) genera and 411 (41%) species were discovered here during 1743-1955, about 73 (47%) genera and 594 (59%) species during 1956-2007, especially from mid eighties of last century. Five new to science genera (*Vietorchis*, *Zeuxinella*, *Christensonia*, *Hamularia*, and *Parapteroceras*) and nearly 120 new to science species were described mostly by the first author. Genera with many new described species are: *Bulbophyllum* (12 species), *Liparis* (11), *Eria* (8), *Cheirostylis* (6), *Paphiopedilum* (5), *Anoectochilus* (4), and *Gastrodia* (4). There are 275 endemic species (27.4% of the total number of orchid flora of Vietnam), distributed in 6 endemism centers of 6 floristic provinces (Sikang-Yunnan, South Chinese, North Indochinese, Central Annamese, South Annamese and South Indochinese). Characteristics and list of endemic species of each center are presented. Genera containing largest number of endemic species are *Bulbophyllum* (30 species), *Dendrobium* (28), *Liparis* (21), *Eria* (19), *Oberonia* (10), *Cheirostylis* (9), *Paphiopedilum* (9), *Cleisostoma* (7), *Coelogyne* (7), *Gastrodia* (6), *Thrixspermum* (6), *Anoectochilus* (5), *Calanthe* (5), *Cymbidium* (5), and *Renanthera* (4). The expected number of orchid species may certainly exceed 1200 species.

Keywords: orchid flora of Vietnam, enumeration of genera and species, geographical groups, endemism centers, new discoveries.

1. INTRODUCTION

Flora of Vietnam is very rich in number of taxa and diverse in their structure. Out of 12,000 estimated native species of higher vascular plant of Vietnam up to now about 10,000 species (85%) have already been identified and cataloged. Great progresses in botanical explorations and scientific investigations in Vietnam during past 17 years have brought new insights into the diversity and patterns of complexity of the flora of Vietnam. The collaborative efforts of the *Vietnam Botanical Conservation Program* (VBCP), a scientific cooperation between the Institute of Ecology and Biological Resources (IEBR), Vietnam and the Missouri Botanical Garden (MBG), USA and many other programs, including the *Program of Basic Researchs in Natural Sciences*, Vietnam have resulted in numerous and exciting plant discoveries.

Orchid family is the richest in number of species as well as the best studied one of the flora of Vietnam. According to up to date available data (for 2007 November) orchid flora of Vietnam includes **155 (100%) genera and 1005 (100%) species**. Among them, 82 (53%) genera and 411 (41%) species were discovered here during “French exploration period” (1743-1954) [45]. About 73 (47%) genera and 594 (59%) species were discovered in Vietnam during post French period (1960-2007). During 1955-1980 floristic studies were not too wide. Later, however, exploration and inventory became more active and fruitful, mostly from 1990 till now.

2. METHODS

Since nearly 20 years, more than 80 field trips to about 200 sites of forested areas of Vietnam were made by the Vietnam Botanical Conservation Program (VBCP). At least 3,000 numbers of orchid specimens were collected in two main kinds of habitats, in primary closed evergreen forests on non-limestone areas of all altitudinal belts, from sea level to the highest peak of Vietnam, Fan Si Pan (3143 m), and in primary closed evergreen forests on limestone areas, mainly in the northern parts of the country, usually from 500-600 m to the highest peaks, around 1600-1700 m. These specimens were studied mainly by the first author of this paper.

3. RESULTS AND DISCUSSION

3.1. New described to science and new records for orchid flora genera and species.

3.1.1. Five new to science genera and nearly 120 new to science species.

They were described mostly by the first author of this paper [1-25, 27, 29-41, 43-44, 47]. *Vietorchis* Aver. & Averyanova is a monotypic and narrow endemic genus with *Vietorchis aurea* Aver. & Averyanova, *Zeuxinella* Aver. - a monotypic and narrow endemic genus with *Zeuxinella vietnamica* (Aver.) Aver. [31], *Christensonia* Haager- a monotypic endemic genus with *Christensonia vietnamica* Haager, *Parapteroceras* Aver.- *Parapteroseras elobe* (Seidenf.) Aver., and *Hamularia* Aver.- *Hamularia puluongensis* Aver. & Averyanova. There are 12 new species of the 2nd richest in number of species orchid genus in Vietnam, **Bulbophyllum** (*B. arculatilabium* Aver., *B. astelidum* Aver., *B. atosanguineum* Aver., *B. crassiusculifolium* Aver., *B. furcatum* Aver., *B. gunnarii* Aver., *B. guttulatoides* Aver., *B. hiepii* Aver., *B. lockii* Aver. & Averyanova, *B. ngoclinhensis* Aver., *B. paraemarginatum* Aver., and *B. sinhoense* Aver.), 11 species of **Liparis** (*L. conopea* Aver., *L. dendrochilodes* Aver., *L. emarginata* Aver., *L. filiformis* Aver., *L. flava* (Aver.) Aver., *L. mamillata* Aver., *L. petraea* Aver. & Averyanova, *L. pumila* Aver., *L. rivularis* Aver., *L. sparsiflora* Aver., and *L. tripartita* Aver. & Averyanova), 8 species of **Eria** (*E. calcarea* Aver., *E. chlorantha* Aver. & Averyanova, *E. diversifolia* Aver., *E. foetida* Aver., *E. lactiflora* Aver., *E. obscura* Aver., *E. pachyphylla* Aver., and *E. spirodela* Aver.), 6 species of **Cheirostylis** (*C. bipunctata* Aver., *C. filipetala* Aver., *C. foliosa* Aver., *C. latipetala* Aver. & Averyanova, *C. marmorifolia* Aver., and *C. serpens* Aver.), 5 species of **Paphiopedilum** (*P. coccineum* Perner & Herrmann, *P. hangianum* Perner & Gruss, *P. helenae* Aver., *P. tranlienianum* Gruss & Perner, and *P. vietnamensis* Gruss & Perner), 4 species of **Anoectochilus** (*A. acalcaratus* Aver., *A. annamensis* Aver., *A. calcareus* Aver., and *A. papillosus* Aver.), 4 species of **Gastrodia** (*G. major* Aver., *G. punctata* Aver., *G. theana* Aver., and *G. tonkinensis* Aver. & Averyanova), 4 species of **Oberonia** (*O. huensis* Aver., *O. multidentata* Aver., *O. quadridentata* Aver., and *O. trichophora* Aver.), 3 species of **Cleisostoma** (*C. flavescens* Aver., *C. melanorachis* Aver. & Averyanova, and *C. subulifolium* Aver. & Averyanova), 3 species of **Dendrobium**, the richest in number of species genus (*D. chapaense* Aver., *D. khanhoaense* Aver., and *D. trantuanii* Perner); each of following genera has two new species, namely **Acanthephippium** (*A. odoratum* Aver. and *A. simplex* Aver.), **Gastrochilus** (*G. minutiflorus* Aver., and *G. simplicilabius* Aver.), **Pristiglottis** (*P. saprophytica* Aver. and *P. umbrosa* Aver.), **Renanthera** (*R. citrina* Aver. and *R. vietnamensis* Aver. & R.Rice), **Sunipia** (*S. nigricans* Aver. and *S. pallida* Aver.), and **Thrixspermum** (*T. hiepii* Aver. & Averyanova and *T. stelidioides* Aver. & Averyanova); each of following genera has only one new species, namely **Amitostigma** (*A. bidupense* Aver.), **Aphyllorchis** (*A. annamensis* Aver.), **Arundina** (*A. caespitosa* Aver.), **Ascolabium** (*A. pusillum* Aver.), **Biermannia** (*B. calcarata* Aver.), **Bromheadia**

(*B. annamensis* Aver. & Averyanova), *Calanthe* (*C. duyana* Aver.), *Coelogyne* (*C. lockii* Aver.), *Corybas* (*C. annamensis* Aver.), *Epipactis* (*E. alatus* Aver. & Efimov), *Goodyera* (*G. rhomboides* Aver.), *Habenaria* (*H. harderi* Aver. & Averyanova), *Hemipilia* (*H. discolor* Aver. & Averyanova), *Holcoglossum* (*H. lingulatum* Aver.), *Lecanorchis* (*L. vietnamica* Aver.), *Luisia* (*L. appressifolia* Aver.), *Odontochilus* (*O. echinatus* Aver. & Averyanova), *Otochilus* (*O. pseudoporrectus* Aver.), *Panisea* (*P. vinhii* Aver. & Averyanova), *Peristylus* (*P. holttumianus* Aver.), *Pholidota* (*P. pachyglossa* Aver.), *Platanthera* (*P. epiphytica* Aver. & Efimov), *Pleione* (*P. vietnamensis* Cribb & Aver.), *Saccolabiopsis* (*S. viridiflora* Aver. & Efimov), *Taeniophyllum* (*T. fasciculatum* Aver.), *Trias* (*T. nummularia* Aver. & Averyanova), *Trichoglottis* (*T. seidenfadenii* Aver.), *Vanda* (*V. bidupensis* Aver.) and *Zeuxine* (*Z. bidupensis* Aver.). Besides, many new records for orchid flora of Vietnam have been similarly documented. Some of them, like *Cymbidium*, *Paphiopedilum* or *Renanthera* have extraordinary significance in ornamental horticulture.

3.1.2. Geographical groups of largest part of new described to science species as well as of new records for orchid flora of Vietnam species.

They are: Asian species (12.5% of all 1005 registered species), Himalayan mainland species (28.8%), South Chinese species (11%), Malaysian species (9.5%), Indochinese species (10.8%), Vietnamese endemic species (27.4% or 275 species). It exhibits very high level of endemism of Vietnamese orchid flora. All these species represent aboriginal indigenous nucleus of ancient local often strictly endemic Vietnamese floras.

3.1.2.1. Asian species in broad sense (12.5%)

This is a group with broad distribution in tropical Asia including Mainland Asia and Islands of Malesia. All these species have wide distribution on large territories. Nevertheless many of them are rare plants in limits of the very broad areas of their distribution. Typical examples of such plants among recently discovered species are *Callostylis rigida* Blume, *Cymbidium dayanum* Rchb.f., *Erythrorchis ochobiensis* (Hayata) Garay, *Eulophia graminea* Lindl., *Goodyera viridiflora* (Blume) Dietr., *Malaxis calophylla* (Rchb.f.) Kuntze, *Pomatocalpa spicata* Breda and *Stereosandra javanica* Blume.

3.1.2.2. Himalayan mainland species in broad sense (28.8%)

Species of this group have Himalayan origin in broad sense and come to Vietnam from NW through Myanmar and SW China along largest ranges of the Indochina like Hoang Lien Son and Truong Son. Typical examples of such plants in the flora of Vietnam are *Bulbophyllum cauliflorum* Hook.f., *Cymbidium cochleare* Lindl., *C. devonianum* Lindl. ex Paxton, *C. erythraeum* Lindl., *C. iridioides* D. Don, *C. mastersii* Griff. ex Lindl., *Dendrobium falconeri* Hook., *D. jenkinsii* Lindl., *D. monticola* P.F.Hunt & Summerh., *Esmeralda clarkei* Rchb.f., *Goodyera biflora* (Lindl.) Hook.f., *Liparis resupinata* Ridl., *Vanda alpina* Lindl., and *V. cristata* Wall. ex Lindl.

3.1.2.3. South Chinese species (11%)

Commonly species of this group have not too large areas and very often are more or less strict endemics of rocky limestone areas of southern China and northern Vietnam. Such plants as *Bletilla ochracea* Schltr., *Bulbophyllum ambrosia* (Hance) Schltr., *Bulbophyllum andersonii* (Hook.f.) J.J. Sm., *Bulbophyllum emarginatum* (Finet) J.J.Sm., *Bulbophyllum funingense* Z.H. Tsi & H.C. Chen, *Bulbophyllum longibrachiatum* Z.H. Tsi, *Calanthe argenteostriata* C.Z. Tang & S.J. Cheng, *Cheirostylis takeoi* (Hayata) Schltr., *Coelogyne ecarinata* S.Schweinf., *Coelogyne malipoensis* Z.H.Tsi, *Cymbidium floribundum* Lindl., *Dendrobium brymerianum* Rchb.f., *Dendrobium hancockii* Rolfe, *Dendrobium moniliforme* (L.) Sw., *Dendrobium strongylanthum* Rchb.f., *Dendrobium trigonopus* Rchb.f., *Hemipilia calophylla* Par. & Rchb.f., *Holcoglossum wangii* Christenson, *Liparis averyanoviana* Szlach., *Panisea yunnanensis* S.C. Chen & Z.H. Tsi, *Paphiopedilum dianthum* Tang & F.T. Wang, *Paphiopedilum emersonii* Koopowitz & Cribb, *Paphiopedilum henryanum* Braem, *Paphiopedilum micranthum* Tang & F.T. Wang, *Paphiopedilum purpuratum* (Lindl.) Stein, *Phalaenopsis wilsonii* Rolfe, *Pholidota missionariorum* Gagnep., *Pholidota roseans* Schltr., *Pholidota rubra* Lindl., *Pholidota yunnanensis* Rolfe, *Pleione grandiflora* (Rolfe) Rolfe, and *Vanda fuscoviridis* Lindl. are typical example of this group.

3.1.2.4. Malesian species (9.5%)

Species of this group have main area of their distribution in Malesia and come to Indochina and Vietnam from the S and SE. Usually such species reach southern part of Indochina only and do not come into northern part of Vietnam. Next species in the flora of Vietnam are typical examples for this group: *Aphyllorchis pallida* Blume, *Bulbophyllum macranthum* Lindl., *Didymoplexiella ornata* (Ridl.) Garay, *Epigeneium labuanum* (Lindl.) Summerh., *Eulophia andamanensis* Rchb.f., *Habenaria rumphii* (Brongn.) Lindl., *Hetaeria alta* Ridl., *Hetaeria nitida* Ridl., *Liparis ferruginea* Lindl., *Luisia antennifera* Blume, *Luisia curtisii* Seidenf., *Luisia ramosii* Ames, *Parapteroceras elobe* (Seidenf.) Aver., *Plocoglottis javanica* Blume, *Thrixspermum amplexicaule* (Blume) Rchb.f. and *Tuberolabium rhopalorrhachis* (Rchb.f.) J.J. Wood.

3.1.2.5. Indochinese endemic species (10.8%)

The group includes species endemic to Indochina Peninsular including Vietnam, Laos, Cambodia, Thailand, Southern Myanmar, and northern Malaya. These species represent aboriginal indigenous nucleus of ancient regional Indochinese flora. Most typical species of this group are *Bulbophyllum bisetoides* Seidenf., *Bulbophyllum farreri* (W.W.Sm.) Seidenf., *Bulbophyllum kanburiense* Seidenf., *Bulbophyllum orientale* Seidenf., *Bulbophyllum pinicolum* Gagnep., *Bulbophyllum psittacoglossum* Rchb.f., *Bulbophyllum pumilio* Rchb.f., *Bulbophyllum smitinandii* Seidenf. & Thorut., *Bulbophyllum thaiorum* J.J.Sm., *Calanthe cardioglossa* Schltr., *Calanthe succedanea* Gagnep., *Ceratostylis siamensis* Downie, *Chiloschista exuperei* (Guillaum.) Garay, *Chiloschista trudelii* Seidenf., *Cleisostoma crochetii* (Guillaum.) Garay, *Coelogyne brachiptera* Rchb.f., *Coelogyne brunnea* Lindl., *Coelogyne lactea* Rchb.f., *Coelogyne lentiginosa* Lindl., *Cyrtosia integra* (Downie) Garay, *Cyrtosia nana* (Rolfe ex Downie) Garay, *Dendrobium christyanum* Rchb.f., *Dendrobium dantaniense* Guillaum., *Dendrobium delacourii* Guillaum., *Dendrobium harveyanum* Rchb.f., *Dendrobium intricatum* Gagnep., *Dendrobium porphyrophyllum* Guillaum., *Dendrobium umbonatum* Seidenf., *Dendrobium unicum* Seidenf.,

Dendrobium venustum Teijsm. & Binn., *Dendrobium virgineum* Rchb.f., *Didymoplexiella siamensis* (Rolfe) Seidenf., *Didymoplexiopsis khiriwongensis* Seidenf., *Epigeneium chapaense* Gagnep., *Eria biflora* Griff., *Eria donnaiensis* (Gagnep.) Seidenf., *Eria eriopsidobulbon* Par. & Rchb.f., *Eria globifera* Rolfe, *Eria globulifera* Seidenf., *Eria sutepensis* Downie, *Eria truncata* Lindl., *Flickingeria albopurpurea* Seidenf., *Flickingeria unibulbis* Seidenf., *Geodorum attenuatum* Griff., *Habenaria amplexicaulis* Downie, *Habenaria erostrata* Tang & F.T.Wang, *Habenaria falcatopetala* Seidenf., *Habenaria godefroyii* Rchb.f., *Habenaria lindleyana* Steud., *Habenaria myriotricha* Gagnep., *Habenaria thailandica* Seidenf., *Habenaria tonkinensis* Seidenf., *Liparis acutissima* Rchb.f., *Liparis balansae* Gagnep., *Luisia psyche* Rchb.f., *Luisia thailandica* Seidenf., *Malaxis octodentata* Seidenf., *Micropera thailandica* (Seidenf. & Smitinand) Garay, *Oberonia langbianensis* Gagnep., *Oberonia rasmussenii* Seidenf., *Oberonia variabilis* Kerr, *Paphiopedilum callosum* (Rchb.f.) Stein, *Paphiopedilum gratixianum* (Mast.) Guillaum., *Pecteilis cambodiana* (Gagnep.) Aver., *Pelatantheria ctenoglossum* Ridl., *Phaius indochinensis* Seidenf. & Ormerod, *Plocoglottis bokorensis* (Gagnep.) Seidenf., *Pomatocalpa angustifolia* Seidenf., *Pomatocalpa falciformis* (Tixier) Garay, *Pomatocalpa tonkinensis* (Gagnep.) Seidenf., *Porpax lanii* Seidenf., *Porpax reticulata* Lindl., *Rhynchostylis coelestis* Rchb.f., *Robiquetia pachyphylla* (Rchb.f.) Garay, *Sarcoglyphis mirabilis* (Rchb.f.) Garay, *Smitinandia helferi* (Hook.f.) Garay, *Spathoglottis eburnea* Gagnep., *Stereochilus dalatensis* (Guillaum.) Garay, *Sunipia annamensis* (Ridl.) P.F.Hunt, *Thrixspermum ancoriferum* (Guillaum.) Garay, *Thrixspermum pusillum* (Guillaum.) Garay, *Thrixspermum sutepense* (Downie) Tang & F.T.Wang, *Vanda liouvillei* Finet, *V. petersiana* Schltr. and *Zeuxine grandis* Seidenf.

3.1.2.6. Vietnamese endemic species (27.4%)

This group includes 275 species endemic to Vietnam (occasionally with nearest allied regions of Laos, Cambodia and China). It exhibits very high level of endemism of Vietnamese orchid flora. All these species represent aboriginal indigenous nucleus of ancient local often strictly endemic Vietnamese floras. Monotypic genera, mostly endemic ones such as *Ascocentropsis*, *Christensonia*, *Cleisostomopsis*, *Eparmatostigma*, *Hancockia*, *Parapteroceras*, *Vietorchis*, *Zeuxinella* represent genera of highest taxonomical level.

3.2. Endemic centers of Vietnamese orchids

Usually endemic orchid species (275 species) in the flora of Vietnam have very limited distribution. In this connection, they serve as floristic markers that clearly indicate centers of endemism and areas of highest plant diversity in aboriginal floras. Next genera contain largest number of endemic species, namely *Bulbophyllum* (30 species), *Dendrobium* (28), *Liparis* (21), *Eria* (19), *Oberonia* (10), *Cheirostylis* (9), *Paphiopedilum* (9), *Cleisostoma* (7), *Coelogyne* (7), *Gastrodia* (6), *Thrixspermum* (6), *Anoectochilus* (5), *Calanthe* (5), *Cymbidium* (5) and *Renanthera* (4). Analysis of distribution of these endemic species confirms floristic division of the territory of eastern Indochina including Vietnam into 6 floristic provinces [26, 28, 42]. They are: Sikang-Yunnan, South Chinese, North Indochinese, Central Annamese, South Annamese and South Indochinese Provinces. In each province there is one endemism center. Brief description of these endemic centers of orchid diversity is presented below.

3.2.1. Sikang-Yunnan endemism center

This center situates in the floristic Sikang-Yunnan province, the territory of which in Vietnam comprises highland areas associated with Hoang Lien Son, Si Lung, Pu Den Dinh and other large mountain ranges coming from China in SE direction. Geographically, they represent SSE extension of the Himalayan highlands. Himalayan floristic element in these areas dominates, but essential local specific endemism also are found in recent field exploration. Orchid flora of Vietnamese part of the province contains 25 endemic species (9% of all endemic species in Vietnam). Most typical endemic species discovered here are: *Bulbophyllum atosanguineum* Aver., *Bulbophyllum insulsum* (Gagnep.) Seidenf., *Bulbophyllum paraemarginatum* Aver., *Calanthe aleizettii* Gagnep., *Cymbidium erythrostylum* Rolfe, *Dendrobium chapaense* Aver., *Eria foetida* Aver., *Eria gagnepainii* Hawkes & Heller, *Eria thao* Gagnep., and *Sunipia nigricans* Aver. Other endemic species of this center are *Acanthephippium simplex* Aver., *Amitostigma keiskeoides* (Gagnep.) Garay & Kittredge, *Anoectochilus chapaensis* Gagnep., *Anoectochilus tridentatus* Seidenf., *Cleisostoma chapaense* (Guillaum.) Garay, *Collabium chapaense* (Gagnep.) Seidenf. & Ormerod, *Collabium chloranthum* (Gagnep.) Seidenf., *Diglyphosa evrardii* (Gagnep.) Tang & F.T.Wang, *Gastrodia taiensis* Tuyama, *Hancockia uniflora* Rolfe, *Holcoglossum lingulatum* (Aver.) Aver., *Liparis rivularis* Aver., *Oberonia quadridentata* Aver., *Peristylus chapaensis* (Gagnep.) Seidenf., and *Rhomboda petelotii* (Gagnep.) Ormerod.

3.2.2. South Chinese endemism center

This center situates in the floristic South Chinese province, the territory of which in Vietnam includes lowland and submontane areas to the north of Hanoi and Red River. SE Yunnan, Guangxi, Guangdong (including Macao), Luichow Peninsula and Hainan also belong to this floristic province from the Chinese side. Rocky highly eroded limestones are characteristic landform very typical for this area. Orchid flora of Vietnamese part of the province contains 48 endemic species (18%). Most typical endemic species discovered recently here are *Coelogyne lockii* Aver., *Epipactis alatus* Aver. & Efimov, *Gastrochilus minutiflorus* Aver., *Hemipilia discolor* Aver. & Averyanova, *Luisia appressifolia* Aver., *Paphiopedilum hangianum* Perner & Gruss, *Paphiopedilum helenae* Aver., *Paphiopedilum tranlienianum* Gruss & Perner, *Paphiopedilum vietnamense* Gruss & Perner, *Renanthera citrina* Aver., and *Renanthera vietnamensis* Aver. & R. Rice. Other endemic species of this center are *Arundina caespitosa* Aver., *Biermannia calcarata* Aver., *Bulbophyllum amygdalinum* Aver., *Bulbophyllum arcuatilabium* Aver., *Bulbophyllum astelidum* Aver., *Bulbophyllum insulsum* (Gagnep.) Seidenf., *Calanthe aleizettii* Gagnep., *Cheirostylis bipunctata* Aver., *Cheirostylis cochinchinensis* Blume, *Cheirostylis latipetala* Aver. & Averyanova, *Cheirostylis marmorifolia* Aver., *Cheirostylis thanmoiensis* (Gagnep.) Ormerod, *Cleisostoma flavescens* Aver. & Averyanova, *Cleisostoma melanorachis* Aver. & Averyanova, *Cleisostoma subulifolium* Aver. & Averyanova, *Collabium chloranthum* (Gagnep.) Seidenf., *Dendrobium chittimae* Seidenf., *Eria boniana* (Gagnep.) Tang & F.T.Wang, *Eria calcarea* V.N. Long & Aver., *Eria gagnepainii* Hawkes & Heller, *Eria spicata* (D.Don) Hand.-Mazz., *Eria thao* Gagnep., *Habenaria apetala* Gagnep., *Habenaria harderi* Aver. & Averyanova, *Hemipilia discolor* Aver. & Averyanova, *Liparis averyanoviana* Szlach., *Liparis conopea* Aver., *Liparis filiformis* Aver., *Liparis petraea* Aver. & Averyanova, *Parapteroceras elobe* (Seidenf.) Aver., *Phaius tonkinensis* (Aver.) Aver., *Pteroceras simondianum* (Gagnep.) Aver., *Rhomboda petelotii* (Gagnep.) Ormerod, *Tainia ruybarrettoi*

(S.Y.Hu & Barretto) Aver., *Thrixspermum fleuryi* (Gagnep.) Tang & F.T.Wang, *Thrixspermum insularum* (Aver.) Aver., and *Zeuxinella vietnamica* (Aver.) Aver.

3.2.3. North Indochinese endemism center

This center situates in the floristic North Indochinese province. The long valley of Red River separates the South-Chinese Province from the lowland and submontane regions in northern Vietnam. This territory belongs to the North Indochinese floristic province. The southern border of this floristic province in Laos and Vietnam coincides with the southern boundary of large systems of ancient limestone massifs that extends in the northwest to southeast direction and represents an important biogeographic boundary in the area. 62 endemic species (23%) were reported for the orchid flora of the Vietnamese part of the province. Most typical endemic species discovered recently here are: *Anoectochilus annamensis* Aver., *Anoectochilus papillosus* Aver., *Aphyllorchis annamensis* Aver., *Arundina caespitosa* Aver., *Bulbophyllum lockii* Aver. & Averyanova, *Bulbophyllum sinhoense* Aver., *Cheirostylis serpens* Aver., *Dendrobium trantuanii* Perner & X.N. Dang, *Dendrobium vietnamense* Aver., *Didymoplexis vietnamica* Ormerod, *Oberonia multidentata* Aver., *Orchipedum echinatum* Aver. & Averyanova, *Paphiopedilum aspersum* Aver., *Paphiopedilum coccineum* Perner & Herrmann, and *Trias nummularia* Aver. & Averyanova. Other endemic species of this center are: *Biermannia calcarata* Aver., *Bulbophyllum amygdalinum* Aver., *Bulbophyllum guttulatooides* Aver., *Cheirostylis cochinchinensis* Blume, *Cheirostylis foliosa* Aver., *Cheirostylis latipetala* Aver. & Averyanova, *Cleisostoma melanorachis* Aver. & Averyanova, *Cymbidium sanderae* (Rolfe) Cribb. & Puy, *Dendrobium amabile* (Lour.) O'Brien, *Dendrobium dentatum* Seidenf., *Dendrobium nobile* var. *albolutea* Huyen & Aver., *Dendrobium ochraceum* De Wild., *Diglyphosa evrardii* (Gagnep.) Tang & F.T.Wang, *Epipactis atromarginata* Seidenf., *Eria calcarea* V.N. Long & Aver, *Eria foetida* Aver., *Eria gagnepainii* Hawkes & Heller, *Eria spirodela* Aver., *Eria thao* Gagnep., *Gastrodia tonkinensis* Aver. & Averyanova, *Goodyera rhombodoides* Aver., *Hamularia puluogensis* Aver. & Averyanova, *Liparis argentopunctata* Aver., *Liparis filiformis* Aver., *Liparis luteola* Lindl., *Liparis petelotii* Gagnep., *Liparis pumila* Aver., *Liparis sparsiflora* Aver., *Liparis tripartita* Aver. & Averyanova, *Micropera poilanei* (Guillaum.) Garay, *Mischobulbon simondii* (Gagnep.) Seidenf. ex Aver., *Oberonia trichophora* Aver., *Parapteroceras elobe* (Seidenf.) Aver., *Pholidota guibertiae* Finet, *Podochilus oxystophylloides* Ormerod, *Pomatocalpa grandis* Seidenf., *Pomatocalpa tonkinensis* (Gagnep.) Seidenf., *Pteroceras simondianum* (Gagnep.) Aver., *Renanthera citrina* Aver., *Rhomboda petelotii* (Gagnep.) Ormerod, *Schoenorchis brevirachis* Seidenf., *Schoenorchis tixieri* (Guillaum.) Seidenf., *Thrixspermum fleuryi* (Gagnep.) Tang & F.T.Wang, *Thrixspermum stelidioides* Aver. & Averyanova, *Vanilla annamica* Gagnep., *Vietorchis aurea* Aver. & Averyanova, and *Zeuxinella vietnamica* (Aver.) Aver.

3.2.4. Central Annamese endemism center

This center situates in the floristic Central Annamese province, covering the montane areas of the central section of Truong Son Range and a number of adjacent high plateaux like Kontum and Pleiku. The North of the Central Annamese province is delimited by limestone area belonging to the North Indochinese Province. The orchid flora of the Vietnamese part of the province includes 66 endemic species (24%). Most typical endemic species discovered recently here are: *Appendicula gracilis* Aver., *Bulbophyllum frostii* Summerh., *Bulbophyllum hiepii* Aver., *Bulbophyllum ngoclinensis* Aver., *Epipactis atromarginata* Seidenf., *Gastrodia theana*

Aver., *Oberonia huensis* Aver., *Odontochilus saprophyticus* (Aver.) Ormerod, *Odontochilus umbrosus* (Aver.) Ormerod, *Pleione vietnamensis* Aver. & Cribb, *Saccolabiopsis viridiflora* Aver., and *Sunipia pallida* (Aver.) Aver. Other endemic species of this center are: *Acanthephippium simplex* Aver., *Anoectochilus annamensis* Aver., *Aphyllorchis annamensis* Aver., *Arundina caespitosa* Aver., *Bulbophyllum crassiusculifolium* Aver., *Bulbophyllum evrardii* Gagnep., *Bulbophyllum frostii* Summerh., *Bulbophyllum sigaldiae* Guillaum., *Bulbophyllum tixieri* Seidenf., *Ceratostylis evrardii* Gagnep., *Cheirostylis cochinchinensis* Blume, *Cheirostylis filipetala* Aver., *Coelogyne dichroantha* Gagnep., *Coelogyne sanderac* Kraenzl., *Cymbidium erythrostylum* Rolfe, *Cymbidium schroederi* Rolfe, *Dendrobium amabile* (Lour.) O'Brien, *Dendrobium dentatum* Seidenf., *Dendrobium ochraceum* DeWild., *Dendrobium phi* Christenson, *Dendrobium porphyrophyllum* Guillaum., *Dendrobium pseudotenellum* Guillaum., *Diglyphosa evrardii* (Gagnep.) Tang & F. T. Wang, *Eria chlorantha* Aver. & Averyanova, *Eria gagnepainii* Hawkes & Heller, *Eria lactiflora* Aver., *Eria lanigera* Seidenf., *Eria obscura* Aver., *Eria spirodela* Aver., *Eria thao* Gagnep., *Gastrochilus simplicilabius* Aver., *Gastrodia punctata* Aver., *Holcoglossum subulifolium* (Rchb.f.) Christenson, *Kingidium minus* Seidenf., *Lecanorchis vietnamica* Aver., *Liparis emarginata* Aver., *Liparis flava* (Aver.) Aver., *Liparis petelotii* Gagnep., *Liparis rivularis* Aver., *Liparis tixieri* Guillaum., *Mischobulbon simondii* (Gagnep.) Seidenf. ex Aver., *Nephelaphyllum cristigerum* Aver., *Neuwiedia annamensis* Gagnep., *Odontochilus acalcaratus* (Aver.) Ormerod, *Parapteroceras elobe* (Seidenf.) Aver., *Phaius indochinensis* Seidenf. & Ormerod, *Phaius longicornu* Guillaum., *Pleione vietnamensis* Aver. & Cribb, *Podochilus banaensis* Ormerod, *Pomatocalpa grandis* Seidenf., *Rhomboda petelotii* (Gagnep.) Ormerod, *Sunipia pallida* (Aver.) Aver., *Taeniophyllum fasciculatum* Aver., *Thrixspermum fragrans* Ridl., *Thrixspermum hiepii* Aver. & Averyanova, *Thrixspermum stelidioides* Aver. & Averyanova, and *Vanilla annamica* Gagnep.

3.2.5. South Annamese endemism center

A number of more or less isolated uplifted plateaux and high mountain systems associated with southern extension of Truong Son Range belong to South Annamese floristic Province. The area entirely lies on the territory of Vietnam and includes Dalat, Djiring, DiLinh plateaux, as well as Chu Yang Sin, Bi Doup, Lang Bian, Hon Vong Phu and some smallest associated with this area ridges. From the south, west and north the isolated highland area of the province is bounded by the lowlands of the Mekong, Krong Ana and Da Rang rivers basins. In this small floristic province 131 endemic orchid species were reported (48%). Most typical endemic species discovered recently here are: *Amitostigma bidupense* (Aver.) Aver., *Bromheadia annamensis* Aver. & Averyanova, *Bulbophyllum clipeibulbum* J. J. Vermeulen, *Calanthe duyana* Aver., *Corybas annamensis* Aver., *Dendrobium khanhoaense* Aver., *Dendrobium phi* Christenson, *Eria diversicolor* V. N. Long & Aver., *Eria obscura* Aver., *Gastrodia major* Aver., *Liparis mamillata* Aver., *Paphiopedilum cribbii* Aver., *Paphiopedilum dalatense* Aver., *Platanthera epiphytica* Aver. & Efimov, *Vanda bidupensis* Aver. & Christenson and *Zeuxine bidupensis* Aver. Other endemic species of this center are: *Arachnis annamensis* (Rolfe) J. J. Sm., *Biermannia sigaldii* Seidenf., *Bulbophyllum bariense* Gagnep., *Bulbophyllum boubetii* Tixier, *Bulbophyllum evrardii* Gagnep., *Bulbophyllum fibratum* (Gagnep.) Seidenf., *Bulbophyllum frostii* Summerh., *Bulbophyllum nigrescens* Rolfe, *Bulbophyllum pinicolum* Gagnep., *Bulbophyllum poilanei* Gagnep., *Bulbophyllum semiteretifolium* Gagnep., *Bulbophyllum sigaldiae* Guillaum., *Bulbophyllum simondii* Gagnep., *Bulbophyllum spadiciflorum* Tixier, *Bulbophyllum subebulbum* Gagnep., *Bulbophyllum tixieri* Seidenf., *Bulbophyllum vietnamense* Seidenf., *Calanthe chevalieri*

Gagnep., *Calanthe petelotiana* Gagnep., *Calanthe velutina* Ridl., *Ceratostylis evrardii* Gagnep., *Cheirostylis phamhoangii* N. T. Tich, *Cleisocentron klossii* (Ridl.) Garay, *Cleisostoma bidoupense* (Tixier et Guillaum.) Aver., *Cleisostoma lendyanum* (Rchb. f.) Garay, *Cleisostomopsis eberhardtii* (Finet) Seidenf., *Coelogyne eberhardtii* Gagnep., *Coelogyne filipeda* Gagnep., *Coelogyne lawrenceana* Rolfe, *Coelogyne mooreana* Rolfe, *Coelogyne sanderae* Kraenzl., *Cymbidium banaense* Gagnep., *Cymbidium erythrostylum* Rolfe, *Cymbidium pseudoballianum* Aver., *Cymbidium sanderae* (Rolfe) Cribb & Puy, *Cymbidium schroederi* Rolfe, *Deceptor bidoupensis* (Tixier & Guillaum.) Seidenf., *Dendrobium amabile* (Lour.) O'Brien, *Dendrobium annamense* Rolfe, *Dendrobium caryaecolum* Guillaum., *Dendrobium chlorostylum* Gagnep., *Dendrobium dalatense* Gagnep., *Dendrobium dantaniense* Guillaum., *Dendrobium ejirii* Yukawa, *Dendrobium filicaule* Gagnep., *Dendrobium hemimelanoglossum* Guillaum., *Dendrobium kontumense* Gagnep., *Dendrobium langbianense* Gagnep., *Dendrobium oxyphyllum* Gagnep., *Dendrobium perulatum* Gagnep., *Dendrobium phi* Christenson, *Dendrobium porphyrophyllum* Guillaum., *Dendrobium pseudointricatum* Guillaum., *Dendrobium pseudotenellum* Guillaum., *Dendrobium simondii* Gagnep., *Epigeneium annamense* (Guillaum.) Seidenf., *Epigeneium cacuminis* (Gagnep.) Summerh., *Eria bidupensis* (Gagnep.) Aver., *Eria carunculosa* (Gagnep.) Aver., *Eria dacrydium* Gagnep., *Eria lanigera* Seidenf., *Eria longipes* Gagnep., *Eria pulverulenta* Guillaum., *Eria simondii* Gagnep., *Eria thao* Gagnep., *Flickingeria stenoglossa* (Gagnep.) Seidenf., *Flickingeria vietnamensis* Seidenf., *Habenaria poilanei* Gagnep., *Holcoglossum subulifolium* (Rchb.f.) Christenson, *Liparis dendrochiloides* Aver., *Liparis flava* (Aver.) Aver., *Liparis mantidopsis* Szlach., *Liparis nigra* Seidenf., *Liparis oppositifolia* Szlach., *Liparis penduliflora* Szlach., *Liparis piriformis* Szlach., *Liparis rivularis* Aver., *Liparis tixieri* Guillaum., *Listera latilabris* Gagnep., *Macodes cupida* Ormerod, *Malaxis finetii* (Gagnep.) Tang & F. T. Wang, *Malaxis tixieri* Seidenf., *Monomeria dichroma* (Rolfe) Schltr., *Neuwiedia annamensis* Gagnep., *Oberonia acarus* Gagnep., *Oberonia dalatensis* Gagnep., *Oberonia dolichocaulis* Seidenf., *Oberonia evrardii* Gagnep., *Oberonia tixieri* Guillaum., *Oberonia trochopetala* Gagnep., *Odontochilus saprophyticus* (Aver.) Ormerod, *Otochilus pseudoporrectus* Aver., *Panisea albiflora* (Ridl.) Seidenf., *Panisea delenatii* Guillaum., *Papilionanthe pedunculata* (Kerr) Garay, *Peristylus holtumianus* Aver., *Phaius indochinensis* Seidenf. & Ormerod, *Phaius longicornu* Guillaum., *Phalaenopsis chibae* Yukawa., *Pholidota pachyglossa* Aver., *Pleione vietnamensis* Aver. & Cribb, *Podochilus banaensis* Ormerod, *Pteroceras semiteretifolium* Pedersen, *Renanthera imschootiana* Rolfe, *Rhynchogyna fallax* (Guillaum.) Seidenf., *Stereochilus brevirachis* Christenson, *Taeniophyllum daroussinii* Tixier & Guillaum., *T. minimum* Guillaum., *Thrixspermum fragrans* Ridl., *Thrixspermum poilanei* (Gagnep.) Tang & F. T. Wang, *Trichotisia dalatensis* (Gagnep.) Seidenf., *Uncifera dalatensis* (Guillaum. Seidenf. & Smitinand), *Vanda bidupensis* Aver. & Christenson, *Vanilla annamica* Gagnep., *V. pierreii* Gagnep. and *Zeuxine langbianensis* N. T. Tich.

3.2.6. South Indochinese endemism center

South Indochinese floristic province includes lowland areas of southern Vietnam and Cambodia, commonly at elevations not higher than 300 m. Dry evergreen, semi-deciduous and deciduous dipterocarp forests are rather most typical kind of vegetation in this area. The orchid flora of the Vietnamese part of the province includes 20 endemic species (8%). Most typical endemic species discovered recently here are: *Acanthephippium odoratum* Aver., *Ascocentropsis pusillum* (Aver.) Sengh. & Schildh., *Ascocentrum christensonianum* Haager, *Bulbophyllum averyanovii*

Seidenf., *B. gunnarii* Aver., *Cleisostoma equestre* Seidenf., *Dendrobium suzukii* Yukawa, *Panisea vinhii* Aver. & Averyanova, *Pelatantheria eakroensis* Haager, and *Trichoglottis seidenfadenii* Aver. Other endemic species of this center are: *Aerides rubescens* (Rolfe) Schltr., *Christensonia vietnamica* Haager, *Dendrobium hamatum* Rolfe, *Doritis regnieriana* (Rchb.f.) Holttum, *Eparmatostigma dives* (Rchb.f.) Garay, *Eria cochinchinensis* Gagnep., *Ornithochilus delavayi* Finet, *Pecteilis cochinchinensis* (Gagnep.) Aver., *Renanthera annamensis* Rolfe and *Renanthera imschootiana* Rolfe.

4. CONCLUSION

Flora of Vietnam includes a great number of not yet discovered orchids. Therefore, the expected number of orchid species may certainly exceed 1200 species. The rapid degradation of primary habitats and illegal commercial exploitation result in fast extinction of orchids in the country. This process moves much faster than professional studies necessary for effective nature protection. In such conditions, many undescribed species will extinct before their discovery.

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