

The Status of Wild and Cultivated Populations of *Cupressus tonkinensis* Silba in Vietnam

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ABSTRACT

Cupressus tonkinensis Silba is a critically endangered conifer species in northern Vietnam, where there is only one wild population with 25 small individuals within a small area of Cai Kinh massif. The total count of cultivated trees is 84 individuals : 58 trees in Huu Lien commune, Huu Lung district; 16 trees in Yen Think commune, Huu Lung district and 10 trees in Van Linh commune, Chi Lang district. The height and diameter of each individual in both populations were measured. One year observations made on 51 individuals in Huu Lien plantings was recorded.

Key words: *Cupressus tonkinensis*, conifer, conservation, endangered species, Vietnam.

Cupressus tonkinensis Silba is a local endemic, restricted to Cai Kinh limestone massif located between 22°16' – 22°31' North latitude and 105°22' – 105°29' East longitude in Huu Lung district, Lang Son province, northern Vietnam. The limestone massif has a total area of about 42,000 hectares and elevation not exceeding 700 m asl (Fig. 2.a). The climate in this area is monsoonal with mild winters and summer rains, average annual temperature is 22-23°C, with three cooler months of winter (monthly average temperature less than 17°C), and total annual rainfall of about 1400-1500 mm (Averyanov *et al.*, 2003). The original forest cover has been described as evergreen broad-leaf closed forest with four forest strata and canopy cover of 80-100%. Today the primary forest of the massif is replaced by grassland, shrub and secondary forest.

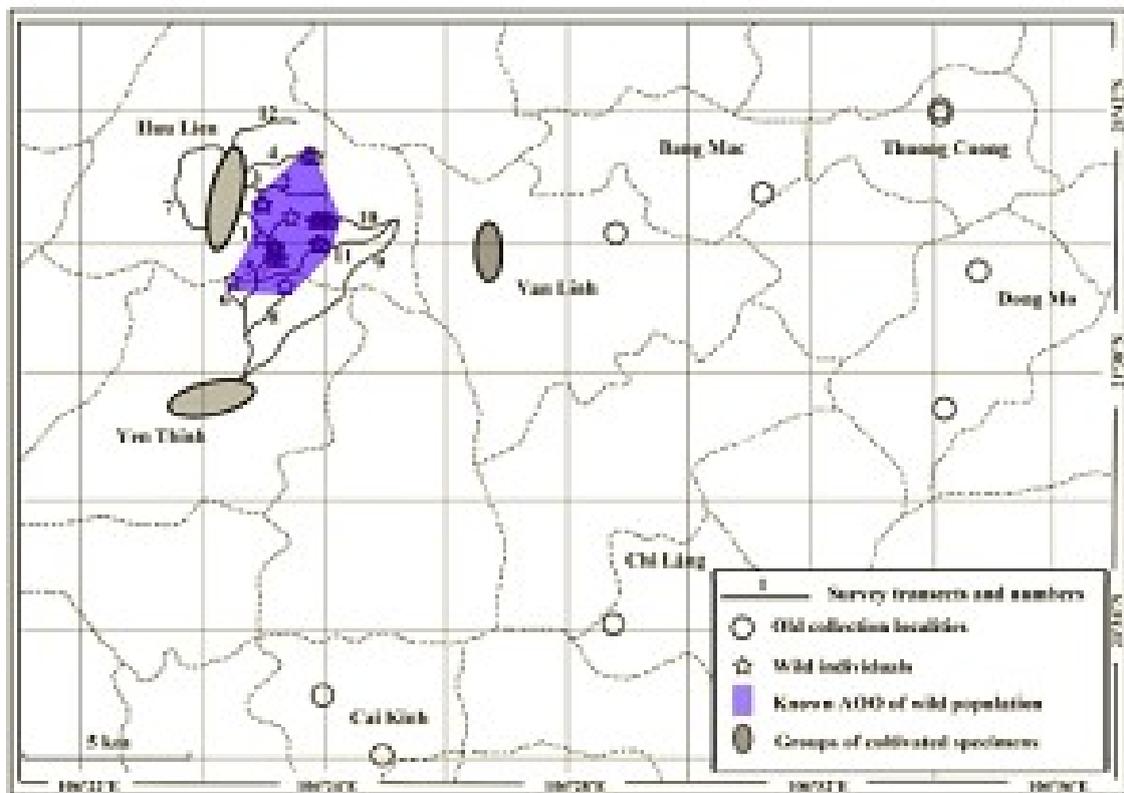
Although *Cupressus tonkinensis* is not currently placed on the IUCN Red List, due to its confused taxonomic identity (Silba, 1994), it is clear that the species is Critically Endangered since its extent of occurrence is 204 km² and the area of occupancy is 8 km² (D. Little *et al.*, 2011). The species is recognised for having highly significant scientific, economic, and conservation values. The commercial exploitation of this species during the last century led to its near extinction, with less than 50 small individuals remaining in the wild and few cultivated in local private gardens (Nguyen Tien Hiep *et al.*, 2011). This paper focuses on the status of the wild and cultivated populations of *Cupressus tonkinensis* in Vietnam.

Material and Methods

From 2008 to 2009, eight field surveys and inventories were conducted to assess the conservation status of wild and cultivated populations of *Cupressus tonkinensis* in Huu Lien Nature Reserve, Lang Son province, northern Vietnam. Twelve transects were established at elevations between 200 m and 464 m asl. Voucher specimens were collected and stored in the herbarium (HN) of the Institute of Ecology and Biological Resources in Hanoi.

Results and Discussion

Natural population : there is only one wild population with 25 small individuals recorded within a small area at Cai Kinh massif in Huu Lien Natural Reserve (Appendix 1; Fig. 1.; Fig. 2.b). The height of trees ranges from 0.3 m (No. H_HL 20) to 3.5 m (No. H_HL 04 – Fig. 1.g), the average height is 1.2 m. The largest tree (No. H_YT 04) with 1.5 m height and 15 cm diameter near ground line (DNG) was cut by local people for commercial exploitation (Fig. 1.a,b). The diameter near ground level (DNG) ranges from 1.0 to 15 cm; the average DNG is 4.1 cm. Only six trees are bearing seed cones (No. H_HL 10, 13, 14, 15; H_YT 04, 05) (Fig. 1.c,d,f). The wild population represents remnant trees that escaped destruction because of their being located on steep cliffs, and for being too small for commercial exploitation (Fig. 1.). In natural conditions, the trees grow very slowly because of depauperate soil. There are no large trees or regenerated trees. It is estimated that they are more than ten years old and are threatened by wildfire and human disturbance. The area of occupancy (AOO) of the population is 5.7 km² (see Map 1).



Map 1 : The distribution of *Cupressus tonkinensis* in the past and present at Cai Kinh massif.

Cultivated population : *Cupressus tonkinensis* exists in cultivation around Cai Kinh massif (Map 1) with three groups and 84 individuals in total. The biggest group is located in Huu Lien commune with a total 58 individuals (Appendix 2; Fig. 2.c). Planted during 1992 – 2000, their heights range from 1.6 m (No. T_HL 35) to 9 m (No. T_HL 11); the average height is 5.4 m. The DNG ranges from 3 cm (No. T_HL 05) to 21.2 cm (No. T_HL 02); the average DNG is 10.4 cm. Nine trees bear seed cones (No. T_HL 02, 18, 19, 23, 24, 27, 28, 29, 33).



Fig.1 : Wild population of *Cupressus tonkinensis* : **a, b** (H_YT04) – A big tree has just been cut by local people ; **c** (H_HL14), **d** (H_HL10) – Trees bearing seed cones ; **e** (H_YT08) – One of the best wild tree ; **f** – Seed cones ; **g** (H_HL04) – Trunk of the highest tree. (All photos by Pham Van The)



Fig.2 : Habitat and conservation of *Cupressus tonkinensis*: **a** – Natural habitat in Cai Kinh limestone massif ; **b** (H_Y107) – A small wild tree ; **c** – Cultivated tree in a private garden with many seed cones ; **d** – Propagation by cuttings ; **e** – Small tree grown from a cutting ; **f** – Seedlings with two cotyledons. (All photos by Pham Van The)

The second group located in Yen Think commune has 16 individuals (Appendix 3). Planted during 1990 – 2002, their heights range from 3 m (No. T_YT 05, 11) to 7 m (No. T_YT 01, 02, 10, 13); the average height is 5.2 m. The DNG ranges from 6 cm (No. T_YT 11) to 20 cm (No. T_YT 01, 10); the average DNG is 11.1 cm. Five trees bear seed cones (No. T_YT 02, 03, 05, 06, 09).

The third group located in Van Linh commune has 10 individuals (Appendix 4). Planted during 1995 – 2007, their heights range from 4 m (No. T_VL 05) to 10 m (No. T_VL 06, 07, 08); the average height is 7.5 m. The DNG ranges from 6 cm (No. T_VL 05, 10) to 23 cm (No. T_VL 06); the average DNG is 15.1 cm. Six trees bear seed cones (No. T_VL 01, 02, 03, 04, 06, 07).

One year observation of the status of trees in cultivation in Huu Lien commune : Observations made from December 2008 to November 2009 on 51 individuals at Huu Lien commune showed increase of DNG from 0 cm (T_HL 10) to 4.8 cm (T_HL 23), with average of 0.9 cm. The increase in height ranged from 0 m (T_HL 10) and 0.9 m (T_HL 12), with average of 0.3 m (Chart 1). Many trees are tall but they did not have cones because they have not yet reached maturity. The results showed that the species thrives better in cultivation than in the wild.

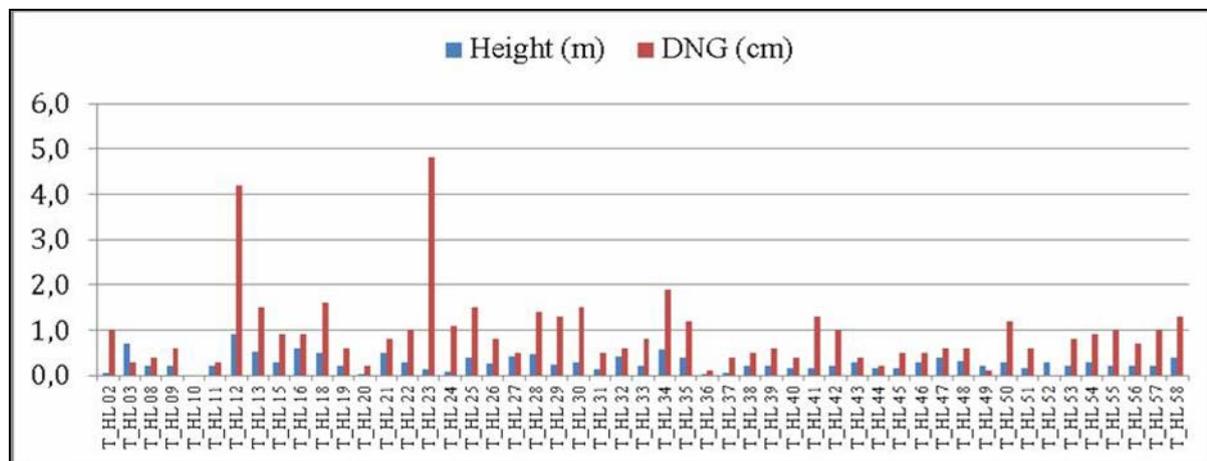


Chart 1: The growth condition of *Cupressus tonkinensis* at Huu Lien cultivated group (December 2008 – November 2009)

Propagation : Recent scientific studies by botanists in Hanoi and subsequent authors in this paper have verified that *Cupressus tonkinensis* has a very low percentage of viable seeds. Like *Cupressus dupreziana* A.Camus of Algeria, this is probably due to the low number of individual trees in the wild populations, and the low probability of cross-pollination of individual trees. The cultivated trees of *Cupressus tonkinensis* in Huu Lung also produce cones with seeds having a very low germination rate (Fig. 2.c). Like other Asiatic *Cupressus* species, germination trials of *Cupressus tonkinensis* in Hanoi have indicated that this species has only two cotyledons in its seedlings (Fig. 2.f). *Cupressus tonkinensis* is currently cultivated in the United Kingdom, from botanist Keith Rushforth's collections (herbarium vouchers at Edinburgh-E). Keith Rushforth made two collections from Huu Lung, as KR-7317, and KR-7325. There are living plants of K.Rushforth at Tregrehan Gardens in Cornwall, England. Recently, researchers at Atlanta Botanical Garden in Georgia (USA) have attempted to root cuttings from the Rushforth collections in England, however these early attempts were not successful because the cuttings were taken during the winter. It seems that *Cupressus* cuttings root better during the summer ; hence more attempts by researchers at Atlanta Botanic Garden to propagate the Rushforth collections in England are planned for the near future. In addition, the Center for Plant Conservation (Vietnam) produced 130 individuals from cuttings during the years 2009-2011 (Fig. 2.d,e). Almost all of them now are growing very well (Nguyen Tien Hiep *et al.*, 2011).

Conclusion

In Vietnam, there is only one wild population with 25 small individuals found in a small area at Cai Kinh massif in Huu Lien Natural Reserve, Lang Son province, northern Vietnam. Only six trees bear seed cones. The remaining population has very poor regeneration and is always threatened by forest fire and human disturbance. The area of occupancy of the population is 5.7 km².

Cupressus tonkinensis exists in cultivation within the Cai Kinh massif with a total 84 individuals. The plantings are located in Huu Lien commune with 58 individuals, in Yen Thinh commune with 16 individuals, and in Van Linh commune with 10 individuals.

One year observations made on 51 individuals in Huu Lien plantings recorded increases of DNG from 0 cm to 4.8 cm; the average is 0.9 cm. Height increases ranged from 0 m to 0.9 m; the average is 0.3 m. The species appear to grow better in cultivation than in the wild.

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Appendix 1 to 4 :

Appendix 1. Status and distribution of *Cupressus tonkinensis* trees found in the wild.

No.	Height (m)	DNG (cm)	Lat. (N)	Lon. (E)	Elev. (m)						
H_HL 01	1	4	21°40'20"	106°23'27"	442	H_HL 16	1,5	4	21°40'17"	106°23'51"	379
H_HL 02	1	3	21°40'00"	106°23'06"	420	H_HL 17	1	3	21°40'17"	106°23'51"	379
H_HL 04	3,5	10	21°40'34"	106°22'57"	320	H_HL 18	0,5	2	21°39'59"	106°23'52"	300
H_HL 05	2,5	10	21°40'34"	106°22'57"	320	H_HL 19	0,5	2	21°39'59"	106°23'52"	300
H_HL 06	1	2	21°41'19"	106°23'44"	464	H_HL 20	0,3	1	21°39'59"	106°23'52"	300
H_HL 07	0,7	2	21°41'19"	106°23'44"	464	H_YT 01	1	4	21°39'46"	106°23'09"	306
H_HL 09	1,5	3	21°41'16"	106°23'06"	437	H_YT 02	0,5	2	21°39'46"	106°23'09"	306
H_HL 10	1,5	3	21°41'16"	106°23'06"	437	H_YT 03	0,4	2	21°39'46"	106°23'09"	306
H_HL 12	0,5	2	21°40'17"	106°23'51"	379	H_YT 04	1,5	15	21°39'46"	106°23'09"	306
H_HL 13	1	2	21°40'17"	106°23'51"	379	H_YT 05	1	5	21°39'46"	106°23'09"	306
H_HL 14	3	7	21°40'17"	106°23'51"	379	H_YT 06	0,7	2	21°39'46"	106°23'09"	306
H_HL 15	2	5	21°40'17"	106°23'51"	379	H_YT 07	0,7	3	21°39'25"	106°22'29"	333
						H_YT 08	1,5	4	21°39'20"	106°23'21"	406

Note: Boldfaced text indicates cone-bearing tree.

Appendix 2. Status of *C. tonkinensis* trees in cultivation in Huu Lien commune in 2008.

No.	Owner	Village	Height (m)	DNG (cm)	Year cultivated						
T_HL 01	Hoang Quoc Toan	Tan Lai	3,0	8,0	1995	T_HL 29	Hoang Van Quynh	Tan Lai	4,7	15,9	"
T_HL 02	Hoang Van Chiem	Coc	8,3	21,2	1992	T_HL 30	Hoang Van Quynh	"	4,9	15,9	"
T_HL 03	Nguyen Van The	Ao Bai	3,7	6,7	2000	T_HL 31	Hoang Van Dam	Lien Hop	3,1	8,3	"
T_HL 04	Vi Van Tiep	Lien Hop	3,0	4,0	1995	T_HL 32	Nguyen Van Khanh	Ao Bai	4,9	8,9	"
T_HL 05	"	"	2,0	3,0	1997	T_HL 33	Huu Lien NR	Lien Hop	6,6	9,9	"
T_HL 06	Hoang Van Mien	"	5,0	7,0	"	T_HL 34	Nong Van Yem	Ao Bai	3,0	5,1	1998
T_HL 07	"	"	3,0	8,0	"	T_HL 35	"	"	1,6	3,2	"
T_HL 08	Huu Lien NR	"	5,0	9,7	1994	T_HL 36	Huu Lien NR	Lien Hop	7,2	11,3	1994
T_HL 09	"	"	6,2	13,1	"	T_HL 37	"	"	5,1	16,6	"
T_HL 10	"	"	2,0	4,6	"	T_HL 38	"	"	6,5	6,1	"
T_HL 11	"	"	9,0	19,7	"	T_HL 39	"	"	4,0	6,7	"
T_HL 12	"	"	4,0	9,6	"	T_HL 40	"	"	8,2	11,1	"
T_HL 13	Hoang Van Dam	"	4,6	8,6	1998	T_HL 41	"	"	8,4	18,2	"
T_HL 14	Vi Van Sao	Ben	4,0	11,0	1994	T_HL 42	"	"	7,0	11,1	"
T_HL 15	Vi Van De	Lien Hop	4,0	7,0	"	T_HL 43	"	"	7,2	12,1	"
T_HL 16	"	"	3,2	7,0	"	T_HL 44	"	"	6,2	14,6	"
T_HL 17	Nguyen Van Tuyen	Ao Bai	4,0	7,0	"	T_HL 45	"	"	8,2	16,6	"
T_HL 18	Nguyen Van Khuong	"	5,6	10,8	"	T_HL 46	"	"	7,5	8,6	"
T_HL 19	Nguyen Van Hoa	"	6,9	15,9	"	T_HL 47	"	"	7,3	11,1	"
T_HL 20	Nguyen Van Luyen	"	3,4	5,1	2000	T_HL 48	"	"	2,9	5,7	"
T_HL 21	"	"	7,2	18,8	1994	T_HL 49	"	"	4,7	6,1	"
T_HL 22	"	"	6,2	11,8	"	T_HL 50	"	"	8,3	17,8	"
T_HL 23	Hoang Van Phan	"	6,7	15,0	"	T_HL 51	"	"	6,8	11,8	"
T_HL 24	Hoang Minh	"	6,4	13,9	"	T_HL 52	"	"	7,8	11,8	"
T_HL 25	Hoang Minh Luat	Tan Lai	6,7	11,1	"	T_HL 53	"	"	2,8	4,8	"
T_HL 26	"	"	2,8	6,4	"	T_HL 54	"	"	6,9	10,0	"
T_HL 27	Hoang Trong Xa	Cuom	6,1	12,4	1998	T_HL 55	"	"	5,0	8,0	"
T_HL 28	"	"	4,4	10,2	1994	T_HL 56	"	"	7,0	9,9	"
						T_HL 57	"	"	6,0	8,6	"
						T_HL 58	"	"	5,9	10,2	"

Note: Boldfaced text indicates cone-bearing tree.

Appendix 3. Status of *C. tonkinensis* trees in cultivation in Yen Thinh commune in 2008.

No.	Owner	Village	DNG (cm)	Height (m)	Year cultivated						
T_YT 01	Mai Thi Hanh	Mam	20	7	1997	T_YT 08	Le Van Con	Lang	7	5	1994
T_YT 02	Le Van Dat	"	18	7	1990	T_YT 09	Le Van Bay	"	16	5	1996
T_YT 03	Dinh Van Can	"	10	6	"	T_YT 10	Ngo Van Truong	"	20	7	1990
T_YT 04	Ngo Tien Quy	Coong	10	6	"	T_YT 11	Le Van Tua	Ang	6	3	2002
T_YT 05	Ngo Tien Quy	"	7	6	"	T_YT 12	Ngo Van Luc	Coong	8	4	1994
T_YT 06	Phan Huu Le	"	8	3	1994	T_YT 13	"	"	14	7	"
T_YT 07	Phan Van Nhung	"	8	4	1996	T_YT 14	"	"	9	5	"
						T_YT 15	Ngo Tuan Lien	Mam	8	4	1995
						T_YT 16	Ngo Van Trong	"	8	4	1993

Note: Boldfaced text indicates cone-bearing tree.

Appendix 4. Status of *C. tonkinensis* trees in cultivation in Van Linh commune in 2008.

No.	Owner	Village	DNG (cm)	Height (m)	Year cultivated						
T_VL 01	Luong Thi Khuya	Mo Cay	22	9	"	T_VL 05	Hoang Van Dung	"	6	4	2007
T_VL 02	Hoang Thi Luoc	"	13	5	"	T_VL 06	Ho Van Thoi	"	23	10	1995
T_VL 03	Lam Van Si	Lang Dam	10	5	"	T_VL 07	Linh Van Thuong	"	14	10	"
T_VL 04	Trieu Van Thanh	Lung Na	22	9	"	T_VL 08	Lang Van Son	Lung Tan	17	10	"
						T_VL 10	Ho Van Vinh	"	6	4	2002
						T_VL 11	Ho Van Su	Xa Dan	18	9	1995

Note: Boldfaced text indicates cone-bearing tree.