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**THE HISTORY OF DISCOVERY AND NATURAL HABITATS OF
XANTHOCYPARIS VIETNAMENSIS (CUPRESSACEAE)**

**ИСТОРИЯ ОТКРЫТИЯ И УСЛОВИЯ ОБИТАНИЯ
XANTHOCYPARIS VIETNAMENSIS (CUPRESSACEAE)**

The history of discovery, environmental conditions and plant communities of natural habitats of *Xanthocyparis vietnamensis* (Cupressaceae) – strict local endemic of limestone area of Ha Giang Province of the northern Viet Nam adjacent to Chinese border is shortly described. Conservation status of this rare plant that needs urgent effective protection is estimated on the base of preliminary exploration.

Among the most remarkable recent plant discoveries in South-East Asia is a member of a new, recently described genus of gymnosperms (Pinophyta) – *Xanthocyparis vietnamensis* Farjon et Hiep, which belongs to the family Cupressaceae and related to a disparate North American species hitherto classified in the genus *Chamaecyparis* (Farjon et al., 2002). According to currently available field data *X. vietnamensis* is locally endemic to the South Chinese floristic province of the Paleotropic floristic kingdom. This new species has an extremely restricted distribution in the Bat Dai Son limestone mountain system in the northwestern part of Ha Giang Province of northern Viet Nam, located near the Chinese border. It occurs commonly as scattered individual trees along the crests of narrow ridges composed of highly eroded, solid marble-like limestone of presumably late Paleozoic age (Dovzikov et al., 1965) as a tree component of rather open, wet, mossy, evergreen or semi-deciduous primary forests on elevations between (900)1000–1200 m above sea level.

Rocky limestone area of Quan Ba District including Bat Dai Son mountains for a long time was restricted border region actually not accessible for free travels and wide exploration. This may be one of the causes why a number of mountain summits and ridges in this region still retain small fragments of pristine primary woods that extinct in other territories of northern Viet Nam many decades ago. First preliminary botanic reconnaissance of this area that was undertaken according to American Orchid Society exploration program resulted in discovery of many plants new for science* .

*Main set of herbarium voucher specimens collected in Ha Giang Province, on which this paper is based, are housed at Herbarium of the Institute of Ecology and Biological Resources of the National Center for Natural Sciences and Technology of Viet Nam (HN) with duplicates distributed to LE, MO and AAU Herbaria.

Among them new monotypic genus – *Grushvitzkya stellata* N. Scvortz. et Aver. (Araliaceae) and such orchids as *Anoectochilus calcareus* Aver., *Bulbophyllum purpurifolium* Aver., *Cheirostylis bipunctata* Aver., *Coelogyne lockii* Aver., *Liparis emarginata* Aver. and *Luisia appressifolia* Aver. (Skvortsova, Averyanov, 1994; Averyanov, 1996, 1997, 2000). Many other species and genera discovered here during preliminary floristic inventory represent new additions to the flora of Viet Nam. Considerable part of such species was regarded as very strict local endemics of southeastern Yunnan and southwestern Guangxi before our exploration. Many orchids collected in Bat Dai Son mountain region belong to this group. Among them such rarest endemics of South Chinese floristic province as *Coelogyne malipoensis* Z.H. Tsi, *Holcoglossum wangii* E. Christenson, *Panisea yunnanensis* S.C. Chen et Z.H. Tsi, *Paphiopedilum henryanum* Braem, *P. malipoense* S.C. Chen et Z.H. Tsi, *P. micranthum* T. Wang et F.T. Wang, *Phaius longicruris* Z.H. Tsi, *Pholidota missionariorum* Gagnep., *P. roseans* Schlechter, *P. yunnanensis* Rolfe and *Vanda fuscoviridis* Lindl. (Averyanov, Averyanova, 2000; Averyanov, 2001).

Mentioned preliminary investigations of the flora in the northern part of Ha Giang Province (Quan Ba District) outlined this rocky limestone region of the northern Viet Nam as a world important center of plant diversity and endemism. This stimulated further botanical exploration of this area and led to new outstanding discoveries among which most exciting is new genus of gymnosperm plants – *Xanthocyparis vietnamensis*.

For the first time *Xanthocyparis vietnamensis* was found by staff members of Forest Inventory and Planning Institute of the Ministry of Agriculture and Rural Development of Viet Nam in 25 September 1999 during wood inventory works in Ha Giang Province. This tree was discovered by Vietnamese foresters Le Van Cham and Vu Van Can near Thanh Van village in Quan Ba District of Ha Giang Province. They collected herbarium materials (*Le Van Cham, Vu Van Can, C658, C662, C663, and C664*), which were reported to be housed at the Herbarium of the Forest Inventory and Planning Institute in Hanoi (HNF). New tree species was compared with species of *Thuja* L. and reported under the name *Thuja quanbaensis* V.V. Can, V.V. Dung et L.V. Cham (V.V. Can, V.V. Dung, L.V. Cham, 1999). Unfortunately the description of this outstanding new discovery was not accompanied with Latin diagnosis and proposed name according to formal rules of botanical nomenclature can not be naturally accepted. Two weeks later *Xanthocyparis vietnamensis* was independently found by N.T. Hiep, L. Averyanov and P. Cribb during field works according to international exploration program of U.S.A. National Geographic Society and American Orchid Society on investigation of the flora of limestone areas of the northern Viet Nam. This species was discovered along tops of limestone ridge near Sing Xuoi Ho village in Can Ti Municipality of the same district of Ha Giang Province in 12 October 1999. It was observed as occasional co-dominant of the second stratum of the primary forest. Vietnamese botanists Dr. N.T. Hiep and Prof. P.K. Loc were first specialists who expected generic specificity of the plant on the base of study of collected herbarium samples (*N.T. Hiep, L. Averyanov, P. Cribb, NTH 3594*), young cones and few old seeds.

One and two years later special trips was undertaken for studies of presumably new gymnosperm genus with support of U.S.A. National Geographic Society and U.S.A. National Science Foundation under management of staff member of Missouri Botanical Garden Dr. D.K. Harder. During April 2000 and February 2001 international group of botanists collected large herbarium materials in three geographical points of Bat Dai Son mountains in Quan Ba District (*D.K. Harder et al., DKH 4977, DKH 6090, DKH 6091, DKH 6224*) for special detailed investigation. Duplicates of these collections were sent to Royal Botanic Garden, Kew for attention of Dr. A. Farjon, who proposed name *Xanthocyparis vietnamensis* and managed appropriate description of this new genus and species.

Expected area of present *Xanthocyparis vietnamensis* distribution do not obviously exceed square estimated as 10 km from the north to the south and 3–4 km from the west to the east covering actually area less than 25 km² (Fig. 1). The region lies 25–30 km to the north of Ha Giang city and adjoins on the north to Viet Nam-Chinese border. This area represents narrow karst rocky mountain system, which is formed by highly eroded remnant rocky limestone ridges and isolated mesae outcropped on the eastern margin of limestone plateau along left side of deep valley of Mien River. Highest predominant peaks here elevated at 800–1200 m a.s.l. Northern part of this rocky area is known as Bat Dai Son Mountains. Commonly *X. vietnamensis* occurs as occasional component of primary coniferous forests with *Pseudotsuga brevifolia* that covers peacks and summits of

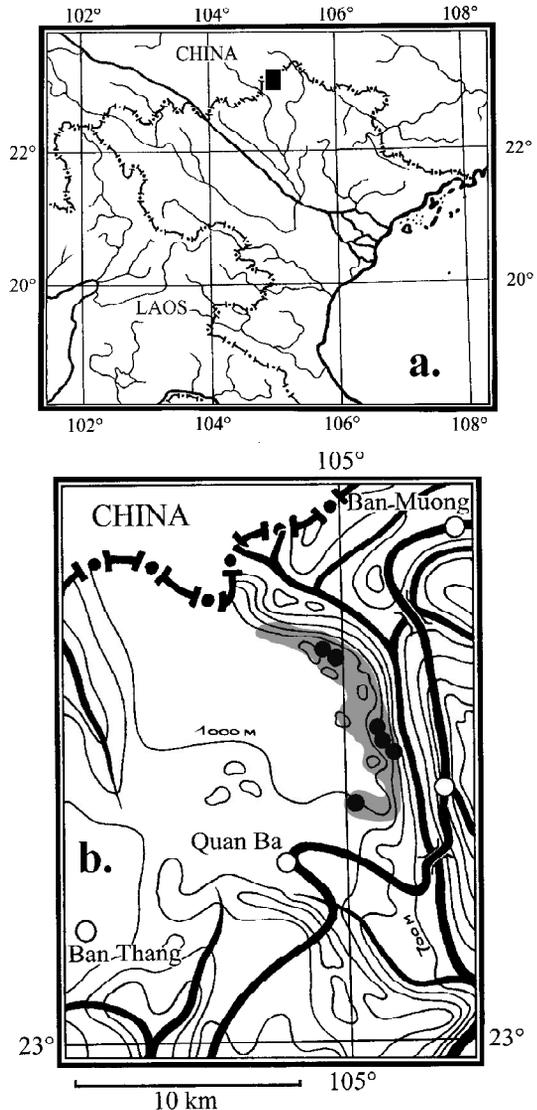


Fig. 1. Distribution of *Xanthocyparis vietnamensis*. a. – Position of enlarged fragment (filled with black) on the map of northern Viet Nam presented below; b. – schematic map of *Xanthocyparis vietnamensis* area (known localities are marked with black rounds; range of last forest remnants where this tree observed as occasional co-dominant of second stratum filled with gray shade).

narrow limestone ridges. Supposedly *X. vietnamensis* inhabited years ago territories of southern China adjacent to Vietnamese border where it probably extinct due to deforestation and agricultural transformations of landscape everywhere to the north of Bat Dai Son mountains.

Climate in the area of *Xanthocyparis vietnamensis* distribution belongs to monsoon tropical climate associated with mountains (Nguyen Khanh Van et al., 2000). Winter here is dry with mean temperatures that lie around 10–13°C (Fig. 2). Coldest month is January when night temperatures may fall to light frost. Morning ground hoarfrost may be occasionally observed in open places of the area during coldest winter weeks at elevations 1000–1200 m a.s.l. Minimal temperature registered in this region at elevation 957 m a.s.l. is –3.6°C (Bac Ha weather station, Nguyen Khanh Van et al., 2000). Cold north and northeast winds are very typical here from later autumn to early spring. During March and first weeks of April they bring persistent cold cloudy mists. Most of the moisture at this time of year comes from this source. The summer in *X. vietnamensis* area lasts from April to September – October. This is warm rainy season with temperatures ranging around 22–26°C (Fig. 2). Maximal temperatures in summer occasionally reach 30–33°C. Maximal rains fall on June – August (Fig. 2). This is time of very high atmosphere humidity. Mean annual rainfalls in habitats of *X. vietnamensis* range from 1800 to 2400 mm. At the same time deep karst erosion of limestone substrate prevents retention of the rain water in soil and keeps habitats of *X. vietnamensis* enough dry even in rainy season.

Xanthocyparis vietnamensis commonly observed as facultative component of second stratum of primary coniferous woods that spreads on tops of rocky limestone ridges. Observed samples of this tree commonly reach 10–15 m in height and 30–50 cm in diameter at breast height. The bark is brown or gray-brown redundant and the satiny pieces hang in numerous irregular, papery strips. In open cliffs or rocky outcrops trees have dark green irregular broadly pyramidal or ovate crown. However in close forest stands tree has slender habit with irregular sub-spherical canopy at the top of the trunk. Dimorphic foliage with bright difference of juvenile and mature sprays is

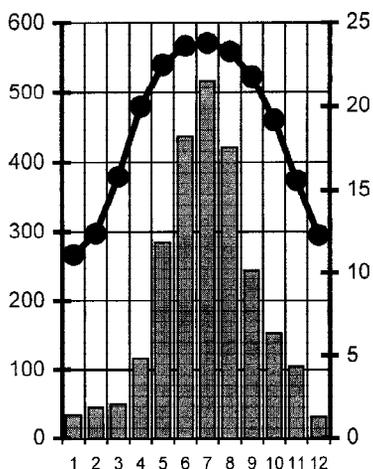


Fig. 2. Climatological data for the area of *Xanthocyparis vietnamensis* distribution extrapolated on the base of data of nearest weather stations – Ha Giang (22°49'N 104°59'E, elev. 118 m a.s.l.) and Bac Ha (22°32'N 104°17'E, elev. 957 m a.s.l.) according to Nguyen Khanh Van et al. (2000).

Black figures at the chart bottom mean numbers of months. Left axis for columns presents atmosphere precipitation in mm (columns designate mean month rainfalls in Ha Giang weather station); right axis for pointed line presents mean month temperature according to Celsius scale (Bac Ha weather station).

very typical for the species. Juvenile branchlets with linear all way directed leaves commonly predominant in lower part of canopy, but upper periphery of crown in old trees composed with mature flattened sprays with imbricate scale-shape leaves. Numerous pollen and seed cones are observed commonly in trees inhabited open places on steep rocky cliffs and narrow isolated ridge tops. Sub-globose female cones about 1 cm in diameter have umbonate rugose shield-like scales and hold 6–9 small light brown two-winged seeds (Suppl. 1).

Pseudotsuga brevifolia W.C. Cheng et L.K. Fu, which reaches 15–20 m tall and 70 cm in diameter is a common regular dominant of the first forest stratum in habitats of *Xanthocyparis vietnamensis*. Usual co-dominants within the second coniferous forest stratum along with *Xanthocyparis vietnamensis* are other gymnosperms including *Amentotaxus hatuyenensis* Hiep, *Nageia fleuryi* (Hickel) de Laub., *N. wallichiana* (C. Presl) Kuntze, *Podocarpus brevifolius* (Stapf) Foxworthy and *Taxus chinensis* (Pilger.) Rehder. Angiosperm taxa in this stratum include mainly deciduous or semi-deciduous species of *Acer*, *Carpinus*, *Lithocarpus*, *Quercus* and *Ulmus*, and also *Pistacia weinmannifolia* J. Poiss. ex Franch., *Platycarya strobilacea* Siebold et Zucc., as well as evergreen *Garcinia paucinervis* Chun et How. The largest trees in this tier may reach 12–15 m in height. Within the third, lower forest stratum are numerous species of smallest trees. Most common among them are species of *Elaeocarpus*, *Eriobotrya*, *Sorbus*, as far as *Myrsine kwangsiense* (E. Walker) Pipoly et C. Chen, *Schefflera pes-avis* R. Vig. and *Tirpitzia sinensis* (Hemsl.) Hallier f.

On some isolated hardly accessible mountain peaks, very large and presumably very old, gnarled trees of *Xanthocyparis vietnamensis* appear as a main forest dominant forming majestic open coniferous forests on steep rocky slopes. Among the numerous shrubby species present here the most common are lithophytic species of *Abelia*, *Ardisia*, *Berberis*, *Mahonia*, *Pittosporum*, *Polygala*, *Rhododendron*, *Spiraea* and *Vaccinium*. Some draft palms, such as *Guihaia* sp. and *Rhapis* sp. are also very typical for these open forests.

Open coniferous forests, in which *Xanthocyparis vietnamensis* is present, support a very rich flora of lithophytic and epiphytic bryophytes, ferns and herbaceous angiosperms. Among the most common herbs are species of Acanthaceae, Begoniaceae (*Begonia*), Convallariaceae (*Aspidistra*, *Ophiopogon*, *Peliosanthes*, *Tupistra*), Gesneriaceae (*Chirita*, *Paraboea*), Rubiaceae (*Ophiorrhiza*, *Hedyotis*) and Urticaceae (*Elatostema*, *Pilea*), as well as numerous sedges (Cyperaceae: *Carex*, *Scleria*) and selaginellas (*Selaginella*). The most common ferns in these forests are presented by species of *Asplenium*, *Cyrtomium*, *Polypodium*, *Polystichum* and *Pyrrosia*.

The orchids reach outstanding diversity and abundance in the habitat of *Xanthocyparis vietnamensis*. Numerous lithophytic representatives of this family including *Bulbophyllum ambrosia* (Hance) Schltr., *B. macraei* (Lindl.) Rehb. f., *B. purpurifolium*, *Coelogyne fimbriata* Lindl., *C. lockii*, *C. malipoensis*, *C. shultesii* Jain et Das, *Epigeneium amplum* (Lindl.) Summerhayes, *Eria coronaria* (Lindl.) Rehb.f., *E. siamensis* Schltr., *Flickingeria* sp., *Liparis distans* C.B. Clarke, *L. mannii* Rehb.f., *L. stricklandiana* Rehb.f., *Monomeria barbata* Lindl., *Pholidota roseans*

and *P. yunnanensis* cover considerable areas over the rocky limestone forest floor. Among the lithophytic orchids here are also occasionally very common *Cleisostoma paniculatum* (Ker-Gawl.) Garay, *Dendrobium chrysanthum* Lindl., *D. nobile* Lindl., *D. thyrsoflorum* Rehb. f., *Eria globulifera* Seidenf., *E. sutepensis* Rolfe ex Downie, *Liparis averyanoviana* Szlach., *Paphiopedilum malipoense*, *P. micranthum*, *P. henryanum* and *Podochilus microphyllus* Lindl. Under shade and in deep karst depressions numerous terrestrial orchids can be found including *Anoectochilus calcareus*, *Calanthe alismifolia* Lindl., *C. argenteo-striata* Tang et Cheng, *Cheirostylis bipunctata*, *Goodyera hispida* Lindl., *Nephelaphyllum tenuiflorum* Blume, *Phaius flavus* (Blume) Lindl., *P. longicruris*, *Rhomboda petelotii* (Gagnep.) Ormerod and *Tropidia curculigoides* Lindl. Epiphytic orchid species are also very common in forests with *X. vietnamensis*. Most of these species commonly become established on older moss-covered branches of this tree, as well as on branches of other tree species. Among such species recorded are *Agrostophyllum callosum* Rehb. f., *Bulbophyllum hirtum* (J.E. Smith) Lindl., *B. reptans* (Lindl.) Lindl., *Ceratostylis himalaica* Hook. f., *Cleisostoma striatum* (Rehb. f.) Garay, *Coelogyne shultesii*, *Epigeneium amplum*, *E. chapaense* Gagnep., *Eria pannea* Lindl., *Luisia appressifolia*, *Monomeria barbata* Lindl., *Ornithochilus difformis* (Wall. ex Lindl.) Schltr., *Pholidota missionariorum*, *P. yunnanensis*, *Renanthera citrina* Aver., *R. coccinea* Lour., *Sunipia scariosa* Lindl., *Thelasis khasiana* Hook.f. and *Thrixspermum calceolus* (Lindl.) Rehb.f. Other common epiphytes with the canopies of *X. vietnamensis* are creeping tuberiferous vine species of *Vaccinium* (Ericaceae). It is remarkable that assemblages of numerous very rare and strictly endemic orchids represent an integral component of *X. vietnamensis* forests. Among such local orchid endemics are *Anoectochilus calcareus*, *Bulbophyllum purpurifolium*, *Cheirostylis bipunctata*, *Coelogyne lockii*, *C. malipoense*, *Dendrobium chittimae* Seidenf., *Holcoglossum wangii*, *Liparis averyanoviana*, *Luisia appressifolia*, *Pholidota missionariorum*, *P. yunnanensis*, *Paphiopedilum malipoense*, *P. micranthum*, *P. henryanum*, *Phaius longicruris*, *Renanthera citrina* and *Rhomboda petelotii*.

Extensive recent explorations of limestone mountain areas in Ha Giang Province outlined very limited distribution of *Xanthocypris vietnamensis*. Range of this species gives very bright example of extremely limited plant endemism of South-Eastern Asia. This unique relic tree presently inhabits isolated tops of limestone ridges on territory less than 25 km². During extensive field works of 2000–2002 years rare scattered individuals of *X. vietnamensis* were found only on 15–30% of studied limestone summits. Colonies of trees do not commonly exceed 3–4 samples on each mountain peak. On the base of our preliminary field studies and direct extrapolation of available data may be certainly state that total number of still existing mature trees of *X. vietnamensis* in all area of its present distribution may be less than 100 individuals. In most habitats immature, juvenile samples and seedlings were observed rare, that indicates very low level of the species reproduction in natural conditions.

Catastrophically fast rate of present day uncontrolled deforestation in the area of *Xanthocypris vietnamensis* distribution make survival of this unique relic tree in

the near future very bleak. Miserable pieces of pristine primary forests, which support populations of *X. vietnamensis* may be found presently just on tops of mountain ridges. According to our observations all remnant forest stands all over the area are still exploited for logging in our days without any limits. It is remarkable, that *X. vietnamensis* produces fine, light yellowish-brown, very hard, fragrant timber. The superb quality of the wood for construction has resulted in the selective harvest of a considerable portion of the largest and oldest individuals of this tree. On the other hand irreversible aridization of the habitats due to overall logging of large trees leads also to rapid extinction of juvenile and immature samples of *X. vietnamensis*, which needs shade and humidity of pristine wood for their normal growth. As a result, this outstanding endemic relic tree species, supporting with other rare tree associates unique plant communities, will certainly be driven to extinction over the coming years if current levels of exploration and deforestation continue. Meanwhile indigenous limestone forests of the northern Viet Nam in which *X. vietnamense* is an sporadic, but integral forest constituent are a world-wide treasure of a great and extraordinary biodiversity value. Without doubts the urgent protection of these forest areas represents an exceptionally high priority of global significance.

Field investigations of last years certainly outline *Xanthocyparis vietnamensis* as a very strict relic endemic of northern Viet Nam that stands presently on the verge of full extinction. Based on our preliminary observations, this species, without any doubts, deserves IUCN rating of Critically Endangered (CR) under criteria B2b-d according to present classification of IUCN Red List Categories Version 3.1 (IUCN Red List, 2001).

As a direct result of our preliminary inventory activities leading to the discovery and description of *Xanthocyparis vietnamensis*, the regional Administration of Ha Giang Province has designated the Bat Dai Son mountain range as a Provincial Protected Area. Such action is the first important step toward National protection of this plant and increased International attention for conservation of endemic indigenous limestone forests in the north of Viet Nam.

Studied material: Northern Viet Nam, Ha Giang Prov., Quan Ba Distr., Can Ti Municipality, vicinities of Sing Xuoi Ho village, 26.2 km to 002° of Ha Giang city. Primary closed evergreen mixed wet mossy forest (with *Xanthocyparis*, *Taxus*, *Nagea* and *Pseudotsuga*) along tops of karst remnant limestone ridge at elev. 1100–1150 m a.s.l. Tree 10–14 m hg. Common, usual co-dominant of 1 forest stratum. 12 Oct. 1999. *N.T. Hiep*, *N.Q. Binh*, *L.Averyanov*, *P. Cribb*, *NTH 3594* (HN); Viet Nam, Ha Giang Province, Quan Ba District, Mountain range to the South of Sin Suoi Ho school. Degraded forest along ridge, limestone exposed outcrops, at approximately 23°06'57"N, 105°01'48"E at 1100 m elevation. Occasional tree 10–15 m at ridge top. 3 April 2000. *D.K. Harder*, *N.T. Hiep*, *L.V. Averyanov*, *N.Q. Hieu*, *DKH 4977* (HN); Viet Nam, Ha Giang Province, Quan Ba District, Bat Dai Son Municipality, Bat Dai Son provincial protected area. Limestone ridge of degraded forest just north-west of Bat Dai Son Border Station 13°09'13"N, 104°59'36"E, 1064 m elevation. Tree, to 10 m, at ridge top, occasional. 10 February 2001. *D.K. Harder*, *N.T. Hiep*, *P.K. Loc*, *L.V. Averyanov*, *G.E. Schatz*, *S. Bodine*, *DKH 6090*, *DKH 6091* (holotype, HN; isotypes, K, MO, LE); Viet Nam, Ha Giang Province, Quan Ba District, Bat Dai Son provincial protected area.

Ridge just west of Bat Dai Son border station, limestone outcrops in disturbed secondary vegetation, 23°09'04"N, 104°59'53"E at 1183 m elevation. Tree to 10 m. 12 February 2001. *D.K. Harder, P.K. Loc, N.T. Hiep, L.V. Averyanov, DKH 6224* (HN, MO); Northern Viet Nam, Ha Giang Prov., Quan Ba Distr., Can Ty Municipality, in the vicinity of Sin Suoi Ho village at right side of Mien River, around point 23°07'12"N, 105°00'52"E. Primary coniferous forest with *Pseudotsuga brevifolia* remnant highly eroded limestone ridge at elev. 1000–1200 m a.s.l. Tree 10–15 m hg up to 35 cm in diam. Occasional component of secondary forest stratum. Occasional. 7 May 2002. *P.K. Loc, L. Averyanov, N.T. Vinh, HAL 1430* (HN); Northern Viet Nam, Ha Giang Prov., Quan Ba Distr., Thanh Van Municipality, in the vicinity of Lung Cung village, around 1 km to the E from point 23°05'32"N, 105°00'10"E. Primary coniferous forest with *Pseudotsuga brevifolia* on remnant highly eroded limestone ridge at elev. 1100–1200 m a.s.l. Tree 10–15 m hg. Rare component of second forest stratum. Rare. 9 May 2002. *P.K. Loc, L. Averyanov, N.T. Vinh, HAL 1491* (HN); Northern Viet Nam, Ha Giang Prov., Quan Ba Distr., Thanh Van Municipality, in the vicinity of Lung Cung village, around 1 km to the E from point 23°05'32"N, 105°00'10"E. Primary coniferous forest with *Pseudotsuga brevifolia* on remnant highly eroded limestone ridge at elev. 1100–1200 m a.s.l. Tree 10–15 m hg. Rare component of second forest stratum. Rare. 9 May 2002. *P.K. Loc, L. Averyanov, N.T. Vinh, HAL 1499* (HN).

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РЕЗЮМЕ

В публикации кратко описывается история открытия, растительные сообщества и условия обитания *Xanthocyparis vietnamensis* (Cupressaceae) – узколокального эндемика останцовых известняковых гор провинции Хазянг, расположенной на севере Вьетнама около границы с Китаем. На основании предварительного исследования установлено, что вид находится на грани полного вымирания и нуждается в организации немедленной эффективной охраны.

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