

Assessment of Distribution and Natural Status of *Paphiopedilum canhii*, VN

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Preliminary Report For Research Exploration Programs

Assessment of Distribution and Natural Status of *Paphiopedilum canhii*, Vietnam

The Rufford Small Grant Foundation

Assessment of Current Natural Status of Critically Endangered Species - *Paphiopedilum canhii* for Its Conservation

Chicago Zoological Society, Chicago Board of Trade Endangered Species Fund

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Summary. The first stage of research program funded from The Rufford Small Grant Foundation and Chicago Zoological Society, Chicago Board of Trade Endangered Species Fund for field assessment of recently discovered *Paphiopedilum canhii* was completed during December 2010. New original data were obtained for habitat and natural conditions of 5 discovered subpopulations of *P. canhii* in course of program studies. Accompanied plant species and vegetation were shortly described and documented with about 1000 collected herbarium specimens. Negative factors leading to fast species extinction are analyzed and discussed. On the base of preliminary studies it is suggested present status of the species as CR, approaching to full extinction in the near future. Actual salvation of species exclusively possible by its introduction into culture. Among accompanied plants in native area of *P. canhii* were discovered 2 new genera (*Phylacium* and

Sinocrassula) and 9 species new for the flora of Vietnam (*Coelogyne micrantha*, *Cuscuta formosana*, *Cymbidium cyperifolium*, *Dendrobium senile*, *Monomeria gymnopus*, *Phylacium majus*, *Pyrrosia nummulariifolia*, *Schoenorchis fragrans* and *Sinocrassula indica*). One genus (x *Lockia*) and 4 species (from such genera as *Dendrobium*, *Poaephyllum* and *Schoenorchis*) among discovered orchids are proposed for description as a new for science. Observations and plant records are illustrated with high resolution images.

BACKGROUND AND INTRODUCTION

Recent field explorations outlined rocky limestone areas of northern Vietnam with their highly endangered primary forests as unique very significant center of *Paphiopedilum* speciation and diversity (Averyanov et al., 2003). These studies reveal on this territory more than 25 geographically isolated local endemics of this genus with dramatically restrict and disjunctive distribution (Averyanov, 2008; Liu Zhong-Jian, et al., 2009a, b). Many of them were formally described outside of Vietnam on the base of specimens exported from the country by plant traders. Very often in this situation biological sciences got no any reliable information about nature of such species, populations of which were extinguished before professional botanical study. Sometime such field investigations were organized too late, when species already completely extinct in the wild due to total over collecting as it happened, for example, with *Paphiopedilum vietnamense* and *P. tranlienianum* (Averyanov et al., 2001; Averyanov, 2003, 2004). Despite obvious significance of botanical explorations in unexplored areas for informal understanding and discoveries of plant diversity for timely protection, such projects are poorly funded. Without such studies a great number of strictly endemic species become extinct before their discovery and description by scientific annals of our civilization in conditions of commercial collecting, wide deforestation and total collapse of native habitats.

Proposed exploration program expected field study of *Paphiopedilum canhii*, species recently discovered in northwestern Vietnam (Averyanov et al., 2010) for identification of its distribution, status in nature and elaboration of strategy for its possible protection. It was previously expected that species with high probability has extremely restrict, limited distribution in northwestern part of Vietnam, presumably in Dien Bien or Son La Province in limestone areas allied to Laotian border, home of such significant ornamental locally endemical orchid species as *Bulbophyllum paraemarginatum*, *Dendrobium farinatum*, *Dendrobium trantuanii*, *D. vietnamense*, *Hayata glandulifera*, *Paphiopedilum aspersum*, *P. coccineum*, *Sunipia nigricans*, etc. (Perner, Dang, 2003; Schildhauer, Schraut, 2004; Averyanov, 2004, 2005, 2007, 2008, 2009).

HISTORY OF DISCOVERY AND STUDY OF *PAPHIOPEDILUM CANHII*

Vietnamese people like orchids. More or less large orchid collections or small family orchid home gardens may be often seen in any city, town or even village all over the country. Various orchids for cultivation may be bought easily on neighbour local markets or just along roads where they cross areas with remains of primary woods. Plants for sale are usually offered by local people who commonly crop selling plants in nearest vicinities, regularly in degraded primary forest logging and burning for their primitive agricultural fields. Such fields are permanently expanded and successively replace primary forests in many botanically unexplored areas. Orchid collecting in such places time to time brings to the market rare, interesting and even undescribed orchids. Similar story was happen with discovery of *Paphiopedilum canhii*.

Orchid growers in Dien Bien and Son La cities firstly denoted samples of unusual slipper orchid that were appeared on the market at the end of 2009. This plant reflected certain attention of many orchid lovers and plant dealers who reasonably suspect that unusual plant may represent new undescribed species. First persons who introduced the plant to scientific society were Mr. Chu Xuan Canh and Mr. Bui Xuan Dang observing market plants in Dien Bien city and in Hanoi.

In fact, *Paphiopedilum canhii* was described on the base of few plants that were brought from remote mountain area at the end of 2009 by H'Mong (Meo) people to office of "Civilian Governmental Service for Care of Natural Resources and Connections with Local Minorities" (Natural Resources Governance, CARE International in Vietnam). At the office, plants were received by Service Officer - Mr. Chu Xuan Canh, who kept plants for further study and description. Even preliminary study revealed unique character and very isolated taxonomical position of collected plants that resulted in immediate description of new species for science - *Paphiopedilum canhii* (Averyanov et al., 2010), named after its actual discoverer.

The publication of discovered species attracted great attention in orchidology and horticulture, as well as activated interests of international orchid trade. The increasing of market demands for newly described species leads to fast rise of cost and plant collecting in the nature. At the same time native area of species long time remained unknown being "know-how" of commercial collectors. According to indirect data species represents very restricted local endemism of limestone areas in limits of Dien Bien and Son La provinces. It was expected that this plant probably may be found in alone or few localities and its populations may stand presently on the verge of extinction. Assessment of distribution and status of *Paphiopedilum canhii* was main goal of the current exploration program with field works started in December 2010.

According to primarily elaborated plan of investigation in present exploration program were successively fulfilled following actions.

Firstly all available indirect relevant information was obtained from local orchid markets, orchid lovers, growers and local dealers in the area of exploration. Additional data were obtained by talks with local peoples, village authorities, local foresters in cooperation with officers of Forest Protection Department of the Ministry of Agriculture and Rural Development. On the base of analysis of this information basic plan of field expedition for detailed field study of 12 regions of expected species occurrence was elaborated and realized during January 2010. Eventually alone locality of *Paphiopedilum canhii* was found. Short description of discovered habitats was made along with preliminary study of vegetation and natural conditions. It was also made estimation of number of plants in 5 discovered subpopulations and expected area of species distribution, as well as identification species status in the wild on the base of original field investigations. Also were preliminary studied species phenology and seed production with identification of optimal time for seed collecting for further possible seed propagation and possible repatriation. Recommendations for reliable strategy of species conservation on the base of obtained data, including training educational aspect for local people in the area of species habitats are proposed. Methodology of car and feet trips in remote mountain areas for personal field investigations of the flora and vegetation in possible regions of *Paphiopedilum canhii* occurrence (Son La, Lai Chau and Dien Bien Provinces) was used in current exploration program. These trips were connected with hire of local people and foresters as a field guides and cooperation with Forest Protection Department officers. Estimation of number of plants, number and size of populations, as well

description of habitat conditions and vegetation will be fulfilled according to standard geobotany and plant geography methods. Voucher specimens documenting plant species records and descriptions of plant communities will be housed in HN, LE and MO Herbaria. All explorations were illustrated with high resolution photography.

LANDSCAPE AND TYPICAL LANDFORMS IN STUDIED AREA

First information about existence of *Paphiopedilum canhiicum* from northwestern Vietnam. In fact, *P. canhiicum* was firstly observed in sale on local markets in Dien Bien and Son La cities. This fact with high probability indicates northwestern part of Vietnam in limits of Dien Bien and Son La provinces, as well as allied regions of Laos as most probable native area of the species. The area accepted for study is shown on figures 1 and 2. The northern part of studied area (except granite Hoang Lien Son Range) represents a number of successive vast alluvial valleys with shale rolling hills and low mountains up to 1500 (2000) m a.s.l. Valleys are appeared as wide, broad depressions covered by unconsolidated Quaternary sediments or occasionally with olivine basalt (Chu Van Ngoi, Luong Thi Thu Hoai, 2007) with valley bottoms elevated to 500-600 m a.s.l. Often they exhibit scattered, more or less isolated systems of remnant, rocky mesa-like hills or mountains, composed with highly eroded, marble like Devonian and Triassic limestone (Fig. 3-5). These spectacular formations with karstic rocky vertical cliffs elevated commonly up to 800-1000 m a.s.l., but sometime reach 1300-1400 m a.s.l. (Fig. 6-10).

Some limestone massives in SW part of studied area represent more or less highly eroded peneplains that forms continuous lines of more or less dissected limestone plateaus extending from NW to SE direction. Largest of them are Son La and Moc Chau with elevations up to 1500-1700 m a.s.l. spread along the Song Da River. Narrow canyons or very deep river valleys separate these plateaus and ridges. This zone of Devonian and Triassic limestone within the peripheral areas of these plateaus appears as a spectacular area of highly eroded karst impressive rocky topography (Averyanov, et al., 2003).

SPECIFIC CHARACTER OF LANDSCAPE AND LANDFORMS IN AREA OF DISCOVERED HABITAT OF *PAPHIOPEDILUM CANHIICUM*

All available relevant information on *Paphiopedilum canhiicum* received from orchid lower, dealers and local people in Dien Bien and Son La provinces was studied and analyzed before start of field work stage of the project realization. It was preliminarily detected on the base of this information that species should occur in the area of mentioned provinces near Laotian border, most probably on rocky limestone. All slipper orchids are obligate element of intact primary forests. Wide extinction of such forests strongly restricted possible regions for perspective field searches. Our field overview and special surveys (Collins, Sayer, Whitmore, 1991) indicate that more than 99.5% of primary forests in the area presently completely extinct due to shifting primitive agriculture, forest logging and timber exploitation for fuelwood. Miserable pieces of remained primary forests may be estimated now as covering less than 1% of total territory. Such unique remnant forest stands were located in few remote mountain regions of studied area in close cooperation with Forest Protection Department of the Ministry of Agriculture and Rural Development. As only primary forests support populations of sensitive aboriginal species including *Paphiopedilum* species, some of these localities were selected for preliminary field exploration (Fig. 2).

In the course of field works according to present exploration program 12 localities of remnant primary forests were found and studied (Fig. 2). Studied localities represent last highly degraded remnants of primary forests in the area that nevertheless still remained intact nucleus of aboriginal flora with very rich aboriginal species composition. Highest level of species diversity and endemism was observed in the area on rocky limestone formations. In such conditions was also found *Paphiopedilum canhii*.

Alone known till now native area of *Paphiopedilum canhii* was found during present explorations in Dien Bien province, to the SW of Dien Bien City, in Dien Bien District on the territory of Na U Municipality. It represents very small isolated massif of few scattered remnant limestone hills composed with highly eroded marble-like rocky limestone with numerous steep slopes and vertical cliffs (Fig. 12-16). These limestone formations topographically are inserted between rolling shale hills on watershed of western tributaries of Nam He River (Fig. 11), but some of them are towered just on flat river valley (Fig. 13). Total square of this hilly limestone mass if not exceed 4 km² (Fig. 11, 12). Tops of limestone remnant hills elevated from 850 to 1050 m a.s.l. still retain severely fragmented degraded pieces of primary forest that give home to remains of aboriginal species. At the same time this limestone refuge is surrounded by shale hills covered by poor weedy secondary plant communities and valleys occupied by agricultural fields (Fig. 12). High anthropogenic transformation of landscape gives no chance to find populations of rare sensitive native species like *P. canhii* in any vicinities of this area outside studied fragments of rich humid primary limestone forest.

In discovered native area of *Paphiopedilum canhii* were found and studied 9 last remained very small primary forest stands that potentially may be support habitats of *P. canhii*. In fact species was found only in 5 studied forest stands with very small subpopulations in each locality (Fig. 11).

MAIN KINDS OF VEGETATION IN STUDIED AREA

Rich primary broadleaved evergreen closed submontane tropical forests represent typical original pristine zonal vegetation formation in the area of *Paphiopedilum canhii* discovery. Very rich species composition, specific horizontal and vertical forest structure, permanent shade and humidity, as well as absence of exotic or weed species is typical feature of such aboriginal vegetation kind. However, sometime, it is not too easy to reconstruct and understand real structure and composition of pristine forest that were spread everywhere in studied area in prehistoric ages. Different stages of successions more or less deep degradation of vegetation is typical picture in our days all over studied area. Very poor secondary woods, secondary scrubs or herbaceous plant communities with high participation of exotic or weed alien species, are regrettably most typical picture in landscapes in all area of the project explorations.

Field studies of this project revealed following preliminary picture of forest structure and species composition in area of *Paphiopedilum canhii*.

First forest (canopy) stratum includes numerous trees which belong to different families. These trees reach on hill slopes regularly 20-25 m tall with canopy coverage 80-100%. Most of trees are evergreen, but participation of deciduous trees may be more or less considerable, particularly on south-faced slopes and on cliffs (Fig. 17-20). Species listed below in Table 1 were observed as more common co-dominant of this and lower strata in primary forest limestone forest.

Table 1.
Co-dominant species of different strata in primary broadleaved evergreen closed submontane tropical forests on hill slopes in *Paphiopedilum canhin* native area.

1. FOREST (canopy) STRATUM			
20-25 m tall			
FAMILY	PLANT SPECIES NAME	EVERGREEN	DECIDUOUS
Anacardiaceae	<i>Allospondias lakonensis</i> Stapf	-	+
Anacardiaceae	<i>Choerospondias axillaris</i> (Roxb.) B.L.Burt et A.W.Hill	-	+
Fagaceae	<i>Lithocarpus</i> sp.	+	-
Lauraceae	<i>Cinnamomum</i> sp.	+	-
Meliaceae	<i>Aglaiasp.</i> 1.	+	-
Meliaceae	<i>Aglaiasp.</i> 2.	+	-
Meliaceae	<i>Chukrasia tabularis</i> A.Juss.	+	-
Moraceae	<i>Ficus</i> sp.	+	-
Sapindaceae	<i>Pometia pinnata</i> J.R. et Forst.	-	+
2. FOREST STRATUM			
10-20 m tall			
Annonaceae	<i>Polyalthiasp.</i>	+	-
Annonaceae	<i>Xylopiasp.</i>	+	-
Euphorbiaceae	<i>Baccaureasp.</i>	+	-
Euphorbiaceae	<i>Deutzianthus tonkinensis</i> Gagnep.	+	-
Euphorbiaceae	gen.sp.	+	-
Moraceae	<i>Streblus macrophyllus</i> Blume	+	-
3. FOREST STRATUM			
5-10 m tall			
Araliaceae	<i>Schefflerasp</i>	+	-
Euphorbiaceae	<i>Sapium rotundifolium</i> Hemsl.	-	+
Podocarpaceae	<i>Podocarpus neriifolius</i> D.Don	+	-
Styracaceae	<i>Alniphyllum</i> sp.	-	+
4. FOREST STRATUM			
shrubs and herbs to 0.1-5 m tall			
Acanthaceae	<i>Strobilanthes</i> sp. 1.	+	-
Acanthaceae	<i>Strobilanthes</i> sp. 2.	+	-
Arecaceae	<i>Arenga pinnata</i> Merr.	+	-
Arecaceae	<i>Caryota</i> sp.	+	-
Convallariaceae	<i>Ophiopogon</i> sp.	+	-

Cyperaceae	<i>Carex</i> sp.1.	+	-
Cyperaceae	<i>Carex</i> sp.2.	+	-
Cyperaceae	<i>Scleria</i> sp.	+	-
Rubiaceae	<i>Psychotria</i> sp.	+	-
Zingiberaceae	<i>Alpinia</i> sp.	+	-

Forest on tops of rocky hills and mountains become shorter and includes in its canopy stratum a number of specific tree species that regularly do not observed on hill slopes. Among them are such species as - *Pistacia weinmannifolia*, *Schefflera pes-avis*, *Platycarya strobilacea*, *Myrsine kwangsiensis* and *Sinosideroxylon*sp. Common in such habitats - thickets of *Dracaena cochinchinensis*. They give to rocky outcrops very characteristic appearance (Fig. 17). Similar plant communities commonly may be observed on very steep rocky slopes and on cliffs of remnant limestone ridges (Fig. 21-23). Main co-dominants of canopy stratum in such specific primary plant community that cover tops of rocky limestone mountains are listed below in Table 2.

Table 2. Co-dominant species of canopy stratum in primary broadleaved evergreen closed submontane tropical dwarf forests on hill tops in *Paphiopedilum canhui* native area.

1. FOREST (canopy) STRATUM			
3-10 m tall			
FAMILY	PLANT SPECIES NAME	EVERGREEN	DECIDUOUS
Agavaceae	<i>Dracaena cochinchinensis</i> (Lour.) S.C.Chen	+	-
Anacardiaceae	<i>Pistacia weinmannifolia</i> J.Poiss. ex Franch.	+	-
Araliaceae	<i>Schefflera pes-avis</i> R.Vig.	+	-
Betulaceae	<i>Ulm</i> ssp.	-	+
Fabaceae	<i>Campylotropis</i> sp.	+	-
Fagaceae	<i>Quercus</i> sp.1	+	-
Fagaceae	<i>Quercus</i> sp.1	+	-
Fagaceae	<i>Quercus</i> sp.2	-	+
Juglandaceae	<i>Platycarya strobilacea</i> Siebold et Zucc.	-	+
Moraceae	<i>Ficus</i> sp.	+	-
Myrsinaceae	<i>Myrsine kwangsiensis</i> (E.Walker) Pipoly et C.Chen	+	-
Sapotaceae	<i>Sinosideroxylon</i> sp.	+	-

In fragments of primary woods opened by forest fire or logging many weedy species appears quickly. They rapidly replace aboriginal primary forest dominants. On first stages of this process were observed in studied area such species as *Clausena*sp. and *Zanthoxylum avicennae* DC. (Rutaceae), species of *Callicarpa* (Verbenaceae), *Euphorbia antiquorum* L. (Euphorbiaceae) and some another representatives of secondary plant communities.

Non strata (extra-strata) vegetation is well presented in habitats of *P. canhii* and includes numerous lithophytic, epiphytic, lianas, creeping and climbing plant species, as well as numerous mosses and lichens.

Group of lithophytic plants includes mainly numerous species of ferns and orchids. A number of herbaceous representatives of Begoniaceae, Gesneriaceae, Urticaceae, Araceae and Acanthaceae also belong here. Rosulate, tuberiferous and creeping living plant forms dominate in this group. In primary intact habitats they can develop continuous mats completely covering rocky outcrops on tops of limestone hills and mountains (Fig. 35).

Ferns and orchids also dominate among epiphytic plant communities in habitats of *P. canhii*. Some tuberiferous epiphytic scandent shrubs, mainly species of *Vaccinium*, also were observed as typical epiphytes on mountain tops. Here epiphytes often completely cover stems and branches of old gnarled trees (Fig. 36), particularly at the stem base and in tree canopies.

Among epiphytic, creeping, climbing and genuine vines were observed species of *Pyrrosia*, *Hoya*, *Dischidia*, *Smilax*, *Stemona*, *Vanilla*, *Clematis* and few species of Cucurbitaceae.

List of species observed during field works is presented in Appendix 1. All species observations and species records are documented with collected voucher herbarium specimens that are housed at Herbarium of the Center for Plant Conservation of Vietnam Union of Science and Technology Associations (Vietnam, Ha Noi) with duplicates delivered into main World Herbaria.

CHARACTERISTIC OF *PAPHIOPEDILUM CANHII* HABITATS

Shady vertical cliffs of N, NE and NW exposition on steep rocky slopes of remnant limestone hills and mountains covered with intact primary broadleaved evergreen forest were observed as typical habitat in all discovered subpopulations of *Paphiopedilum canhii* (Fig. 24-34). Discovered subpopulations of *P. canhii* in its native area were observed at elevation 950-1100 m a.s.l. The species grow in upper part of hill slopes, just on high cliffs, commonly in 40-60 m below hill tops, newer occurring on mountain summits. Plants regularly grow as a typical rosulate lithophyte on rough solid vertical walls covered with scattered mosses in permanent humidity and in constant shade provided by intact canopy stratum of primary forest. Very often roots of plants adressed to just solid unbroken limestone wall using no any crevices or holes. Remnants of primary forest supporting populations of *P. canhii* in all its discovered populations was observed as a still intact, but very endangered unit threatened by expected coming logging (Fig. 24-34).

In fact, *P. canhii* grows in very similar natural, environmental and climate conditions, which were described in details for *Paphiopedilum coccineum* (*P. barbigerum* var. *coccineum*) in our early publication (Averyanov et al., 2003, 2004).

***PAPHIOPEDILUM CANHII* IN ITS NATURAL HABITATS AND ESTIMATION OF ITS PRESENT STATUS**

Up to now *Paphiopedilum canhii* was discovered in 5 subpopulations settled in small isolated limestone area in square less than 0.5 km². The formal area of probable species occupancy is even smaller and may be formally estimated (according to methodology recommendations proposed by IUCN) as polygon with square is about 0.35 km² (Fig. 56). Actually real total primary square

occupied by species growing on vertical cliffs is certainly less than few hundred meters. Total number of specimens in all 5 subpopulations before commercial collecting may be estimated presently very approximately, but most probably the plant number was less than 10.000-15.000 mature (flowering-size) samples. There exist certainly high probability that 5 mentioned subpopulations represent alone existing locality of *P. canhii*. Plants in the past in their natural habitats grow as a rosulate lithophyte forming on vertical shady walls more or less dense colonies, each with 10 to 50 mature and juvenile samples spreading commonly on square 1-2 m². Few time ago many such colonies were scattered on a number of high cliffs in studied locality, like it may be seen on Fig. 42. However, even at this time number of specimens and total species area in each subpopulation was miserable.

Regrettably all discovered and studied subpopulations to moment of our exploration were already tragically depleted by commercial collecting. In our studies during December 2010 was found no one intact colony. Absolute majority of colonies in all 5 subpopulations were extinguished completely and only occasionally in most inaccessible cliffs were observed poor remains in form of single commonly depressed or juvenile specimens (Fig. 37-50). Plants were exactly collected just recently, certainly few months before our studies and many cliffs still retained numerous sad traces of former majestic species abundance. Very rarely few remained mature plants were observed in places of former many numbered colonies. Proportion of such plants may reach 30% (Fig. 55). However this is alone observed example. In all other cases plants are eliminated from colonies on 99 to 100% (Fig. 51-54). Total extinction of plants during 2009-2010 year may be estimated as at least 99%. At the same time the number of surviving mature (flower-sized) specimens in all subpopulations hardly exceeds presently 0.01% of former species population. Such unique relicts are presented on Fig. 38-50. As commercial collecting still can not be stop immediately, these are, probably, last photos of *P. canhii* in nature.

On the base of available data and current original observations *Paphiopedilum canhii* may be estimated presently in IUCN terms as critically endangered species (CR), which is facing an extremely high risk of extinction in the wild in nearest future.

TAXONOMY, MORPHOLOGY AND BIOLOGY OF *PAPHIOPEDILUM CANHII*

Paphiopedilum canhii was described by Prof. Leonid Averyanov and Mr. Olaf Gruss in 2010 on the base of few specimens of uncertain origin collected supposedly in Son La Province and flowered in Ha Noi in private orchid collection of Mr. Chu Xuan Canh in March 2010. It is most probably that locality of the type was not indicated in description properly, being based on talks of local dealers which is commonly very far from scientific accuracy. Later species was found in present investigation in Dien Bien Province, but no any reliable data on its occurrence are yet available from Son La Province.

At first the publication with illustrations and description of new species appeared in May issue of American Orchid Society Magazine that immediately introduced species to broad circle of orchid lovers all over the world. Unfortunately, name published in this edition may not be accepted as valid due to superfluous citation of two elements as a nomenclature type (Art. 8.1 & 8.2 of ICBN). Few months later in the same year species was described in full accordance with rules of botanical nomenclature in Russian scientific journal - *Turczaninowia* (Averyanov, 2010).

Below standard taxonomic citation of *P. canhii* and its corrected and improved description with addition of recently obtained original data are listed.

Paphiopedilum canhii Aver. et O.Gruss, 2010, in Aver., Orch. Viet. Ill. Surv. Orchidoideae, Turczaninowia, 13, 2: 92. - "*Paphiopedilum canhii*" Aver. et O.Gruss, 2010, Orchids, Mag. Amer. Orch. Soc., 79, 5: 288, nom. invalid.

Illustrations. d-EXSICCATES OF VIETNAMESE FLORA 0170; Aver. et O.Gruss, 2010, Orchids, Mag. Amer. Orch. Soc., 79, 5: 288-290, fig. 1-9; Aver., Orch. Viet. Ill. Surv. Orchidoideae, Turczaninowia, 13, 2: 94, Fig. 62; Fig. 39-50.

Described from NW. Vietnam ("NW. Vietnam, Son La prov."). **Holotype** ("Chu Xuan Canh CXC 101, 14 Nov. 2009", in fruit) – HN; **epitype** ("Phan Ke Loc HAL 1290722 March 2010", in flower) – LE.

Description. Lithophytic sympodial rosulate herb with (2) 3-4 (5) leaves. Leaves elliptic to oblong, 4-7 cm long, 1-2 (2.5) cm wide, slightly emarginate and shortly apiculate at the apex, distinctly tessellated light and dark green above, pale green and heavily marked with dark dirty-violet below. Inflorescence erect, 1-flowered; peduncle slender, (6) 8-10 cm long, dark green, sometimes with dirty-purple tint, pubescent with dirty olive-violet hairs. Bract narrowly ovate-elliptic, acute, 1.2-1.4 cm long, 0.5 cm wide, green, olive-violet pubescent. Flowers 6-8 cm across. Dorsal sepal ovate to broadly ovate, acute; 2-3 cm long, 1.5-1.8 cm wide; white, slightly greenish at the base, in lower half veined with 5-7 purple nerves; densely hairy outside. Synsepal narrowly ovate, acute; 1.5-2 cm long, 0.6-1 cm wide; light uniformly dull green; hairy outside. Petals 3-4 cm long, 0.5-0.7 cm wide at the base; spreading, more or less horizontal; cuneate, narrowing from broad base to elongate, acuminate apex; background light green to pinkish-green, brightly deep green toward base, dull purple-violet to the apex; with 7-9 dark purple-violet longitudinal stripes along nerves; long white ciliate along irregularly slightly undulate margin; petal base with dense tuft of long dark violet papillae at lower margin faced to lip entrance. Lip slipper-sac-like; 2-2.5 cm long, 0.8-1.4 cm wide, light dull green, with light brownish-purple tint on smooth and glossy incurved side lobes; inside at the base densely haired with long white glassy papillae, dark violet at apex. Column short and broad, 3-4 mm long, brightly green. Stamens with elongate acute filament apices; filaments green; anther spherical, yellow to orange. Stigma white to light greenish. Staminode large, 1.2-1.6 cm long, 0.6-0.8 cm wide; entire, glossy, broadly ovate to ovate-elliptic, flat, hardly indistinctly emarginate and grooved at apex; white to light greenish, with irregular washy yellowish-green or greenish veins. Pedicel and ovary 2-3 cm long, dark green, densely pubescent with dirty olive-violet hairs. Fruit dry, narrowly ellipsoid, ribbed, shortly beaked capsule about 2 cm long and 4-5 mm in diameter.

Ecology. Broadleaved primary shady humid forests on rocky limestone at elevations about 900-1100 m a.s.l., obligate lithophyte on vertical shady limestone cliffs near tops of ridge, with roots adpressed to solid vertical walls having no soil. Fl. (February) March - April. Extremely rare (CR).

Distribution. Vietnam (Dien Bien Province). Endemic.

Note. Samples of *P. canhii* bloom in nature in March-April. Fruit formation is rather low. Very few samples developed fruits (probably less than 10%) according to observation in 2010. Capsules are rather small. They ripening and disperse seeds commonly during August-September.

Along with some another strict slipper orchid endemics, *P. canhii* certainly represents example of very strict local Indochinese endemism. This species according to its floral and vegetative morphology has very isolated taxonomical position morphologically intermediate between species of section *Parvisepalum* Aver. et P.J.Cribb (subgenus *Parvisepalum* Karas. et Saito) and section *Barbata* (Kraenzl.) V.A.Albert & Boerge Pett. (subgenus *Paphiopedilum*). It undoubtedly deserves separation in rank of separate subgenus or section most close to subgenus *Paphiopedilum*sect. *Barbata* (Averyanov et al., 2010).

HISTORY OF EXPLOITATION AND EXTINCTION OF *PAPHIOPEDILUM CANHII*

Hard exploitation of *Paphiopedilum canhii* started immediately after its discovery in middle of 2009 year. Most probably species was at first found by H'Mong (Meo) local people and collected along with other orchids for their regular sale in local markets of Dien Bien and Son La cities. Very distinct unusual slipper orchid was highly valued by local orchid lovers and fanciers just immediately after its appearance in orchid market. In few weeks rumours on intriguing new species speeded widely reaching Ha Noi and other large cities of northern Vietnam. First flowers of mysterious plant were open at the beginning of 2010 in a number of private collections in Ha Noi, Dien Bien and Son La cities. At this moment become clear that orchid society met one more new exciting slipper orchid species. Next days internet was filled with images of new flower.

At this time price for flowering plants reached its maximum. Illustrated publication of new species in world-known American Orchid Society Magazine also activated market demands and supported fast cost rise. Additionally, participation in the trade of foreign dealers provided much highest influence to the market price dynamics. Numerous international dealers arrive in spring 2010 to Son La and Dien Bien cities for trading. Best plant clones at this time were traded by costs up to 100 USD for alone plant. Largest lots of plants were supposedly imported to Taiwan.

Strong rumours about high prices for plants provoked true orchid fever in the area of *Paphiopedilum canhii*. All people from neighboring villages layaway their each day home duties and come to the forest looking for a plants. In some days more than 20 people collected plants in dream to sell them for high price. Naturally high supply of plants on the market for sale, immediately exceeded demands. Very soon after plant flowering period price come down to 100 and then 50 USD per kg. To the end of 2010 the cost was only 10-20 USD for 1 kg, but even for these costs trade was very weak and most not sold plants were simply trashed. Ironically the collecting of great majority of plants was fruitless. They bring no money to local people, no profit to local or international trade, no happiness to orchid lovers all over the world. These last specimens of unique critically endangered species that stands on verge of full extinction were simply wasted (Fig. 151). Low level of horticulture and lack of necessary experience in slipper orchid cultivation permit no long cultivation *P. canhii* in local collections and nurseries. So even large flowering size plants actually have no chance to survive in conditions of primitive agriculture (Fig. 151-154). To the end of 2010 trade of *P. canhii* actually completely exhausted due to 3 main reasons: - no more demands from foreign dealers (they already bought best clones

necessary for propagation and breeding); - no more demands from domestic purchasers (due to hard difficulties in plant cultivation in primitive conditions); - very few plants in nature (that make their search and collecting unprofitable).

According to very approximate estimation 25-35 kg of *P. canhii* samples were collected during short history of its discovery, exploitation and extinction. Plants are fairly small when 1 kg contains about 300-350 mature (flowering-size) plants and commonly 200-300 offspring juvenile samples. Following to these calculations totally were collected at least 10.000-15.000 mature and juvenile specimens. Direct observation in nature indicates that about 99.5% of populations were extinguished in one year of exploitation. In our opinion species has no chance survive in nature. It is particularly true taking into consideration fast deforestation in its small native area.

MAIN FACTORS OF *PAPHIOPEDILUM CANHII* EXTINCTION

Deforestation is main and leading factor of extinction of aboriginal floras. Unique local floras having very high diversity of locally endemic life forms vanish completely in process of deforestation. Fast following degradation of fertile soils and denudation of subsoil horizons opens way to fast degradation of vegetation in successions terminating in climax community of secondary shrub and herbaceous weed species (Fig. 142). This process is irreversible. Primary forests with their assemblage of very sensitive aboriginal species never regenerate. Extinction of such forest formations leads to catastrophic decreasing of the world genetic diversity. Such picture is observed in studied area in its bright typical form. Our present field studies indicate that more than 99.5% of primary forests covering land surface in studied area presently completely extinct. This observation stands in full accordance with data of earlier special regional surveys (Collins, Sayer, Whitmore, 1991).

Primitive slash-and-burn agriculture and forest logging for domestic constructions and fuel timber are main reason of countrywide deforestation in conditions of remaining traditional forms of local economic and fast increase of human populations. Miserable pieces of remaining primary forests may be presently estimated in studied area as less than 0.1% of territory. Such unique remnant forest stands are still occur in few remote mountain regions. Their protection and conservation is impossible without urgent special actions of municipal, provincial and governmental authorities that sounds unrealistic on the background of fast forest destruction. All this is entirely true for home area of *P. canhii* (Fig. 141-147). According to our estimation it is hardly possible to preserve intact primary vegetation that supports remnants of *P. canhii* subpopulations. Without special very urgent and effective actions forest here will be destroyed in the nearest future. The survival of sensitive aboriginal species including *P. canhii* after forest destruction will be impossible.

Constructions of roads, highways, mining, high-voltage line communications, as well as any another large land exploitation projects are also important factors of nature destruction, that usually come after primary forest extinction. For example, road construction in area of *P. canhii* home area destroys not only vegetation, but also even landscape faces (Fig. 149, 150).

Landscape desertification and aggressive weed introgression play role of slow-acting, but irreversible and insuperable destructive factors in last isolated stands of primary forests all over the world in tropical zone. Deforestation on great majority of the land surface leads to landscape

desertification resulting in higher summer temperatures and loss of air humidity, particularly during dry seasons. This effect seriously depresses primary humid-loving vegetation, particularly in its small isolated refugia. Most sensitive species in such conditions slowly decline even in physically intact primary plant community. Particularly this concerns woody conifers and herbaceous shade-loving lithophytes (Averyanov et al., 2000, 2005, 2009). Shade-loving aboriginal herbaceous lithophytes growing on vertical cliffs in conditions of permanent humidity represent most sensitive and endangered group of species. Such species always vanish first as during process of habitat destruction vertical cliffs lose humidity and surface damp much faster than other substrates. Assessed *P. canhii* and its slipper orchid relatives belong to just this group of species.

Destruction of aboriginal floras by introgression of aggressive exotic and weed species represents great problem all over the world. Such species can easily and fairly fast spread in the area of disturbed primary plant communities gradually replacing indigenous species. Eventually primary plant community becomes transformed into secondary thickets of weed and alien exotic species (Fig. 148). This process moves without bright visible cataclysms, but leads to strong depression of native species and eventually kills them. This is particularly true for most sensitive and rare endemic orchids, including all species of *Paphiopedilum*.

REMARKABLE PLANT SPECIES ASSOCIATED WITH HABITATS OF *PAPHIOPEDILUM CANHII* IN ITS HOME AREA

Remnants of primary forests in the area of *P. canhii* still retain principal nucleus of very rich and highly endemic flora. As a result great number of rarest species were observed and collected as herbarium voucher specimens during expedition for documentation of our field studies. Totally were collected about 280 species which belong to 157 genera and 58 families of higher plant (Appendix 1). Many observed species vanished in other regions of Vietnam years ago, but in studied area they are still survived and sometime are presented by fairly large populations. Most rare and interesting species are slipper orchids, - relatives of *P. canhii*, such as *P. malipoense*, *P. coccineum* (*P. barbigerum* var. *coccineum*) and *P. dianthum* (Fig. 57-68). All these discoveries essentially expand our knowledge about distribution of these rare slipper orchid species and represent new records for areas of NW Vietnam.

Tuberiferous ericaceous epiphytic shrubs are very typical for primary vegetation in humid mossy forest of *P. canhii* area. They are mainly representatives of *Vaccinium* genus (Fig. 69-74). Beside orchids and genuine ferns some fern allies, like *Selaginella tamariscina*, belong to typical lithophytes found on vertical rocky limestone cliffs (Fig. 75-77).

About 50 orchid species were observed as direct associates in habitats of *P. canhii* subpopulations. Some of them are presented on Fig. 78-112. As a most common orchids here were observed such species as:

Acampe rigida,

Bulbophyllum ambrosia

B. apodum

Callostylis rigida
(Fig. 111, 112)

D. loddigesii,

Epigeneium amplum

Eria carinata

E. pannea

Oberonia cavaleriei,

O. ensiformis (Fig. 78-80)

Panisea tricallosa (Fig. 89, 90)

Paphiopedilum dianthum
(Fig. 66-68)

<i>Ceratostylis himalaica</i>	<i>Flickingeria angustifolia</i> ,	<i>Pholidota levelleana</i> ,
<i>Cleisostoma filiforme</i>	<i>Liparis mannii</i>	<i>P. yunnanensis</i>
<i>C. striatum</i>	<i>L. viridiflora</i>	<i>Sunipia scariosa</i>
<i>Coelogyne fimbriata</i>	<i>Luisia zollingeri</i>	<i>Thrixspermum calceolus</i>
(Fig. 83, 84)	<i>Monomeria barbata</i>	(Fig. 99)
<i>C. ovalis</i> (Fig. 138, 139)	(Fig. 85-87)	<i>Trichosma coronaria</i>
<i>Dendrobium heterocarpum</i>	<i>M. gymnopus</i>	(Fig. 81, 82)
(Fig. 103)	(Fig. 120, 121)	<i>Vanda brunnea</i> (Fig. 91-98).

Some extremely rare orchids were known before on the base of few or single collections were also found during field works in home area of *P. canhii*. Species of this group are listed below:

<i>Acampe ochracea</i>	<i>Cymbidium eburneum</i>	<i>Eriodes barbata</i> (Fig. 137)
(Fig. 100, 101)	(Fig. 108, 109)	<i>Porpax elwesii</i>
<i>Anoectochilus calcareus</i>	<i>Dendrobium longicornu</i>	(Fig. 134-136)
(Fig. 88)	(Fig. 105)	<i>Sunipia andersonii</i>
<i>Bulbophyllum lockii</i>	<i>D. moniliforme</i>	(Fig. 106, 107)
(Fig. 128, 129)	(Fig. 104)	<i>Taeniophyllum glandulosum</i>
<i>Cheirostylis latilabris</i>	<i>D. nobilevar. albolutea</i>	(Fig. 140)
(Fig. 130, 131)	(Fig. 102)	<i>Vanda brunnea</i> (Fig. 91-98).
<i>Coelogyne assamica</i>	<i>D. porphyrochilum</i>	
(Fig. 110)	(Fig. 126, 127)	
<i>C. ovalis</i> (Fig. 138, 139)	<i>Eria bambusifolia</i>	

Partial identification of materials collected during field works revealed a number of important taxonomic and floristic discoveries. Among them 2 genera discovered and reported for the flora of Vietnam at first. They are *Phylacium* Benn. (Fabaceae) and *Sinocrassula* A.Berger (Crassulaceae) with new species for the flora - *Phylacium majus* Collett et Hemsl. and *Sinocrassula indica* A.Berger.

At least 7 plant species were found during current survey in Vietnam at first. All they represent new records for the flora of Vietnam. Among them creeping fern - *Pyrrosia nummularifolia* Ching (Polypodiaceae) common in habitat of *P. canhii*, parasitic achlorophyllous vine - *Cuscuta formosana* Hayata (Cuscutaceae) and such orchids (Orchidaceae) as - *Coelogyne micrantha* Lindl. (Fig. 116-119), *Cymbidium cyperifolium* Lindl. (Fig. 132, 133), *Dendrobium senile* Par. et Rchb.f. (Fig. 125), *Monomeria gymnopus* (Hook.f.) Aver. (Fig. 120, 121) and *Schoenorchis fragrans* (Par. et Rchb.f.) U.C.Pradhan (Fig. 124).

Among taxa discovered and proposed for description as a new for science are 5 orchids: new genus and species - *x Lockia sonii*, gen. et sp.nov. (Fig. 113-115) and 4 species from genera *Dendrobium*, *Poaephyllum* and *Schoenorchis* (Fig. 122, 123).

Data on all discoveries now are in preparation for publication in form of series of separate special articles with appropriate references and acknowledgements for supporting organizations.

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TECHNICAL AND FINANCIAL REPORT

Current investigation program was financially supported by 2 agencies with following details -

Grant name: "Assessment of distribution and natural status of *Paphiopedilum canhii*, Vietnam", The Rufford Small Grant Foundation (RSGF); found amount - £ 6000

Grant name: "Assessment of current natural status of critically endangered species - *Paphiopedilum canhii* for its conservation", Chicago Zoological Society, Chicago Board of Trade Endangered Species Fund (CZS CBTESF); found amount - USD 4500

The first stage of the work on Program in December 2010 included 18 days, starting from 9 to 26 December 2010. It included field work trip and short laboratory session for preliminary summarization of obtained data. Five main project participants (L.Averyanov, P.K.Loc, P.V.The, N.T.Vinh, C.X.Canh) were involved in the field expedition work in Dien Bien and Son La Provinces during 13 days, from 9 to 22 December 2010. In course of these studies preliminary data for current assessment were obtained, were studied and described 12 localities, were found and shortly described 5 subpopulations of *Paphiopedilum canhii* and accompanied plant species, collected about 1000 herbarium specimens with 310 collecting numbers. Data on actual schedule of field works and plant collecting are presented in Table 3. Short preliminary summarization of obtained data in form of first report draft were completed during laboratory session in Hanoi with participation of 3 main project participants (L.Averyanov, P.K.Loc, P.V.The) in 4 days, from 23 to 26 December 2010.

Table 3.
Schedule of field work in December 2010.

№ of studied locality	Date	Administrative and geographical position	Collected specimen numbers
1	9 Dec.	Dien Bien Prov, Dien Bien Distr., Na U Municipality, Ca Hau village, around point 21°13'08"N 102°57'14"E.	CPC 848-851
2	11 Dec.	Dien Bien Prov, Dien Bien Distr., Muong Phang Municipality	CPC 852-858
3	11 Dec.	Dien Bien Prov, Dien Bien Distr., Na U Municipality, Ca Hau village, around point 21°12'52"N 102°57'18"E	CPC 859-865
4	13 Dec.	Dien Bien Prov, Tua Chua Distr., Tua Thang Municipality, around point 21°58'04"N 103°25'21"E	CPC 866-869
5	13 Dec.	Dien Bien Prov, Tua Chua Distr., Ta Phin Municipality, around point 22°00'41"N 103°21'33"E	CPC 870-871
6	13 Dec.	Dien Bien Prov, Tua Chua Distr., Sin Chai Municipality, around point 22°03'38"N 103°18'56"E	CPC 872-917
7	14 Dec.	Dien Bien Prov, Tua Chua Distr., Sin Chai Municipality, around point 22°03'38"N 103°19'56"E	CPC 918-1008, 1047
8	16 Dec.	Dien Bien Prov, Tua Chua Distr., Ta Phin Municipality, around point 22°00'21"N 103°21'39"E	CPC 1009-1043

9	16 Dec.	Dien Bien Prov, Tua Chua Distr., Xu Nhe Municipality, around point 21°51'09"N 103°23'37"E	<i>CPC 1044-1046</i>
10	18 Dec.	Dien Bien Prov, Muong Cha Distr., Mua Ngai Municipality, around point 21°52'19"N 103°10'01"E	<i>CPC 1048-1097</i>
11	20 Dec.	Son La Prov., Son La City, Chieng Co Municipality, around point 21°18'24"N 103°52'53"E	<i>CPC 1098-1141a</i>
12	21 Dec.	Son La Prov., Mai Son Distr., Hat Lot town, around point 21°13'05"N 104°06'44"E	<i>CPC 1142-1156</i>

Financial report for the first stage of the project realization schematically is presented in Table 4.

Table 4.
Financial report of the first stage of exploration program.

Income:

1 - £6000 (= 9,600 USD for Dec. 2010), from RSGF.

2 - 4,500 USD, from CZS CBTESF.

Total income: 14,100 USD

Justification of expenses:

ITEM	DESCRIPTION	RSGF & CBTESF	OTHER SOURCES
<i>TRANSPORTATION</i>			
Airfare	1 roundtrip air ticket and connected travel costs St. Petersburg-Hanoi for project leader		1,000
Vehicle Rental	rental of vehicle for 13 days field work	1,300	
Field Vehicle Gas and Maintenance	fuel and driver costs	625	
<i>SUBSISTENCE</i>			
Lodging	5 participants +driver for 13 days by \$10/day	780	
Food	5 participants +driver for 13 days by \$20/day	1,560	
<i>FIELD WORK</i>			
Equipment	tents, sleeping bags, herbarium presses, mosquito nets, rucksacks		600
Field Supplies	maps, batteries, memory cards, external discs, adapters, electricity stabilizer, herbarium paper, alcohol, sacks, lease of electricity generators	300	600
Assistants/Consultants	guides, porters, local assistants	400	

LABORATORY WORK			
Logging in Hanoi	1 participant (Project Leader) for 4 days by \$35/day	140	
Food	3 participants for 4 days by 20/day	240	
Equipment	Herbarium driers		400
Lab Supplies	Herbarium paper and package cartons		200
Assistants/Consultants	Label and field book writing		200
Tests	Plant preliminary identification and descriptions		300
Other	herbarium specimen processing, drying, sorting and package	300	100
Host institutes overhead costs			500
MANAGEMENT			
Telephone/fax/postage	post, fax, telephone		50
Miscellaneous	passport, visa and permissions processing	55	100
Participant salaries			3,500
TOTAL IN PARTS		5,700	7,550
TOTAL EXPENDED		13,250	

Other funding sources:

- Komarov Botanical Institute of the Russian Academy of Science (about USD 5,050)
- The Center for Plant Conservation, Vietnam Union of Science and Technology Associations (about USD 2,500).

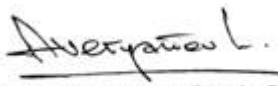
Expended found received from RSGF and CZS CBTESF for January 2011 is USD 5,700 (proportionally USD 3,762 from RSGF and USD 1,938 from CZS CBTESF).

The rest of joined RSGF and CZS CBTESF fund is USD 8,400 (proportionally USD 5,544 from RSGF and USD 2,856 from CZS CBTESF).

Second expedition for succeeding season of field works on current exploration program will be organized during March-April 2011. Final report will be submitted in August-September 2011.

Some scenes of field work of main project participants during first stage or the project realization (December 2010) are presented on Photos 155-161.

Project Leader,
Prof. Leonid V. Averyanov


AVERYANOV LEONID

25 January 2011

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