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New records of coniferous species (Gymnospermae, Pinidae) for the non-native woody flora of Tunisia and North Africa

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Key words: alien species, Chorology, Coniferae, *Cryptomeria* D. Don, Laricoideae, naturalization, Pinopsida, *Taxodium* Rich.

Ključne besede: tujerodne vrste, horologija, Coniferae, *Cryptomeria* D. Don, Laricoideae, naturalizacija, Pinopsida, *Taxodium* Rich.

Abstract

Ten new taxa of gymnosperms are added to the non-indigenous woody flora of Tunisia, after almost two decades of botanical surveys. Four of them (*Cryptomeria japonica*, *Pinus brutia* var. *pityusa*, *Pseudotsuga menziesii* var. *glauca*, *Taxodium distichum* var. *distichum*) are also new for the flora of North Africa. *Pinus coulteri* is here first reported for the Mediterranean Basin. Three genera (*Cryptomeria*, *Pseudotsuga* and *Taxodium*) are firstly recorded for the non-native vascular flora of Africa whereas two genera (*Cedrus* and *Platycladus*) are reported for the first time only for the woody flora of Tunisia. Brief descriptions together with filed photographs, global distributions and habitats at national scale are provided. Some taxonomic comments on their distinguishable features as well as updated keys are also presented.

Izvleček

Po skoraj dveh desetletjih botaničnih raziskav smo neavtohtoni lesnati flori Tunizije dodali deset novih taksonov golosemenk. Štiri med njimi (*Cryptomeria japonica*, *Pinus brutia* var. *pityusa*, *Pseudotsuga menziesii* var. *glauca*, *Taxodium distichum* var. *distichum*) so novi tudi za floro Severne Afrike. *Pinus coulteri* je prvič omenjen za sredozemski bazen. Trije rodovi (*Cryptomeria*, *Pseudotsuga* in *Taxodium*) so bili prvič zabeleženi za tujerodno floro cevnic Afrike, medtem ko sta dva roda (*Cedrus* in *Platycladus*) prvič zabeležena le za floro lesnatih rastlin Tunizije. Podani so kratki opisi s fotografijami, globalna razširjenost in habitati v Tuniziji. Predstavljeni so tudi nekateri taksonomski komentarji o njihovih značilnostih in posodobljeni določevalni ključi.

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Introduction

The introduction, during the last few centuries and in recent decades, of thousands of woody plant species in almost all over of the world is increasingly intensified. These species used mainly in ornamental gardening, silviculture, erosion control, for fruit sources or other purposes, can easily escape and resulting in the naturalization (sometimes even as invasive) of many trees and shrubby taxa (Richardson & Rejmánek, 2011). Woody plants selected for introduction usually originate from regions with similar climate conditions; therefore, after certain time lag, they start to spread outside places of cultivation, become naturalized or even invasive (Gudžinskas et al., 2017). Such introductions contribute in the majority of cases to the increase of alien woody species in Europe as well as in other regions of the world (se e.g. Pyšek et al., 2009; Richardson & Rejmánek, 2011; Pergl et al., 2016; Mayer et al., 2017). Regions with the largest number of woody invasive alien species are Australia (183 species), Southern Africa (170 species), North America (163 species), and Pacific Islands (147 species) whereas Europe with 107 woody invasive alien species (59 species of trees and 48 species of shrubs) is in the fifth place together with New Zealand (cf. Richardson & Rejmánek, 2011). In Northern Africa, there is no exact updated number for woody (incl. gymnosperms) alien species since the percentage (ca. 13 %) published by Vilà et al. (1999) despite many recent publications dealing with new shrubby and woody alien species (see e.g. El Mokni 2019a, 2019b, 2019c, 2019d, 2019e, 2019f, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d; El Mokni & De Bélair, 2020; El Mokni & Domina, 2020a, 2020b; El Mokni & Iamonico, 2020; El Mokni & Verloove, 2020a, 2020b; Iamonico & El Mokni, 2021; El Mokni et al., 2022). Thus, high probability of new records of escaped woody species exists and needs more and more field investigations. Providing data about the distribution and status of naturalization of escaped alien woody plants remains useful and essential to prevent or reduce their impacts/threats on native communities and ecosystems (see e.g. Pyšek et al. 2020; Gallardo et al. 2019).

As part of an ongoing investigation on the Tunisian coniferous diversity, extended botanical surveys were undertaken, over the last twelve years in some Northern and Central Tunisian areas (mainly Kroumirian, Mogods' and Tunisian Dorsale mountains) and had led to the collection of specimens of 10 conifer species that represent new national/North African records or new distributions at national scale. This paper details those new records, updates dichotomous keys for each new reported taxon and gives an updated checklist of the Pinidae Subclass in Tunisia.

Material and methods

This work is based on extensive field botanical surveys carried out in various regions of Tunisia mainly within the governorate of Jendouba for more a decade (2010 to 2022) and the revision of relevant literature. Collected specimens are stored at the personal herbarium of the author (Herbarium El Mokni!) deposited in the Faculty of Pharmacy of Monastir (not yet listed in Index Herbariorum, Thiers, 2023+), Monastir University. Reported taxa are presented in alphabetical order (the nomenclature and taxonomic treatment are following mainly Raab-Straube, 2014+ in Euro+Med PlantBase; POWO, 2022; APD, 2022), morphological description (incl. author personnel observation) and global distribution are mainly according to Earle (2007+), Eckenwalder (2009), Farjon & Filer (2013) and Farjon (2017), distribution and habitat in Tunisia are reported from personal observations. When other genera are newly cited within the same family or also other species and/or subspecies within the same genus are newly reported for the Tunisian coniferous flora, an updated (dichotomous) key is provided (cf. Schulz et al., 2005; Farjon, 2017). Taxonomic notes are also given, once necessary.

A list of updated and hierarchical taxonomic position of different accepted gymnosperm taxa (native and aliens) in Tunisia with their actual distributions is provided in Appendix 1.

Results

Ten new taxa of gymnosperms that represent new Tunisian/North African records are here arranged alphabetically according to their Subclasses, Orders, Families, Subfamilies, Genera, Subgenera, Sections and Subsections. Four of them (*Cryptomeria japonica*, *Pinus brutia* var. *pityusa*, *Pseudotsuga menziesii* var. *glauca*, *Taxodium distichum* var. *distichum*) are new for the flora of North Africa. *Pinus coulteri* is here first reported for the Mediterranean Basin. Three genera (*Cryptomeria*, *Pseudotsuga* and *Taxodium*) are firstly recorded for the non-native vascular flora of Africa while the genera *Cedrus* and *Platycladus* are reported for the first time only for the woody flora of Tunisia.

SUBCLASS **PINIDAE**[1] Cronquist, Takht. & Zimmerm., Taxon 15: 134 (1966).

ORDER 1. **PINALES** Gorozh., Lekts. Morf. Sist. Archegon.: 88 (1904).

1 Within this Subclass, we find also the genus *Araucaria* Juss. [Araucariaceae Henkel & W. Hochst., Araucariales Gorozh. (1904)] with commonly *A. araucana* (Molina) K. Koch, *A. heterophylla* (Salisb.) Franco planted in many regions of Tunisia where they are able to produce a lot of seeds each year without any note for juvenile individuals from seedlings!

Family. 1. **Pinaceae** Spreng. ex F.Rudolphi, Syst. Orb. Veg.: 35 (1830), nom. cons.
Subfam. 1. **Abietoideae** (Bercht. & J.Presl, 1820) Rich. ex Sweet, 1826.
Genus 1. ***Cedrus*** Trew, 1757
Cedrus atlantica (Endl.) Manetti ex Carrière, Traité Gén. Conif.: 285. 1855.
Syn. *C. libani* A. Rich. var. *atlantica* (Endl.) Hook. f., [Cedars Lebanon] Nat. Hist. Rev., ser. 2, 2: 15. 1862; *C. libani* A. Rich. subsp. *atlantica* (Endl.) Batt. & Trab., Fl. Algérie Tunisie: 397. 1905.

First official report as an established taxon for the flora of Tunisia.

Trees up to 20 m tall and ca. 30 cm in diameter at breast height, usually with a single columnar *trunk*, often forked. Crown broad-conical, composed of massive primary branches, with foliar units often arranged in horizontal planar groups; *bark* rough, reddish brown weathering dark gray. Twigs short, firm, gray-brown. Vegetative buds' ovoid or globose; bud scales broad-ovate, reddish to very dark brown, deciduous; *leaves* on long shoots spirally arranged, more crowded near base of shoot; on short shoots densely crowded; apex acute to acuminate; *seed cones* also terminal on short shoots, erect, sessile, woody in the second year, ovoid to cylindrical with an obtuse to inset apex, 5–8 × 3–5 cm, light green ripening to pale brown, dehiscent with a persistent rachis; *seed scales* thin, coriaceous, 2–3 cm long and 2.5–2.5 cm wide, glabrous, pubescent at base, orange-brown, margin entire; *seeds* ovoid-conical, brown, 8–13 mm long.

Distribution: The species has a North African native range (Algeria and Morocco). It was introduced and cultivated in many European countries (Portugal, Spain, France, Italy), reported as naturalized in Great Britain and as casual in Corse (as *Cedrus libani* subsp. *atlantica* (Endl.) Batt. & Trab.) (Raab-Straube, 2014+ in Euro+Med PlantBase; POWO, 2022a; APD, 2022a).

Habitat in Tunisia (Figure 1): *Cedrus atlantica* is found (more than 100 individuals) within mixed oak forests (*Quercus canariensis* Willd. and *Q. suber* L.) in the region of Aîn Draham (Aîn Boulehya) and its surround-

Figure 1: *Cedrus atlantica* in Tunisia. A: habit of some trees in their habitat within Kroumirian forests; B: part of the bark trunk; C: leaves; D: immature female cones; E: mature seed cone. (Ghar Dimaou, NW Tunisia), Photographs R. El Mokni.

Slika 1: *Cedrus atlantica* v Tuniziji. A: habitus dreves na njihovem rastišču v Kroumirskih gozdovih; B: del lubja; C: listi; D: nezreli ženski storži; E: zrel semenski storž. (Ghar Dimaou, SZ Tunizija), fotografije R. El Mokni.

ings (El Ghorra, Djebel Bir, Majen Essaf), in the region of Ghar Dimaou (El Mouadjen), in the surroundings of Tabarka region within Jendouba governorate (NW Tunisia) where it was introduced since colonization. Populations of El Mouadjen, Majen Essaf and El Ghorra show many individuals of different ages and diameter at breast height thus many are from seedlings.

Notes: Compared to *Cedrus libani* A. Rich. (an indigenous to E Mediterranean area), *C. atlantica* shows seed cones up to 8 cm long when fully mature (vs. up to 10 (–12) cm long). Moreover, pollen cones are shorter than 5 cm for both *C. atlantica* and *C. libani* whereas they are usually longer than 5 cm in *C. deodara* (Lamb.) G. Don.

Subfam. 2. **Pinoideae** Link, 1831.
Genus 2. ***Pinus*** L., Sp. Pl. 2: 1000 (1753).
Subg. 1. ***Pinus***
Sect. 1.1. ***Trifolius***[2] Duhamel
Subsect. 1.1.1. ***Ponderosae*** Loudon
Pinus coulteri D. Don, Trans. Linn. Soc. London 17: 440. 1836.
Syn. *Pinus ponderosa* Douglas *ex* C. Lawson subsp. *coulteri* (D. Don) E. Murray, Kalmia 12: 23.1982.

First official report as a casual species for the coniferous flora of Africa and the Mediterranean area.

Trees to 15–25 m tall; *trunk* monopodial, straight or curved at base; *bark* on trunk rough, dark brown with black fissures; *branches* spreading horizontally to more or less ascending, forming a broad, irregular pyramidal and open crown; ***leaves*** in fascicles of 3, very rigid, straight or curved, slightly twisted, 15–25(–30) cm long, 1.9–2.2 mm wide; margins serrulate; apex acute pungent to subulate; leaf colour light green to grey-green; *seed cones* solitary (occasionally in pairs), or in whorls of 3–4(–5) on bole of young trees; *mature cones* ovoid, massive, heavy, usually slightly oblique or curved, moderately serotinous, 20–35 × 15–20 cm when open, extremely resinous; *seed scales* flat, thick woody with thin, curved margins, widest towards the apophysis; *apophysis* very strongly developed, merging into a long, uncinate umbo, up to 30 mm wide, light yellowish brown or light caramel coloured; *dorsal umbo*, elongate, curved, with keeled sides, 25–35 mm long, 10–15 mm wide at base, ending in a sharp uncinate claw (Figure 2.A); *seeds* obliquely obovoid, slightly flattened, 10–18 × 7–10 mm, smooth, lustrous dark brown, turning blackish; *seed wings* dolabriform to semi-ovate, 18–30 × 12–16 mm, orange-brown to dark reddish brown.

Distribution: The species is native to the USA: California (Coast Ranges); Mexico: Baja California Norte. In North Africa, the taxon is reported as introduced in Morocco and as cultivated in Algeria (Raab-Straube, 2014+ in Euro+Med PlantBase).

Habitat in Tunisia: *Pinus coulteri* is found within some clayey slopes in the region of Aîn Draham and its surroundings, within Jendouba governorate (NW Tunisia) where it seems to be introduced since colonization. Juvenile individuals (ca. 17) are reported from seedlings but usually misidentified due to the absence of their typical seed cones!

Notes: Despite that *Pinus coulteri* shows similarities with *P. sabiniana* Douglas *ex* D. Don (with which shares in part the same biotope) in having almost fasciculate leaves; persistent seed cones, opening slowly; scales thick woody; apophyses extremely raised and elongated into a strongly curved spine; it is different by having thick and rigid leaves, 1.9–2.2 mm wide (*vs.* slender leaves, pliant, 1.5 mm wide), seed cones solitary or in whorls of 2–5 (*vs.* seed cones solitary, rarely in pairs for *P. sabiniana*).

Sect. 1. 2. ***Pinus***
Subsect. 1. 2.1. ***Pinaster*** Mayr *ex* Koehne
Pinus brutia Ten., Fl. Napol. 1, Prodr.: lxxii. 1811–15.
Pinus brutia Ten. var. ***pityusa*** (Steven) Silba, Phytologia 58: 367. 1985.
Syn. *P. pityusa* Steven, Bull. Soc. Imp. Naturalistes Moscou 11: 49. 1838.

First official report as a naturalizing taxon for the flora of North Africa.

Trees up to 30 m tall; *trunk* usually a straight bole, or slightly sinuous, sometimes forked; *bark* thin, orange-brown, becoming thick only on lower trunk of large trees, then deeply fissured longitudinally, scaly, breaking into elongated plates, pale brown to red-brown; *branches* long, spreading and ascending, forming a broad pyramidal or rounded, open crown; *buds* ovoid-conical, acute, 10–15 mm long, not resinous; cataphylls with recurved apices, reddish brown fringed with white hairs; *leaves* in fascicles of 2 (sometimes 3), held by a 5–8 cm long, rigid and spreading, persistent sheath, retained on branchlet 2–3 years, straight and rigid, spreading, rarely lax and pendulous, (5–)10–18(–29) cm long, 1–1.5 mm wide; *pollen cones* spirally arranged, short cylindrical, 1–2 cm long, yellow; *seed cones* solitary or in whorls of 2–3(–4), short pedunculate to nearly sessile, persistent, spreading forward or at right angle to shoot when full grown, narrowly or broadly ovoid-conical or ovoid to rarely sub-

2 Within this section, many species (*Pinus contorta* Douglas; Subsect. *Contortae* Little et Critchfield and *P. radiata* D. Don; Subsect. *Attenuatae* Van Der Burgh) were introduced and cultivated with hundreds of individuals in many regions mainly of Northern Tunisia and could more probably naturalizing from seedlings!

globose when closed, (4–)6–11(–13) cm long, variously serotinous, 3–5 cm wide when closed, 5–8 cm wide when opened; *seed scales* thick woody, rigid, straight, oblong; *apophyses* nearly flat or slightly raised, (sharply) transversely keeled and with thin rays radiating from the centre, more or less rhombic or often with a rounded upper margin, to 20 mm wide at mid-cone, lustrous red-brown weathering grey; umbo flat or depressed, 4–7 mm wide, broadly rhombic in outline, tan or grey-brown, unarmed; *seeds* obovoid, slightly flattened, 6–7(–8) mm long, grey-brown, sometimes dark mottled; *wing* 14–20 mm long, 8–11 mm wide, oblique, grey-brown with darker streaks.

Distribution: the variety *pityusa* (Steven) Silba is native to North Caucasus: Krasnodar, Transcaucasia (Abkhazia), Georgia, Ukraine: Krym (POWO, 2022f).

Habitat in Tunisia (Figure 2): *Pinus brutia* var. *pityusa* is found within mixed oak forests predominantly by cork oak (*Quercus suber* L.) in the region of Aîn Draham (Babouch) and the region of Fernana (Aîn Debba) within the governorate of Jendouba (NW Tunisia) where it was introduced and cultivated since many decades in clayey slopes. Both populations, mainly that of Aîn Debba show many individuals of different ages and diameter at breast height thus many are from seedlings.

Notes: the variety *pityusa* is easily distinguished for the other known varieties (var. *brutia*, var. *eldarica* (Medw.) Silba, and var. *pendulifolia* Frankis) by its short leaves with only 5–8 cm long (*vs*. 10–18 cm long in var. *brutia* and 18–29 cm long in var. *pendulifolia*) and its red-brown apophyses (*vs*. whitish grey in var. *eldarica*).

Figure 2: *Pinus* spp. in Tunisia. A: *P. coulteri,* mature close-up seed cone; B–C: *P. brutia*, crown, leaves and details of dehiscent mature seed cones. (Aîn Draham, NW Tunisia). Photographs R. El Mokni.

Slika 2: *Pinus* spp. v Tuniziji. A: *P. coulteri*, zrel semenski storž od blizu; B–C: *P. brutia*, krošnja, listi in podrobnosti zrelih semenskih storžev. (Aîn Draham, SZ Tunizija). Fotografije R. El Mokni.

Pinus pinaster Aiton subsp. ***escarena*** (Risso) K. Richt., Pl. Europ. 1: 1. 1890.

Syn. *P. escarena* Risso, Hist. Nat. Europ. Mérid. 2: 340, 459. 1826.

First official report as an established taxon for the flora of Tunisia.

A medium tree of (8)15–20 m in height, with an irregular habitus and a clear crown; *leaves* up to 25 cm long with 2 mm wide, persistent, rigid with acute apex and finely denticulate margins, united in pairs in a sheath of 10–20 mm; *male cones* yellow conical of 5 to 10 mm agglomerated at the tops of the branches; *female cones* shiny light brown 8–15(18) x 5.5–7 cm, subsessile, solitary or grouped, subconical with woody scales, apical rhomboidal shield strongly keeled and mucronate; *seed cones* up to 22 cm long; *seeds* 7–8 mm with a 20–30 mm wing.

Distribution: The subspecies has a W Mediterranean native range from Spain, Baleares to Italy, Sicily and Malta in Northern Mediterranean basin and only Algeria and Morocco in Northern Africa (Raab-Straube, 2014+ in Euro+Med PlantBase; POWO, 2022b; APD, 2022b).

Habitat in Tunisia (Figure 3): *Pinus pinaster* subsp. *escarena* is found within mixed oak forests (*Quercus canariensis* Willd. and *Q. suber* L.) in the region of Aîn Draham (Babouch) and the region of Fernana (Aîn Debba) within the governorate of Jendouba (NW Tunisia) where it was introduced and cultivated since many decades in clayey slopes. Both populations, mainly that of Aîn Debba shows many individuals (ca. 70) of different ages and diameter at breast height thus many are from seedlings.

Figure 3: *Pinus pinaster* subsp. *escarena* in Tunisia. A: crown in bottom view; B: detailed part of the bark trunk; C: pollen cones above and seed cones below; D: solitary light brown shiny seed cone. (Tabarka & Fernana, NW Tunisia), Photographs R. El Mokni.

Slika 3: *Pinus pinaster* subsp. *escarena* v Tuniziji. A: krošnja od spodaj; B: podroben del lubja debla; C: pelodni storži zgoraj in semenski storži spodaj; D: posamezen svetlo rjav svetleč semenski storž. (Tabarka & Fernana, SZ Tunizija), fotografije R. El Mokni.

Pinus pinaster Aiton subsp. ***pinaster***
Syn. *P. pinaster* Aiton subsp. *atlantica* Villar, Bol. Soc. Esp. Hist. Nat. 33: 427. 1934.

First official report as an established taxon for the flora of Tunisia.

Trees up to 30 m tall; *leaves* 10–20 cm long; resin ducts at base of leaves (within sheath) limited to the two lateral, larger ducts, at mid-leaf several additional small ducts; *seed cones* 10–18 cm long.

Distribution: The subspecies is known as native in Portugal, Spain, France (Atlantic coast), Corse and Italy. It is reported as introduced only in Sardegna (Raab-Straube, 2014+ in Euro+Med PlantBase). In North Africa, the taxon was cited as introduced without any precision about its actual status or doubtfully present in Morocco and Tunisia (POWO, 2022c; APD, 2022c).

Habitat in Tunisia (Figure 4): *Pinus pinaster* subsp. *pinaster* is found within coastal kermes oak (*Quercus coccifera* L.) in the region of Nadhour (Les Grottes), within Bizerta governorate (NE Tunisia). It was introduced since many decades and is extending with many individuals (ca. 50) of different ages and diameter from seedlings.

Figure 4: *Pinus pinaster* subsp. *pinaster* in Tunisia. A: summital crown part with leaves, juvenile and mature seed cones; B: mature close-up seed cones. (Bizerta, NE Tunisia), Photographs R. El Mokni.

Slika 4: *Pinus pinaster* subsp. *pinaster* v Tuniziji. A: vršni del krošnje z listi, juvenilnimi in zrelimi semenskimi storži; B: zreli semenski storži, bližnji pogled. (Bizerta, SV Tunizija), fotografije R. El Mokni.

Notes: The taxonomy of *Pinus pinaster* s.lat. has not been thoroughly studied and is still debated; however, three sub-species are generally recognized (Farjon, 1998), which show small differences related mainly to the anatomy of the leaves and to the length of leaves and seed cones.

Updated key to species of the genus *Pinus* Subsection *Pinaster*[3] in Tunisia

1a. Fascicle sheaths of new leaves 20–30 mm long; leaves thick, 1.5–2 mm wide; seed cones 10–20(–22) cm long, persistent, opening slowly; umbos on scales forming a central, rigid spine ..... *P. pinaster*
1b. Fascicle sheaths of new leaves shorter than 20 mm; leaves 0.7–1.5(–1.8) mm wide; seed cones shorter than 13(–15) cm, deciduous or persistent; umbos unarmed or with a minute prickle 2
2a. Bark on trunk breaking into large plates; fascicle sheaths of new leaves short, to ca. 10 mm long; seed cones broadly ovoid to subglobose when closed; seeds 15–20(–22) mm long, thick, with a rudimentary wing much shorter than the seed ..... *P. pinea*
2b. Bark on trunk breaking into small or elongated plates; fascicle sheaths of new leaves (9)10–20 mm long; seed cones ovoid-conical or oblong-conical when closed; seeds less than 10 mm long, with a wing at least 2 × the length of the seed..... 3
3a. Leaves in fascicles of only 2, (6–)7–10(–12) cm long, 0.7–0.8 mm wide ..... *P. halepensis*
3b. Leaves in fascicles of 2 or sometimes 3, (5–)10–18(–29) cm long, 1–1.5 mm wide ..... ***P. brutia***

Subfam. 3. **Laricoideae** (Rendle) Pilg. & Melch. (1954).
Genus 3. ***Pseudotsuga*** Carr., Traité Conif., ed. 2: 256 (1867).
Pseudotsuga menziesii (Mirb.) Franco var. ***glauca*** (Beissn.) Franco, Conif. Duarum Nom.: 6. 1950 [& Bol. Soc. Brot., ser. 2, 24: 76. 1950].
Syn. *Tsuga douglasii* (Sabine *ex* D. Don) Lindl. var. *glauca* Beissn., in Jäger & Beissner, Ziergeh. Gärt. Park., ed. 2: 446. 1884; *Pseudotsuga menziesii* (Mirb.) Franco subsp. *glauca* (Beissn.) E. Murray, Kalmia 12: 24. 1982.

First official reports of the genus and the species as established taxa for the flora of North Africa.

A small tree; *trunk* monopodial, straight, columnar; *bark* on large trunks rough and scaly; *branches* spreading horizontally; *branchlets* slender, flexible; *leaves* spreading

3 In this subsect. many plantations of *Pinus canariensis* C. Sm. are introduced and cultivated with hundreds of individuals within Northern Tunisia mainly and could more probably naturalizing from seedlings!

more or less radially, (1.5–)2.5–3.5(–4) cm long, 1.2–1.5(–1.7) mm wide, more or less petiolate and slightly twisted at base, linear, straight, flattened, obtuse or acute at apex; *pollen cones* 1.5–2 cm long, yellow, with red brown perular scales at base; *seed cones* pendulous on 0.5–1 cm long peduncles, deciduous, ovoid-conical, obtuse or pointed at apex, 4–9(–10) cm long, 2–4 cm wide with opened scales, green, with yellowish green bracts, ripening to brown or dull grey brown, with light brown bracts. Seed scales obovate-cuneate, convex, 2–2.5 × 2–2.5 cm at mid-cone; base more or less cuneate; *bracts* ligulate, trilobate at apex, with cusp longer than lateral lobes, 2.5–3.5 cm long, exserted, not reflexed, often curved towards cone apex; *seeds* ovoid-cuneate, 6–8 × 4–5 mm, light brown, often with dark spots; wings ovate oblong, 9–14 × 5–8 mm, yellowish brown.

Distribution: the species is native to North America with two subspecies: the coastal Douglas fir (*Pseudotsuga menziesii* var. *menziesii*) occurs from British Columbia southward along the Pacific Coast to central California; and the Rocky Mountain Douglas fir (*Pseudotsuga menziesii* var. *glauca*) occurs from central British Columbia along the Rocky Mountains into the mountains of central Mexico (Farjon, 2010; Hermann & Lavender, 1990). The first seeds were introduced in Europe by David Douglas in 1827 and then planted at Drop more Park (Buckinghamshire, UK), where there is a tree which is usually considered the oldest Douglas fir of Europe (Elwes & Henry, 1909). Initially planted as ornamental, Douglas fir started to be used as a forest species by the end of the nineteenth century. This fir became a major reforestation species in Western Europe after the Second World War, mainly with the support of national or regional forest grants. In Europe, 80% of the total Douglas fir area is to be found in three countries: France (half of the European area), Germany and United Kingdom. Outside Europe, Douglas fir has also been introduced in several countries of the southern hemisphere (South Africa, South America, New Zealand and Australia) (Bastien & al., 2013) and also in Turkey as an important fast-growing tree species for industrial plantations (with a limited distribution of approximately 140 ha). In North Africa, no report for the genus (Raab-Straube, 2014+ in Euro+Med PlantBase; POWO, 2022d).

Habitat in Tunisia (Figure 5): *Pseudotsuga menziesii* subsp. *glauca* is found (ca. 30 individuals) within mixed oak forests (*Quercus canariensis* Willd. and *Q. suber* L.) in the region of Tabarka (Majen Roumi) within Jendouba governorate (NW Tunisia) where it seems introduced since colonization and show many juvenile individuals of different heights and diameter at breast height growing from seedlings.

Notes: the variety *glauca* remains a smaller tree than the var. *menziesii* (up to 100 m tall) and has usually shorter, wider (1.5–2.5(–3.5) cm × 1.4–1.7 mm) and more glaucous green leaves with usually smaller seed cones [*vs*. dark green leaves (2–)2.5–3.5(–4) × 1.2–1.5 mm and seed cones 4–9(–10) cm long].

Figure 5: *Pseudotsuga menziesii* var. *glauca* in Tunisia. A: habit of some trees in their habitat within Kroumirian forests; B: detailed part of the bark trunk; C: detailed of mature seed cone with typical ligulate, trilobate bracts at apex, longer than lateral lobes. (Tabarka, NW Tunisia), Photographs R. El Mokni.

Slika 5: *Pseudotsuga menziesii* var. *glauca* v Tuniziji. A: habitus dreves na njihovem rastišču v Kroumirskih gozdovih; B: podrobno prikazan del lubja debla; C: detajl zrelega semenskega storža z značilnimi jezičastimi, trilobatimi ovršnimi lističi na vrhu, daljši od stranskih režnjev. (Tabarka, SZ Tunizija), fotografije R. El Mokni.

Updated key to the genera of the Pinaceae family in Tunisia

1a. Adult green leaves bundled with 2–5(-8) together on dwarf shoots (1 species with a single leaf on a dwarf shoot); seed cones biennial (rarely triennial), with distinction between each year's growth apparent as an umbo and apophysis on each scale; seed held to the wing in a pair of claws ..... *Pinus*

1b. Adult green leaves either solitary or in pseudowhorls of more than 10 together on short shoots; seed cones mostly annual (if biennial without umbo); seed held to the wing in a cup **2**

2a. Seeds without resin vesicles; seed scales with a broad basis, persistent, mature seed cones spreading or pendulous from mostly plagiotropic branches; leaves equally distant on all (segments of) shoots bract scales of cones large; exserted and trilobate at apex ..... ***Pseudotsuga***

2b. Seeds with resin vesicles; seed scales with a narrow, petiolate basis, persistent or deciduous; leaves spirally and remotely arranged on long shoots, in dense pseudo-whorls on short shoots; mature seed cones erect maturing in two years, disintegrating on tree with deciduous seed scales ..... ***Cedrus***

ORDER 2. **CUPRESSALES** Link, Handbuch 2: 470 (1829).

Family. **Cupressaceae** Gray, Nat. Arr. Brit. Pl. 2: 222. (1822), nom. Co

Subfam. 1. **Taxodioideae** Endl. ex K.Koch

Genus 1. ***Cryptomeria*** D.Don, Ann. Nat. Hist. 1: 233 (1838).

Cryptomeria japonica (Thunb. ex L. f.) D. Don, Trans. Linn. Soc. London 18: 167. 1839.

Syn. *Cupressus japonica* Thunb. ex L. f., Suppl. Pl.: 421. 1781.

First official reports of the genus and the species as established taxa for the flora of North Africa.

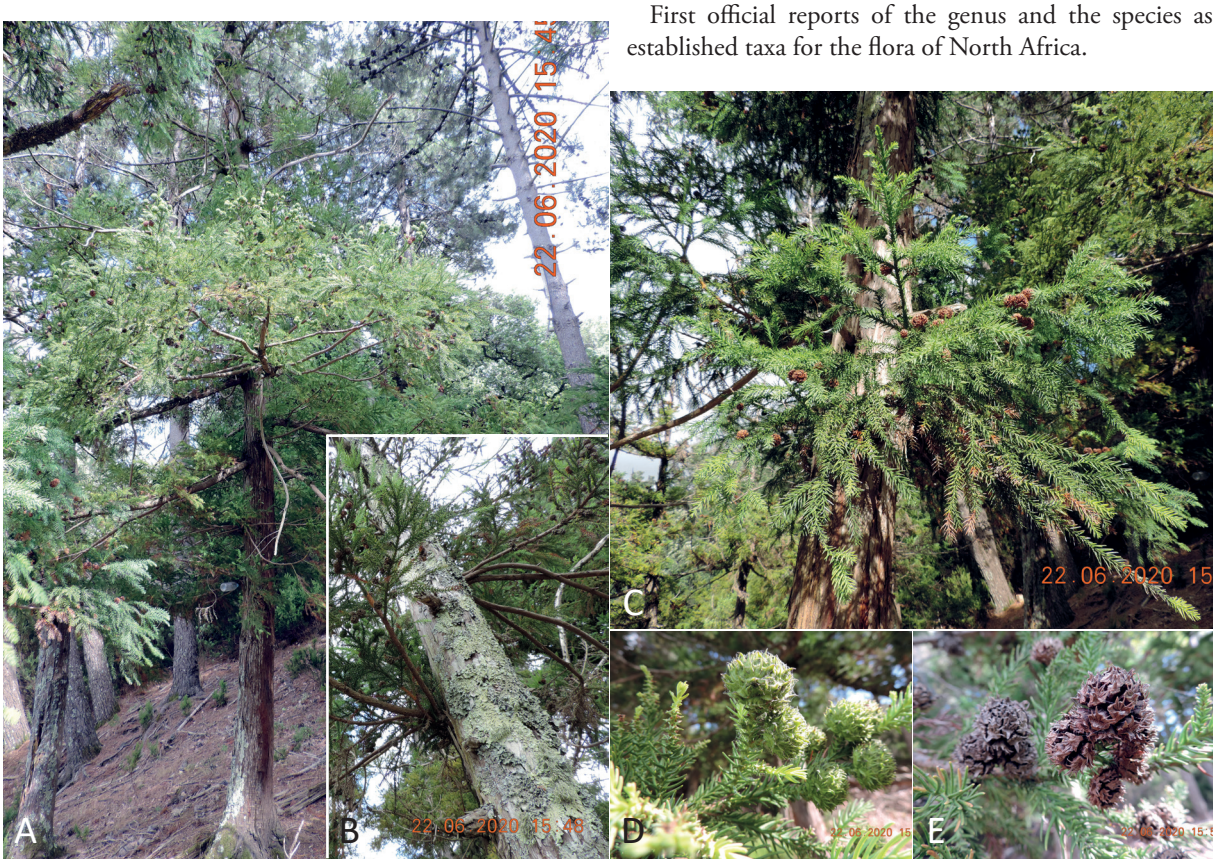

Figure 6: *Cryptomeria japonica* in Tunisia. A: habit of some tree in their habitat within Kroumirian forests; B: part of the bark trunk fully covered by lichens; C: outspread densely arranged branches with decurrent, linear-subulate leaves; D: aggregated terminal close-up seed cones; E: dehiscent globose, squarrose seed cones with typical cuneate scales providing small teeth above the recurved bract tip. (Tabarka, NW Tunisia), Photographs R. El Mokni.

Slika 6: *Cryptomeria japonica* v Tuniziji. A: habitus dreves na njihovem rastišču v Kroumirskih gozdovih; B: del lubja v celoti prekrit z lišaji; C: razprte, gosto razporejene veje s padajočimi, črtasto šilastimi listi; D: končni semenski storžki; E: razpršeni kroglasti, kvadratasti semenski storžki s tipičnimi klinastimi luskami, ki tvorijo majhne zobce nad ukrivljeno konico ovršnega lista. (Tabarka, SZ Tunizija), fotografije R. El Mokni.

Tree, 30–40(–60) m high, evergreen, monoecious; *trunk* straight, slender, usually not over 1–2 m in diameter; *branches* densely arranged, outspread or ascending, young branches green, glabrous, forming a conical crown in young trees and a rounded crown in mature trees; *leaves* helically arranged in ranks of 5, decurrent, spreading but incurved in various degrees, directed forward, linear-subulate, slightly flattened laterally, distinctly keeled abaxially, stiff, green, 3–20(–25) × 1–2 mm, margins entire, apex acute; *pollen cones* numerous, axillary and crowded towards ends of 2nd-year branchlets, 3–6 × 2–3 mm, elongating to 10 mm at anthesis; *seed cones* terminal on down-curved branchlets with normal leaves, often aggregated or solitary, occasionally with proliferating vegetative short shoot at apex, globose to subglobose, squarrose with spreading bract-scale complexes, soft woody, 12–20(–25) mm in diameter; *seeds* red-brown, (1–)2–5 per bractscale complex (some ovules may abort), 4–5 × 3 mm, flattened, irregularly ovate with 2 wings; *wings* unequal, 1–1.5 mm wide, forming a strip around the seed.

Distribution: *Cryptomeria japonica* is an endemic and widely distributed species in Japan. Locally it is the most important commercial forestry species. It has been grown extensively also in forestry plantations in China and has naturalized in some areas there. It is considered as a popular ornamental tree in many temperate countries and in different parts of the world including India (Maity & Moktan, 2019). Sanbu-sugi, mainly planted in Sanbu district and Chiba Prefecture, is one of the best logging cultivars of *C. japonica* (cf Miyajima, 1973).

Habitat in Tunisia (Figure 6): *Cryptomeria japonica* is found within mixed oak forests (*Quercus canariensis* Willd. and *Q. suber* L.) in the surroundings of Tabarka within Jendouba governorate (NW Tunisia) where it seems introduced since colonization and show more than 25 individuals of different heights and diameter at breast height.

Genre 2. ***Cupressus*** L., Sp. Pl. 2: 1002. 1753.

Cupressus arizonica Greene var. ***glabra*** (Sudw.) Little, Madroño 18: 162. 1966.

Syn. *C. glabra* Sudw., Amer. Forestry 16: 88. 1910; *Callitropsis glabra* (Sudw.) D. P. Little, Syst. Bot. 31 (3): 473. 2006 (nom. ut. rej., Art. 56); *Hesperocyparis glabra* (Sudw.) Bartel, Phytologia 91 (1): 181. 2009.

First official report as a casual taxon for the flora of Tunisia.

Large shrubs or trees 5–20(–30) m tall; *trunk* monopodial or multistemmed from near the ground; *bark* smooth on branches and younger trees, soon turning grey, then exfoliating with thin scales and strips, exposing reddish bark remaining smooth well into maturity of trees, even-

Figure 7: *Cupressus arizonica* var. *glabra* in Tunisia. A: habit of a tree in its habitat within Kroumirian forests; B: detailed part of the bark trunk; C–D: mature close-up seed cones (Fernana, NW Tunisia), Photographs R. El Mokni.

Slika 7: *Cupressus arizonica* var. *glabra* v Tuniziji. A: habitus drevesa na njegovem rastišču v Kroumirskih gozdovih; B: podroben del lubja na deblu; C–D: zreli semenski storži od blizu (Fernana, SZ Tunizija), fotografije R. El Mokni.

tually near base of large trunks becoming fissured, up to 1 cm thick, exfoliating with small flakes; *branches* long and spreading, more often ascending or erect, forming a conical, broad conical, pyramidal, or oval and round-topped, dense crown; *branchlets* numerous, stout; *leaves* usually conspicuously and actively glandular; *pollen cones* numerous, terminal, solitary, subglobose, elliptic-oblong or cylindrical, 3–5 × 1.7–2.2 mm; *seed cones* terminal, often grouped or clustered, subglobose to irregularly broad ovoid, 15–27(–30) mm, while growing with prominent bosses large or small on the scales; *seeds* red-brown, not glaucous or slightly glaucous.

Distribution: the taxon is native to USA: Arizona (Coconino, Gila, Maricopa and Yavapai Co.), Mexico Northeast, Mexico Northwest, New Mexico, Texas. It is reported as introduced in Argentina Northeast, Free State, Italy, Turkey, Turkey-in-Europe (POWO, 2022e) whereas Raab-Straube (2014+) reported the taxon as cultivated in Algeria, Azerbaijan, with Nakhichevan, Italy, Morocco, Portugal, Romania, Sardinia, Spain, with Gibraltar and Andorra.

Habitat in Tunisia (Figure 7): *Cupressus arizonica* Greene var. *glabra* is found within an opened cork oak forest (*Quercus suber* L.) where many coniferous taxa were planted in the region of Fernana (Aîn Debba) within Jendouba governorate (NW Tunisia) where it seems introduced since colonization and show more than 7 individuals of different heights and diameter at breast height.

Notes: the variety *glabra* is distinguished from the other varieties [var. *arizonica*, var. *nevadensis* (Abrams) Little, var. *stephensonii* (C.B. Wolf) Little and var. *montana* (Wiggins) Little] of the *Cupressus arizonica* complex by having mainly seed cones 2–2.5 (–3.2) cm in diameter (*vs*. 1.5–2.5 cm in var. *montana*, (1.5–)2–3(–3.5) cm in var. *nevadensis*, (1–)2–2.5 cm in var. *stephensonii* and (1.2–)2–3 cm in var. *arizonica*) remaining closed at maturity (*vs*. opening at maturity for the var. *montana*) and seeds (3–)4–5(–8) mm long, with minute wings, usually waxy (*vs*. (3–)4–5(–6) mm long, with wings 1 mm wide, usually not waxy in var. *arizonica*, 3–4(–5) mm long, with wings 1–5 mm wide, usually not waxy in var. *montana*, 3–6 mm long, with wings to 2 mm wide, occasionally slightly waxy in var. *nevadensis* and (4–)5–8 mm long, with wings 1–3 mm wide, usually waxy in var. *stephensonii*).

Updated key to species of the genus *Cupressus* in Tunisia

1a. Seed cones usually in dense, serotinous clusters; pollen sacs often 5 or more per microsporophyll; glands present on scale leaves; seed cones spherical or a little elongated, (1.5–)2–3 cm long, gray or brown at maturity, often waxy before this, with 3 or 4(–6) pairs of seed scales; seeds (5–)8–15(–20) per scale, (3–)4–6(–8) mm long, light to dark brown ..... ***C. arizonica***

1b. Seed cones solitary or in groups, not densely clustered; pollen sacs up to 4 per microsporophyll; glands on all scale leaves; Seed cones usually oblong, (1.5–)2–3(–4) cm long, brown at maturity, not waxy; with 3–5 or 6 or 7 pairs of seed scales; seeds (1–)8–20(–25) per scale, 4–7 mm long, reddish brown ... *C. sempervirens*

Genus 3. ***Taxodium*** Rich., Ann. Mus. Natl. Hist. Nat. (Paris) 16: 298. 1810.

Taxodium distichum[4] (L.) Rich., Ann. Mus. Natl. Hist. Nat. (Paris) 16: 298. 1810.

T. distichum (L.) Rich. var. ***distichum***

Syn. *Cupressus disticha* L., Sp. Pl. 2: 1003. 1753.

First official reports of the genus and the species as naturalized taxon for the flora of Tunisia.

A winter deciduous tall tree, to 40(–46) m tall; *trunk* monopodial, erect; base often swollen, fluted or buttressed; 'pneumatophores' or 'knees' common, numerous on root systems of trees growing in or near water, conical, 1(–4) m tall; *bark* on trunk fissured, exfoliating in more or less fibrous, long strips, light brown, turning grey; *branches* spreading or ascending, forming a conical or pyramidal crown in young trees, old trees becoming increasingly flat-topped with long main branches in upper half of tree; short shoots spreading in two ranks, or in 5–8 ranks, mostly persistent but with occasionally assurgent or nearly erect *branchlets*; *leaves* linear, flattened, pectinately arranged, twisted near base, 10–15(–22) mm long, straight or slightly curved, obtuse or mucronate; *pollen cones* solitary or in pairs, globose to ovoid-oblong, 3–5 × 2–3 mm, yellowish green turning purplish to brown; microsporophylls (5–)6–10(–15), ovate-peltate, keeled, bearing (2–)4–9(–10) globose pollen sacs; *seed cones* often clustered, subglobose or more or less ovoid but irregular, (15–)20–35(–40) mm long; *seeds* ca. 20–40 per cone, 4–7 mm long, lustrous brown, with a large, (sub)lateral, pale coloured hilum; *wings* very small or vestigial, forming up to 3 narrow ridges of ca. 1 mm wide.

Distribution: the species is indigenous to South-East USA: Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, South Texas and Virginia.

4 The same taxon is known in Algeria within the National Park of El Kala since many decades but any indication if casual or naturalized is reported!

Figure 8: *Taxodium distichum* var. *distichum* in Tunisia. A: habit of some trees in their habitat within Kroumirian forests; B: detailed part of the bark trunk; C: branchlets with linear, flattened, pectinately arranged leaves; D: clustered, subglobose mature close-up seed cones; E: habit of some tree in the winter season. (Tabarka, NW Tunisia), Photographs R. El Mokni.

Slika 8: *Taxodium distichum* var. *distichum* v Tuniziji. A: habitus nekaterih dreves na njihovem rastišču v Kroumirskih gozdovih; B: podroben del lubja debla; C: veje s črtastimi, sploščenimi, glavničasto razporejenimi listi; D: grozdasti, subkroglasti zreli semenski storži od blizu; E: habitus drevesa v zimski sezoni. (Tabarka, SZ Tunizija), fotografije R. El Mokni.

Figure 8 (continued)**:** *Taxodium distichum* var. *distichum* in Tunisia. F: dehiscent seed cone; G: pneumatophores or knees; H: pollen cones yellowish green turning purplish to brown (Tabarka, NW Tunisia), Photographs R. El Mokni.
Slika 8 (nadaljevanje)**:** *Taxodium distichum* var. *distichum* v Tuniziji. F: razpadli semenski stožec; G: dihalne korenine ali kolena; H: pelodni storži rumenkasto zeleni, ki se spreminjajo v vijolično do rjavo (Tabarka, SZ Tunizija), fotografije R. El Mokni.

Habitat in Tunisia (Figure 8): *Taxodium distichum* var. *distichum* is found within lowland river flood plains and swamps in the surroundings of the region of Tabarka within Jendouba governorate (NW Tunisia) where it seems that it has been introduced since colonization and show many individuals (ca. 600) of different heights and diameter at breast height.

Notes: the var. *distichum* can be easily distinguished from the var. *imbricarium* (Nutt.) Sarg. by the presence of numerous 'Pneumatophores' or 'knees' [*vs*. uncommon and if present more rounded (not conical)], its linear, flattened leaves pectinately arranged, twisted near base, 10–15(–22) mm long, straight or slightly curved, obtuse or mucronate (*vs*. largely appressed but with free apices leaves, not twisted at base, short acicular (subulate) to narrowly lanceolate, 3–10 mm long, keeled, acute or pungent in the var. *imbricarium*).

Subfam. 2. **Cupressoideae** Rich. ex Sweet
Genus 1. ***Platycladus*** Spach, Hist. Nat. Vég. Phan. 11: 333. 1841.

Platycladus orientalis (L.) Franco, Portugaliae Acta Biol., sér. B, Sist. Vol. "Julio Henriques": 33.1949.
Syn. *Thuja orientalis* L., Sp. Pl. 2: 1002. 1753, *Biota orientalis* (L.) Endl., Syn. Conif.: 47. 1847.

First official reports of the genus and the species as casuals to naturalizing taxa for the flora of Tunisia.

Trees to 20–25 m tall, evergreen, monoecious; *trunk* monopodial or multistemmed from low above ground, with stem(s) erect or ascending; *bark* on large stems becoming fibrous, exfoliating in thin, long sheets; *branches* spreading, ascending or erect, contorted in old trees, higher order branches mostly spreading, forming a pyramidal, rounded or irregular crown; *leaves* decussate, decurrent, scale-like, on lateral branchlets dimorphic, facials more or less rhombic to obtrullate, with appressed, obtuse apex, green or greyish green; *pollen cones* terminal on ultimate branchlets, solitary, subglobose, 2–3 × 2 mm; microsporophylls (6–)8–10(–12), decussate, peltate, bearing 3–6 abaxial pollen sacs; *seed cones* terminal, ampulliform, glaucous or purplish cones 15–20(–25) × 10–18 mm

Figure 9: *Platycladus orientalis* in Tunisia. A: habit of a tree in its habitat; B: detailed part of the bark trunk; C: leaves with terminal, solitary pollen cones; D: terminal, ampulliform, glaucous seed cones; E–F: mature purplish seed cones. (Monastir, NE Tunisia), Photographs R. El Mokni.

Slika 9: *Platycladus orientalis* v Tuniziji. A: habitus drevesa na njegovem rastišču; B: podroben del lubja debla; C: listi s končnimi, posamičnimi pelodnimi storži; D: terminalni, stekleničastimi, sivkastimi semenski storži; E–F: zreli škrlatni semenski storži. (Monastir, SV Tunizija), fotografije R. El Mokni.

which open widely and turn brown when the seeds have ripened; *seeds* 6–10(–12), ovoid to narrowly ovoid, 5–7 × 3–4 mm, greyish brown with a large, light brown hilum; *wings* absent or rudimentary.

Distribution: the species is indigenous to China (S Gansu, Hebei, Henan, Shaanxi, Shanxi, Nei Mongol [Inner Mongolia]), Korea, and Russian Far East. It seems to be the most widely introduced cupressaceous conifer in Asia. In many areas inside and outside China it has 'escaped' from cultivation and established spontaneous populations. In Europe, the plant was reported as naturalized only in Austria and Italy whereas it is casual in Czech Republic, Germany, Spain and Portugal. In North Africa, it is cited as cultivated only in Morocco and Algeria (Raab-Straube, 2014+; APD, 2022d).

Habitat in Tunisia (Figure 9): *Platycladus orientalis* is found within borders of ornamental gardens and roadsides in the regions of Monastir and Mahdia (NE Tunisia) where many juvenile and shrubby individuals (ca. 50) of different heights were observed not far from adult cultivated specimens.

Notes: Despite that both genera show seed cones with 3–6 decussate pairs of fertile and sterile scales. The genus *Thuja* shows thin seed cone scales, the distal pair reduced and connate; seeds winged whereas the genus *Platycladus* shows thickened seed cone scales with well-developed and spreading distal pair and unwinged seeds.

Updated key to the genera of the Cupressaceae family in Tunisia

1a. Leaves on lateral branchlets and cone scales helically arranged; leaves (almost) all linear, flat or short acicular to subulate in one variety; lateral branchlets (semi)deciduous; pollen cones numerous on leafless branchlets; seed cones on thicker branches, often aggregate ..... ***Taxodium***

1b. Leaves on lateral foliage branchlets scale-like or subulate or lanceolate, or a mixture of scale-like and linear leaves present on the same mature plant, lateral branchlets evergreen **2**

2a. Leaves on lateral branchlets scale-like, appressed, or subulate or lanceolate; seed cones squarrose; cone scales cuneate, with small teeth above the recurved bract tip ..... ***Cryptomeria***

2b. Leaves on lateral, short branchlets at least in part scale-like or subulate, or a mixture of scale-like and linear leaves present on the same mature plant; seed cones not squarrose; cone scales decussate, opposite or whorled ... 3

3a. Leaves scale-like or acicular-linear; seed cones berry-like, ± soft, indehiscent; cone scales (almost) entirely fused ..... *Juniperus*

3b. Leaves on lateral branchlets decussate, scale-like, rarely acicular or linear; seed cones not berry-like, (eventually) dehiscent; cone scales at least partly integer **4**

4a. Leaves on lateral branchlets decussate, monomorphic or at least not clearly divided in facials and laterals; seed cones globose to ovoid, with > 6 peltoid scales; seeds numerous, small, winged ..... *Cupressus*

4b. Leaves decurrent, dimorphic; seed cones (sub)globose or ampulliform, with ≤ 6 scales; seeds ≤ 12, wings sometimes absent or rudimentary **5**

5a. Leaves weakly dimorphic, appressed, long decurrent, adnate to branchlets except for the small apex; seed cones (sub)globose when closed, woody with 4(-5–6) subpeltate scales in decussate pairs; seeds 4–6 winged ..... *Tetraclinis*

5b. Leaves decurrent, dimorphic, facials more or less rhombic to obtrullate, with appressed, obtuse apex, laterals bilaterally flattened, distal part spreading or reflexed, appressed or free, with incurved, obtuse apex; seed cones ampulliform with 3–6 decussate pairs of fertile and sterile thickened scales, the distal pair well developed and spreading; seeds up to 12 unwinged or more rarely with rudimentary wings ..... ***Platycladus***

Key to the families of the Pinopsida Class in Tunisia

1. Seed cones with seed scales in the axils of bracts (bracts can be much reduced in mature, woody cones but are conspicuous in immature cones at early stages of development); cones clearly compound and never reduced; seeds two on the adaxial (upper) side of each fertile scale; adult green leaves acicular-linear ..... ***Pinaceae***

2. Seed cones with seed scales fused with bracts (bracts make up the bulk of the cone), or with bracts only (which may be much enlarged, swollen and/or woody at maturity), or with scales obscure, much reduced or absent; seeds either single or more than two per fertile scale; adult green leaves scale-like, or acicular, or with a distinct lamina, or replaced by phylloclades (phyllodes); seed cones with seed scales fused with bracts, or with bracts only which are much enlarged and often swollen at maturity and may then form a compact, globose cone; seed cones consisting of bracts forming the cone scales only (sometimes with rudimentary seed scales only visible at very early stages of development); seeds 1-many, axillary or on the base of each bract (rarely only a single seed per cone); true leaves scale-like or acicular (needle-like), cataphylls absent, phyllodes absent ..... ***Cupressaceae***

Discussion

The list of coniferous species here presented is only a starting point for Tunisia and in part for North Africa. Further surveying and assessment of the status of woody alien plants is required for many regions within the Tunisian country and/or within the extended area of the northern African countries. Subspecies (*escarena* and *pinaster*) of *Pinus pinaster* were discovered with very extended populations as well-established aliens in many localities (in the northeastern and the northwestern) of the country. These taxa seem to have escaped by different means of dissemination since long time ago but not reported due perhaps to lack of investigations, or could be overlooked (vegetative resemblance with the autochthonous subspecies, *renoui*) either misidentified. Moreover, among the recorded taxa, *Pinus brutia* var. *pityusa* can be considered especially dangerous since invasiveness has been previously observed and assessed more recently in other regions mainly within the northwestern part of Tunisia. A prompt invasion status could be assigned in the nearer future to *Taxodium distichum* in the marshy areas of the northwest since actual surveys show active dispersal in new localities ca. 15 km far away the historical know locality. The remaining taxa (mainly *Cryptomeria japonica*, *Cupressus arizonica* var. *glabra*, *Pinus coulteri* and *Pseudotsuga menziesii* var. *glauca*) can be considered less-threatening up to now, according to our field observations. However, invasive status may vary with time, and taxa could modify their ecological behavior especially with the global changing of environmental conditions (Richardson & Bond, 1991; Willis et al. 2010). Consequently, many alien species already present in an area and currently deemed 'safe' (non-invasive) may well become invasive.

Conclusion

Novelties presented in this study within coniferous group (Gymnospermae *sensu lato*) enhance the evidence of the ongoing process of introductions and naturalization of alien (introduced trees and shrubs) plants and ornamentals in Tunisia and North Africa, as in many parts of the World. Data here firstly presented is mainly related to woody species of the Pinidae group escaping specially from botanical gardens (arboreta) and nurseries' surroundings. The increase of field surveys with a proper identification allow a better understanding of pathways of introductions and vectors of invasiveness for both recent and old escapes and help in reducing the impacts of these introduction on native plant communities and invaded habitats.

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