GRACIOUS CONTRIBUTION TO THE PROJECT - TRAVELLERS AND MEDIATORS PROJECT

TRAVELING TREES' QR CODE INFORMATION

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1. INTRODUCTION

This document is part of a graceful collaboration between the University of the Azores and the 'TRAVELERS AND MEDIATORS' project and includes scientific information about the following traveling trees that once grew on the island of São Miguel:

The Azorean native 'faia-da-terra' (*Morella faya*); the cultivated and escaped from culture, 'criptoméria' (*Cryptomeria japonica*); the exotic 'acácia' (*Acacia melanoxylon*) which, after escaping from culture, became naturalized in the Azorean islands; and finally, one of the worst invasive exotic species in the Azores archipelago, the 'incenso' (*Pittosporum undulatum*).

As an introductory background we can say that the pristine Azores had many types of vegetation as grasslands, scrublands, rocky coastal vegetation, and different types of forests (Trota and Pereira, 2018). The dense native forests on São Miguel Islands Azores were soon decimated (in about 150 years) after the systematic colonization of the territory from 1439 (Frutuoso, 1586-91).

Due to the lack of natural big forests, in the middle of 19th century several rich gentleman farmers introduced thousands of exotic species, looking for new wood source species (and other species of economic interests). Some species offers today a source of economical income to the islands (*e.g.* cryptomeria, tea, pineapple), but many escaped from culture being currently invasive species (Trota and Pereira, 2018).

In 1934, the forest composition on São Miguel Island was characterized by the predominant existence of maritime pine forests (*Pinus pinaster*) (804 ha), Australian blackwood (*Acacia melanoxylon*) (570 ha) and Japanese cedar (*Cryptomeria japonica*) (533 ha), a reality that in no way resembles the one we have today (Dias et al. 2007). In 1951, the forested area on this island did not reach 6% of the land area. This value reflected the poor situation in which the forestry sector found itself, resulting from the lack of correct land planning, a situation created by unregulated and uncontrolled exploitation, not compensated by corresponding planting, having been aggravated by the Second World War (Dias et al. 2007). Consequently, in 1948 the Forest District of Ponta Delgada was created, which promptly drew up and implemented tree planting plans for the existing common areas on the islands of São Miguel and Santa Maria (Dias et al. 2007). It was then that work began on large-scale reforestation with the establishment of forest nurseries, and the construction of forest paths and other infrastructures (Dias et al. 2007). This institution immediately put legislation into effect that obliged landowners to reforest after felling the forests and conditioned the cutting of trees and the transformation of crops, halting the process of unregulated exploitation of forest areas (Dias et al. 2007). In 1960, the Forest Circumscriptions of the cities of Angra do Heroísmo and Horta were created, which continued these works in the remaining islands of the archipelago. The increase in forest areas, especially with cryptomeria, was the result of the driving action of the Forestry Services in the Region which, over the last 40 years, have invested in this species, due to its better behaviour in the winds, compared to the *Pinus pinaster* and *Acacia melanoxylon,* and to its rapid growth (Dias et al. 2007).

2. TRAVELLER: FAIA-DA-TERRA (PORTUGUESE NAME)

2.1 *Morella faya* or *Myrica faya*? The history of its scientific name

'Faia-da-terra' is the Portuguese azorean name of a species that belongs to the family *Myricaceae.* This family includes three genera and around 50 species, world spread, generally in temperate zones or subtropical regions (CRONQUIST, 1981). The literature and electronic databases refer frequently to this species as *Myrica faya* Aiton and only after 2002, the change of genus made by WILBUR in 1994 starts to be recognized (STAPLES et al., 2002). In 2005, HERBET publishes a dichotomous key that distinguishes the genus *Morella* from the genus *Myrica*. According to this key the plants of the genus *Morella* distinguish from that belonging to *Myrica* genus, because they are evergreen shrubs or trees, with not sunken stomata, inflorescences borne on the present year's growth, and papillose fleshy fruits bird-dispersed, which is the case the Azorean species (figure 1). Considering this, the scientific name of 'faia-da-terra' is ***Morella faya* (Aiton) Wilbur**, first published in Sida 16: 103 (1994).

A **B**

Figure 1. The scientific name of Faia-da-terra is *Morella faya* (Aiton) Wilbur because is an evergreen shrub or small tree (**A**) with papillose fleshy fruits borne on the present year's growth (**B**): **A.** Specimen of 'faia-da-terra', planted at Azores University Garden in Ponta Delgada (19th March 2009); **B.** Wild specimen of 'faia-da-terra' near Sete Cidades bearing fruits (6th september 2003); photos by M.J. Pereira.

2.2 *Morella faya* description

Morella faya is an evergreen shrub or small tree, branching from the base, generally 3-6 m tall (up to about 16m). Usually with dense foliage, it displays simple, alternate oblong-cuneate and entire to crenate-serrate leaves (4-11 x 0.8-4 cm). The naked flowers borne on the present year's growth in axillary branched catkins; generally dioecious, the male flowers are grouped into yellowish-greenish small, elongated, and branching catkins while the female catkins are pinkish and shorter than the males' ones. The fruits are fleshy drupes, formed by 2-5 fused endocarps turning and black as they ripen (4-6 mm Ø) (FERNANDES and FERNANDES, 1987; FRANCO, 1971; WALKER, 1990; SCHAEFER, 2005).

2.3 *Morella faya* distribution

Morella faya is a native species of the Azorean islands (SILVA et al., 2010), Madeira Island (JARDIM and SEQUEIRA, 2008) and Canaries (BRAMWELL and BRAMWELL, 1990). *Morella faya* is possibly native of the western coastal Portuguese mainland (SCHAEFER, 2005; AGUIAR and PINTO, 2007) but RUSHFORTH (1999) suggests it may be the result of an ancient naturalization from plants introduced from the Azores or Madeira.

This species was introduced by Human species in Florida (HODGES and GARDNER, 1985), New Zealand (OWEN, 1997) and Australia (CSURHES and EDWARDS, 1998). In Hawaii, where it was introduced by Portuguese immigrants at the end of the 19th century (FOSBERG, 1937; KIM, 1969), is now considered an invasive species (SMITH, 1985; SCHAEFER, 2005).

2.4 *Morella faya* at Azores

At the Azores, this species is known by the local names of 'faia' (DROUET, 1866), 'faia-da-terra' (PALHINHA, 1966), 'faia-da-ilhas' and 'samouco' (FEIJÃO, 1960), the blooming season occurs from March to April (SCHAEFER, 2005), and the ripened fruits can be found between August to October (SILVA and TAVARES, 1997). Endozoocoric seed dispersal by *Turdus merula azorensis* and *Columba palumbus azorica* (DIAS, 1996; SILVA and TAVARES, 1997) (figure 2) and pluvial dispersion are both present.

A

B

Figure 2. Azores University Garden in Ponta Delgada: **A.** *Turdus merula azorensis* Hartert, 1905 (3rd November, 2008); **B.** *Columba palumbus azorica* Hartert, E, 1905 at (9th April, 2018); photos by M.J. Pereira.

Morella faya is a characteristic species of the following native Azorean plant communities: coastal 'faia' bushes, 'faia' woods and 'faia' forests (DIAS, 1996). This species found in all the Azorean islands, usually below 600 m, except for Pico Island (up to 1000 m of altitude) (SJÖGREN, 1973; FERNANDES and FERNANDES, 1987; SCHAEFER, 2005). The original species distribution on the islands strongly decreased due to human occupation and competition with exotic invasive species as *Pittosporum undulatum* (FERNANDES and FERNANDES, 1987), nevertheless, the *Morella faya* ability to fix nitrogen (TURNER and VITOUSEK, 1987), the high seed production and the effectiveness of seed dispersal give to the species some resilience. At the Azores this plant is still planted as shelter hedges for cultures (DROUET, 1866; SJÖGREN, 1984; FERNANDES and FERNANDES, 1987), the wood was used as combustible, for charcoal production, and carpentry, the bark was used in leathers tanning, the cattle can feed on their leaves, and the fruits were used to make compotes (RIBEIRO, 1946; DIAS, 1996; VILELA, 2007). The ingestion of mature fruits and bark decoctions were used on the islands as antidiarrhea medicine (BOTELHO, 2007).

At Azores SILVA and TAVARES (1997) and Pereira et al. (2014), studied respectively the demography and propagation of *Morella faya* by seeds and cuttings. In the last decades the Azorean governmental and several European Community projects produced this and other native species by seed for landscape conservation and for *Pyrrhula murina* wildlife habitat restoration (LIFE: Priolo 2003-2008; LIFE: Laurissilva Sustentável 2009-2013; LIFE: Terras do Priolo 2013-2018).

3. TRAVELLER: CRIPTOMÉRIA (PORTUGUESE NAME)

3.1 *Cryptomeria japonica* (Thunb. ex L.f.) D.Don.; the history of its scientific name

It was the Swedish naturalist Carl Peter Thunberg, a former student of Carl Linnaeus at Uppsala University (Svedelius, 1944), who first collect this species on the mountains of Nagasaki (Linnaeus, 1871) in 1776, where the species was spontaneous but also cultivated (Thunberg, 1784). The specimen with mature male cones, collected by Thunberg, is stored at the Linnean Society of London (LINN-HS 1487.1). Carl Thunberg (Thunb.) was only 2 years older than Carl Linnaeus' son (L.f.) and they studied together at Uppsala University. So, when Thunberg travelled to the Dutch colonies and Japan, he shared that knowledge with Carl Linnaeus the Younger, who validly published, in his best-known work *Supplementum Plantarum systematis vegetabilium* of 1781, the first scientific name for this species: *Cupressus japonica* Thunb. ex L.f.. After the premature death of Carl Linnaeus, the Younger in 1783, Thunberg succeed him as professor of medicine and natural philosophy at Uppsala University of and in 1784 he published Flora japonica with a detailed description of *Cupressus japonica*. Also in 1784, the mother of Carl Linnaeus the Younger, sold all the Herbaria – and the *Cupressus japonica* specimen - to Sir James Edward Smith who founded in 1788 the Linnean Society of London. (SMNH, 2023; Svedelius, 1944; Müller-Wille, 2006). In 1839 a David Don a Scottish botanist Professor of Botany at King's College, London, and librarian at the Linnean Society of London (JSTOR Global Plants, 2023), created a new genus *Cryptomeria* to place the *Cupressus japonica* of Thunberg, the only species of this new genus (POWO, 2023).

3.2 *Cryptomeria japonica* description

Cryptomeria japonica is a conical, evergreen tree with branches sightly pendulous at the tips, usually grows as a single trunk tree up to 50 (65) m tall in its native habitat. The trunk is covered with red-brown bark which peels in vertical strips. The leaves are arranged spirally, needle-like, 0.7–1.4 cm long; and the seed cones globular, 1–2 cm diameter with about 20–30 scales (The gymnosperm database, 2023) (figure 3).

Figure 4. *Cryptomeria japonica*, Ponta Delgada, São Miguel Island, 23 april 2009 (photo by M.J.Pereira).

3.3 *Cryptomeria japonica* distribution

Cryptomeria japonica is native to Japan where is commonly called sugi. At Japan, sugi has been planted from immemorial times and is one of the most economically important timber species. This species has been assessed for The IUCN Red List of Threatened Species in 2010 and is listed as Near Threatened. (Thomas et al. 2010). Cryptomeria japonica was introduced in Azores, China, Czechoslovakia, Denmark, Føroyar, Great Britain, Korea, Mauritius, New Zealand North, Réunion, Sweden and Turkey (POWO, 2023).

3.4 *Cryptomeria japonica* at Azores

The dense native forests on São Miguel Islands Azores were soon decimated after the systematic colonization of the territory from 1439 (Frutuoso, 1586-91). *Cryptomeria japonica* was introduced in São Miguel Island in the middle of the 19th century, when there was a shortage of wood for the boxes used to export oranges and later pineapples (Braga, 2019). In 1951, the forested area on this island did not reach 6% of the land area (Dias, et al. 2007), since then, efforts have been made to install production forests. Today, according to the Forest Inventory of the Autonomous Region of the Azores, *Cryptomeria japonica* forests extend over more than 12,000 hectares of Azorean territory, in pure and mixed stands, and the species is most representative in São Miguel, where it numbers around 35 % of production forest area. Its presence is also relevant in Terceira and Faial. A significant part of the cryptomeria is under the management of the Regional Government, says the Regional Directorate for Forest Resources of the Azores, namely the stands that are found in the Forest Perimeter and in the Regional Forests of the Island of São Miguel. In the production forests of the Azores, trees are felled after a growth period of 30 years; at the age of 30, a tree has an average of 21 m in height. Currently, the USA is the main destination for exported wood (Plataforma florestas, 2021). In addition to the use of wood in houses construction, the wood has been used in the production of surfboards (Breklim®). The essential oil is also extracted and marketed from this tree (Destillazores company). In the several islands of Azores archipelago this tree is known by the following common names: criptoméria, cricomé, titomé, clica, and clipa.

4. TRAVELLER: ACÁCIA (PORTUGUESE NAME)

4.1 *Acacia melanoxylon* R.Br.; the history of its scientific name

With 28 years, the Scottish botanist Robert Brown leave on a maritime expedition, arriving to Western Australia in December 1801. For three and a half years Brown did intensive botanic research in Australia, collecting about 3400 species, of which about 2000 were previously unknown, (Dooley, 2013) including this species of *Acacia* that he saw for the first time at Tasmania Island (Aiton, 1813). The scientific name was published for the first time in 1813 in Hortus Kewensis Catalogue and remains unchanged until today (Aiton, 1813).

4.2 *Acacia melanoxylon* description

Evergreen tree 8-15 (up to 45) metres high. Shallow root system with dense surface feeder roots. Trunk straight, crown dense and pyramidal to cylindrical, sometimes with heavy spreading branches. Bipinnate leaves (feathery) on seedlings and young shoots turning later in to phyllodes. Phyllodes are 7-10 cm long, greyish turning dark dull green, straight to slightly curved, with 3-7 prominent longitudinal veins and fine net-veins between. Pale yellow, globular flower heads. Reddish-brown pods, narrower than leaves, slightly constricted, twisted; flat roundish shiny black seeds 2-3mm long, seeds almost encircled by pinkish-red seed stalks (aril) (Global Invasive Species Database, 2023).

Figure 4. *Acacia melanoxylon* at Pico Island, 16 april 2003 (photo by M.J.Pereira).

4.3 *Acacia melanoxylon* distribution

Acacia melanoxylon is native to the rainforests of Southeast Australia (New South Wales, Queensland, South Australia, Victoria) and Tasmania. However, it has been disseminated throughout the rest of the world*, mainly due to its ornamental properties and the value of its black wood. Unfortunately, it is also recognized as a harmful invasive species in the many countries where it was introduced. (POWO, 2023; GISD, 2023).

*[Algeria, Amsterdam-St.Paul Is, Angola, Argentina Northeast, Assam, **Azores**, Brazil South, California, Canary Is., Cape Provinces, Chile North, Chile South, Colombia, East Himalaya, Easter Is., Ecuador, Eritrea, Ethiopia, Florida, France, Great Britain, Greece, Hawaii, India, Italy, Juan Fernández Is., Kenya, KwaZulu-Natal, Lesotho, Madeira, Mauritius, Morocco, Nepal, New Zealand North, New Zealand South, Pakistan, Palestine, Peru, Portugal, Puerto Rico, Réunion, Spain, Sri Lanka, St.Helena, Swaziland, Tanzania, Transcaucasus, Ukraine, Uruguay, Venezuela, Western Australia, Zaïre]

4.4 *Acacia melanoxylon* at Azores

We Know by R. Brown that the *Acacia melanoxylon* (Australian blackwood) was introduced in England about 1808. José do Canto a Gentleman farmer introduced the species around 1851 on São Miguel Island (Pereira, 2023), in 1872, the species was already well known in the Azores (Fouqué, 1873). Today the species is present in all the Azorean islands except for Corvo island.

At Azores, *Acacia melanoxylon* has a higher development than cryptomeria, the species can propagate vegetatively and by seed; its superficial roots can advance many meters and burst again, its seeds are able to germinate in the driest soils. Waterlogging and competition with other invasive species (*Pittosporum undulatum*) are two of the few factors limiting the expansion of this species, considered an invasive species at Azores.

The grinded leaves and branches of *Acacia melanoxylon* along with other species are used in pineapple greenhouses beds (CICA, 2023). The wood of *Acacia melanoxylon* is being used for almost all purposes, although it is difficult to dry this wood. Its great rusticity and stump sturdiness, explains why acacia today is covering more than 60% of recent lava fields – locally called 'biscoitos' - where this species is exploited for firewood (Dias et al., 2007). Currently this species is of only marginal interest in forestry and the remains of former settlements have re-established small groves, except for certain areas on the island of Pico, where the species has established itself with aggressive regeneration and expansion (Dias et al., 2007).

5. TRAVELLER: INCENSO (PORTUGUESE NAME)

5.1 *Pittosporum undulatum* Vent. The history of its scientific name

Only 9 years before his death Etienne-Pierre Ventenat a French botanist publish the scientific name *Pittosporum undulatum* in his work 'Description of New and Little-Known Plants Cultivated in the Garden of J.M. Cels (Ventenat, 1799), along with a draw and a detailed description of the blooming specimen (he could not observe the fruit). He doesn´t know that this species is native to Australia, referring that the came from Canaries some years ago, which mean that this species was one of the first species to arrive Europe after the maritime expeditions to Australia. The name is currently accepted in POWO (2023) database.

5.2 *Pittosporum undulatum* description

Pittosporum undulatum is a tree up to 12 metres high. It provides dense shade and spreads up to 7 metres across. It has coarse grey bark and glossy green elliptical leaves some 6-15 cm long and 1.5-4 cm wide with distinctive wavy, or undulating margins. The leaves are about 75 mm long with toothed margins. Small, white, fragrant flowers occur in terminal clusters and are followed by orange-tan berries 1 cm in diameter in autumn, which persist for several months (ANPSA, 2023) (figure 5).

Figure 5. *Pittosporum undulatum* at Pico Island, 8 november 2006 (photo by M.J.Pereira).

5.3 *Pittosporum undulatum* distribution

Pittosporum undulatum is native to Australia (New South Wales, Queensland, Victoria, and Tasmania Island) and scaped from culture in Europe (Italy, Portugal), Africa (Morocco, Tunisia, Zimbabwe, Cape Provinces, KwaZulu-Natal), North America (California), South America (Bolivia, South and Southeast Brazil, Ecuador), and several oceanic islands: Azores, Madeira, Canaries, Jamaica, St.Helena, Norfolk, Marianas, and Hawaii.

5.4 *Pittosporum undulatum* at Azores

José do Canto a Gentleman farmer introduced the species around 1851 on São Miguel Island (Pereira, 2023). Trelease in 1897 states that *Pittosporum undulatum* is long cultivated, and appearing spontaneous, but doubtfully established as truly escaped. Today the species is one of the worst invasive species being present in all the Azorean islands, between sea level and around 500 m of altitude (Azores Bioportal, 2023); together with *Hedychium gardnerianum* (another serious invasive species), they changed profoundly the appearance of the Azorean landscapes.

Pittosporum undulatum is adapted to dry and poor nutrients soil conditions and exposure to winds, forming very dense populations that prevent the growth of other species, waterlogging limits the expansion of this species (Dias et al. 2007). A large part of the coastal and mid-altitude natural plant communities was profoundly altered and even extinct due to the invasion of this species. When this very large and heavy trees occur in hillside areas, they are often associated with landslides. This problem exists for instance, on abandoned vineyards in São Jorge Island slopes, currently occupied by *Pittosporum undulatum* (Dias et al. 2007). This tree bursts from stumps and roots, which makes mechanical removal expensive and laborious, in many cases impossible due to the instability of the site, and it is always necessary the application of chemical products in the cut surface. However the spread of this species, can be minimized with measures that limit the abandonment of the land and the substitution of this species by others by land owners. The wood of *Pittosporum undulatum* is considered of little interest which is of a hard nature (used, due to its grain, in Santa Maria, to make wooden spoons) (Dias et al. 2007). In the Azores, farmers often use the branches of this plant seasonally to feed cattle. The grinded leaves and branches of *Pittosporum undulatum*, *Acacia melanoxylon* and other species are used in pineapple greenhouses beds (CICA, 2023).

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Ponta Delgada, (Azores) - 23 April 2023

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