

STUDY OF A LOW-ELEVATION OCCURRENCE  
OF *PINUS DALATENSIS* FERRÉ (PINACEAE)  
IN GIA LAI PROVINCE, VIETNAM

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A low-elevation primary mixed forest stand with old-growth trees of *Pinus dalatensis*, a conservationally important conifer species of Vietnam, was studied during field documentation of conifers of the region conducted for the Dendrological Atlas Project. The site was visited following recent reports of a new occurrence of this species in Gia Lai province. Following a preliminary exploration in January 2004 in cooperation with the Department of Botany, Institute of Ecology and Biological Resources (Hanoi) and the Department of Ecology, Da Lat University (Lam Dong) field documentation was conducted in the Dak Doa district. The forest stand with mature trees of *P. dalatensis* at 1,070–1,100 m is among the lowest occurrences of the species. The survey included observations on the habitat conditions, documenting the major associated species for our herbaria, and examination of the morphology of the pine specimens.

Key words: Gia Lai province, Kon Jot forest, pine distribution, *Pinus dalatensis*, threatened conifer, Vietnam

## INTRODUCTION

Species and habitat documentation of *Pinus dalatensis* Ferré in Vietnam has been part of a series of expeditions for the Dendrological Documentation Project and its publications, the *Dendrological Atlas*, Vols I–IV (in preparation) and *Conifers Around the World* (DEBRECZY and RÁCZ 2007). Most major species of temperate conifers in Vietnam have been documented, including *Abies fansipanensis* Q. P. Xiang, L. K. Fu, et Nan Li, *Keteleeria rouletii* (A. Chev.) Flous, *Pinus kesiya* Royle, *P. krempfii* Lecomte, and *Xanthocyparis vietnamensis* Farjon et Hiep.

*Pinus dalatensis* was described by FERRÉ (1960) based on specimens collected at Trai Mat, 6 km from Dalat in Lam Dong province, Vietnam. The species has a fragmented distribution with isolated populations in mainly

montane habitats covered by subtropical evergreen forests. *P. dalatensis* drew the attention of researchers because it is among the threatened species of the Vietnam flora that occur in remnant primary forests, often affected by uncontrolled selective logging and loss of surrounding natural habitats. This is exemplified by the fact that at the type locality in the year 2000 only one tree of *P. dalatensis* remained of the five trees recorded in 1984 (NGHIA 2000).

Until recently, the species was regarded as one of the endemic trees of Vietnam, although several references noted the possibility of its occurrence in the mountain ranges extending into Laos (RUNDEL 1999, WU and RAVEN 1999, BUSINSKY 1999, LUU and THOMAS 2004). Its presence in Laos was confirmed in 2006 by the discovery of a population with over 200 trees occurring between 800–1,100 m in the Nakai Nam Theun conservation area (THOMAS *et al.* 2007). This new locality represents a significant extension of the northernmost limit of the species.

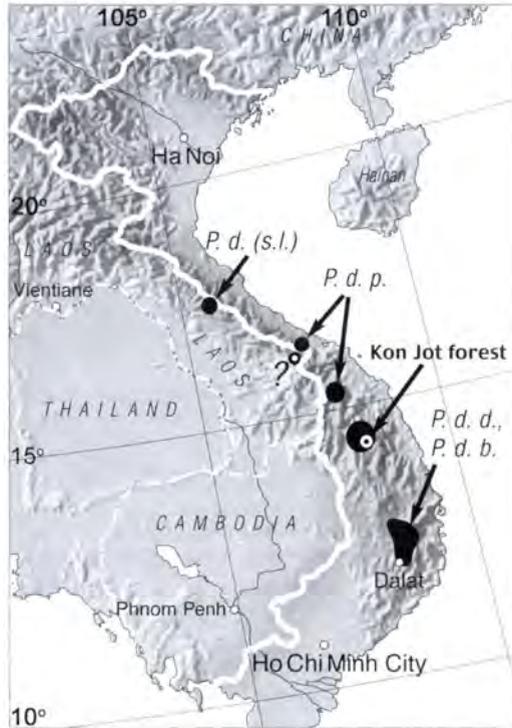
In Vietnam, the *Checklist of the plant species of Vietnam* (LOC 2001) recorded *P. dalatensis* from Kon Tum, Dak Lak, Lam Dong, Khanh Hoa and Ninh Thuan provinces. More recent reviews of the conifer flora report additional occurrences in Gia Lai and Thua Thien-Hue provinces, but without giving further details (LUU and THOMAS 2004, NGUYEN *et al.* 2004). In his account of the distribution and morphology of the species, BUSINSKY (1999) also refers to a number of possible occurrences of *P. dalatensis* in the above provinces. A locality in the Mang Giang Forest Enterprise area of Gia Lai is also mentioned in an overview of the threatened trees of Vietnam (NGHIA 2000). Its isolation (see Fig. 1) from other known locations made it a suitable subject for our investigations.

The altitudinal range of *Pinus dalatensis* in NGUYEN and VIDAL (1996) was given as 1,500–2,400 m, in the *Checklist of the plant species of Vietnam* (LOC 2001) as 1,400–2,600 m and in LUU and THOMAS (2004) as (1,400–) 1,500–2,200 (–2,400) m. BUSINSKY (1999) refers to the location of *P. dalatensis* var. *dalatensis* near the city of Da Lat (1,470 m) as the lowest known occurrence. Based on the general descriptions and location data given by Businsky, and the localities of all of the specimens cited in his work, the species' altitudinal range in Vietnam appears to be as follows:

- *Pinus dalatensis* subsp. *dalatensis* var. *dalatensis* – 1,470 to 2,442 m,
- *Pinus dalatensis* subsp. *dalatensis* var. *bidoupensis* – 1,800 to 1,895 m,

– *Pinus dalatensis* subsp. *procera* – 1,720 to 2,250 m.

As described below, the lowest known occurrence of the species in Vietnam is in the Kon Jot forest, vicinity of Pleiku, part of the Kondzatrám mountain range in the middle part of the Annam Highlands.



**Fig. 1.** The presently known (combined) range of *P. dalatensis* (black) with the Kon Jot occurrence, based on BUSINSKY (1999), LUU and THOMAS (2004), NGUYEN *et al.* (2004) and THOMAS *et al.* (2007). *P. d. d.* = *Pinus dalatensis* (var./subsp. *dalatensis*), *P. d. b.* = *P. dalatensis* var. *bidoupensis*, and *P. d. p.* = *P. dalatensis* subsp. *procera* (*P. d. s. l.*: subspecific status not specified in THOMAS *et al.* 2007). The location with “?” remains unverified.

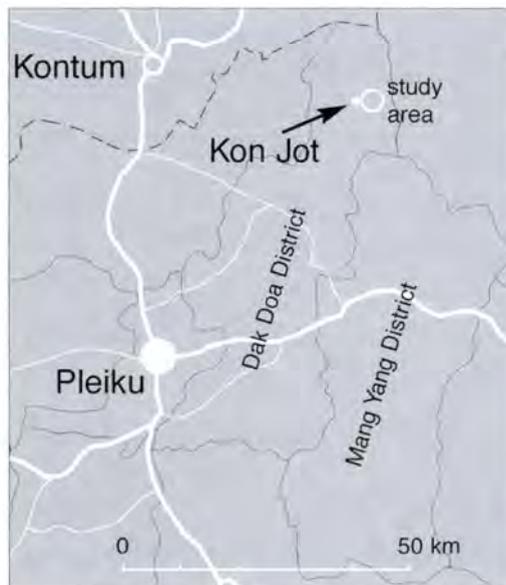
The morphology and taxonomy of *Pinus dalatensis* have been discussed, even if briefly, in several works (FIPI 1996, NGHIA 2000, NGUYEN *et al.* 2004). Only BUSINSKY (1999) made a detailed morphological account of *P. dalatensis* and established a new subspecies and a new variety. His taxonomy was based on thorough field investigation but left open some questions, *i.e.* the exact distribution of his subspecific taxa. FARJON (2005)

discussed Businsky's treatment and commented that the "*discriminating characters are largely continuous and overlapping, but it seems probable that some of the variation is sufficiently consistent within the disjunct populations to merit recognition as varieties*". This also highlights the need for further studies of the distribution and morphology of the species in the broad sense.

*Pinus dalatensis* is usually treated as a separate species, although SILBA (1986) proposed its transfer under *P. wallichiana* A. B. Jackson at varietal level, a taxonomy usually not followed by others.

### HABITAT CONDITIONS AROUND KON JOT, DAK DOA DISTRICT

Kon Jot village in Dak Doa district lies approximately 50 km in a straight line north-northeast of Pleiku, at 740 m elevation,  $14^{\circ} 16.195' N$ ,  $108^{\circ} 14.816' E$  (Fig. 2). The climate has a peculiar weather pattern with a relatively dry and hot period of approximately the half-year from November to April/May, and a wet, humid, and less hot period during the rest of the year.



**Fig. 2.** The study area showing the location of Pleiku and Kon Jot.

The yearly rainfall is 1,800–2,000 mm, the average temperature is about 22 °C, and the absolute minimum and maximum temperature is 7 °C and 37 °C, respectively (*pers. comm.*, Prof. Chinh N. D. of Da Lat University). During our visit in March 2004 the weather was hazy but very dry and quite hot with daily maximums of 34–35 °C.

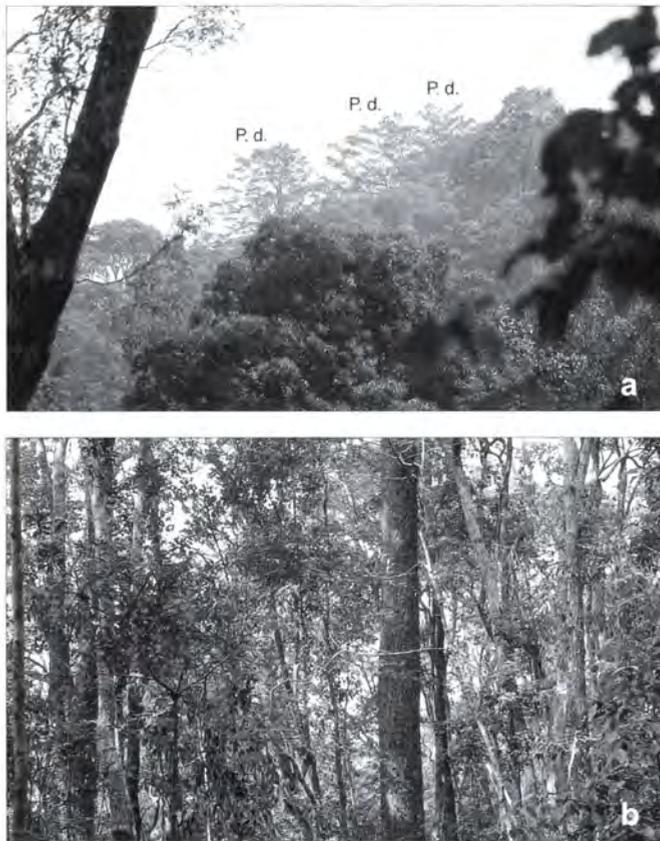
Around Kon Jot village, which consists of just a few simple houses, most of the forest has recently been cleared and construction of new logging roads has started; limited agriculture continues on cleared land, including coffee plantations under remaining trees or second-growth. However, the primary forest with *P. dalatensis*, which lies 1 km in a straight line east to south from the village and about 200 m higher (and possibly farther up), is strictly protected, thus logging here is not permitted.

A few trees of *P. dalatensis* can be easily seen on nearby ridges (Fig. 3a); they have flat or roundish crowns overtopping the forest canopy of broad-leaved trees. At around 1,050 m the first fallen cones of *P. dalatensis* were noticed lying on the ground. Scattered large (36–38 m) trees of the pine were observed on a flat ridge covered by rich tropical evergreen forest reaching a canopy height of 30–35 m (Fig. 3b). In a small clearing a massive tree – about 40 m tall, close to 30 m across, and a trunk 410 cm in circumference at breast height – was documented (Fig. 4a, b). Further up, at 1,100 m, a small grove of *P. dalatensis*, consisting of a few relatively young, and 6 old trees were surveyed. Several seedlings were seen only along the path and in some more open areas, but no saplings or young trees smaller than 12 m were observed.

The upper canopy of the mixed primary forest is dominated by *Rhodoleia championii* (50% coverage) and *Schima crenata* (50%) with scattered trees of very old *Pinus dalatensis* (20%) emerging from the upper canopy of the broad-leaved trees. Smaller trees of this plant community include *Lithocarpus dinhensis*, *Litsea* cf. *monopetala*, *Memecylon acuminatum*, and *Michelia* sp. The dense lower tree and upper shrub layers are dominated by young plants of the above species (except the pine), and various other species including *Acacia* sp., *Ardisia* sp., *Euodia leptota*, *Eurya* sp., *Eurycoma longifolia* subsp. *longifolia*, *Garcinia gaudichaudii*, *Ixora coccinea*, *Mallotus apelta*, *Oldenlandia* sp., *Syzygium* sp., and two palms (*Daemonorops* sp., *Pinanga* sp.). Large specimens of the fern *Cibotium barometz* were found scattered in the forest, along with two species of *Smilax* and *Dianella ensifolia* and *Thysanolaena maxima*.

The only other gymnosperm found nearby (within 100 m distance of the stand described above) was *Podocarpus neriifolius* D. Don (~10 m by 15 cm DBH).

Although the local forestry authorities have done some inventory work in the area, no plant recording or thorough vegetation survey has been conducted to identify the species and the forest composition. The determination of a number of specimens collected for our herbaria that represent other associated species is in progress.



**Fig. 3. a.** View of the ridge above Kon Jot village with very old trees of *Pinus dalatensis* (P. d.) emerging from the forest canopy. – **b.** Forest interior of the same stand with a mature trunk of *P. dalatensis* (90 cm DBH).



Fig. 4. a. The crown of the largest tree of *Pinus dalatensis* documented in the Kon Jot forest (~40 m by 410 cm GBH). – b. The lower trunk of the above tree.

#### MORPHOLOGY OF *PINUS DALATENSIS* IN THE KON JOT AREA

The morphological characters of the Kon Jot population were considered in comparison with the subspecific/variety categories established by BUSINSKY (1999). The trees observed by us were 12 to 38–40 m high with trunk diameters from 25 to almost 140 cm (DBH), mostly having straight clean trunks often divided into several main stems from the middle of the crown, and eventually forming a wide-spreading rounded crown. Bark of the younger trees is rather smooth but was shedding in thin, reddish-grey plates; bark on the mature old trees is dark reddish-grey, detaching in small, irregular, flat plates. In this population the branchlets are glabrous with the exception of collection #69270. This collection was a mature coning tree with ovuliferous and pollen cones just at time of pollen shedding; in this specimen the young branchlets are sparsely grey pubescent but the previous-year branchlet glabrous. The branchlets in all specimens were more or

less initially pruinose, later greenish or reddish-grey, becoming grey in subsequent years. (As shown by BUSINSKY (1999), the first-year shoots are sparsely, unevenly or densely pubescent in *P. d.* var. *dalatensis*, totally glabrous in var. *bidoupensis*, and mostly densely pubescent in subsp. *procera*). Needles in the Kon Jot area are 4.5–10.5 cm, light green abaxially, silvery-white adaxially. Cones are 6–14.5 cm, with stalks up to 2.5 cm, conical to conical-cylindrical, with convex scales; mature open cones are in various shades of yellowish- or reddish-brown, weathering to brownish-grey or light grey; umbos are blunt. Seeds are 4–6 mm, long-winged (2–3 cm). Cone variation is illustrated in Figure 5.

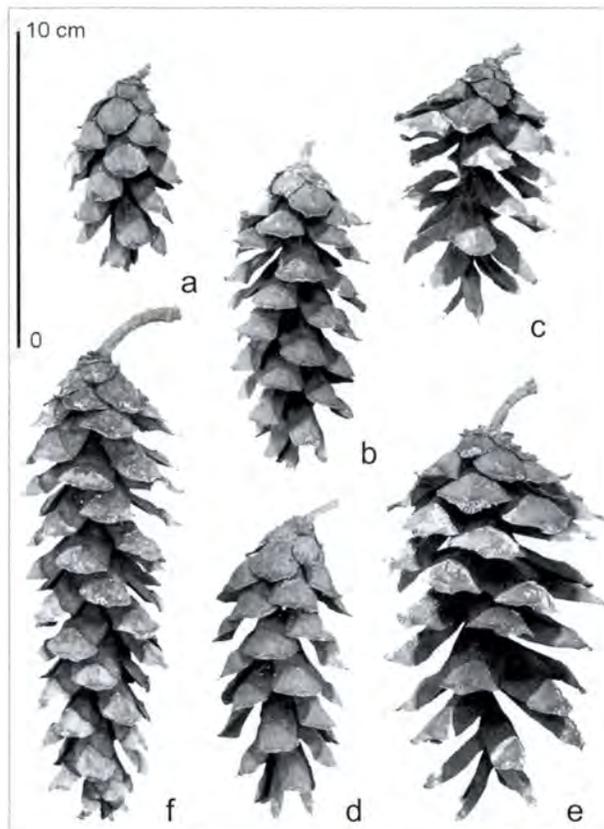


Fig. 5. Cone variation based on specimens collected from under six mature trees of *P. dalatensis* (a–e: #69224×, f: #69176).

## CONCLUSIONS

The locality at Kon Jot represents one of the lowest occurrences of *Pinus dalatensis* and is an addition to the presently known distribution of the species. Figure 2 is a modified range map combining that of BUSINSKY (1999), LUU and THOMAS (2004), the Kon Jot forest, and the sites in Laos discussed in THOMAS *et al.* (2007).

Since there are unconfirmed occurrences of the species at even lower elevations over the larger area in the Dak Doa district (Gia Lai province), further investigation needs to be done to identify possible additions to the range of the species.

Based on morphological characters, the trees of *Pinus dalatensis* observed above Kon Jot may be assigned to both the type variety (subspecies) and var. *bidouensis*. The leaves and cones on average are relatively short, and fall within the range of var. *dalatensis*. The mostly glabrous and initially pruinose branchlet refers the specimens to var. *bidouensis*. Interestingly, one tree here (documented under #69176) having cylindrical closed cones (without stalk) up to 14 by 3 cm (a length-width ratio close to 5) shows resemblance to the cones of Businsky's subsp. *procera*. BUSINSKY (1999) himself refers to variation within populations in the entire range of the species. The characters of the 6 trees documented in this study most closely fit with Businsky's description of *Pinus dalatensis* var. *bidouensis*. However, it would be premature to state that the whole population represents this variety. Further study of the Kon Jot forest is highly recommended in order to assess the full extent of this population and clarify its taxonomic position.

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