

*Cupressus pygmaea* (Lemmon) Sargent 1901***Cupressus pygmaea* is a valid species**

In 1895 Lemmon described a new taxon from Mendocino County, and recognising its affinity with *Cupressus goveniana* Gordon (1849), but with enough differences to separate it from the later, he described it as a variety *Cupressus goveniana* var. *pygmaea*<sup>1</sup>. Six years later, considering the tiny black seeds and that

the isolation of the region which it inhabits remote from that occupied by other Species make it possible and convenient to separate this northern tree from the *Cupressus Goveniana* of central and southern California,

Sargent (1901) raised this taxon to specific rank as *Cupressus pygmaea*<sup>2</sup>. C.B.Wolf (1948) acknowledged this view and stressed the fact that it is necessary and possible to look for distinct characters not visible on dry herbarium material.

E.Little (1953) chose to reduce several new world *Cupressus* species to synonymy. *Cupressus pygmaea*, *Cupressus abramsiana* Wolf and *Cupressus sargentii* Jepson were simply merged into *Cupressus goveniana*<sup>3</sup> and given as synonyms. In 1970, he revised his opinion of systematic synonymisation, but did not choose to return them back to species rank. He reduced the different *Cupressus* species to varietal rank, four as *Cupressus arizonica* Greene varieties, two as *Cupressus goveniana* varieties, one as a variety of *Cupressus guadalupensis* Watson, and finally admitting *Cupressus sargentii* as a valid species. Despite Wolf, and arguing about the fact that this author gave hint that these new combinations could be acceptable, he justified his choice almost exclusively by very broad morphological considerations. It is to be noted that, except for *Cupressus pygmaea*, all the other taxa were first described by their respective authors at specific rank. Insufficient observations, of seeds for instance, failed to understand that *Cupressus abramsiana* is closer to *Cupressus sargentii* than to *Cupressus goveniana*.

Since that time various authors have followed either Wolf or E.Little without giving much further support to their choice ; their arguments are limited to a few disputable morphological characters. See Appendix 2 (page 33) for a summary of different authors' choice.

A review of these two taxa brings new elements which help to decide on the rank of the Mendocino Cypress. Because the morphological characters of both taxa (cones and foliage) are variable and because it is difficult to identify each one considering only these characters when the trees are fully mature, it is necessary to make use of other sets of characters involving physiology, phenology, discarded morphological traits, geography and molecular analysis. Growing both taxa in the same field side by side when the edaphic, exposure and climatic conditions are identical allowed us to conclude several distinct observations.

**Physiology**

*Growth* : except on a podsolic soil, the Mendocino Cypress grows (much) faster than the Gowen Cypress. *Scent* : the scent of both taxa is quite different. The Mendocino Cypress foliage when crushed emits an odour reminiscent of lemon, while the foliage of Gowen Cypress has a petroleum scent. *Acidity of the soil* : according to a study conducted by McMillan (1959 and 1964), the Gowen Cypress cannot grow where the acidity of the soil is pH=3.8-4.0, yet the Mendocino Cypress will survive.

<sup>1</sup> As noted by E. Little (1970), Lemmon's original spelling "var. *pigm a*" was « corrected in ink to "*pygmaea*" ».

<sup>2</sup> In the protologue Sargent wrote the Latin name with a *y*. This is the spelling to retain at species rank, for there is no obligation to keep the same spelling or same name when changing the rank of a taxon.

<sup>3</sup> A the same time he merged *Cupressus glabra* Sudw., *Cupressus nevadensis* Abrams and *Cupressus stephensonii* Wolf into *Cupressus arizonica* Greene, and *Cupressus forbesii* into *Cupressus guadalupensis* S.Watson.

## Phenology

In a normal soil, not a podsollic one, the Gowen Cypress will already be able to begin to pollinate when smaller than 60 cm, and will be able to produce seed cones before it gets to a height of one metre and at least one year before its northern relative. In the same conditions, the Mendocino Cypress was never observed with cones before attaining a height of 1.50 metres. Both taxa are shedding their pollen in winter, usually in February. In 2012, a difference in pollen cone maturity was observed, the Mendocino Cypress being able to pollinate before the Gowen Cypress. Further observations during the next years is necessary to understand if the trees placed in the same fields will show distinct pollination periods or if there is an overlap, allowing any hybridisation. At the end of May 2012, the new seed cones were bigger on the Mendocino Cypress than on the Gowen Cypress.

## Morphology

*Cotyledons* : one of the main differences between the two taxa is shown by the cotyledons. While Gowen Cypress displays 3 and 4 cotyledons, the seedlings of Mendocino Cypress bear 2, 3 or 4 cotyledons. This morphological character was first noticed by McMillan (1953; see table I for McMillan's data).

Table I : Frequency of cotyledon number in two populations of *Cupressus pygmaea*, from McMillan (1953, p. 29).

Mendocino City						Anchor Bay					
Cotyledons	2	3	4	5	Total	Cotyledons	2	3	4	5	Total
Seedlings	18	138	8	0	164	Seedlings	7	108	14	0	129
%	10.98	84.15	4.88	0.00	100.00%	%	5.43	83.72	10.85	0.00	100.00%

Silba (2008) became aware of this distinct character and B.Huang made a new species of it under the name *Cupressus silbae*. Here at the *Cupressus* Conservation Project in 2005 a first set of germinating seeds of the Mendocino Cypress gave a certain amount of seedlings with 2 cotyledons, but no statistical record was done at that time. More recent observations (2010-2011) with two sources of Mendocino Cypress, one from the main stand around Fort Bragg, Mendocino County (courtesy of John Silba) the second from Salt Point near Plantation, Sonoma County (courtesy of Joey Malone) gave the following results, which confirm McMillan's observations :

Table II : Frequency of cotyledon number in two populations of *Cupressus pygmaea*.

Fort Bragg						Salt Point					
Cotyledons	2	3	4	5	Total	Cotyledons	2	3	4	5	Total
Seedlings	52	212	11	0	275	Seedlings	4	93	10	0	107
%	18.91	77.09	4.00	0.00	100.00%	%	3.74	86.92	9.35	0.00	100.00%

The number of seedlings with 4 cotyledons is much lower in the first population than those with 2 cotyledons, and remains low in the second (under 10%). For *Cupressus goveniana*, McMillan (1953) gives the following statistics :

Table III : Frequency of cotyledon number of *Cupressus goveniana*.

Huckleberry Hill					
Cotyledons	2	3	4	5	Total
Seedlings	0	78	28	0	106
%	0.00	73.58	26.42	0.00	100.00%

It was observed that the seedlings with 2 cotyledons are displaying normal growth in containers, among the tallest after one and an half years. A survey of the cotyledon numbers by different authors is given in Appendix 3 (see page 33). Only very few authors are giving this information, when it is a key character allowing to distinguish both species.

*Crown* : while still young, the two taxa show different crown shapes. The branches of the Mendocino Cypress are spreading at an angle quickly away from the trunk and the leader shoots up. The Gowen Cypress has a more narrow shape when young.

*Height* : the height of both taxa is a major trait to distinguish them. Contrary to one common name ‘Pygmy Cypress’, the Mendocino Cypress is able to attain a height of 60 metres when growing in a fertile soil. Mathews (1929) mentions a tree with a girth of 8.23 m (27 ft) and a height “well over” 45 m (150 ft). The Gowen Cypress merely gets to 20 metres. This is consistent with the growth rate of both species. See appendix 4 (page 33) for the details of Mathews (1929) measurements.

*Foliage colour* : the foliage of *Cupressus pygmaea* is darker than that of *Cupressus goveniana* (Wolf 1948). When grown in the same field, with the same edaphic conditions and exposure, this observation is easy to verify (see fig. 1).

Figure 1 : Foliage of *Cupressus pygmaea* appears darker green than the one of *Cupressus goveniana*. Two *Cupressus goveniana* in the foreground and behind them a row of *Cupressus pygmaea*, cultivated trees ; note also the different sizes of trees planted at the same time – August 2012.



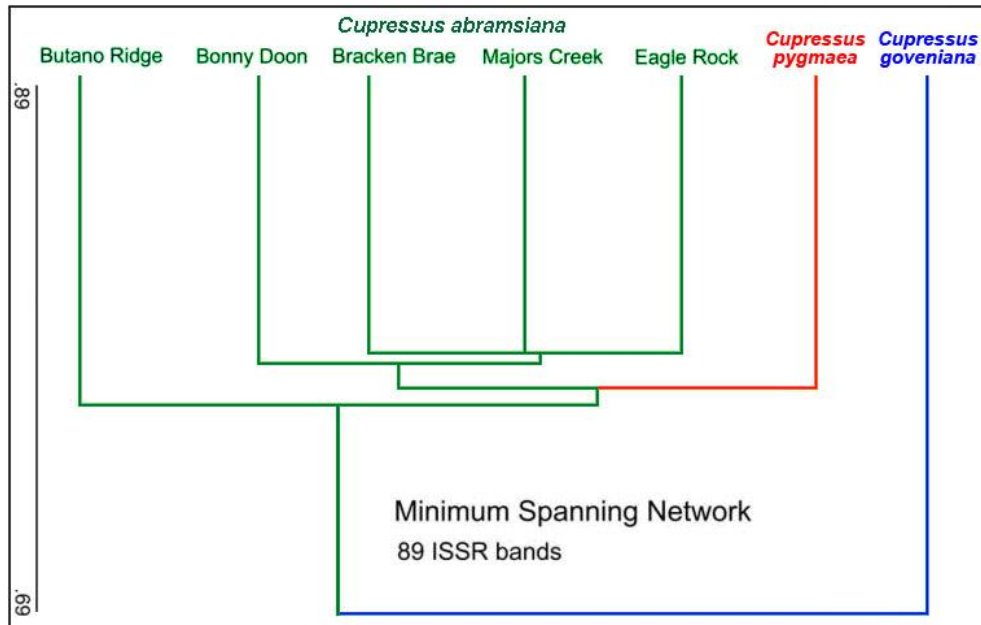
The others morphological traits are so variable that they are likely to overlap. To find any difference, a statistical approach is required.

### **Molecular analysis**

The results of various molecular analyses are unambiguous and confirm the placement of the Mendocino Cypress as a valid species. See D.P. Little 2004, p. 1878, fig. 2, D.P. Little 2006, p. 466, fig. 1, and also Adams & Bartel (2009a and 2009b).

The cladogram by Adams & Bartel (2009b, p. 292, fig. 3, presented simplified here) shows that *Cupressus goveniana*, as a species including its northerner relatives as synonyms or as varieties or subspecies, would make this taxon paraphyletic.

Figure 2 : Simplified cladogram (after Adams & Bartel, 2009b, fig. 3, p. 292.) showing that *Cupressus goveniana* as a species including the Mendocino population either as a synonym or at a varietal or subspecies rank would be considered paraphyletic.



## Geography

The two cypresses, as noted by Sargent, have completely distinct distribution ranges along the Pacific coast of California: the Gowen Cypress in central California (Monterey County) with only two localities, and the Mendocino Cypress with a wider range in northern California (Mendocino to Sonora Counties). The main population is growing around Fort Bragg, and there are two other smaller stands south of it at Anchor Bay (Mendocino County) and in the Salt Point State Park (Sonora County). These two taxa of *Cupressus* are isolated from each other by a distance of 250 km in a straight line and any natural hybridisation – even if their pollination period overlaps – is effectively impossible due to the direction of the main winds. This is an important factor allowing speciation.

## Conclusion

Considering all these observations, the Mendocino Cypress is best considered as a valid taxon at species rank. See Appendix 1 (page 32) for a summary of the main differences.

***Cupressus pygmaea*** (Lemmon) Sargent, North American Trees. *Botanical Gazette (Crawfordsville)* 239 (31 April 1901).

**Basionym** : *Cupressus goveniana* var. *pygmaea* Lemmon, *Handbook of West-American Cone-Bearers*. 3rd ed.: 77 (1895).

### Synonyms :

- ≡ *Cupressus goveniana* subsp. *pygmaea* (Lemmon) Camus, *Les Cyprès* 50. (1914).
- ≡ *Callitropsis pygmaea* (Lemmon) D.P.Little, *Systematic Botany* 31 (3): 474. (2006).
- ≡ *Cupressus silbae* B.Huang bis, *J. Int. Conifer Preserv. Soc.* 15 (1): 10. (2008).
- ≡ *Hesperocyparis pygmaea* (Lemmon) Bartel, *Phytologia* 91 (1): 182. (2009).
- ≡ *Neocupressus goveniana* var. *pygmaea* (Lemmon) De Laubenfels, *Novon* 19 (3): 303. (2009).
- ≡ *Hesperocyparis goveniana* var. *pygmaea* (Lemmon) De Laubenfels, *Novon* 22 (1): 13. (2012).

**Type** : J.G.Lemmon and wife 188, as *Cupressus goveniana*, var *pygmaea*. n. var. ined. White, ashly Plains, near Mendocino, lectotype designated by Wolf (1948): 200 – UC 185946.

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**Appendix 1 : Summary table : comparison between *Cupressus pygmaea* and *Cupressus goveniana*.**

Characters	<i>Cupressus pygmaea</i>	<i>Cupressus goveniana</i>
Height	To 60 m.	Below 20 m.
Growth <sup>1</sup>	Quick	Not as quick
Scent of foliage	Lemon scent	Oil scent
Foliage colour <sup>1</sup>	Dark green	Bright green
pH	Survives on very low pH	Does not survive on very low pH
Crown (saplings)	Branches large spreading when young	More narrow habit
Cotyledons	2-3-4	3-4
First pollination <sup>1</sup>	After 1 m.	Before 60 cm.
First cones <sup>1</sup>	Above 1 m.	Below 1 m.
Seeds	Thin, black, smaller	Thick, light red or brown, longer

<sup>1</sup> Observations on cultivated trees, close to each others in soil pH from 5.0 to 8.5.  
Further statistical studies are underway.

**Appendix 2 : The rank of *Cupressus pygmaea* according to several authors.**

Authors		Genus	Species		
Gordon <sup>1</sup>	1849	<i>Cupressus</i>	<i>goveniana</i>		
Lemmon	1895	"	<i>goveniana</i>	var. <i>pigmaea</i>	<b>new</b>
Sargent	1901	"	<i>pygmaea</i>		<b>new</b>
A. Camus	1914	"	<i>goveniana</i>	subsp. <i>pygmaea</i>	<b>new</b>
Wolf	1948	"	<i>pygmaea</i>		
McMillan	1953	"	<i>pygmaea</i>		
E. Little	1953	"	<i>goveniana</i>	synonym	
Den Ouden	1965	"	<i>goveniana</i>	synonym	
Dallimore & Jackson	1966	"	<i>pygmaea</i>		
Gausson	1968	"	<i>pygmaea</i>		
E. Little	1970	"	<i>goveniana</i>	var. <i>pigmaea</i>	
Griffin & Critchfield	1972	"	<i>pygmaea</i>		
Callen	1976	"	<i>pygmaea</i>		
Krüssmann	1985	"	<i>goveniana</i>	var. <i>pygmaea</i>	*
Silba	1986	"	<i>goveniana</i>	synonym	
Rushforth	1987	"	<i>goveniana</i>	var. <i>pygmaea</i>	*
Bartel	1991	"	<i>goveniana</i>	subsp. <i>pigmaea</i>	*
Silba	1998	"	<i>goveniana</i>	var. <i>pigmaea</i>	
Lanner	1999	"	<i>pigmaea</i>		*
Farjon	2005	"	<i>goveniana</i>	synonym	
Silba	2005	"	<i>goveniana</i>	subsp. <i>pigmaea</i>	*
Schulz	2005	"	<i>goveniana</i>	synonym	
D. Little	2006	<i>Callitropsis</i> <sup>2</sup>	<i>pigmaea</i>		* <b>new</b>
Silba	2008	<i>Cupressus</i>	<i>silbae</i>		<b>new</b>
Bartel	2009	<i>Hesperocyparis</i>	<i>pygmaea</i>		<b>new</b>
Eckenwalder	2009	<i>Cupressus</i>	<i>goveniana</i>	var. <i>pigmaea</i>	
de Laubenfels	2009	<i>Neocupressus</i> <sup>2</sup>	<i>goveniana</i>	var. <i>pygmaea</i>	* <b>new</b>
Debreczy & Rác	2011	<i>Cupressus</i>	<i>pygmaea</i>		
de Laubenfels	2012	<i>Hesperocyparis</i>	<i>goveniana</i>	var. <i>pygmaea</i>	* <b>new</b>
Earl	2012	<i>Cupressus</i>	<i>goveniana</i>	var. <i>pigmaea</i>	
CCP	2012	"	<i>pygmaea</i>		

The correct spelling for each rank according to the nomenclature rules is in **blue**.

To be noticed that the correct Latin spelling is *pygmaea*

**new** = new combination

\* Faulty spelling

<sup>1</sup> Until 1895 and the beginning of the 20th century, *Cupressus sargentii*, *pygmaea* and *abramsiana* were not distinguished from *goveniana*.

<sup>2</sup> Invalid

**Appendix 3 : Cotyledons number according to several authors.**

Authors		<i>C. goveniana</i>	<i>C. pygmaea</i>	
A. Camus	1914	3-4	-	subspecies
Wolf	1948	3-4-5	3-4	species
MacMillan	1953	<b>3-4</b>	<b>2-3-4</b>	species
Silba	1986	3-4-5	3-4-5	synonym
Silba	1998	3-4-5	3-4-5	variety
Farjon	2005	3-4	3-4	synonym
Silba	2005	3-4-5	3-4-5	subspecies
Schulz	2005	3-4-5	3-4-5	synonym
D. Little	2006	3-4	3-4	species
Eckenwalder	2009	3-4(-5)	3-4(-5)	variety
CCP	2012	3-4 <sup>1</sup>	<b>2-3-4</b>	species

<sup>1</sup> Trusting the data by MacMillan ; to be confirmed by new observations on seedlings of the two known populations.  
**Data in blue** : statistical data with reference to the number of observations.

**Appendix 4 : *Cupressus pygmaea* measurements by Mathews 1929.**

	inch = 0.0254		height		circumference		diameter		Measurement height			
	foot = 0.3048	feet	m.	feet	inches	m.	feet	inches	m.	feet	inches	m.
Situation 1	1	100	<b>30.50</b>		100	<b>2.50</b>			<b>0.80</b>		30	<b>0.80</b>
	2	80	<b>24.50</b>		80	<b>2.00</b>			<b>0.65</b>	5		<b>1.50</b>
	3	70	<b>21.50</b>			<b>3.50</b>		44.5	<b>1.10</b>		47	<b>1.20</b>
	4	100	<b>30.50</b>		115	<b>2.90</b>			<b>0.95</b>	5		<b>1.50</b>
	5	80	<b>24.50</b>		80	<b>2.00</b>			<b>0.65</b>	5		<b>1.50</b>
	6	85	<b>26.00</b>			<b>1.90</b>	2		<b>0.60</b>			
	7	100	<b>30.50</b>	11	3	<b>3.40</b>			<b>1.10</b>			
	8	> 50			14	9	<b>4.50</b>		<b>1.40</b>	6		<b>1.80</b>
	9	90	<b>27.50</b>		102	<b>2.60</b>			<b>0.80</b>	6		<b>1.80</b>
	10	136	<b>41.50</b>			<b>3.00</b>		37	<b>0.95</b>	3		<b>0.90</b>
	11	?				<b>3.00</b>		38	<b>0.95</b>	4		<b>1.20</b>
	12	200	<b>61.00</b>	11		<b>3.40</b>			<b>1.10</b>			
Situation 2	13	150	<b>45.50</b>	27		<b>8.20</b>		<b>2.60</b>	5		<b>1.50</b>	
		<b>Average</b>	<b>31.80</b>			<b>2.89</b>		<b>0.92</b>				

Figure 3 : *Cupressus pygmaea*, Anchor Bay, Mendocino County, California. Photo : Jeff Bisbee

