



Bulletin of the *Cupressus* Conservation Project

No 28

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Voyages through conifer landscapes

Abies pinsapo subsp. *marocana*, an expedition to study the firs from Morocco 71

T. Madern

Abstract : During the winter 2023, a short trip to Morocco was decided to visit the different populations of the Moroccan Fir in the Rif mountains. The absence of snow allowed the collection of seeds, seedlings and scion material. A photo album and a map illustrate this trip report.

Taxonomic note on the Moroccan Fir 100

D. Maerki

Abstract : Since the first botanical description of the Moroccan Fir, different taxonomic ranks have been used for it through the years. These are reviewed with their translations into English. The most appropriate taxonomic rank for the fir groves present in Morocco is suggested and justified. Cotyledon number statistics are published.

A monograph of leaf characters in genus Abies

(*Abietoideae*, *Pinaceae*) – extract 116

V.M. Dörken & H. Nimsch

Abstract : Leaf characters of the Spanish and Moroccan Firs are reviewed in details. The pages are extracted from that monograph with the kind permission of the authors.

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Bulletin No 28

Cover photo: Moroccan fir on Djebel Tazaot, Morocco. 2023.02.28. © T. Madern.

Voyages through conifer landscapes *Abies pinsapo* subsp. *marocana*¹, an expedition to study the firs from Morocco.

From 24 to 27 February 2023.

The closest departure town to visit the Moroccan Fir populations is Chefchaouen, a small town in the Atlas Mountains, closest to the Talassemame Park. The first day was used to find a means to travel up the mountains along dirt roads. A driver, very knowledgeable of all the paths in the surrounding areas, was found who agreed to lead us to the different fir forests with his 4x4 car.

The second day was dedicated to accessing the Djebel Tazaot forest to the north of the distribution range, while the third day was used to cross the Talassemame Park and to reach the population close to Adeldal.

The study by Terrab *et al.* (2007) records three localities in Spain and five localities in Morocco. This information was very useful to prepare the trip.

		Localities	Altitude	Coordinates
			m	
<i>Abies pinsapo</i> (S Spain)	1	Sierra de Grazalema	1230	36°46' N - 5°25' W
	2	Sierra de las Nieves	1629	36°40' N - 5°03' W
	3	Sierra Bermeja	1350	36°29' N - 5°11' W
<i>A. tazaotana</i> (NW Morocco)	4	Djebel Tazaot	1550	35°16' N - 5°06' W
<i>A. marocana</i> (NW Morocco)	5	Djebel Azilane	1700	35°11' N - 5°13' W
	6	Djebel Gharbouch	1460	35°07' N - 5°04' W
	7	Talassemtane Park	1560	35°07' N - 5°08' W
	8	Adeldal	1420	35°07' N - 5°01' W

Table 1: after Terrab *et al.*, 2007, Table 1.

Unfortunately the easternmost population is not close to Adeldal (while the Djebel Gharbouch is just to the south side of that village), but to Taria el Aoulia (cf. Map 1, p. 94-95).

<i>A. marocana</i> (NW Morocco)	5	Djebel Azilane	1700	35°11' N - 5°13' W
	6	Adeldal - Djebel Gharbouch	1460	35°07' N - 5°04' W
	7	Talassemtane Park	1560	35°07' N - 5°08' W
	8	Taria el Aoulia	1420	35°07' N - 5°01' W

Table 2: correction of the 8th locality name (after Terrab *et al.*, 2007, Table 1).

Against some expectations, this study showed that, in its cpDNA, the Tazaot population is not significantly distinct genetically from the other Moroccan fir localities, and that the most different firs are the ones from Taria el Aoulia, a forest located at the extreme eastern side of the *Abies* distribution area (cf. Terrab *et al.* 2007: 410, Fig. 1). It would have therefore been most interesting to visit that site to collect significant genetic material here as well as from the all other areas, since those four populations, including Djebel Tazaot, are supposed to be genetically more similar to each other. Unfortunately because of the confusion in locality names, the third day was dedicated to visit only the Adeldal-Djebel Gharbouch site, but not Taria el Aoulia.

During the present expedition to Morocco, it was thus possible to collect material (scions and/or seeds and seedlings) from two of the mentioned populations, Djebel Tazaot and Talassemame. The

¹ For the different taxonomic treatments of the southern Spanish and Moroccan Firs, see the Taxonomic note, p. 100.

purpose is to graft the scions and germinate the seeds to later plant them close to each others and to study their developments *ex situ* for possible comparisons in the same environment. The material collection will be also crucial for further observations on morphology and phenology. For instance, their behaviour and adaptation to other environments will be observed regarding warmer and drier conditions at lower altitudes.

Another of the purposes of the expedition was to verify the appearance of the Moroccan firs *in situ*. For instance, opinions on its foliage differ, especially about the pointed or rounded shape of the needle tips, depending on whether it is from the Spanish or the Moroccan population. During this visit to the main Moroccan distribution area, it was noted that the needles on branches in the mid-crown of the trees were blunt.

Many photos of the trees at all stages of their development were taken and are presented in the following pages. These photos will be useful to illustrate the different characteristics of those populations in their natural environments.

Observations of the surrounding vegetation were carried in order to deduce the nature of the soil. For instance the presence of *Arbutus unedo* growing in these areas suggests some autoecologic data as this species is rather thermophilic and heliophilic, and growing on filtering soils, which point usually to a siliceous substrat (Rameau *et al.* 2008: 453).

To complete the study of all these *Abies* populations growing on two continents south and north of the Gibraltar strait, a survey of the Spanish localities will be necessary to ascertain the shape of the needles and to allow comparisons based on the same criteria.

In conclusion, this expedition to Talassemame and the surrounding areas was a rich learning experience. The material collection and the study of the surrounding vegetation will contribute to a better understanding of the growth and development of these Moroccan firs and will lead to further observations which will be the object of further publications.

Bibliography

- Rameau, J.-C., D. Mansion; G. Dumé & C. Gauberville, J. Bardat, E. Bruno & R. Keller (2008). *Flore forestière française, guid écologique illustré*. Vol. 3: Région méditerranéenne. Institut pour le Développement Forestier.
- Terrab, A., S. Talavera, M. Arista, O. Paun, T. F. Stuessy & K. Tremetsberger (2007). Genetic diversity at chloroplast microsatellites (cpSSRs) and geographic structure in endangered West Mediterranean firs (*Abies* spp., Pinaceae). *Taxon* 56 (2): 409-416.



Fig. 1: Seeds of Moroccan Fir collected on the southern side of Djebel Tazaot. Scale: ~1x.

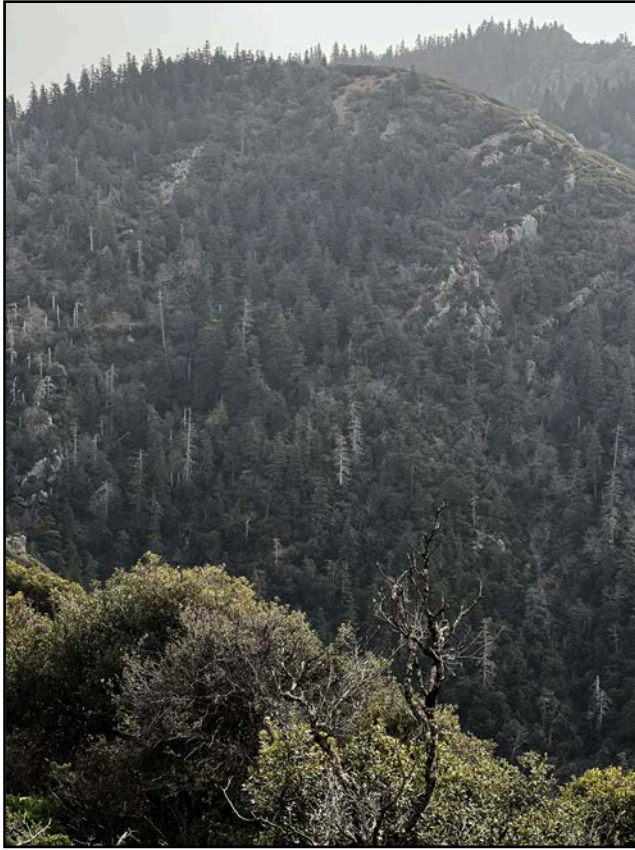


Fig. 2: First firs seen after leaving Akchour.

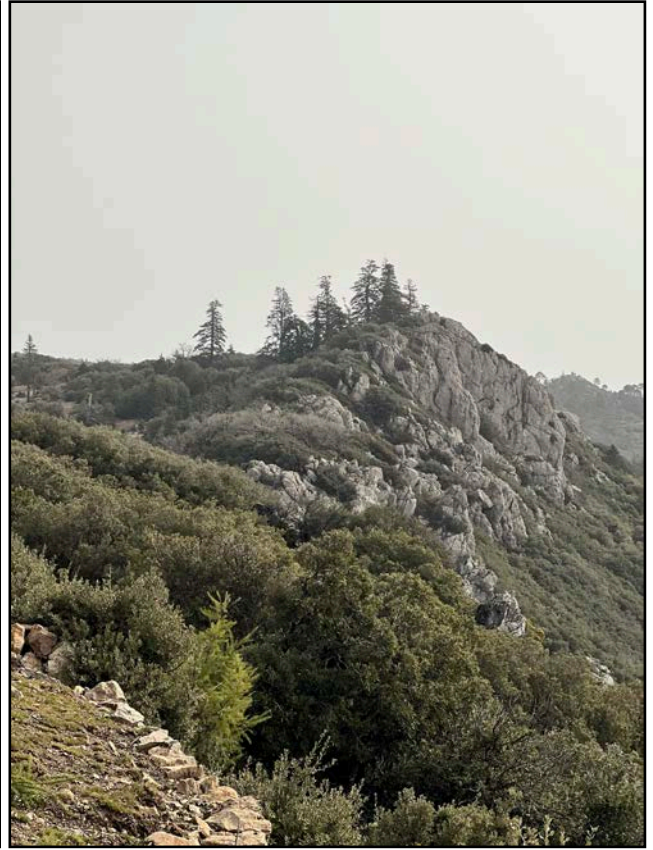



Fig. 3: Arriving on the plateau before the summit of Djebel Tazaot.

On the map: **Figs 1 & 2**, before marker 


Figs 4 to 17, marker 

Fig. 4 & 5: Plateau with scattered trees in a dry environment before the Djebel Tazaot forest.

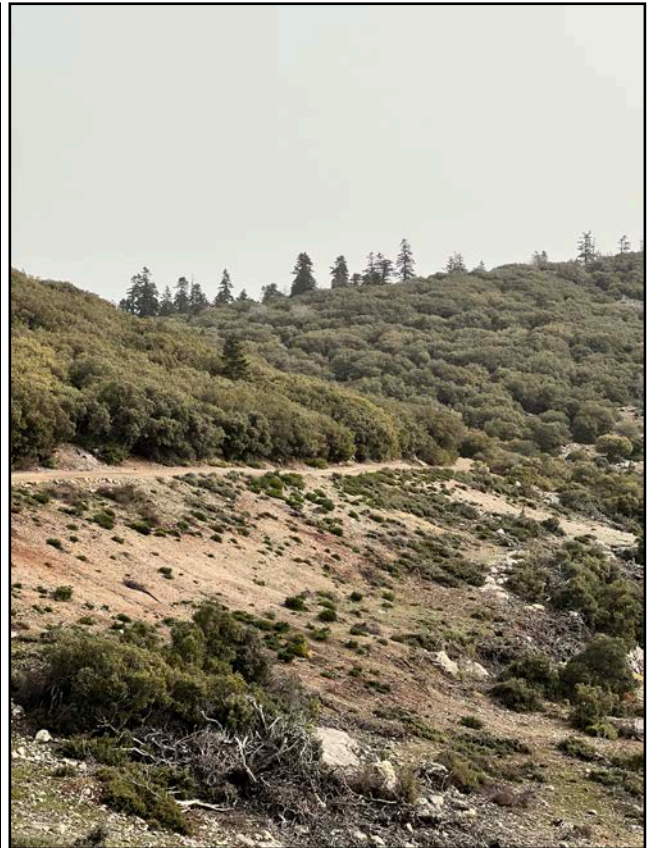




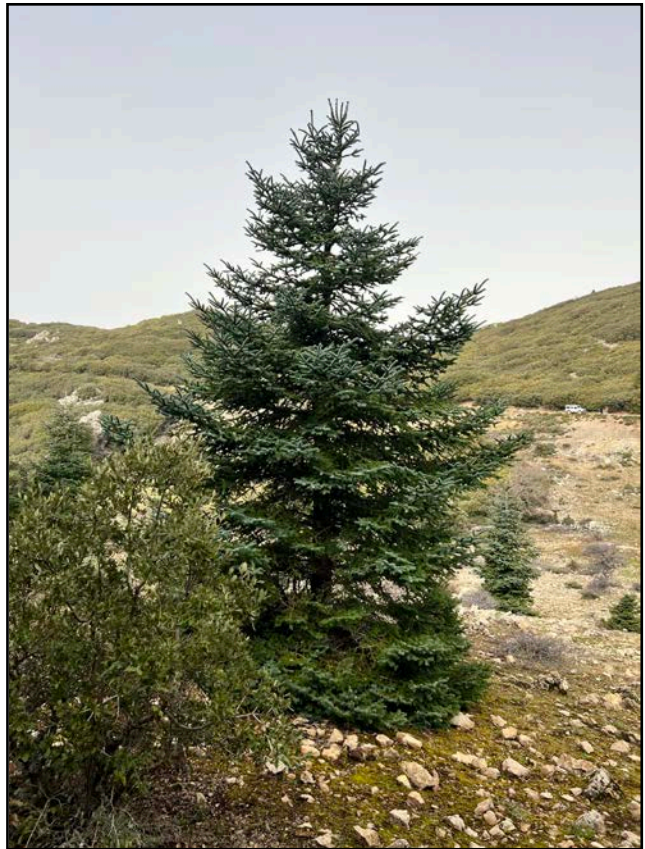
Fig. 6: Regeneration is occurring everywhere on the plateau. All young plants have acute needles.

Figs 7 to 9: Illustrations of the variability of the foliage.





Fig. 10: Isolated sapling in the dry environment of the plateau, altitude between 1620 and 1630 m.



Figs 11 & 12: Small trees with good crown shape despite the shallow soil.

Figs 13 & 14: Other seedlings showing that regeneration is not rare even among stones.





Fig. 15: Beautiful isolated tree on the plateau.



Fig. 16: With age, this tree has suffered major storm damage. Cf. next photo.



Fig. 17: Same tree as Fig. 16, notice the exposed roots and dead branches. This isolated tree is visible on satellite photos.



Fig. 18: Arriving in the Djebel Tazaot forest. The author gives the size of the trunk. Altitude 1630 m.



Fig. 19: Pinsapo recreation area.

Cover photo: a majestic tree at this very locality.

On the map: **Figs 18 & 19 & cover,** marker **2**.



Fig. 20: View of part of the Djebel Tazaot forest. Altitude 1635 m.

On the map: **Fig. 20**, marker **3** and **Fig. 21**, marker **4**.

Fig. 21: An isolated grove at 1680 m. These trees are visible on satellite photos.





Figs 22 & 23: Tree with multiple trunks at 1710 m.

On the map: Figs 22 & 23, marker **5** and Figs 24 & 25, marker **6**.

Figs 24 & 25: Another tree along the dirt road at 1620 m.

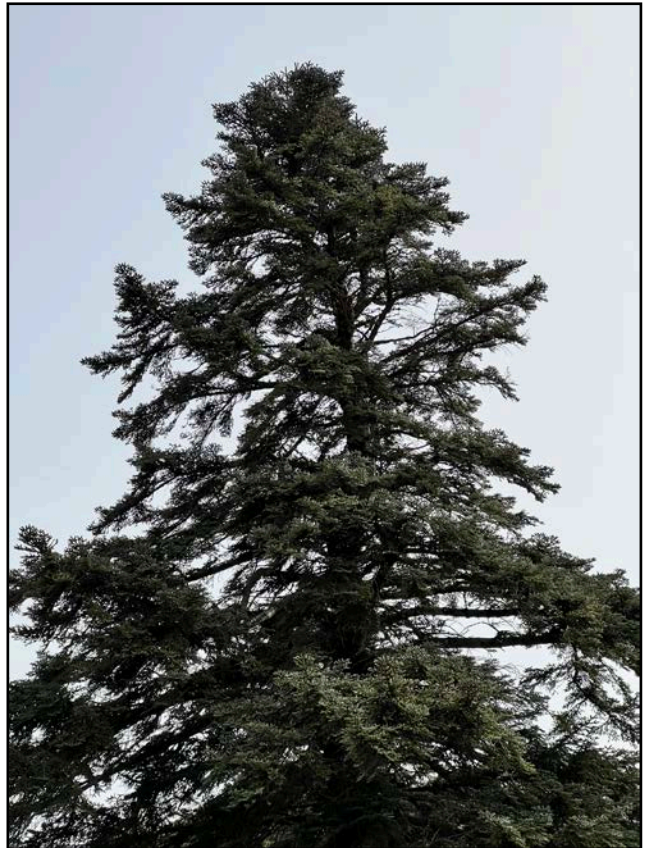




Fig. 26: Another isolated tree on the side of the road with the top damaged, at 1610 m altitude.

On the map: **Fig. 26**, marker .



Fig. 27, 28 & 29: Isolated tree between Djebel Tazaot and Talassemrane, at 1500 m. The author hugging the fir, showing the size of the trunk.

On the map: Figs 27, 28 & 29, marker **8**.



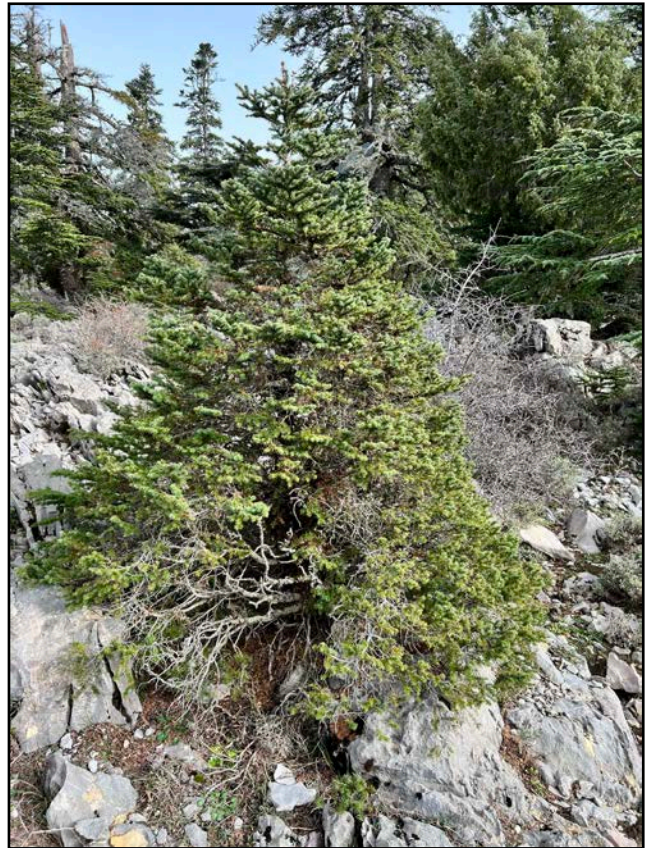




Fig. 33: Majestic tree in the heart of the Talassemrane National Park.

Previous page: Figs 30, 31 & 32: Arrival at the centre of the Talassemrane National Park. Limestone rocks are clearly visible.

On the map: **Figs 30 to 35,** marker **9**. Altitude 1720 m.



Fig. 34: At some places, the growth of the firs is limited by the substratum. Driver (in black coat) and Gilali, friend of the author, who organised the expedition.

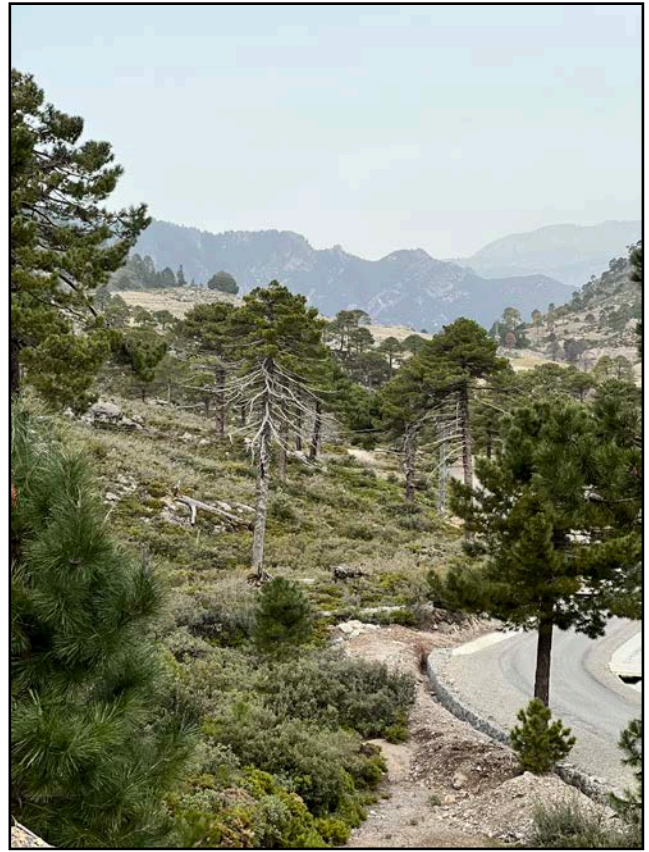
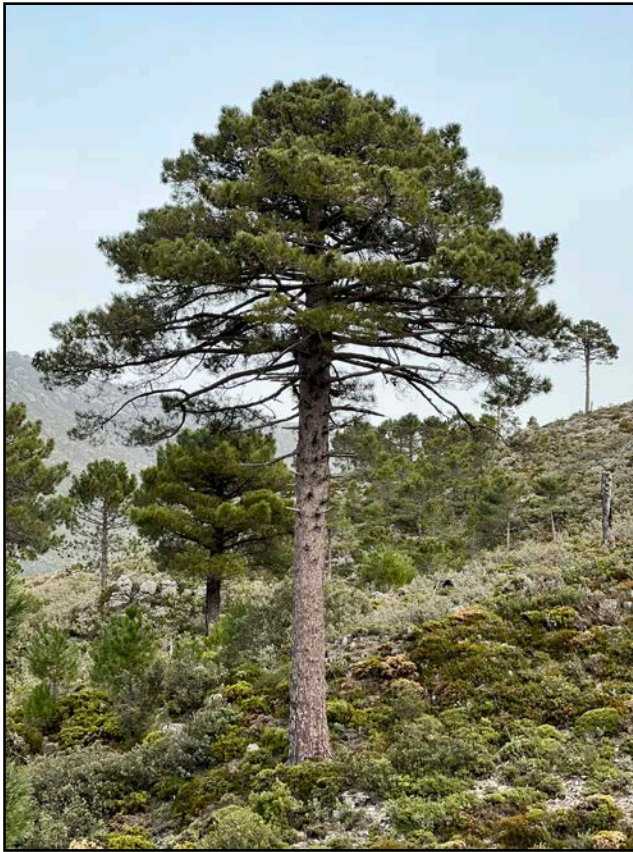
On the map: **Fig. 36**, marker **10**.

Fig. 35: Seedling on the limestone rock.




Fig. 36: The author and his driver. Alt. 1680 m. Notice the clouds covering the valley behind.





Figs 37 & 38: *Pinus pinaster* on the road, south to Adeldal.

On the map: **Fig. 37 & 38:** marker . Altitude 1400 m.

Figs 39 & 40: See caption of Fig. 41 on the next page.

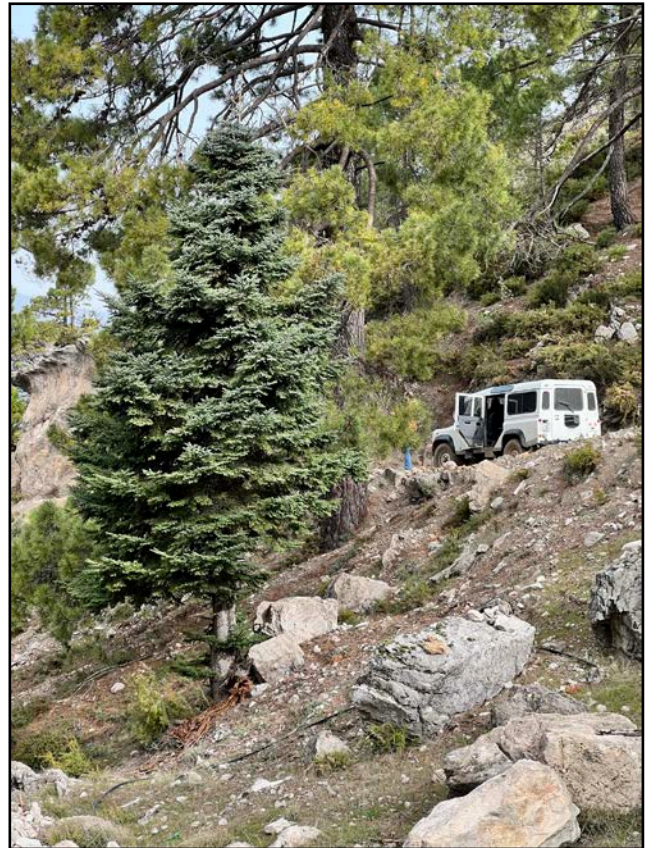




Fig. 41: On the road before Adeldal, the Moroccan Firs mix with *Pinus pinaster*, the latter occupying the drier sites.


On the map: **Fig. 39 to 41:** marker . Altitude 1320 m.



Fig.42: On a slope close to Adeldal, the Moroccan Firs form an open forest very different from the one on Djebel Tazaot. Compare with Figs 19 & 20. *Pinus pinaster* is present especially at the top of the slope.

On the map: **Fig. 42**, marker . Altitude 1210 m.



Fig. 43: Shoot of Moroccan Fir with mature foliage showing obtuse needles and the resinous buds.

On the map: **Figs 43 to 52**, small side valley between markers **14** and **15**. Alt. between 1250 and 1350 m.



Fig. 44: Another of a slope above Adeldal.

Map 1: Visited groves of the Moroccan Fir.
2023-02-22/23

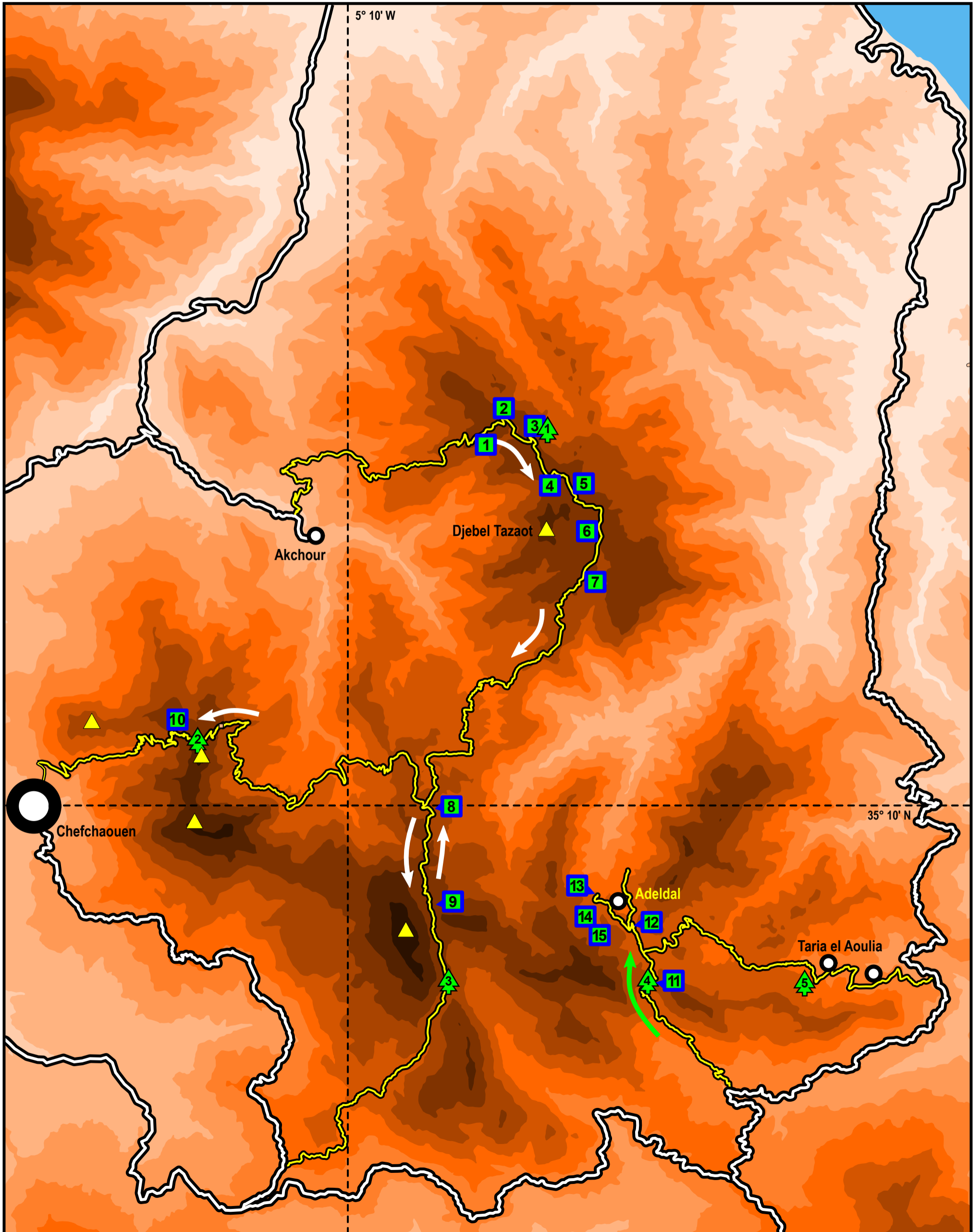
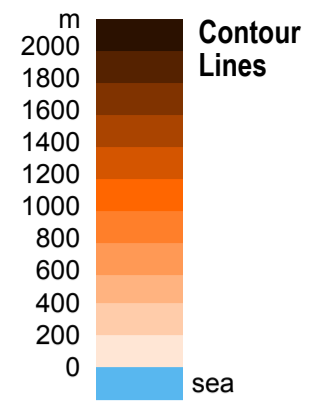
Scale: ~1:100.000

Localities
from Terrab
et al. 2007

- Djebel Tazaot 1
- Djebel Azilane 2
- Talassemtane 3
- Adeldal 4
- Taria el Aoulia 5

- Town
- Summit
- Photos
- Trip direction:
white: 1st day
green: 2nd day

- Main road
- Dirt road

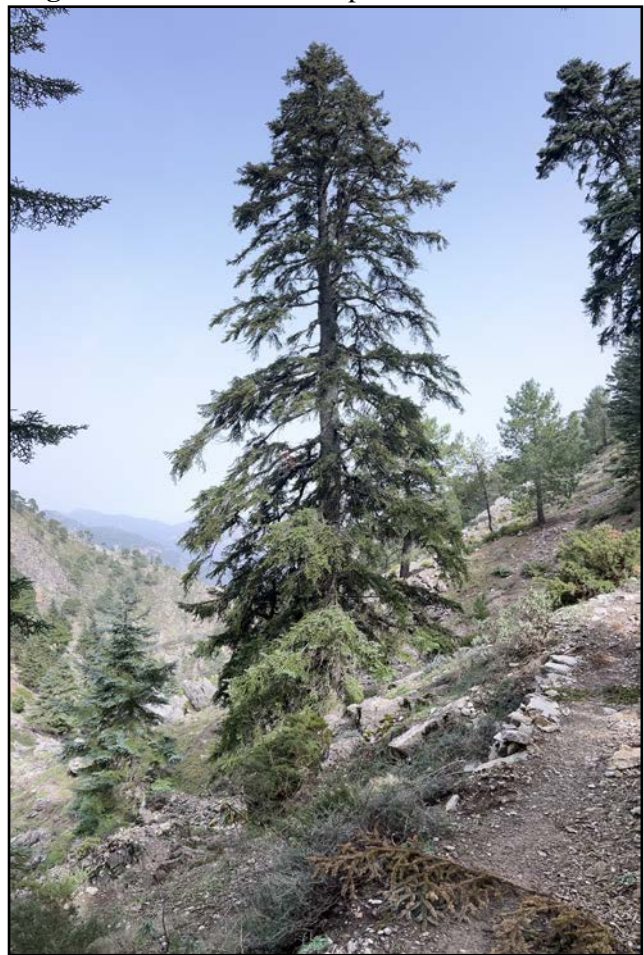
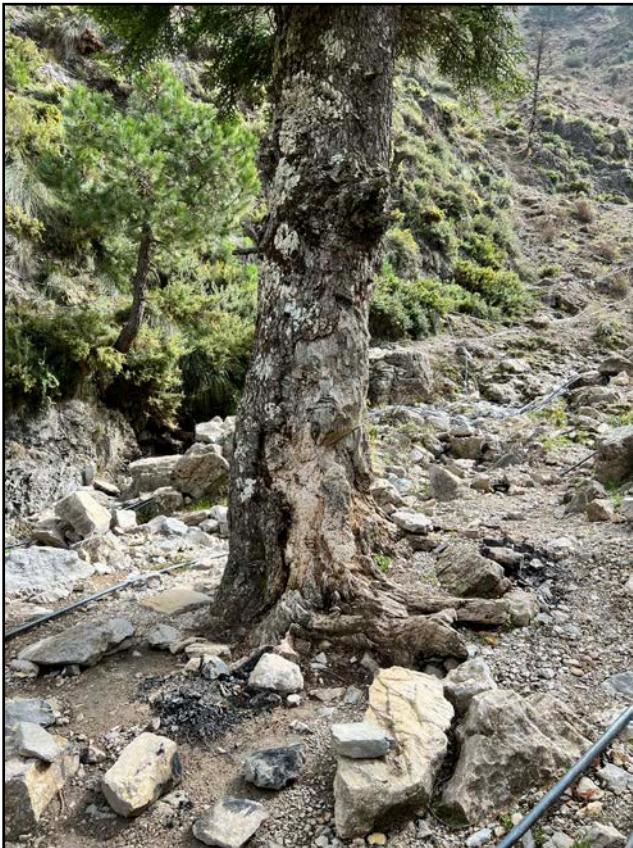




Figs 45 & 46: Seedlings.

Fig. 48: Isolated fir on a slope.

Fig. 47: At the bottom of the valley, the soil at the base of the trunk was washed away by intermittent streams, exposing the roots.



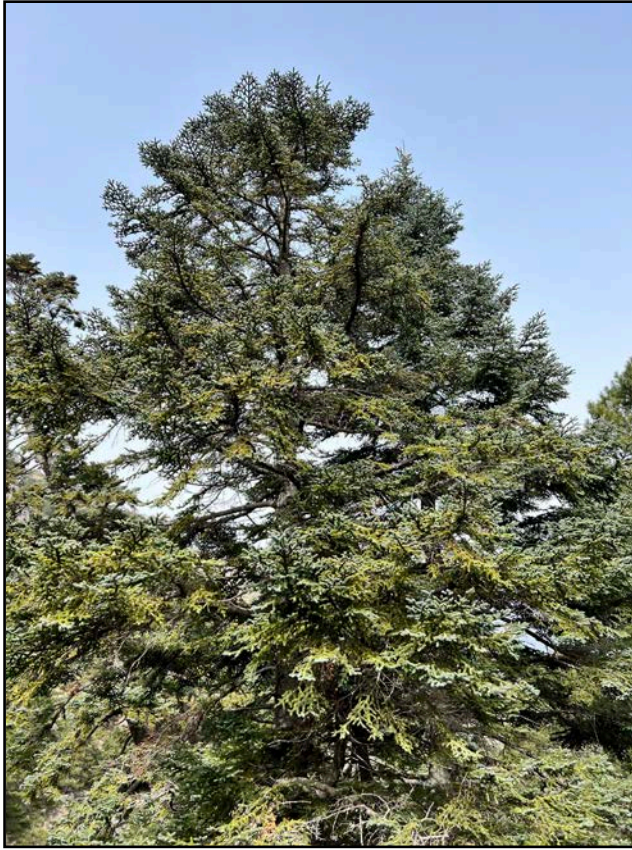


Fig. 49: This tree displays an irregular crown.

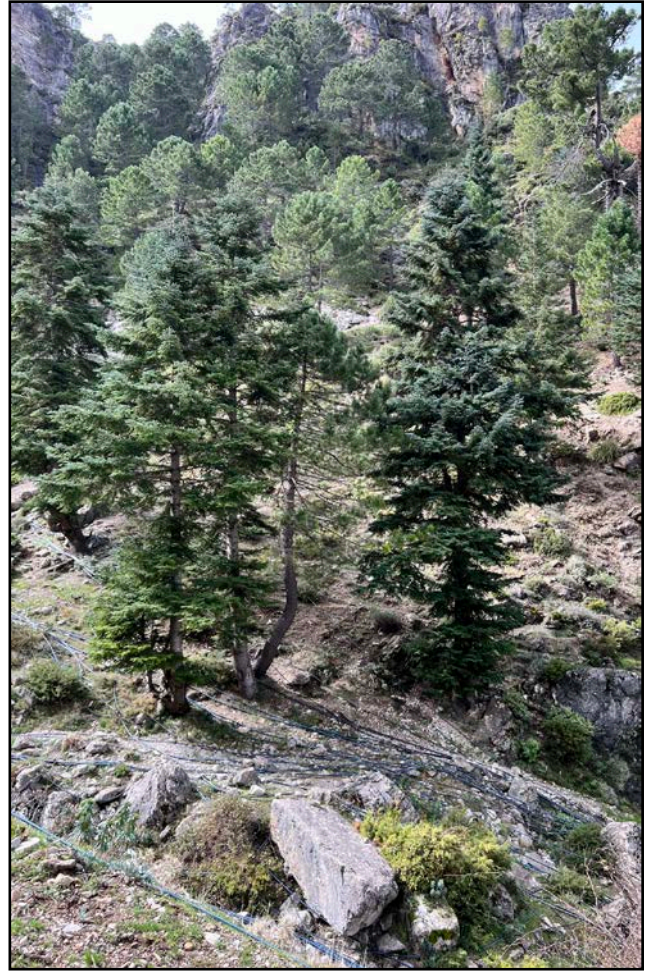


Fig. 50: The sizes of the firs are limited and the pines occupy the upper slope.



Fig. 51: View downstream of a small side valley west above Adeldal.



Fig. 52: Despite being on the river bed or close to it, these firs are suffering. The pines on the slopes display much better crowns.



Fig. 53: Above Adeldal and along the dirt road, a tall *Pinus pinaster*. Altitude 1260 m.

Taxonomic note on the Moroccan Fir

The Spanish Fir was described in 1838 by [Boissier](#) as *Abies pinsapo* (see Appendix A, p. 113), the specific name derived from the local vernacular name. When samples of the firs from Morocco came to the attention of botanists, two new species were described and several new combinations were created. This is the list of those new scientific names¹:

Abies marocana Trab., *Bull. Soc. Bot. France* 53: 154 (1906).

Abies pinsapo subsp. *marocana* (Trab.) Emb. & Maire, *Bull. Soc. Hist. Nat. Afrique N.* 19(7): 245 (1928).

Abies pinsapo var. *marocana* (Trab.) Ceballos & Martín Bol., *Servicio Forestal de Investigaciones y Experiencias* 1(2): 62 (1928).²

Abies tazaotana Côtzar ex Villar, *Types Sol Afr. Nord.* 1: 79 (1947).

Abies tazaotana A.Chev., *Revue Unasylya* ii. 370 (1948); cf. A. Cheval. in *Rev. Bot. Appliq.* xxix. 420 (1949).

Abies pinsapo var. *tazaotana* Pourtet, *Ann. École Natl. Eaux.* 9(1): 100 (1954).

Abies pinsapo subsp. *tazaotana* (Côtzar ex Villar) Govaerts, *World Checkl. Seed Pl.* 1(1): 6 (1995).

Abies pinsapo subsp. *marocana* (Trab.) Silba, *J. Int. Conifer Preserv. Soc.* 15(2): 44 (2008), isonym.

Abies marocana subsp. *tazaotana* (Côtzar ex Villar) Rivas Mart., *Itinera Geobot.* 18(2): 481 (2011).

All the original diagnoses are either in French or Spanish: their English translations are given in the following pages in chronological order to help assess which details motivated their splitting from the Spanish Fir. Discussion of the importance of the proposed taxonomies is made.

- *Bulletin de la Société Botanique de France*, vol. 53, pp. 154-155, Plate 3, 1906.

Il est donné lecture de la communication qui suit :

Sur la présence d'un *Abies* nouveau au Maroc (*Abies marocana*)

PAR M. L. TRABUT.

M. JOLY, qui a exploré dernièrement les montagnes de Tétuan et qui y a découvert le *Viscum cruciatum*³ sur l'Olivier, nous a fait parvenir ces jours-ci de la même région des rameaux d'un *Abies*.

A première vue, ce Sapin a beaucoup d'analogie avec l'*A. Pinsapo* Boiss.; mais l'examen de la feuille permet facilement de l'en séparer, il est exactement intermédiaire entre l'*A. Pinsapo* et l'*A. numidica*. La feuille est moins épaisse, plus large que celle du *Pinsapo*, elle est également pourvue de stomates à la face supérieure; mais en moindre quantité, les glandes résineuses reposent sur l'hypoderme inférieur, elles ne sont pas comme dans l'*A. Pinsapo*, en plein parenchyme vert.

D'un autre côté la feuille est aiguë, tandis qu'elle est obtuse et plus longue dans l'*A. numidica*, elle est épaissie à la base, qui ne subit pas une torsion, comme chez le *numidica*⁴.

En résumé, d'après les seuls caractères des rameaux, il est possible d'établir une espèce nouvelle dans ce genre, déjà bien représenté dans le bassin méditerranéen.

ABIES MAROCANA, sp. nov. — Feuilles aiguës, épaissies à la base, plus larges et plus longues que dans l'*A. Pinsapo*, ne se tordant pas à la base pour s'infléchir sur les rameaux, hypoderme double,

¹ Source : ipni.org

² Ipni: *Abies pinsapo* var. *marocana* (Trab.) Ceballos & Martín Bol., *Bol. Inst. Nac. Invest. Agron.* 1(2): 18 (1929).

³ *Bull. Soc. bot. Fr.*, 1905, p. 501.

⁴ Voy. TRABUT, L'*Abies numidica* in *Rev. gén. bot.*, I, p. 405.

stomates sur les deux faces de la feuille, mais en moindre quantité sur la face supérieure; glandes résinifères sur l'hypoderme inférieur; cône non vu.

Les montagnes du sud de Tétuan, à Chechaouen janvier 1906 [Joly].

Légende de la Pl. III de ce volume.

Deux rameaux d'*Abies marocana* Trab. gr. nat.

On the presence of a new *Abies* in Morocco (*Abies marocana*)

BY M. L. TRABUT.

Mr. Joly, who has recently explored the Tetuan mountains and who discovered *Viscum cruciatum* on the Olive, has sent us these days from the same region branches of an *Abies*.

At first glance, this Fir has a lot of analogy with the *A. pinsapo* Boiss.; but examination of the leaf makes it easy to separate it from it, it is exactly intermediate between the *A. pinsapo* and the *A. numidica*. The leaf is less thick, wider than that of the Pinsapo, it is also provided with stomata on the upper side; but in lesser quantity, the resin glands rest on the lower hypodermis, they are not like in the *A. pinsapo*, in full green parenchyma.

On the other hand, the leaf is acute, while it is obtuse and longer in *A. numidica*, it is thickened at the base, which does not undergo a twist, as in *numidica*.

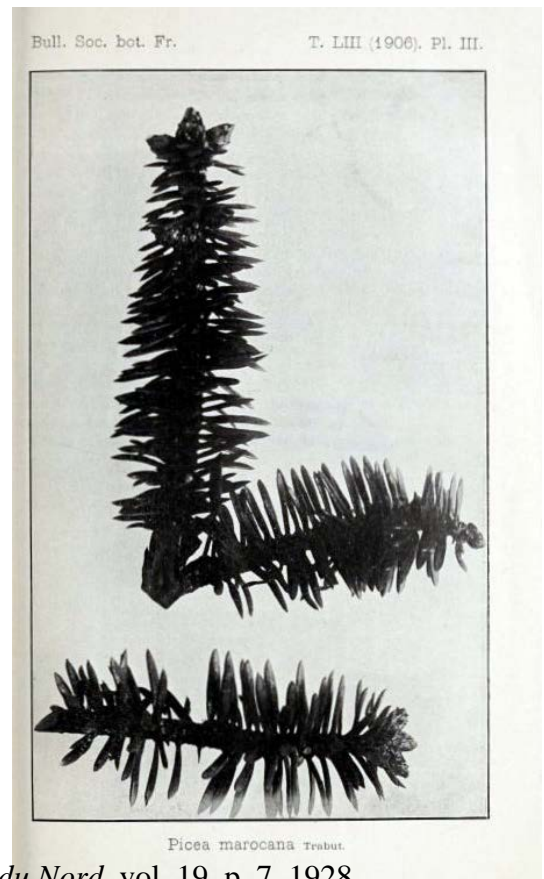
In summary, based on the characteristics of the branches alone, it is possible to establish a new species in this genus, already well represented in the Mediterranean basin.

Abies marocana, *sp. nov.* – Acute leaves, thick at the base, wider and longer than in *A. pinsapo*, not twisting at the base to bend on the twigs, double hypodermis, stomata on both sides of the leaf, but in lesser quantity on the upper side; resiniferous glands on the lower hypodermis; cone not seen.

The mountains of the south of Tetuan, in Chechaouen in January 1906 [Joly].

Legend of Pl. III of this volume.

Two branches of *Abies marocana* Trab., 1×⁵.



- *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, vol. 19, p. 7, 1928.

SÉANCE DU 14 JANVIER 1928

Communications

M. le D^r MAIRE présente trois rameaux d'un *Abies* qui lui a été envoyé des montagnes de Chaouen (Djebel Mago) par M. VIDAL Y LOPEZ. Ces rameaux, malheureusement stériles, sont absolument des rameaux d'*Abies pinsapo* Boiss.; les caractères observés sur un rameau rapporté de la même région par JOLY en 1905 et qui avaient permis au Dr Trabut de différencier le sapin de Chaouen de l'*A. pinsapo* sous le nom d'*A. maroccana* Trabut, n'existent pas ici; en particulier les canaux sécréteurs sont noyés dans le chlorenchyme comme dans les feuilles des branches moyennes et hautes du Pinsapo.

MEETING OF JANUARY 14, 1928

⁵ Here the plate is reduced.

Communications

Mr. Dr. Maire presents three shoots of an *Abies* that was sent to him from the mountains of Chaouen (Djebel Mago) by Mr. Vidal y Lopez. These branches, unfortunately sterile, are absolutely shoots of *Abies pinsapo* Boiss.; the characters observed on a branch reported from the same region by Joly in 1905 and which had allowed Dr. Trabut to differentiate the Chaouen fir from *A. pinsapo* under the name of *A. marocana* Trabut, do not exist here; in particular the secretary canals are drowned in the chlorenchyma as in the leaves of the medium and high branches of the Pinsapo.

- *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, vol. 19, pp. 244-245, 1928.

SÉANCE DU 7 JUILLET 1928

Communications

M. le Dr MAIRE, au nom de M. EMBERGER et au sien, fait une communication sur la flore et la végétation de l'Atlas rifain occidental. Les Montagnes calcaires y présentent, au-dessus de l'étage montagnard caractérisé par des forêts de *Quercus Ilex* et de *Q. lusitanica*, un étage subalpin caractérisé par des forêts de Sapins [*Abies pinsapo* Boiss. ssp. *maroccana* (Trabut) Emb. et Maire] associés à quelques Cèdres, au *Quercus lusitanica* Lamk. et à l'*Acer granatense* Boiss. Les montagnes gréseuses présentent un étage méditerranéen caractérisé par des forêts de *Quercus Suber* avec *Olea* et *Pistacia Lentiscus*; un étage montagnard inférieur où la forêt de *Quercus Suber* se continue, mais sans *Olea* et *Pistacia Lentiscus*; un étage montagnard supérieur caractérisé par des forêts de *Quercus tozae* Bosc., chêne nouveau pour l'Afrique, avec quelques *Q. lusitanica* Lamk.; un étage subalpin caractérisé par des forêts de *Cedrus atlantica*, associé à quelques *Quercus tozae*, *Q. lusitanica*, *Acer granatense*, *Ilex Aquifolium*, etc. Le *Q. tozae* se retrouve sur le Mont Outka, chez les Beni-Zeroual, au N. de Fès, où il s'hybride copieusement avec le *Q. lusitanica*.

L'étude des cônes de l'*Abies* rifain a montré que ce Sapin, quoique très voisin de l'*A. pinsapo* d'Espagne, en diffère constamment par les écailles séminifères plus larges, à bords tendant à se recourber en crochet, et par les bractées atteignant souvent et même dépassant la moitié de la longueur de l'écaille. L'*Abies* du Rif constitue donc une sous-espèce bien caractérisée du Pinsapo: *Abies pinsapo* Boiss. subsp. *maroccana* (Trabut) Emb. et Maire. Parmi les nombreuses plantes remarquables récoltées, il y a lieu de citer le *Halimium atriplicifolium* (Lamk.) Spach, arbuste ibérique nouveau pour l'Afrique, et une espèce, probablement nouvelle, du genre *Gratiola*, genre inconnu jusqu'à présent dans l'Afrique du Nord.

MEETING OF JULY 7, 1928

Communications

Mr. Dr. Maire, on behalf of Mr. Emberger and his own, is making a presentation on the flora and vegetation of the Western Rif Atlas. The limestone mountains present, above the montane stage characterized by forests of *Quercus ilex* and *Q. lusitanica*, a subalpine stage characterized by fir forests [*Abies pinsapo* Boiss. ssp. *marocana* (Trabut) Emb. and Maire] associated with some cedars, with the *Quercus lusitanica* Lamk. and to the *Acer granatense* Boiss. The sandstone mountains have a Mediterranean floor characterized by *Quercus suber* forests with *Olea* and *Pistacia lentiscus*; a lower montane floor where the *Quercus suber* forest continues, but without *Olea* and *Pistacia lentiscus*; an upper montane floor characterized by *Quercus tozae* Bosc forests, oak new to Africa, with some *Q. lusitanica* Lamk.; a subalpine floor characterized by *Cedrus atlantica* forests, associated with some *Quercus tozae*, *Q. lusitanica*, *Acer granatense*, *Ilex aquifolium*, etc. The *Q. tozae* is found on Mount Outka, among the Beni-Zeroual, north of Fez, where it hybridizes copiously with the *Q. lusitanica*.

The study of the cones of the Rif *Abies* has shown that this fir, although very close to the *A. pinsapo* of Spain, constantly differs from it by the wider seminiferous scales, with edges tending to curl into a hook, and by the bracts often reaching and even exceeding half the length of the scale.

The *Abies* of the Rif therefore constitutes a well characterised subspecies of the Pinsapo: *Abies pinsapo* Boiss. subsp. *maroccana* (Trabut) Emb. and Maire. Among the many remarkable plants collected, it is worth mentioning the *Halimium atriplicifolium* (Lamk.) Spach, Iberian shrub new to Africa, and a species, probably new, of the genus *Gratiola*, genus unknown until now in North Africa.

- Ceballos, L. & M. Martín Bolaños (1928). El Pinsapo y el Abeto de Marruecos. *Servicio Forestal de Investigaciones y Experiencias* 1(2): 61-62.

También fueron objeto de nuestra observación sobre el terreno las jóvenes plantitas procedentes de semillas recién germinadas, en todas las cuales contamos constantemente seis cotiledones, sin que tampoco pueda pretenderse dar como preciso este carácter, muy variable en casi todas las abietíneas.

De todo lo hasta aquí expuesto respecto a este asunto podemos deducir en resumen: que coincidiendo con las manifestaciones del Dr. Trabut, se trata de un tipo de abeto intermedio entre el de Numidia y el pinsapo, pero mucho más próximo a éste, del cual no obstante, le separan algunas diferencias suficientes para poder justificar la creación de una nueva especie, si se aquilatan con el criterio estrecho y detallista del que analiza solamente estas cuestiones para poder establecer subdivisiones sistemáticas. Pero si, por el contrario, en vez de a desmembrar, tendemos a la agrupación de afinidades y semejanzas, considerando al mismo tiempo lo poco ostensibles que son las diferencias indicadas, este árbol, que prácticamente es igual al pinsapo, muy bien podría referirse a esta especie como variedad marroccana, de los que existen en nuestra Península. Acordes con este criterio, como tal variedad le consideramos nosotros en todas las cuestiones objeto de este estudio, que se desarrollan en las páginas siguientes.

The young plants from newly germinated seeds were also the object of our observation on the spot, in all of which we constantly count six cotyledons, without it being possible to pretend to give as precise this character, very variable in almost all abietineae.

From all that has been explained so far regarding this issue we can deduce in summary: that coinciding with the statements of Dr. Trabut, it is a type of fir intermediate between that of Numidia and the pinsapo, but much closer to it, from which, however, some sufficient differences separate it to be able to justify the creation of a new species, if they are evaluated with the narrow and detailed criterion of the one that analyzes only these issues to be able to establish systematic subdivisions. But if, on the contrary, instead of dismembering, we tend to the grouping of affinities and similarities, considering at the same time how inconspicuous the indicated differences are, this tree, which is practically the same as the pinsapo, could very well refer to this species as the variety maroccana [sic!], of those that exist in our Peninsula. In accordance with this criterion, we consider it as such a variety in all the issues that are the subject of this study, which are developed in the following pages.

- del Villar, E.H. (1947). *Types de sol de l'Afrique du Nord*. Vol. 1: 78-80.

PINACEAE

Abies tazaotana S. Côtzar, (1946 hispanice descripta) : Tazaot : extrémité N des montagnes à substratum calcaire des Beni-Zejjel : CS⁶ avec S⁷ rare de *Pinus Pinaster* v. *maghrebiana*.

Abies marocana Trab. (1906) = A. Pinsapo Bss. (1938) ssp. marocana (Trab.) Emb. M. (1928) = A. P. v. marocana Ceb. et Bol. (1928). — Monts calcaires des Beni-Zejjel depuis 1.500 - 1.600 m. à 2.130 m. au sommet du Magou (pouvant descendre accidentellement à 1.400-1.300). CS depuis le mt. Magou (Magot) vers l'E. jusqu'à Tirira, Tamsat et Tizi-Mareix, et vers le S. jusqu'au Bou-Halla, fréquemment avec S. de *P. Pinaster* v. *maghrebiana*, *P. Clusiana* v. *mauretanica* et *Cedrus atlantica* ; et S dans la pineraie de *maghrebiana* de Deldel ou Daldal.

Abies numidica De Lannoy in Carr. (1866) = A. baborensis Coss. mscr. = A. Pinsapo var. baborensis Coss. in Rev. hort. (1866). Algérie : massif des Babors, surtout au Grand Babor : depuis 1679 m. (versant N.) jusqu'au sommet (2.004 m.) en AS⁸ ou S avec Cèdre.

Les *Abies* du S. méditerranéen (espèces citées plus *A. cilicica* Carr. du S. de l'Asie mineure et *A. Pinsapo* Bss. du S. de l'Espagne) forment en dedans du genre, un groupe naturel, caractérisé par les bractées des strobiles, incluses ; à différence du groupe septentrional euro-méditerranéen à bractées saillantes. Dans cet ensemble nous séparons spécifiquement l'*A. marocana* de l'*A. Pinsapo* parce que les caractères qui les distinguent sont du même ordre que ceux qui différencient toutes les espèces du groupe, et quelques uns plus importants encore. *A. Pinsapo*, par son port trapu, la grosseur de ses acicules (1-1'3 mm. contre 0'5-0'7) et les canaux résinifères centraux dans les acicules des rameaux stériles, s'éloigne de tout le reste du groupe. Il coïncide avec *marocana* par l'hypoderme interrompu vers la face dorsale (ininterrompu dans *numidica* et *cilicica*) ; mais, tandis que dans *marocana* il est simple aux côtés et vers la face ventrale, dans *Pinsapo* il est triple.

Quant à l'**A. tazaotana** S. Côtz., il n'est nullement une espèce intermédiaire entre l'*A. Pinsapo* et l'*A. marocana*, comme la géographie pourrait le faire supposer. Par certains caractères, comme la longueur des acicules et des cônes, elle est plutôt intermédiaire entre *numidica* et *cilicica*, et très éloignée des autres deux espèces occidentales (49⁹).

Voici une diagnose de l'*Abies tazaotana*, que l'auteur de l'espèce nous autorise à avancer, courte mais suffisante pour justifier l'indépendance spécifique dont il s'agit :

Statura maxima : sæpissime 30, sæpe 45, interdum 50 m. attingens, × 3 - 4'85 circuitu, ad altitudinem hominis (*Pinsapo* - 30, *marocana* 12 - 15, *numidica* 20 - [25], *cilicica* 20-30).

Coma ovoidea ramis præcipue reflexis (ap. ceteras species conica, imo ap. *cilicicam* stricta).

Acicularum ramulorum sterilium : logitudo (12 - 18 mm.) intermedia inter eas sp. *numidicæ* (15) et sp. *cilicicæ* (20 - 30) , eas *Pinsapo* et *marocanæ* (10 - 12) superans ; latitudo 2 - 2'5 mm. ; crassitudo ut ap. sp. *marocanam* (0'5), minor quam ap. *numidicam* et *cilicicam* (0'6 - 0'7) et *Pinsapo* (1 - 1'3) ; canales resiniferi inferi ut ap. ceteras species, excepta *Pinsapo* ubi centrales.

Aciculæ cacuminales ad 19 cm. usque longæ (-10 ap. *marocanam*, - 18 ap. *Pinsapo* et *numidicam*, 20 t.m. ap. *cilicicam*).

Strobili intermedi, magnitudine (16 - 20 cm. × 4 - 6 cm.) inter eos sp. *numidicæ* (12 - 16 [-20] × 3 - 6) et sp. *cilicicæ* (15 - 30 × 4'6), valde majores quam ap. *Pinsapo* (10 - 16) et *marocanam* (15 t. m.).

Squamæ cuneiformi-triangules.

Bractæe rotundato-capitatæ, ante maturitatem dimidiam squamam superantes, post maturitatem hoc dimidio breviores (dum ap. *Pinsapo* 1/5 - 1/6 squamæ, ap. *marocanam* et *numidicam* dimidium attingentes, ap. *cilicicam* hoc superantes).

⁶ CS = consocietas (dominance exclusive d'une espèce).

⁷ S = societas (présence subordonnée, dans toute l'association).

⁸ AS = associetas (dominance partagée entre deux ou plus d'espèces).

⁹ Lorsqu'on parle d'acicules sans plus de spécification, il est entendu qu'on se rapporte à celles des rameaux stériles.

PINACEAE

Abies tazaotana S. Côtzar, (1946 Spanish description): Tazaot: N extremity of the mountains with limestone substrate of the Beni-Zejjel: CS¹⁰ with rare S¹¹ of *Pinus Pinaster* v. *maghrebiana*.

Abies marocana Trab. (1906) = *A. pinsapo* Bss. (1938) ssp. *marocana* (Trab.) Emb. M. (1928) = *A. p.* v. *marocana* Ceb. and Bowl. (1928). - Limestone mountains of Beni-Zejjel from 1,500 - 1,600 m. to 2,130 m. at the top of the Magou (may accidentally descend to 1,400-1,300). CS from the Mt. Magou (Magot) towards the E. to Tirira, Tamsat and Tizi-Mareix, and towards the S. to Bou-Halla, frequently with S. of *P. pinaster* v. *maghrebiana*, *P. clusiana* v. *mauretanica* and *Cedrus atlantica*; and S in the *maghrebiana* pine grove of Deldel or Daldal.

Abies numidica De Lannoy in Carr. (1866) = *A. baborensis* Coss. mscr. = *A. pinsapo* var. *baborensis* Coss. in Rev. hort. (1866). Algeria: Babors massif, especially in Grand Babor: from 1679 m. (N. slope) to the summit (2,004 m.) in AS¹² or S with Cedar.

The *Abies* of southern Mediterranean (species mentioned + *A. cilicica* Carr. from the south of Asia Minor and *A. pinsapo* Bss. from the south of Spain) form within the genus, a natural group, characterised by the included bracts of the strobiles, unlike the northern Euro-Mediterranean group with protruding bracts. In this set, we specifically separate *A. marocana* from *A. pinsapo* because the characters that distinguish them are of the same order as those that differentiate all the species of the group, and some even more important. *A. pinsapo*, by its stocky habit, the size of its needles (1-1'3 mm. against 0'5-0'7) and the central resiniferous channels in the needles of the sterile branches, differs from all the rest of the group. It coincides with *marocana* by the hypodermis interrupted towards the dorsal surface (uninterrupted in *numidica* and *cilicica*); but, while in *marocana* it is simple at the sides and towards the ventral surface, in *pinsapo* it is triple.

As for the *A. tazaotana* S. Côtz., it is by no means an intermediate species between *A. pinsapo* and *A. marocana*, as geography might suggest. By certain characters, such as the length of the needles and the cones, it is rather intermediate between *numidica* and *cilicica*, and very distant from the other two Western species (¹³).

Here is a diagnosis of the *Abies tazaotana*, which the author of the species authorises us to advance, short but sufficient to justify the specific independence in question :

Maximum stature: reaching most often 30, often 45, sometimes 50 m, 3-4'85 around, at a person's height (*pinsapo* -30, *marocana* 12-15, *numidica* 20-[25], *cilicica* 20-30).

Crown ovoid with mainly reflexed branches (by other species, conical, on the contrary by *cilicica* narrow).

Needles on sterile shoots: length (12-18 mm.) intermediate between them sp. *numidica* (15) and sp. *cilicica* (20-30), surpassing *pinsapo* and *marocana* (10-12); width 2-2'5 mm.; thickness ap. sp. *marocana* (0'5), less than ap. *numidica* and *cilicica* (0'6-0'7) and *pinsapo* (1-1'3); inferior resiniferous canals, while central by the other species, except *pinsapo*.

Needles at the top up to 19 mm long (-10 by *marocana*, -18 by *pinsapo* and *numidica*, 20 average size by *cilicica*).

Seed cones intermediate size (16-20 cm x 4-6 cm) between sp. *numidica* (12-16[-20] x 3-6) and sp. *cilicica* (15-30 x 4'6), much longer than by *pinsapo* (10-16) and *marocana* (15 average size).

Cuneiform-triangular scales.

Rounded-headed bracts, surpassing half the scale before maturing, after maturing become shorter (while by *pinsapo* 1/5-1/6 of the scale, by *marocana* and *numidica* reaching half, by *cilicica* surpassing this).

¹⁰ CS = consocietas (exclusive dominance of a species).

¹¹S = societas (subordinate presence, throughout the association).

¹² AS = associetas (dominance shared between two or more species).

¹³ When we speak of needles without further specification, it is understood that we are referring to those of sterile twigs.

- Chevalier, A. (1948). Nouvelles du monde: Sciences de base: Maroc. *Unasylya*, 2: 370.

Nouvelles du monde

Les échos reproduits ci-dessous sont des résumés de nouvelles susceptibles d'intéresser les lecteurs d'Unasylya. Ils sont présentés sous des rubriques couramment employées par la Division des Forêts et des produits forestiers pour le classement de références, et suivant l'ordre alphabétique des noms des pays qu'ils concernent. Le Rédacteur serait heureux de recevoir des lecteurs des échos authentiques d'actualité susceptibles d'être publiés dans cette section de la revue. (...)

Sciences de base

MAROC

Un ingénieur forestier du protectorat espagnol du Maroc a récemment attiré l'attention sur le massif du Tazaot, situé à environ 25 km au nord-est de Chauen, et qui, sur 1.500 ha environ et à une altitude comprise entre 1.400 et 1.700 m, renferme en un superbe massif d'Abies méditerranéens, qui présente de grandes analogies avec les *Abies pinsapo*, *A. numidica* et *A. marocana*. Il propose de lui donner le nom d'*A. tazaotana*.

Dans l'aspect général de l'arbre, la différence la plus frappante avec l'*Abies pinsapo* est la forme de la cime, qui n'est pas aiguë, mais aplatie, rappelant d'assez près celle du *Cedrus atlantica*.

Après comparaison avec l'*A. numidica* et surtout l'*A. marocana*, il semble qu'on se trouve en présence d'un type particulier du pinsapo, qui, notamment après la séparation par le détroit de Gibraltar des continents européens et africains, aurait donné naissance à divers types, par suite d'une évolution progressive ou régressive. Le type le plus régressif serait représenté par l'*A. pinsapo marocana*, qui n'atteint en moyenne que 12 à 15 m de haut en peuplements clairs et souvent entièrement composés d'arbres difformes, tandis qu'avec sa hauteur moyenne de 30 à 45 m, et aussi la dimension plus allongée de son cône, l'*A. tazaotana* représenterait le type progressif le plus évolué. Le climat du massif est tempéré-froid et son sol, constitué par des calcaires biasiques, est recouvert d'un humus abondant. Les comptages effectués sur ce massif ont montré que le volume à l'hectare représenté par cette essence s'élevait entre 600 et 800 m³; la composition du peuplement, qui renferme jusqu'à 5 arbres à l'hectare de diamètre compris entre 1 m et 1,50 m à hauteur d'homme et de 35 à 45 mètres de haut, est remarquable du fait de la quasi-absence des arbres compris entre 0,10 m et 0,40 m; mais ce fait s'explique par la pratique des indigènes voisins de n'exploiter que les arbres ne dépassant pas 0,45 m de diamètre, ne disposant pas de l'outillage nécessaire pour utiliser les bois plus gros. En mélange avec l'Abies en question se trouvent quelques érables (*Acer granatense*) et divers chênes: *Quercus mirbeckii*, *Q. pyrenaica* et *Q. toza*. Dans le sous-bois, l'arbuste le plus caractéristique est une variété de l'*Ilex aquifolium*.

World news

The echoes reproduced below are summaries of news that may be of interest to Unasylya readers. They are presented under headings commonly used by the Division of Forests and Forest Products for the classification of references, and according to the alphabetical order of the names of the countries they concern. The Editor would be happy to receive from readers authentic echoes of current events that may be published in this section of the journal.

Basic sciences

MOROCCO

A forestry engineer from the Spanish protectorate of Morocco recently drew attention to the Tazaot massif, located about 25 km northeast of Chauen, and which, on about 1,500 ha and at an altitude between 1,400 and 1,700 m, contains a superb massif of Mediterranean Abies, which has great analogies with *Abies pinsapo*, *A. numidica* and *A. marocana*. He proposes to give it the name of *A. tazaotana*.

In the general appearance of the tree, the most striking difference with *Abies pinsapo* is the shape of the crown, which is not acute, but flattened, recalling quite closely that of the *Cedrus atlantica*.

After comparison with *A. numidica* and especially *A. marocana*, it seems that we are in the presence of a particular type of *pinsapo*, which, especially after the separation by the Strait of Gibraltar from the European and African continents, would have given birth to various types, as a result of a progressive or regressive evolution. The most regressive type would be represented by the *A. pinsapo marocana*, which reaches on average only 12 to 15 m high in clear stands and often entirely composed of deformed trees, while with its average height of 30 to 45 m, and also the more elongated dimension of its cone, *A. tazaotana* would represent the most evolved progressive type. The climate of the massif is temperate-cold and its soil, consisting of basic limestones, is covered with abundant humus. The calculations carried out on this massif showed that the volume per hectare represented by this species amounted to between 600 and 800 m³; the composition of the stand, which contains up to 5 trees per hectare with a diameter of between 1 m and 1.50 m at human height and from 35 to 45 meters high, is remarkable because of the almost absence of trees between 0.10 m and 0.40 m; but this fact is explained by the practice of the neighboring natives to exploit only the trees not exceeding 0.45 m in diameter, not having the necessary tools to use the larger woods. Mixed with this *Abies* are some maples (*Acer granatense*) and various oaks: *Quercus mirbeckii*, *Q. pyrenaica* and *Q. toza*. In the undergrowth, the most characteristic shrub is a variety of the *Ilex aquifolium*.

- Pourtet, J., Catalogue des espèces cultivées dans l'Arboretum des Barres, *Ann. École Natl. Eaux.* 9(1): 100 (1954).

ABIES MAROCANA TRABUT.

Afrique : espèce endémique des montagnes calcaires du Rif au Maroc (1 800 mètres). Il se rattache aux Sapins circumméditerranéens et en particulier aux *Abies numidica* et *pinsapo*.

Rameaux glabres brun rouge luisants ; bourgeons petits, coniques, résineux, caractérisés par la divergence de la pointe des écailles (même caractère chez *Abies cilicica* mais sans résine); aiguilles en écouvillon, lancéolées, apex corné, acéré ; face supérieure marquée sur la ligne médiane de quelques lignes incomplètes de stomates ; face inférieure vert grisâtre.

Il a fructifié en 1953. Le cône est très voisin de celui d'*Abies pinsapo* (les bractées sont incluses).

N – 11 : unique exemplaire planté en 1930 et issu de graines de Chechaouen. C'est un sujet très vigoureux qui, jusqu'à présent, n'a pas souffert du froid. Sa croissance est très satisfaisante, il mesure 0,60 m sur 9 m. (Hauteur : 2 m en 1942.)

Il semble qu'il s'agisse d'une espèce méritant d'être plus largement expérimentée.

En 1953 existent en pépinière des jeunes plants issus de graines récoltées au Maroc espagnol et reçues sous le nom d'*Abies pinsapo* Boiss. var. *tazaotana* H. V.

ABIES MAROCANA TRABUT

Africa: endemic species of the limestone mountains of the Rif in Morocco (1,800 meters). It is related to the circum-Mediterranean Firs and in particular to *Abies numidica* and *pinsapo*.

Glabrous shiny red-brown twigs; small, conical, resinous buds, characterized by the divergence of the tip of the scales (same character in *Abies cilicica* but without resin); needles in a swab, lanceolata, apex horny, sharp; upper side marked on the median line with some incomplete lines of stomata; lower side grayish green.

It fruited in 1953. The cone is very close to that of *Abies pinsapo* (the bracts are included).

N - 11 : unique specimen planted in 1930 from Chechaouen seeds. This is a very vigorous individual which, so far, has not suffered from the cold. Its growth is very satisfactory, it measures 0.60 m by 9 m. (Height: 2 m in 1942.)

It seems that this is a species that deserves to be more widely experimented with.

In 1953, there are in the nursery young plants from seeds harvested in Spanish Morocco and received under the name of *Abies pinsapo* Boiss var. *tazaotana* H. V.

- *Abies pinsapo* subsp. *tazaotana* (Côzar ex Villar) Govaerts, *World Checkl. Seed Pl.* 1(1): 6 (1995).

Abies pinsapo* subsp. *tazaotana (Côzar ex Huguet del Vilar) Govaerts comb. & stat. nov.
 basionym: *Abies tazaotana* Côzar ex Huguet del Vilar, *Types des Sols Afr. Nord*; 1 :79 (1947)

- Silba, J. (2008). An international census of the Coniferae. II, Pinaceae, Part 1 (excluding *Cedrus* & *Pinus*). *J. Int. Conifer Preserv. Soc.* 15: 36-66.

33.b. *Abies pinsapo* Boiss. subsp. *marocana* (Trab.) Silba, *Comb. Nova*.
 Basionym: *Abies marocana* Trab., *Bull. Soct. Bot. France* 53: 154 (1906). N. Morocco: S. Tetuan; W. Mount Rif, 1800-2100 m.

33.c. *Abies pinsapo* Boiss. subsp. *tazaotana* (S. Cozar ex Villar)
 R. Govaerts, *World Checklist Seed Pl.* 1(1): 6 (1995).
 N. Morocco: Mount Tazaot, 1400-1700 m.

- Rivas-Martínez, S. (2011). Mapa de series, geoserias y geopermaseries de vegetación de España. *Itin. Geobot.* 18(2): 425-800.

4.5. NOVEDADES TAXONÓMICAS

En este apartado se ofrece en orden alfabético algo más de un centenar de novedades taxonómicas y nomenclaturales, correspondientes a la flora de España, Portugal y África del Norte.

Abies marocana Trabut subsp. *tazaotana* (Villar) Rivas Mart. comb. nova
 [Basionymon: *Abies tazaotana* Villar, *Types Sols Afrique N.1*: 80. 1947]
 Endemismo rifeño dolomítico.

4.5. TAXONOMIC NOVELTIES

This section offers in alphabetical order more than a hundred taxonomic and nomenclatural novelties, corresponding to the flora of Spain, Portugal and North Africa.

Abies marocana Trabut subsp. *tazaotana* (Villar) Rivas Mart. *comb. nova*
 [Basionymon: *Abies tazaotana* Villar, *Types Sols Afrique N.1*:80. 1947]
 Dolomitic Rif endemism.

Which taxonomic rank for the Moroccan Fir?

The previous documents testify of the hesitation of the different botanists as to the rank to give to the Moroccan Fir.

The first observations were based on quite few available samples (cf. Plate III, p. 108), which consisted of shoots only. The problem is that foliage is in part dependent of the climate and of the local meteorological conditions. Thus *Abies nebrodensis* the Sicilian Fir, cultivated close to Arezzo in Italy cannot be distinguished from *Abies alba* (F. Dulci, pers. comm.). There are several descriptions viewing the Moroccan Fir as intermediate between the *Abies pinsapo* and *Abies numidica* (the Algerian Fir). By molecular analysis it was shown that the Spanish and Moroccan Firs belong to the *Abies alba* group, while *Abies numidica* belongs to a group with the Greek Fir (*Abies cephalonica*) (Scaltsoyiannes *et al.* 1999: 298, Fig. 3). The common characteristic foliage with upright rather short needles on the shoots (forming like a brush) of all those southwestern Mediterranean firs is determined by a climatic adaptation reducing water loss during the typical dry Summer season (see Fig. 2, p. 115 as an illustration).

Several characters were tentatively used to separate the Moroccan from the Spanish Fir like the needles (acute *versus* obtuse tips) or the buds (non resinous *versus* resinous). But with not limited samples, those differences disappear and account only for the variability inside both taxa.

To determine a taxonomic rank¹⁴, we have adopted the definitions proposed by Christensen (1987: 384):

The species concept used in the present work is morphological, and mostly in line with Rothmaler (1944) and Du Rietz (1930). The taxonomic ranks used are defined as follows:

Forma of a variety, subspecies or species occurs sporadically within the distribution area of the taxon of higher rank to which it is referred and differs from that taxon in a single character.

Varietas of a subspecies or species is to some extent allopatric and forms local, distinct populations as well as mixed, integrating populations within the distribution area of the subspecies or species. They differ from each other in usually more than a single, distinct character.

Subspecies of a species are both regionally and locally allopatric. They differ from each other in several, distinct characters, but intergrade in overlapping areas.

Species of a genus differ from each other in numerous, distinct characters and have a characteristic distribution area of their own. Where closely related species meet occasional hybridization and introgression may occur.

Unfortunately those definitions do not fit exactly the characteristics of the firs here under scrutiny. Both taxa have a distinct distribution range (→ species rank). Looking at the wind regime in the region, it appears that the main winds are blowing East-West or West-East between the Atlantic and the Mediterranean Sea, and not North-South or South-North, making unlikely any genetic exchange between the European and African populations. Now to satisfy the species rank, numerous, distinct characters are required, a condition very difficult to accept, notably due to the lack of statistical data. Sekiewicz *et al.* (2013) thoroughly studied the needles with almost all possible measures of two populations in Spain (Grazalema and Sierra de las Nieves) and two in Morocco (Djebel Tazaot and Talassemtane). Unfortunately there is no data about the different meteorological conditions during the growing season which could have also explained the differences. Further the study found differences between the two Spanish populations which are difficult to explain without the meteorological data of both distinct ranges. To equalise the environmental conditions the method of choice would be to plant the different origins in the same field with the same exposure. Thus the morphological as well as phenological differences – if any – due to the environmental factors could be completely discarded.

Statistical data for cones and seeds are not available.

The conditions to choose the variety rank are not met: there is no “mixed, integrating populations within the distribution area”. Thus remains the subspecies rank, provided there are enough differences which can be accounted for.

The study by Terrab *et al.* (2007) provides one such discrimination considering the cpDNA (cf. abstract, below p. 113). Overall, although there are several haplotypes in common which are the traces of a common ancestor not a so long time ago considering the geological periods, the study shows a difference between the haplotypes of both countries. The Table 3 (here p. 112, compare with Terrab *et al.* 2007: 412, Table 2): “Frequencies of the haplotypes identified with six cpSSR loci in the eight *Abies* populations investigated” is reproduced here with the following modifications: the Moroccan populations have been reordered from North to South and then from West to East with a correction for two locality names according to the given geo-coordinates (El

¹⁴ Some authors do not explain and do not even try to justify their choice of a taxonomic rank. To satisfy the validity of a new combination, it is enough – as per the nomenclature rules – to indicate a “basionym”, that is a previous valid description at a different taxonomic rank.

Aoulia instead of Adeldal, and Adeldal instead of Djebel Gharbouch). The frequencies have been replaced by the number de specimens for each locality and each haplotype. Computed data have been added to evaluate precisely (without the Amova test used by the authors) the differences between the studied populations.

- Index 1: total number of specimens of each haplotype; the most frequent ones (≥ 10) appear in bold characters; among the eight most frequent haplotypes, only two are common between Spain and Morocco; they are highlighted in red bold characters: h9 is marginally present in Grazalema, while h18 is marginally present in la Sierra de las Nieves, each haplotype with only one specimen present in Spain. The most frequent Spanish haplotypes are only present in this country.
- Index 2: number of specimens with haplotypes present only in the said population. For instance the Azilane samples have no unique haplotype present only in Azilane; at the opposite the El Aoulia samples show 40% of specimens with unique haplotypes present in no other population; the Djebel Tazaot samples show the unique h26 with only one specimen as being found in no other locality.
- Index 3: number of specimens with haplotypes present within each country only.
- Index 4: to the total of specimens listed under index 3, the h9 and h18 specimens are added considering the marginal presence of those two haplotypes in the Spanish samples (only one specimen of each).

To summarise those results, index 3 for Spain and index 4 for Morocco show in each country a distinct pattern among the samples separating them from the populations of the other continent.

A rather constant remark is that there is a difference in the number of cotyledons (cf. Ceballos & Martin Bolaños 1928: 61 and above p. 103).

- Spanish Fir: a majority of 7 cotyledons;
- Moroccan Fir: a majority of 6 cotyledons.

Alaoui *et al.* (2013: 199) note: “the number of cotyledons seems to be discrete and constant, with 6 for the Moroccan Firs and 7 for the Spanish Firs (Soto 1996, pers. com.)” This character is not linked to the environment. To verify that observation, T. Madern sowed seeds of both origins. Here are the results:

Table 1: Cotyledon number of *Abies pinsapo* seedlings, origin Grazalema.

Cotyledon numbers	6	7	8	6.59	Average
Percentages	47.06%	47.06%	5.88%		
Number of seedlings	24	24	3	51	Sample size

Table 2: Cotyledon number of the Moroccan Fir seedlings, origins Talassemrane, Adeldal and Taria el Aoulia

Cotyledon numbers	5	6	7	8	6.26	Average
Percentages	12.17%	55.22%	28.26%	4.35%		
Number of seedlings	27	131	68	10	236	Sample size

The cotyledon number difference is thus not as clear cut as previous observations hinted. But it is still statistically possible to distinguish between the two origins: while on our sample there is an equal number of seedlings with 6 and 7 cotyledons for the Spanish origin, the number of seedlings with 6 cotyledons is almost double than those with 7 cotyledons for the Moroccan origins.

Thus when the molecular differences are obvious, there is at least one statistically meaningful morphologic divergence between the Spanish and Moroccan populations. As for the other characters, as previously exposed, the best test will be to plant the different origins in the same field, with the same soil, and same exposure and to observe their development throughout the years to their maturity. This is one of the tasks of the *Abies* Conservation Project.

The species rank is not validated by the absence of “numerous, [statistically] distinctive [morphological] characters”. The variety rank is not validated because of the absence of a “[mixed, integrating population within the distribution area](#)” (Christensen 1987: 384).

The molecular analyses and the disjunct distribution ranges of the different populations north and south of the Gibraltar strait (with a main latitudinal wind regime, that is West-East or East-West, Kling & Ackerly 2020) justify for the Moroccan firs the rank of a subspecies as *Abies pinsapo* subsp. *marocana* (Trab.) Emb. & Maire.

The *tazaotana* case

In 1947, the Djebel Tazaot firs were described as a new species distinct from the other Moroccan firs: it was argued that the trees on that mountain are taller and the cones bigger. Those differences can be explained by different environmental conditions. Two important factors allow a better development of the trees: a locality closer to the sea, with higher humidity (see for instance Fig. 20, p. 82), and a soil rich in humus (cf. Chevalier 1948, above p. 107). Several photos allow the comparison between the different landscapes. Thus on the slope opposite to the sea with a stony soil (Figs 3 to 17), the forest is not yet present and tree growth appears limited on a rocky environment. The forest with the tallest trees begins near the crest line and closer to the Mediterranean Sea (Figs 18 to 20). The second condition is a soil rich in humus. Such a soil retains humidity and thus allows the better development of the trees during the growing season and a better access to nutriment. Further south (above Adeldal for instance), a closed forest is absent; the firs are present at lower altitudes with pines on the slopes above them (cf. Figs 42, 44, 50 to 52), while pines are absent on Djebel Tazaot.

Another factor to be taken into account is the situation of the Djebel Tazaot in comparison with the other localities: it is at a higher altitude and farther away from villages, that is less accessible and making their exploitation more difficult. Chevalier (1948, and above p. 107) made an interesting observation that trees above 0.45 m in diameter are not cut.

Worth noticing is that the highest number of unique haplotypes (4 with 6 specimens) is not linked with the firs growing on Djebel Tazaot (one unique haplotype with one specimen), but with the easternmost population of El Alouia.

Thus the epithet *tazaotana* – whatever the rank – is not validly supported as a different taxon from *Abies pinsapo* subsp. *marocana* (cf. Terrab *et al.* 2007: 414, “the very low divergence among the Moroccan fir taxa”).

Here again the crucial test will be to cultivate the Djebel Tazaot origin together with the other ones in the same field.

Table 3: Number of specimens for each haplotype by locality (modified after Terrab *et al.* 2007, Table 2).

	Spain			Morocco					Index 1
	Grazalema	Nieves	Bermeja	Tazaot	Azilane	Talassemtane	Adeldal	El Aoulia	
Total	30	30	30	30	30	30	30	15	225
Haplotypes									
h1	4	1	1						6
h2	2		5						7
h3	3			3		1			7
h4	4	7	3						14
h5	2		1						3
h6	6	7	9						22
h7	4	13	1						18
h8	2				1	1	2		6
h9	1			4	9	12	8		34
h10	1								1
h11	1								1
h12			4				1		5
h13			2		1		1	2	6
h14			1						1
h15			1				1		2
h16			1						1
h17			1						1
h18		1		4	7		2		14
h19		1							1
h20				2		1	1		4
h21				3	3	3	1		10
h22				2	4		4	6	16
h23				6	2	10	4		22
h24				3	2				5
h25				1			3		4
h26				1					1
h27				1	1				2
h28						2			2
h29							1		1
h30							1	1	2
h31								2	2
h32								1	1
h33								2	2
h34								1	1
Index 2	2	1	3	1	0	2	1	6	
Index 3	24	29	23	19	12	16	15	13	
Index 4				27	28	28	25	13	
	80.0%	96.7%	76.7%	90.0%	93.3%	93.3%	83.3%	86.7%	

Bibliography

- Alaoui, M.L, F.G. Novo & J.B.G. Fernández (2013). Los pinsapares de Andalucía y del Rif en el norte de Marruecos: diversidad, evolución y situación actual. In *Quintanilla* 2013, 197-207.
- Boissier, M.E. (1838). *Notice sur l'Abies pinsapo*. Bibliothèque Universitaire de Genève.
- Ceballos, L. & M. Martín Bolaños (1928). El Pinsapo y el Abeto de Marruecos. *Servicio Forestal de Investigaciones y Experiencias* 1(2): 45-101.
- Del Villar, E.H. (1947). *Types de sol de l'Afrique du Nord*. Vol. 1: 78-80.
- Esteban, L.G., P. de Palacios & L. Rodríguez-Losada Aguado (2010). Abies pinsapo forests in Spain and Morocco: threats and conservation. *Oryx* 44(2): 276-284. <https://doi.org/10.1017/S0030605310000190>
- Kling, M.M. & D.D. Ackerly (2020). Global wind patterns and the vulnerability of wind-dispersed species to climate change. *Nat. Clim. Chang.* 10 : 868-875.
- Linares, J.C. (2011). Biogeography and evolution of *Abies* (Pinaceae) in the Mediterranean Basin: the roles of long-term climatic change and glacial refugia. *J. Biogeogr.* 38: 619-630. <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2699.2010.02458.x>
- Pourtet, J. & P. Turpin (1954). Catalogue des espèces cultivées dans l'Arboretum des Barres. *Ann. École Natl. Eaux* 9(1): 5-254.
- Quintanilla, J.L, R.M.N. Cerrillo, J.C. de la Fuente, M.C. Pérez & C.R. Hiraldo (Ed.) (2013). *Los pinsapares en Andalucía: (Abies pinsapo Boiss.) Conservación y sostenibilidad en el siglo XXI*. Junta de Andalucía & Universidad de Córdoba.
- Sánchez-Robles, J.M., F. Balao, A. Terrab, J.L. García-Castaño, M.A. Ortiz, E. Vela & S. Talavera (2014). Phylogeography of SW Mediterranean firs: different European origins for the North African *Abies* species. *Molec. Phylogen. Evol.* 79: 42-53. <http://dx.doi.org/10.1016/j.ympev.2014.06.005>
- Scaltsoyiannes A., M. Tsaktsira & A.D. Drouzas (1999). Allozyme differentiation in the Mediterranean firs (*Abies*, Pinaceae). A first comparative study with phylogenetic implications. *Pl. Syst. Evol.* 216: 289-307. <https://doi.org/10.1007/BF01084404>
- Sękiewicz, K., M. Sękiewicz, A.K. Jasińska, K. Boratyńska, G. Iszkuło, A. Romo & A. Boratyński (2013). Morphological diversity and structure of West Mediterranean *Abies* species. *Pl. Biosyst.* 147(1): 125-134. <https://doi.org/10.1080/11263504.2012.753130>
- Terrab, A., S. Talavera, M. Arista, O. Paun, T.F. Stuessy & K. Tremetsberger (2007). Genetic diversity at chloroplast microsatellites (cpSSRs) and geographic structure in endangered West Mediterranean firs (*Abies* spp., Pinaceae). *Taxon* 56(2): 409-416. <https://doi.org/10.1002/tax.562012>
- Abstract:
We investigated patterns of genetic variation within and among the eight extant populations of the genus *Abies* in the western Mediterranean Basin. Using six chloroplast microsatellite (cpSSR) loci, a total of 22 alleles and 34 haplotypes was found among 225 individuals. The analyzed populations showed high levels of genetic diversity (mean $H_e = 0.84$). Two clearly separated main groups corresponding to the three Spanish and the five Moroccan populations, respectively, were distinguished. A phylogeographic signal was evident and a Mantel test revealed a strong positive correlation between geographic and genetic distances of the eight populations. Analysis of Molecular Variance (AMOVA) assigned 85% of the total genetic variation to differences between continents. Within each continent, populations were remarkably little differentiated with the exception of one highly divergent Moroccan stand; the origin of this divergence requires further investigation. Our results document a strong effect of the Strait of Gibraltar on *Abies* differentiation in this region, whereas the high diversity within and the low differentiation among populations on each side point to a certain level of pollen-mediated gene flow among the extant stands. On the other hand, our analysis indicates that the population formerly assigned to the species *A. tazaotana*, in fact, genetically very close to most *A. marocana* stands. We discuss implications of the observed population structures for conservation and management of West Mediterranean *Abies* taxa.
- Trabut, L. (1906). Sur la présence d'un *Abies* nouveau au Maroc (*Abies marocana*). *Bull. Soc. Bot. France* 53: 154.
- Parducci

Appendix A:

Boissier 1838, 8: *Abies pinsapo* diagnosis:

“1. *Abies Pinsapo*. — Foliis super ramos cylindricè dispositis, 5-3 lineas longis, subteretibus, apice integris, strobilis ovato-cylindricis ; squamis bracteolaribus inclusis, carpellis mult brevioribus.”



Fig. 1: Moroccan Fir, cultivated, France. The cones were fertilised with pollen from Djebel Tazaot. 2024-08-04.

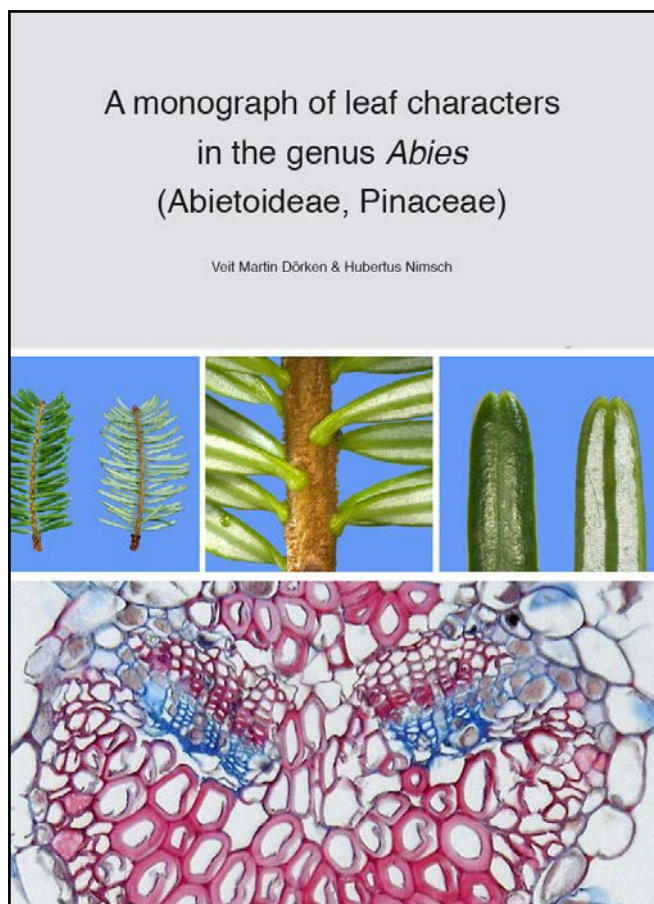


Fig. 2: Foliage of *Abies numidica* showing its adaptation to a full sunlight.
Cultivated France. 2024-07-27.

Dörken, V.M. & H. Nimsch (2018). A monograph of leaf characters in genus *Abies* (Abietoideae, Pinaceae). Verlag Kessel, Germany.

166 p.

ISBN: 978-3-945941-40-9



"This monograph deals with the leaf characters of the genus *Abies* (Pinaceae) and represents one of the most comprehensive studies, which includes nearly all species worldwide, their subspecies and varieties and also several of the natural and artificial hybrids as well. All morpho-anatomical features are presented in detailed diagnostic descriptions and in over 90 full-page colour figures, including macro- and microscopic details of the entire foliar shoots and single needle leaves, scanning electron microscopic images of the stomata and anatomical sections. In addition to the precise documentation of all leaf characters, morpho-anatomical comparisons are drawn, useful to distinguish between quite similar species."

The following pages are extracted from the above book (pp. 58-59 & 135-137) by permission of the authors. Dörken and Nimsch are thanked for their authorisation.

Abies pinsapo* var. *marocana
(Sect *Piceaster*)

Leaf arrangement: helical; on plagiotropic and orthotropic shoots leaves spreading regularly to all sides; **Color:** adaxial dark green; abaxial light green; **Shape:** linear; flat; adaxial a shallow longitudinal depression; **Size:** (0.5-) 1-2 (-2.5) cm long; 2-3 mm wide; 530-570 µm thick; **Petiole:** short; occasionally twisted and curved; leaf base broad disc-shaped; **Tip:** on plagiotropic and orthotropic shoots obtuse, on juvenile trees acute; **Margin:** hick; roundish; not revolute; **Midrib:** abaxial distinctly developed; broad, about ¼ of the leaf's width; separating the two abaxial stomatal bands; **Stomata:** adaxial few in irregular longitudinal rows; stomata even at the leaf base; about 7-10 stomatal rows on each side of the leaf; stomata quite similar in shape; only the crater-like depressions surrounding the stomata strongly varying in size and shape; stomata 20-30 µm long; deeply sunken in the epidermis; stomatal pores all in the same orientation - parallel to the midrib; **Cuticle:** well-developed; in particular the stomata covered with a thick layer of wax, visible as whitish dots; **Epidermis:** on the ad- and abaxial surface smooth; epidermal cells roundish to ovate in cross section; thick-walled, the outside exposed anticlinal cell walls thicker than the inner walls; **Hypodermis:** well-developed; 1 layer of strongly thick-walled and lignified cells; abaxial interrupted by the respiratory chambers of the stomata; **Mesophyll:** dimorphic; 2-3 layers of adaxial palisade parenchyma towards all outer light-exposed parts; inner spongy parenchyma with large intercellular spaces; **Endodermis:** well-developed; consisting of parenchymatic cells strongly varying in size and shape, forming a closed sheath; **Vasculature:** 1 collateral vascular bundle strand; oval; about 410 x 270 µm in diameter; divided by 2-4 layers of parenchymatic cells into two parts; each part also divided again by several one-cell broad parenchymatic bands; transfusion tissue well-developed; abaxial a distinct sclerenchyma adjacent to the inner wall of the endodermis; **Resin ducts:** 2, one at each side; adjacent to the abaxial hypodermis; about 90-110 µm in diameter; **Morpho-anatomical comparisons:** differs from *A. pinsapo* var. *pinsapo* by a greenish leaf color; lacking an adaxial longitudinal furrow; less adaxial stomata; **Taxonomic note:** ECKENWALDER (2009), FARJON (2010) and DEBRECZY & RACZ (2011) accept this taxon as a variety of *A. pinsapo*; RUSHFORTH (1987) accepts *A. marocana* as a distinct species; **Figure:** 70.

Abies pinsapo* var. *pinsapo
(Sect. *Piceaster*)

Leaf arrangement: helical; on plagiotropic and orthotropic shoots leaves spreading regularly to all sides; **Color:** adaxial dark, green, due to a thick cuticle often bluish; abaxial light green; **Shape:** linear; flat to rhombic; with or without an adaxial longitudinal depression; **Size:** (0.5-) 1-2 (-2.5) cm long; 2-3 mm wide; 550-610 μm thick; **Petiole:** short; mostly not twisted and not curved; leaf base broad disc-shaped; **Tip:** on plagiotropic and orthotropic shoots obtuse to acute; **Margin:** thick; roundish to obtuse; not revolute; **Midrib:** abaxial distinctly developed; quite broad, about $\frac{1}{3}$ of the leaf's width; separating the two abaxial stomatal bands; **Stomata:** on both sides of the leaf, even at the leaf base; adaxial some irregular longitudinal stomatal rows; majority abaxial in 2 longitudinal stomatal bands, each band consists of 7-9 stomatal rows; stomata strongly varying in shape from roundish to flat elliptical; similar in shape; 20-30 μm long; deeply sunken in the epidermis, but significantly less than in *A. pinsapo* var. *marocana*; stomatal pores all in the same orientation - parallel to the midrib; **Cuticle:** well-developed; in particular stomata covered with a thick layer of wax, visible as whitish dots; **Epidermis:** on the ad- and abaxial surface smooth; epidermal cells roundish to ovate in cross section; thick-walled, the outside exposed anticlinal cell walls thicker than the inner walls; **Hypodermis:** well-developed; 1-2 layers of strongly thick-walled and lignified cells; abaxial interrupted by the respiratory chambers of the stomata; **Mesophyll:** dimorphic; 2-3 layers of adaxial palisade parenchyma towards all outer light-exposed parts; inner spongy parenchyma with large intercellular spaces; **Endodermis:** well-developed; consisting of parenchymatic cells strongly varying in size and shape, forming a closed sheath; **Vasculature:** 1 collateral vascular bundle strand; roundish to oval; about 410 x 310 μm in diameter; divided by 2-4 layers of parenchymatic cells into two parts; each part also divided again by several one-cell broad parenchymatic bands; transfusion tissue well-developed; abaxial a distinct sclerenchyma adjacent to the inner wall of the endodermis; **Resin ducts:** 2, one at each side; adjacent to the abaxial hypodermis; about 120-140 μm in diameter; **Taxonomic note:** RUSHFORTH (1987), ECKENWALDER (2009), FARJON (2010) and DEBRECZY & RACZ (2011) accept *A. pinsapo* var. *pinsapo* as a distinct species; **Figure:** 71.

Abies pinsapo* var. *tazaotana
(Sect. *Piceaster*)

Leaf arrangement: helical; on plagiotropic and orthotropic shoots leaves spreading regularly to all sides or on plagiotropic shoots leaves arranged in two lateral series; leaves inserted on the lower side of the shoot axis turn upwards and are crowded on the upper side; all leaves distantly spreading; **Color:** adaxial dark green; abaxial light green; **Shape:** linear; flat to lanceolate; ad-axial with or without a shallow longitudinal depression; **Size:** (1-) 1.5-2 (-2.5) cm long; 1.5-2 mm wide; 540-590 μm ; **Petiole:** strongly twisted; leaf base broad disc-shaped; **Tip:** on plagiotropic and orthotropic shoots acute; **Margin:** thick; roundish to obtuse; not revolute; **Midrib:** abaxial distinctly developed; quite broad, about $\frac{1}{3}$ - $\frac{1}{4}$ of the leaf's width; separating the two abaxial stomatal bands; **Stomata:** on both sides of the leaf arranged in longitudinal rows; adaxial some irregular shaped rows close to the tip; majority abaxial in 2 longitudinal stomatal bands, each band consists of 6-8 stomatal rows; stomata quite similar in shape; 20-25 μm long; deeply sunken in the epidermis; stomatal pores all in the same orientation - parallel to the midrib; **Cuticle:** on both sides well-developed; stomata covered with a thick layer of wax, visible as whitish dots; **Epidermis:** on the ad- and abaxial surface smooth; epidermal cells globose to ovate in cross section; thick-walled, the outside exposed anticlinal cell walls thicker than the inner walls; **Hypodermis:** well-developed; 1 layer of strongly thick-walled and lignified cells; abaxial interrupted by the respiratory chambers of the stomata; **Mesophyll:** dimorphic; 1-3 layers of adaxial palisade parenchyma; abaxial spongy parenchyma with large intercellular spaces; **Endodermis:** well-developed; consisting of parenchymatic cells strongly varying in size and shape, forming a closed sheath; **Vasculature:** 1 collateral vascular bundle strand; oval; about 550 x 350 μm in diameter; divided by 4-5 layers of parenchymatic cells into two parts; each part also divided again by several one-cell broad parenchymatic bands; transfusion tissue well-developed; few vascular sclereids; **Resin ducts:** 2, one at each side; adjacent to the abaxial hypodermis; about 160-180 μm in diameter; **Morpho-anatomical comparisons:** differs from *A. pinsapo* var. *pinsapo* by more twisted leaf bases, less adaxial stomata and a strongly acute leaf tips; **Taxonomic note:** RUSHFORTH (1987) accepts *A. tazaotana* as a distinct species; ECKENWALDER (2009) described this taxon as a variety of *A. pinsapo*; in FARJON (2010) treated as synonymous to *A. pinsapo* var. *marocana*; in DEBRECZY & RACZ (2011) this taxon is not discussed; **Figure:** 72.

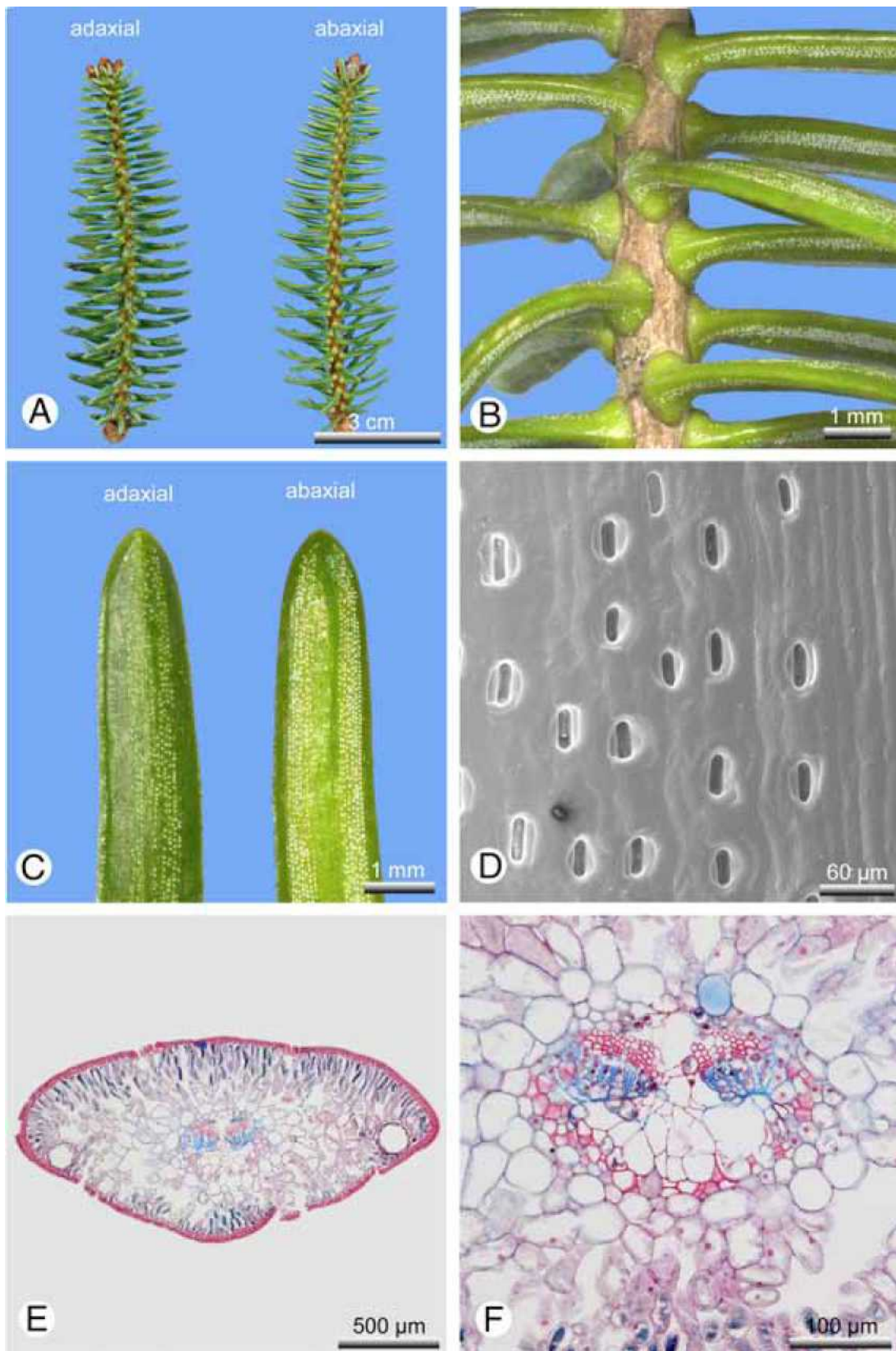


Fig. 70: *A. pinsapo* var. *marocana* (Sect. *Piceaster*); **A:** Leaf arrangement on a plagiotropic shoot; **B:** Detail leaf bases; **C:** Detail leaf tip; **D:** Abaxial stomatal detail (SEM-image); **E:** Cross section of a leaf; **F:** Detail of a vascular bundle.

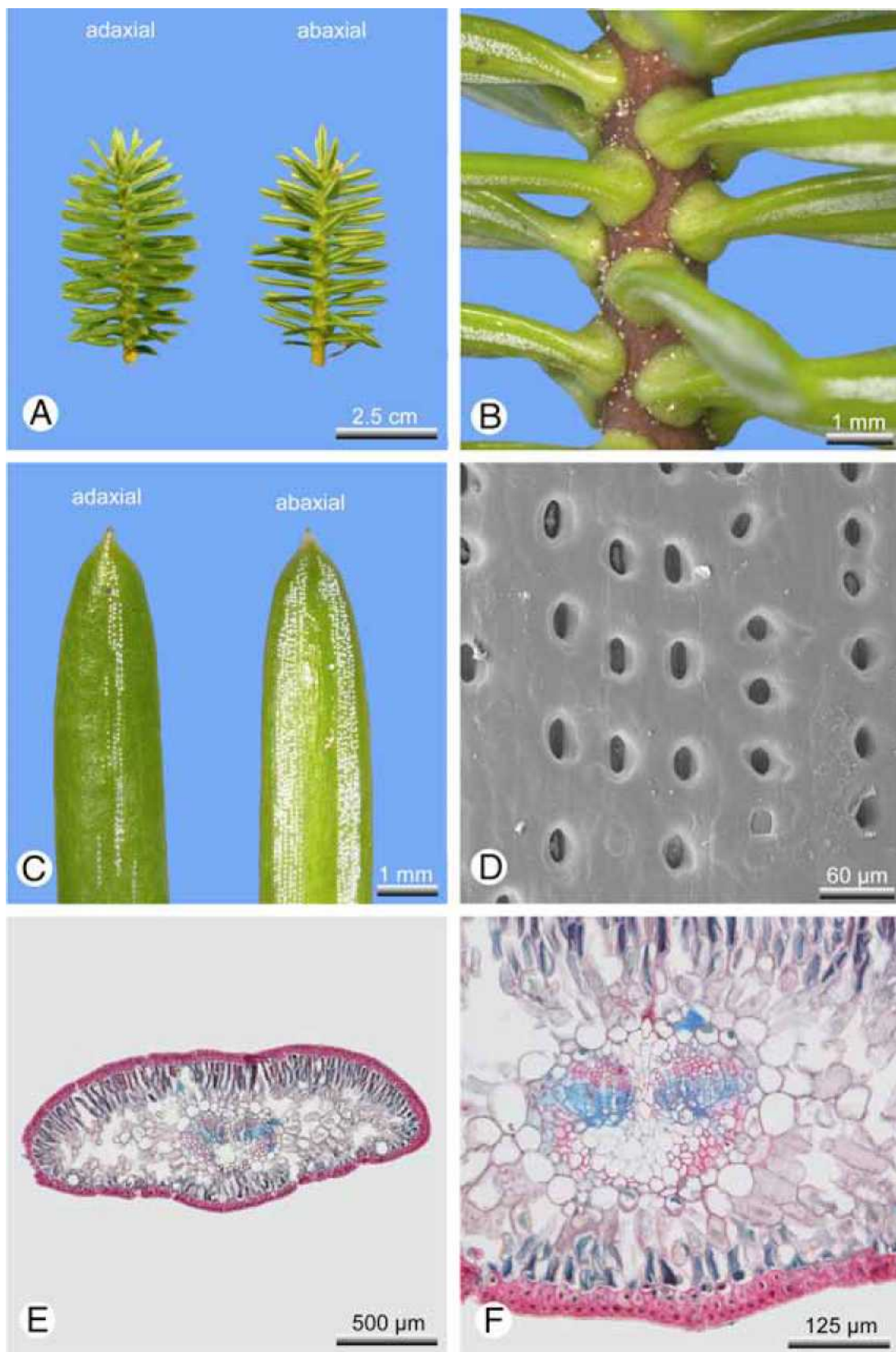


Fig . 71: *A. pinsapo* var. *pinsapo* (Sect. Piceaster); **A:** Leaf arrangement on a plagiotropic shoot; **B:** Detail leaf bases; **C:** Detail leaf tip; **D:** Abaxial stomatal detail (SEM-image); **E:** Cross section of a leaf; **F:** Detail of a vascular bundle.

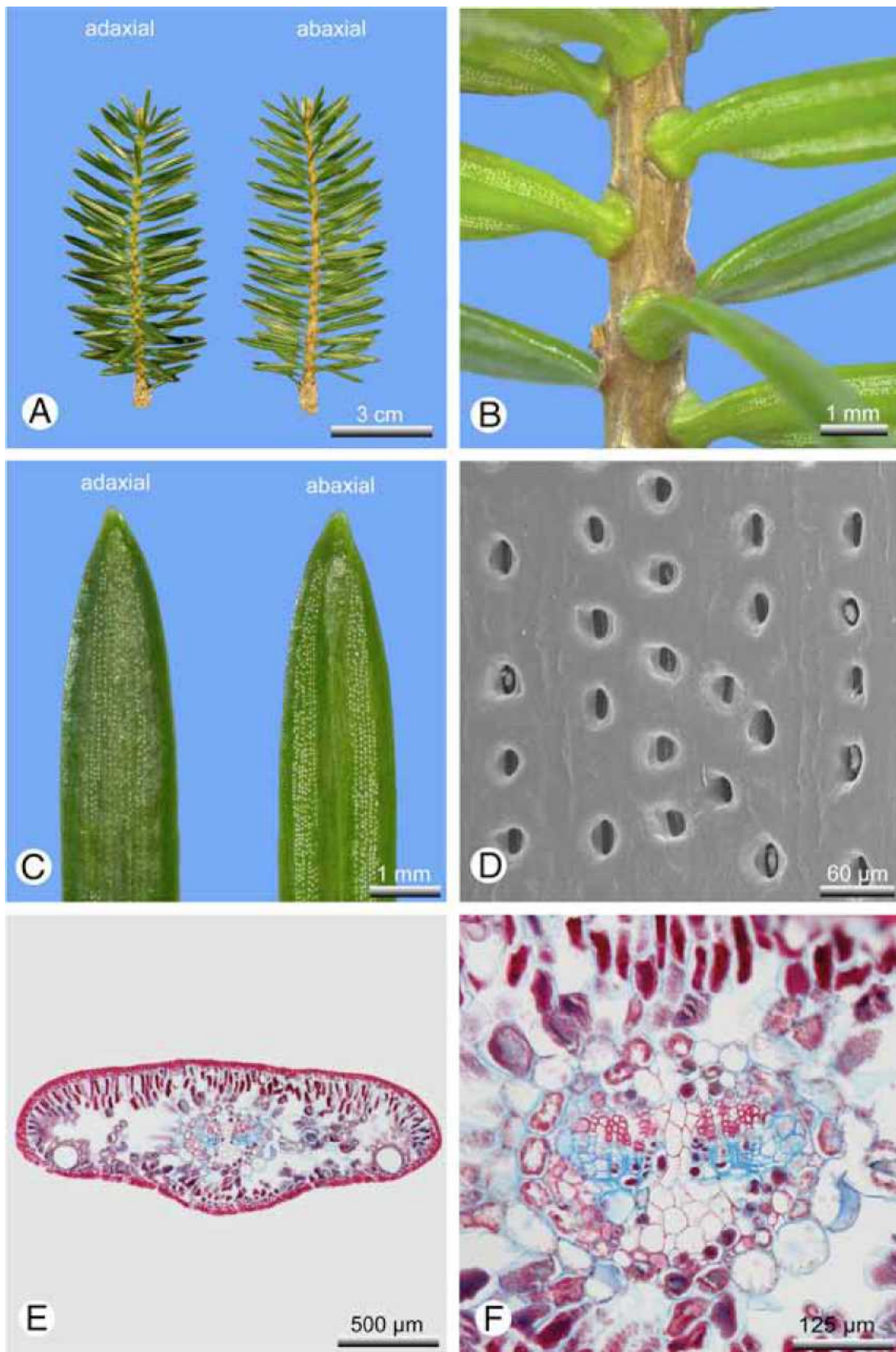


Fig. 72: *A. pinsapo* var. *tazaotana* (Sect. Piceaster); **A:** Leaf arrangement on a plagiotropic shoot; **B:** Detail leaf bases; **C:** Detail leaf tip; **D:** Abaxial stomatal detail (SEM-image); **E:** Cross section of a leaf; **F:** Detail of a vascular bundle.